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Methodology

The Lost Productivity Cost of Premature Mortality Owing to Cancers in Iran: Evidence From the GLOBOCAN 2012 to 2018 Estimates

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ABSTRACT

Objectives: Estimation of the lost productivity cost of premature deaths because of cancers can provide invaluable information for identifying the priorities and resource needs in the design of cancer control strategies. This study aimed to estimate the premature mortality costs because of cancers using GLOBOCAN estimates in Iran.

Methods: In this study, we estimated the lost productivity cost of premature deaths because of cancers in Iran from 2012 and 2018, using the human capital approach with respect to the cancer site, sex, and age. Data on cancer mortality were extracted from the GLOBOCAN reports. In addition, economic information, such as annual income, employment rate, housekeeping rate, and gross domestic product, was extracted from the World Bank Data and the Statistical Center of Iran. A discount rate of 3% was applied and costs were reported in constant 2017 international dollars.

Results: From 2012 and 2018, the lost productivity cost of premature deaths because of cancers increased by 18% in Iran ($2453 million in 2012 and $2887 million in 2018). In contrast, the number of deaths and the years of life lost because of cancers increased by approximately 8%. The mortality cost was approximately 35% and 56% higher in men than in women in 2012 and 2018, respectively. Stomach, colorectal, esophageal, and breast cancers accounted for > 40% of total cancer mortality costs in 2012. Stomach cancer, brain cancer, nervous system cancer, lung cancer, and leukemia were responsible for 57% of cancer mortality costs in 2018.

Conclusions: Based on the findings, the lost productivity costs of premature mortality because of cancers have increased significantly in Iran. Overall, evidence-based policy making for managing the costs of cancers and resource allocation depends on analyzing epidemiological and economic data in the health sector. This study presented helpful findings on cancer mortality costs to support evidence for decision making in healthcare systems.

Keywords: cancer, Iran, productivity cost, years of life lost.

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Introduction

Cancer is currently a major public health concern and one of the main causes of morbidity and mortality worldwide.[1] According to the GLOBOCAN estimates that have been published by the International Agency for Research on Cancer, there were 18.1 million new cases of cancer in 2018.[2] In addition, the World Health Organization estimates that cancer, after ischemic heart disease, is the second cause of mortality worldwide. Cancer is responsible for 9 million deaths and 196.3 million years of healthy life lost annually worldwide.[3,4] In Iran, cancer is the third leading cause of mortality after cardiovascular diseases and traffic accidents, accounting for approximately 53 350 deaths in 2012 (30 115 men and 23 235 women).[5,6]

Cancers not only have clinical consequences for the patients but also affect the quality of life and economic status of these patients and their families.[7,8] This economic burden comprised direct and indirect costs. Recently, indirect costs have become one of the most important tools to evaluate the economic impacts of diseases from a societal perspective.[9,10] Generally, indirect costs are related to costs outside the medical sector, such as lost productivity because of morbidity and mortality.[11] Economic studies on cancer reported that the largest proportion of indirect costs was related to the lost productivity cost of premature mortality because of cancers.[12,13] In the United States, the lost productivity cost because of cancer mortality increased from US$116 billion in 2000 to US$148 billion in 2020, representing an approximate increase of 30%.[14] In addition, in the European Union countries, the productivity loss cost because of cancer was €126 billion in 2009. According to previous studies, the average cost of lost productivity per premature cancer death was €219 241 in Europe, and the indirect cost of premature death because of cancers was equivalent to 0.58% of European gross domestic product (GDP).[15,16]

Most studies on productivity loss, associated with premature cancer mortality, have been conducted in developed countries, whereas approximately 60% of cancer cases and > 65% of cancer

deaths occur in low- and middle-income countries.[17] In Iran, many studies on economic burden have estimated the cost of lost productivity because of premature cancer deaths. Nevertheless, these studies have only considered costs of a particular cancer or a single year.[18-20] Overall, the main problem of such studies is that they have not specifically estimated the costs of cancer mortality and have not compared the costs of productivity loss for different types of cancers.

To the best of our knowledge, there are few studies on the lost productivity cost of premature mortality because of cancers in Iran. Two studies have only estimated the mortality costs of 10 most common cancers in 2010 and 2012, respectively.[21,22] Nevertheless, from 2012 to the present, there is a lack of information about mortality costs because of cancers in Iran. This study aimed to address this gap in the literature by estimating the lost productivity costs of premature deaths because of cancers in Iran from 2012 and 2018.

