

The incidence and mortality of cancer in Eastern Mediterranean Regional Office (EMRO) and its relationship with Human Development Index (HDI): An Ecological Study

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Background: the cancer was considered as the second cause of mortality in the developed countries and all around the world after the cardiovascular diseases. Also, it was reported as the third cause of mortality in the less developed countries after cardiovascular diseases. The current study was aimed to evaluate the epidemiology, incidence, and mortality of all cancers in East-Mediterranean region by gender and age.

Methods: This study was an ecologic study in Asia for assessment of the correlation between age-specific incidence rate (ASIR) and age-specific mortality rate (ASMR) with HDI (life expectancy at birth, mean years of schooling and gross national income (GNI) per capita) Data about SIR and SMR for every Asian country for the year 2012 were obtained from the global cancer project. Correlation bivariate method for assessment of the correlation between incidence and mortality rates was used. Statistical analysis using Stata-14 and $P < 0.05$, respectively and a significant < 0.05 .

Results: in East-Mediterranean region, some 555318 cases of cancer recorded in 2012. The highest incidence rates of cancer were reported for breast, colo-rectum, lung, liver, and bladder being 17.9%, 5.9%, 5.9%, 5.3%, and 5%, respectively. Also, the highest mortality of cancer were reported for breast, colo-rectum, lung, liver, and bladder being 11.5%, 5.8%, 5.9%, 7.6%, and 3.8%, respectively.

The highest and lowest mortality ratios were reported for Somalia, and Saudi Arabia being 106.2, and 53.9 cases per 100000 people, respectively. Lung cancer and Human Development Index (HDI) had significant correlation with each other ($P > 0.05$). Also, a significant correlation was seen between Human Development Index (HDI) and mortality rates of breast, colorectal, lung and liver cancer ($P > 0.05$).

Conclusion: the cancer was considered as one of the main causes of mortality in the most countries of East-Mediterranean region. The breast and colorectal cancers were reported as the most common types of cancer in this region. As for the alarming trend and remarkable distribution of cancer to the disease load in East-Mediterranean countries, controlling the cancer should be considered as one of the priorities of health policy.

Key words: Cancer, Incidence, Mortality, Eastern Mediterranean Regional Office (EMRO).

Introduction

Maintaining and promoting the human being health need the enough information, screening of the current situation, and correct selection of future priorities. Preventing and controlling the noncontagious and chronic diseases were considered as one of the most important priorities of healthcare system. The noncontagious and chronic diseases were superseded for contagious diseases including infectious diseases and malnutrition demonstrated as the top factors of disability and early mortality[1-6]. Although the human achieved the significant successes in preventing and controlling the contagious diseases during the last decades, they encountered the increasing trend of chronic and