Method

Study Design

This study estimated the lost productivity cost of premature deaths because of cancers in Iran from 2012 and 2018. Although the lost productivity cost can be decomposed into 2 subgroups, including mortality and disability cost, we only focused on the lost productivity cost because of premature cancer death in this study. The mortality costs are based on the assumption that, without cancer, an individual's productive capacity would continue from the age of diagnosis to retirement age.[13] We applied the human capital approach to estimate the lost productivity cost of premature mortality because of cancers. Overall, this method is the dominant approach to estimate mortality costs.[14,16,23] We applied this method to calculate the standard expected years of life lost (YLL) because of premature cancer death and to estimate the present value of lifetime income (PVLI) forgone based on the discount rate.

Data Sources

In this study, we extracted 2 groups of data. The first group included the cancer mortality data. For this reason, we abstracted cancer death information by sex and age for 2012 and 2018 in Iran, according to the GLOBOCAN reports.[2,24] Generally, the GLOBOCAN project provides a suitable tool for estimating the incidence, mortality, and prevalence of all cancer sites in all countries or territories of the world. We defined the number of cancer deaths, according to the International Classification of Diseases, Tenth Revision,[25] and estimated the mortality costs based on this classification: stomach (C16), colorectum (C18-C21), esophagus (C15), female breast (C50), lung (C33-C34), leukemia (C91-C95), brain and central nervous system (CNS) (C70-C72), non-Hodgkin's lymphoma (C82-C86 and C96), bladder (C67), liver (C22), ovary (C56), kidney (C64-C65), pancreas (C25), Hodgkin's lymphoma (C81), prostate (C61), multiple myeloma (C88 and C90), gallbladder (C23-C24), testis (C62), larynx (C32), lip and oral cavity (C00-C06), cervix uteri (C53), thyroid (C73), nasopharynx (C11) and other pharynx sections (C09-C10 and C12-C13 for oropharynx and hypopharynx, respectively), melanoma of skin (C43), corpus uteri (C54), Kaposi sarcoma (C46), salivary glands (C07-C08), mesothelioma (C45), and vagina (C52).

The second group of data included economic information, that is, the annual income, employment rate, housekeeping rate, and GDP, according to the World Bank Data and the Statistical Center of Iran.[26,27] We specified the data for 2012 and 2018 separately. Because the data for 2018, such as GDP per capita and annual wages, were unavailable, we included the data for 2017 as an alternative.

Estimation Methods

We used the human capital approach to estimate the lost productivity cost of premature mortality because of cancers. In this approach, the social perspective is taken into account, and the labor force earnings were estimated to be considered the individual's contribution to society. Therefore, the human capital approach encompasses the patient's perspective and counts any time not worked as time lost.[28,29] This approach is based on the assumption that the death of a person for a specific reason could be prevented and that he or she would contribute to national productivity.[30] The human capital approach requires estimating the YLL because of premature death, based on economic factors. For a standard life expectancy, the following steps were taken to estimate the YLL of cancer mortality in Iran. First, we extracted the number of deaths because of each cancer in terms of sex and age (0-14, 15-29, 30-44, 45-59, 60-74, and $>$ 75 years). We excluded deaths of those younger than 15 years from our analysis in the human capital method, and the lost productivity cost was only calculated for the working labor force. Second, the YLL was calculated in terms of sex and age, using the standard Iranian lifetable.[31] These calculations can be represented as follows:

$$\mathrm{YLL} = \sum_{x}^{i} d_x e_x$$

where YLL denotes the standard expected YLL, x is the age at which death occurred, i is the optional lifetime (maximum lifetime), d_x is the number of deaths at a certain age for a specific reason, and e_x represents the life expectancy for age x based on the standard life table.[32] Subsequently, we estimated the lost productivity cost because of premature death for every cancer in terms of gender, using the estimated YLLs. We used the following formula to calculate the mortality costs:

$$\mathrm{PVLI}_{y,g} = \sum^{\mathrm{MAX}} \left(\mathrm{P}_{y,g}(n)\right) \times \left[\mathrm{Y}_g(n) \times \mathrm{E}_g(n) + \mathrm{Y}^{h}_{g}(n) \times \mathrm{E}^{h}_{g}(n)\right]$$

$$\times 1 \,/\, (1+r)^{n-y}$$

where $\mathrm{PVLI}_{y,g}$ is the present discounted value of lifetime income for a deceased of age y and gender g; $\mathrm{P}_{y,g}(n)$ is the probability that a person at age y will survive until age n (YLL); y is the age of the person at present; MAX is the maximum age group; n and g denote the age and gender of the person, respectively; $\mathrm{Y}_g(n)$ is the mean annual earning of an employed person of gender g and age n; $\mathrm{E}_g(n)$ is the proportion of population of gender g and age n, who are employed in the labor market; $\mathrm{Y}^{h}_{g}(n)$ is the mean annual imputed value of household production for a person of gender g and age n; $\mathrm{E}^{h}_{g}(n)$ is the proportion of population of age n and gender g, who are responsible for housekeeping; and r is the discount rate.[33]

In the human capital approach, the lost productivity cost is only estimated for working people. In developing countries, such as Iran, women have different jobs and responsibilities, such as housekeeping and production of household goods. Although these jobs have production values, they are commonly ignored in official statistics. Therefore, we used 2 kinds of wages for women, the specific wage for working women equal to the wages of working people and a wage for housekeeping women. In contrast, we did not have access to any data about wages for the household activity. Therefore, we calculated the value of housekeeping using

Table 1. The mortality number and the lost productivity costs due to cancer deaths in Iran in 2012.

Sex and age, years	Number of deaths	Potential life expectancy	Number of YLL	Employment rate (%)	housekeeping rate	PVLI ($ million)
Females						
15-29	443	57.73	25 574	10.73	61.29	59
30-44	2271	43.13	97 948	16.49	77.98	268
45-59	5576	28.76	160 366	10.15	80.68	423
60-74	6528	15.66	102 228	3.28	69.09	235
75+	4753	6.5	30 895	2.16	66.79	60
Total	19 571	—	417 011	—	—	1045
Males						
15-29	614	55.63	34 157	63.49	—	155
30-44	1390	41.5	57 685	87.98	—	289
45-59	5007	27.56	137 993	68.81	—	529
60-74	8706	14.96	130 242	29.21	—	308
75+	10 284	6.26	64 378	24.09	—	127
Total	26 001	—	424 455	—	—	1409

PVLI indicates present discounted value of lifetime income; YLL, years of life lost.

the minimum daily wage, equivalent to approximately one-third of the wage of employed people; the minimum wage approach has been used in other studies.[21,34] We applied the GDP per employed person to calculate the annual wages and excluded the share of oil from GDP to obtain a more realistic estimate of wages. The GDP per employed person without the share of oil is $13 800 and $15 600 for 2012 and 2018, respectively.[26,35] All costs were converted to constant 2017 international $ (constant 2017 int$) using a 3% discount rate. We used Microsoft Office Excel 2016 (Microsoft, Redmond, WA) to developed estimation models and drew the charts.

Results

In 2012, there were 45 572 deaths because of cancers among adults (≥ 15 years) in Iran, including 19 571 deaths in women and 26 001 deaths in men (Table 1). The YLL because of cancer mortality was 417 011 and 424 455 in women and men, respectively. The total PVLI lost because of cancer mortality was calculated to be $1045 million for women and $1409 million for men. The highest PVLI was reported in the age group of 45 to 59 years in both sexes ($423 million in women and $529 million in men). Nevertheless, the highest number of deaths was 6528 in

Table 2. The mortality number and the lost productivity costs due to cancer deaths in Iran in 2018

Sex and age, years	Number of deaths	Potential life expectancy	Number of YLL	Employment rate (%)	housekeeping rate	PVLI ($ million)
Females						
15-29	488	58.36	28 480	13.61	60.44	80
30-44	2357	43.73	103 072	20.83	74.7	227
45-59	4291	29.36	125 984	13.71	81.3	403
60-74	7473	16.13	120 539	3.65	75.1	330
75+	5627	6.7	37 701	2.38	72.8	87
Total	20 236	—	415 776	—	—	1127
Males						
15-29	684	56.23	38 461	62.87	—	194
30-44	1641	42.06	69 020	86.53	—	383
45-59	5697	28.06	159 858	69.75	—	674
60-74	10 223	15.33	156 719	28.24	—	373
75+	10 647	6.36	67 715	22.01	—	136
Total	28 892	—	491 773	—	—	1760

PVLI indicates present discounted value of lifetime income; YLL, years of life lost.

Table 3. The PVLI loss due to cancer mortality among adults aged ≥ 15 years in Iran from 2012 and 2018

Cancer site	PVLI ($ million)		Percentage of total cost (%)		Number of deaths		PVLI/death ($ thousand)*	
	2012	2018	2012	2018	2012†	2018	2012	2018
Stomach	345.40	433.21	14.08	15.01	8243	8954	41.9	48.4
Colorectum	255.36	237.01	10.41	8.21	4253	4137	60	57.3
Esophagus	231.83	98.61	9.45	3.42	4915	2128	47.2	46.3
Breast	231.37	250.27	9.43	8.67	3303	3524	70	71
Lung	218.15	332.91	8.89	11.53	4356	6103	50.1	54.5
Leukemia	208.12	293.3	8.48	10.16	2699	3394	77.1	86.4
Brain and central nervous system	162.44	295.99	6.62	10.25	1713	3509	94.8	84.4
Non-Hodgkin lymphoma	128.76	123.21	5.25	4.27	1920	1502	67.1	82
Bladder	83.30	51.62	3.40	1.79	2280	1255	36.5	41.1
Liver	73.18	183.34	2.98	6.35	1473	3391	49.7	54.1
Ovary	63.73	54.70	2.60	1.89	1070	861	59.6	63.5
Kidney	56.90	31.34	2.32	1.09	978	542	58.2	57.8
Pancreas	52.63	108.73	2.15	3.77	1096	2128	48	51.1
Hodgkin lymphoma	46.25	45.38	1.89	1.57	462	391	100.1	116.1
Prostate	44.47	79.95	1.81	2.77	2297	3069	19.4	26.1
Multiple myeloma	40.57	43.25	1.65	1.5	766	701	53	61.7
Gallbladder	33.58	19.50	1.37	0.68	707	366	47.5	53.3
Testis	31.89	15.9	1.30	0.55	252	84	126.6	189.3
Larynx	31.30	68.67	1.28	2.38	549	1161	57	59.2
Lip and oral cavity	26.40	23.83	1.08	0.83	448	384	58.9	62
Cervix uteri	20.49	27.81	0.84	0.96	370	467	55.4	59.5
Thyroid	19.16	15.8	0.78	0.55	610	289	31.4	54.7
Nasopharynx	18.63	6.61	0.76	0.23	213	71	87.5	93
Other pharynx	10.17	4.2	0.41	0.15	151	82	67.3	51.2
Melanoma of skin	8.99	9.31	0.37	0.32	208	143	43.2	65.1
Corpus uteri	8.98	19.58	0.37	0.68	196	329	45.8	59.5
Kaposi sarcoma	1.18	6.59	0.05	0.23	44	65	26.9	101.4
Salivary glands	—	4.31	—	0.15	—	64	—	67.4
Mesothelioma	—	1.20	—	0.04	—	15	—	80.2
Vagina	—	0.51	—	0.02	—	7	—	72.6
Penis	—	0.47	—	0.02	—	10	—	46.72
Vulva	—	0.14	—	0.00	—	2	—	69.08
All	2453	2887	100	100	45 572	49 128	53.8	58.8

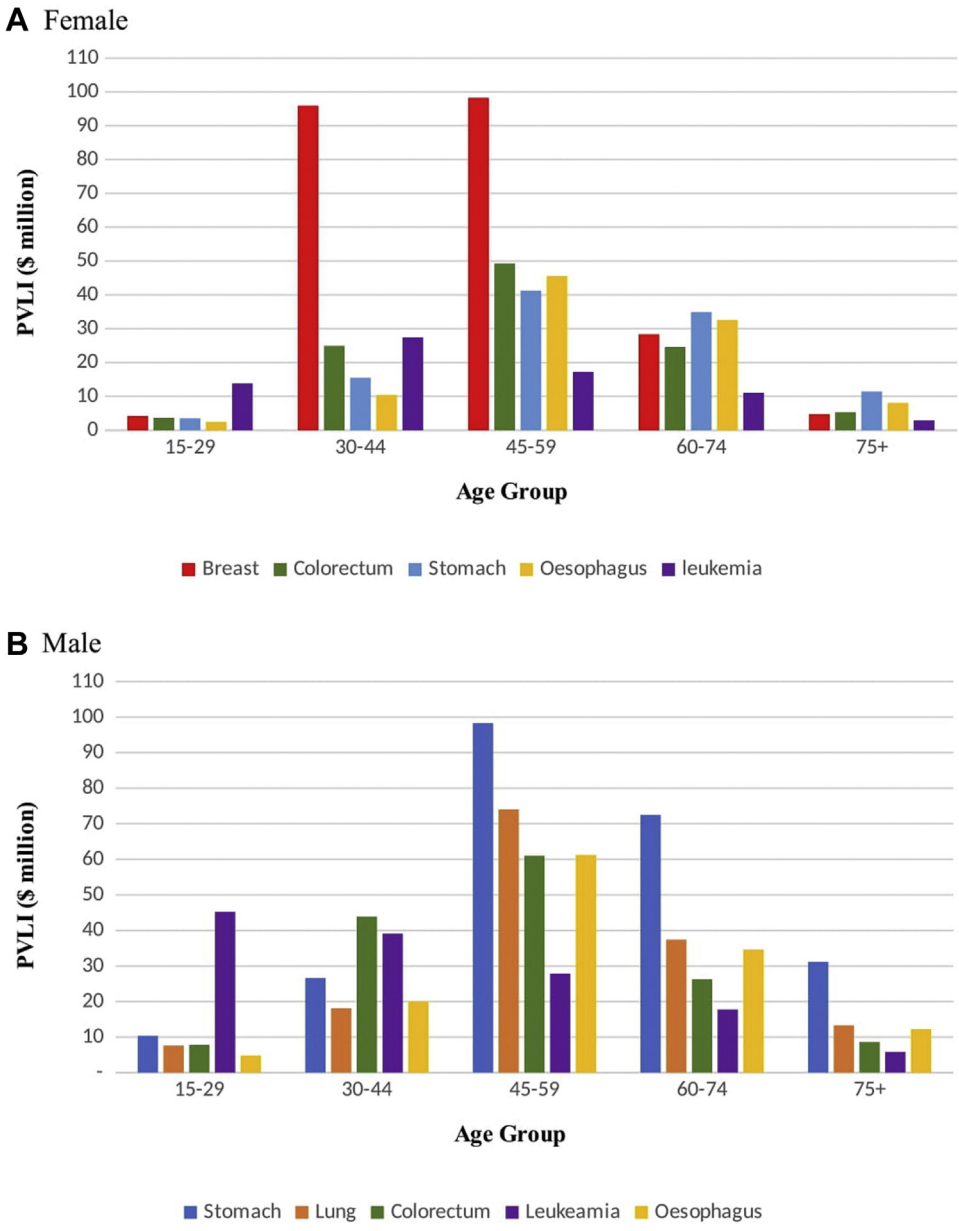
PVLI indicates present discounted value of lifetime income.
*The numbers are rounded; therefore, the average values may not be equal to the sum of costs divided by the number of deaths.
†In this study, the number of deaths in 2012 may not be equal to other estimates because some cancer types might not have been captured.

women at the age of 60 to 74 years and 10 284 in men older than 75 years.

The number of cancer-related deaths and the lost productivity costs in Iran in terms of age and sex in 2018 are summarized in Table 2. The number of cancer-related deaths was 49 128, including 28 892 deaths among men and 20 236 deaths among women. Cancer-related mortality in males was responsible for 54.1% of the total YLL and 60% of the total PVLI loss.

The lost productivity costs of premature mortality because of cancers and the PVLI loss per death in terms of cancer site among adults aged ≥ 15 years from 2012 and 2018 are presented in Table 3. In 2012, stomach cancer, with a cost of $345.4 million, accounted for 14.08% of the total PVLI loss because of cancer mortality, followed by colorectal cancer (10.41%) and esophageal cancer (9.45%). Deaths due to stomach cancer were responsible for 15% of the total cost of cancer mortality in 2018. In addition, in terms of the PVLI loss, the next most costly cancers were lung and brain/CNS cancers, which accounted for approximately 11.53% and 10.25% of the total PVLI loss, respectively. Moreover, the most costly cancers in 2012 were testicular cancer ($126 600 per death), Hodgkin's lymphoma ($100 100 per death), and brain/CNS cancers ($94 800 per death), respectively. Nevertheless, in terms of PVLI in 2018, the most costly cancer was testicular cancer ($189 300), followed by Hodgkin's lymphoma and Kaposi sarcoma.

Figure 1. Cancers with the highest PVLI loss among adults aged ≥ 15 years in Iran in 2012.



PVLI indicates present value of lifetime income.

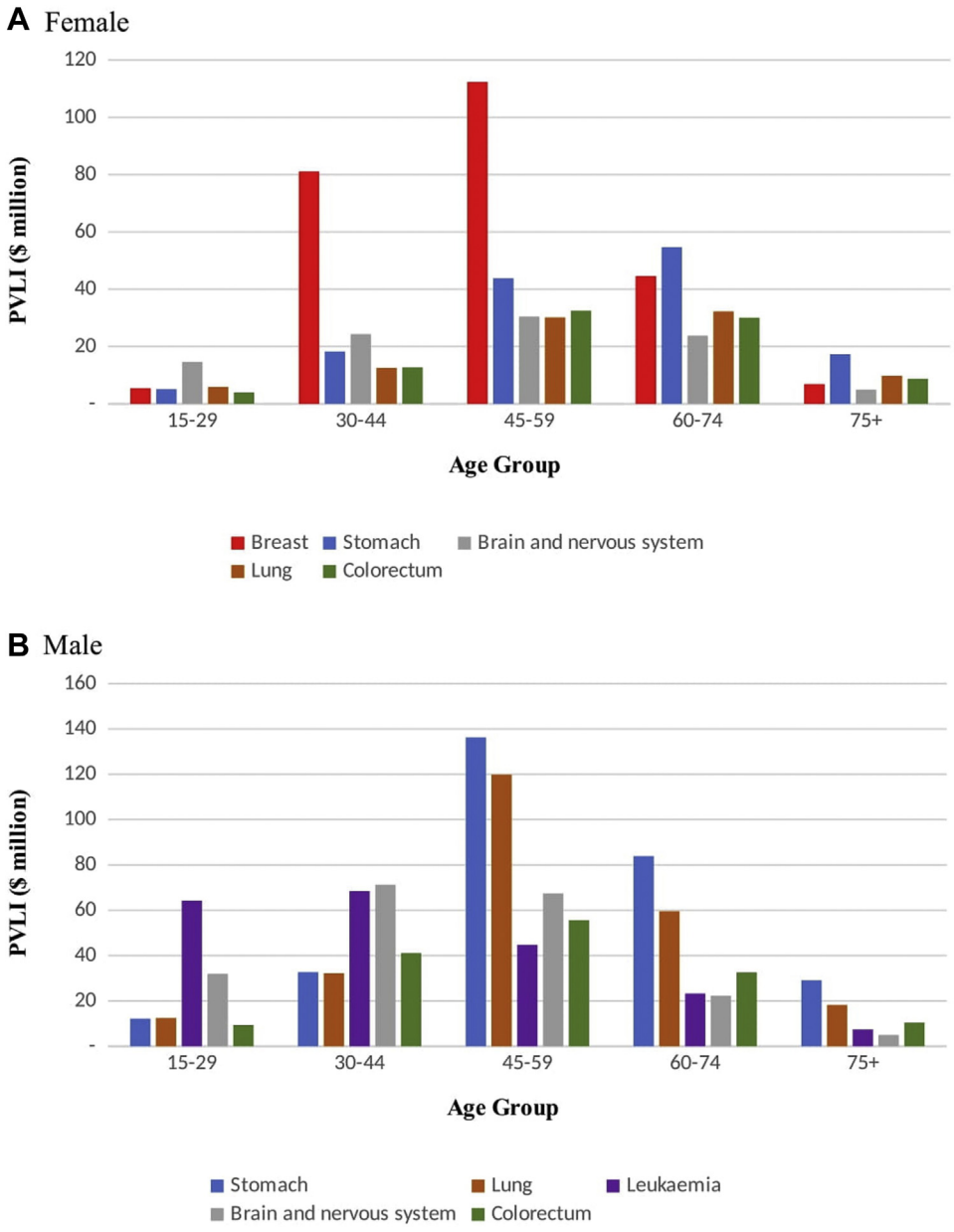
The total PVLI loss for the most costly cancers in 2012 is shown in Figure 1, stratified by age and sex. The most costly cancers in women were breast cancer, colorectal cancer, stomach cancer, esophageal cancer, and leukemia, respectively. For women younger than 29 years, leukemia accounted for the greatest mortality costs. In addition, breast cancer imposed the greatest costs on women aged 30 to 59 years. In women aged ≥ 60 years, stomach and esophageal cancers were the most costly cancers. In men, the cost of stomach cancer mortality was higher than the cost of all other cancers in men aged ≥ 45 years. Deaths from colorectal cancer caused the greatest PVLI loss in men aged 30 to 44 years.

The productivity losses by sex and age for cancers with the highest PVLI in 2018 are presented in Figure 2. In women, the most costly cancer was breast cancer regarding the total PVLI loss. This cancer was the main contributor to mortality costs among women aged 30 to 59 years. Nevertheless, in women at the age of < 29 years, brain/CNS cancers accounted for the greatest mortality costs, whereas stomach cancer had the greatest impact on women aged ≥ 60 years. In men, the most costly cancer was stomach cancer in terms of productivity loss. This cancer caused the greatest PVLI loss in men aged ≥ 45 years. The next most costly cancers in men were lung cancer, leukemia, brain cancer, CNS cancer, and colorectal cancer, respectively.

Discussion

In this study, the total lost productivity cost of premature mortality because of cancers was estimated at $2453 million in

Figure 2. Cancers with the highest PVLI loss among adults aged ≥ 15 years in Iran in 2018.



PVLI indicates present value of lifetime income.

2012 in Iran, with 45 572 deaths and YLL of 841 466 years. This rate increased to $2887 million in 2018, with 49 128 deaths and 907 549 YLL. Consequently, the lost productivity cost of cancer mortality increased dramatically by 18% from 2012 and 2018 in Iran, and the number of deaths and YLL because of cancers grew by approximately 8%. The considerable increase in lost productivity cost because of cancer deaths could be attributable to increased cancer deaths and changes in economic aspects. In 2018 compared with 2012, cancer death increased for some cancers and decreased for others. Overall, cancer deaths have risen by an average of 8%. A proportion of the increase in cancer mortality cost has occurred because of economic conditions. Iran's economy has always met high inflation and unemployment rate in recent decades. The decomposition of the lost productivity cost of cancer mortality based on the death number and economic variable can be a subject for upcoming research.

The present findings revealed that stomach, colorectal, esophageal, and breast cancers accounted for > 40% of total mortality costs because of cancers in 2012. Stomach cancer was responsible for 14.08% of the lost productivity cost because of cancers, and colorectal, esophageal, and breast cancers accounted for 10.41%, 9.45%, and 9.43% of the lost productivity costs, respectively. In addition, the analysis of PVLI loss because of cancer mortality in 2018 indicated that stomach cancer accounted for 15% ($433 million) of the total PVLI loss for cancers, followed by lung cancer (11.53%), brain/CNS cancers (10.25%), and leukemia

(10.16%). This finding reveals some potential value of early detection and screening programs in controlling the cost of cancer mortality and can help health policy makers to control the cancer mortality costs.[36,37]

This study showed that the ranking of cancers has changed in terms of lost productivity costs from 2012 and 2018. This change could be related to the number of deaths, variations in the age and sex of the population, and economic factors.[23,38] For example, stomach cancer was the most costly cancer in 2012 and 2018; the total PVLI loss increased by 26% from 2012 ($345 million) and 2018 ($433 million), and the number of deaths increased by 8% (8243 deaths in 2012 vs 8954 deaths in 2018). In contrast, the mortality cost of esophageal cancer decreased by 57% ($231 million in 2012 and $98 million in 2018), and the number of deaths reduced by 56% (4915 deaths in 2012 vs 2128 deaths in 2018). In addition, the lost productivity costs reduced for the bladder cancer, kidney cancer, gallbladder cancer, non-Hodgkin lymphoma, ovarian cancer, lip and oral cavity cancer, thyroid cancer, nasopharyngeal cancer, and testicular cancer. Besides, the results revealed that the PVLI loss per death increased notably in nonmajor cancers. The PVLI per death was $116 100 in Hodgkin lymphoma and $101 400 for Kaposi sarcoma.

A group of studies have been conducted in recent years, with a particular emphasis on estimating the economic burden of cancers.[14-16] Overall, comparison of lost productivity costs because of premature cancer mortality should be done with caution, because the mortality costs of cancers are influenced by factors, such as age, sex, and socioeconomic factors of the population, besides the number of deaths. Based on the results, cancer mortality costs accounted for approximately 0.41% of Iran's GDP in 2012 ($598.868 billion) and 0.98% of GDP in 2018 ($294.357 billion).[39] In this regard, Bradley et al[14] calculated the lost productivity cost of cancer mortality in the United States. They estimated a cancer mortality cost of $115.8 billion, which is equivalent to 1% of GDP in 2007. In addition, their results showed that these costs would increase by $147.6 billion in 2020. In Europe, Hanly et al[16] estimated the lost productivity cost of premature deaths to be €75 billion in 2008 for all cancers, with an average cost of €219 241 per cancer death. Their results revealed that the cancer mortality cost was approximately 0.58% of the European Union GDP.[16] Another study by Luengo-Fernandez et al[15] reported that the lost productivity cost of cancers was 0.36% of the total GDP across Europe in 2009. In Australia, the lost productivity cost of cancer mortality was estimated at $AU4.2 billion in 2010 ($AU163 000 per death).[40] In Iran, Khorasani et al[21] calculated the cancer mortality costs to be $1208 and $721 million for men and women, respectively, in 2012. There are some differences between the results of study of Khorasani et al[21] and our study. These differences are observed between the total costs of all cancer deaths and for particular cancers. Some reasons are for these deviations. First, we only estimated the total costs of lost productivity by cancer deaths identified in the study. In contrast, the total lost productivity cost is not well defined for what cancers in study of Khorasani et al.[21] Additionally, the number of cancer deaths in 2012 was different because some cancer types might not have been captured. Second, much of this difference in the lost productivity cost was driven by assumptions and approaches in these studies. For example, we used the GDP per person without oil share as a proxy for wages, and all costs were converted to constant 2017 international $.

This study is consistent with previous research on the cost of cancer mortality in terms of gender.[14,16,21] Although every woman loses more YLL because of cancer death at a specific age because of a longer life expectancy, the lost productivity cost because of cancer mortality in men exceeded that of women. Our results revealed a notable difference in the total PVLI loss because of cancer mortality between men and women. The cancer mortality costs were approximately 35% and 56% higher in men than in women in 2012 and 2018, respectively. This difference can be attributed to the following reasons. First, the number of cancer deaths may partly explain this difference. Cancer-related deaths were approximately 33% and 43% higher in men than in women in 2012 and 2018. The role of death number became more evident when we found that premature deaths because of cancers were higher in women at younger ages. In 2018, the number of deaths at the age of 30 to 44 years in women was almost twice as high as men. Second, economic variables, such as the annual income, employment rate, and housekeeping rate, may also contribute to this difference. The employment rate was 54% in Iranian men versus 10% in women in 2018. The role of employment rates (the ratio of the employed to the working age population) in the gender gap in lost productivity costs becomes more apparent when we understand that the per capita mortality costs are almost the same for men and women. The PVLI per death is nearly $55 and $60 thousand, respectively, in 2018. It should be noted that, in the human capital approach, the mortality costs are measured for a working population.

This study is the first to estimate the lost productivity costs of premature deaths for all cancers in Iran. In addition, it has updated the cancer mortality for 2012 and 2018. Comparing the mortality costs during the different years can be a road map for health policy makers to provide appropriate strategies to reduce the cost of each cancer. Nevertheless, there are some limitations in this study. We used the human capital approach to estimate the lost productivity cost of premature mortality because of cancers. Although the human capital approach is the most common method in the cancer literature, it has some restrictions. In this approach, it is assumed that the income earned by a labor force reflects the individual's productivity, which in turn represents his/her role in social production.[28] These measurements require a full employment status, competitive labor markets, and insignificant transaction costs. Nevertheless, such assumptions are rare in developing countries, such as Iran, where many interventions are needed to stabilize the market and prices. Another challenge of the human capital approach is dealing with income and employment patterns. In this study, wages were determined separately for men, women, and different age groups, which could reinforce the existing differences of earning patterns. In addition, this approach excludes the contributions of people when they are retired, unemployed, or unpaid (eg, time spent on household tasks). Nevertheless, in this study, we considered a salary for housekeepers to improve the accuracy of our results. Some articles declared that productivity losses should not be included in costs in economic evaluation studies, because if income is reduced because of illness, this may subsequently affect the patient's quality of life. Therefore, it can be resulting in "double counting."[41,42]

Other limitations of this study were related to our assumptions. We did not calculate the mortality costs of premature deaths before the age of 15 years and did not estimate the mortality costs of those who died after the age of 79 years; nevertheless, the cost of productivity loss in these groups could be significant. For example, there were 315 deaths from leukemia among people younger than the age of 15 years. Another limitation in this regard is associated with the housekeeping rate. We considered determined wages for housewives to estimate the PVLI loss because of cancer deaths. This assumption could overestimate the productivity losses in women, especially those who are younger and have more life expectancy. In addition, the lost productivity costs of

disabilities associated with cancers were not included in the analysis, because our information about the time of disabilities was insufficient, and estimation of the costs required separate modeling. We believe that combining the costs of mortality with disability costs can better reflect the lost productivity because of cancers.

Conclusions

The lost productivity costs of premature mortality because of cancers increased by 18% in Iran from 2012 and 2018, and the number of cancer-related deaths increased by approximately 8%. In this study, we presented an analysis of cancer mortality costs in terms of sex, age, and cancer type and estimated the lost productivity cost per cancer death. We believe that the present results can be used as a guide for health policy makers, given that evidence-based policy making depends on the analysis of epidemiological and economic data to control the costs of cancers and resource allocation in the health sector; overall, this study provided helpful results on cancer mortality costs. In addition, the results on cancer mortality costs could be applied in economic evaluation using a societal perspective.

Article and Author Information

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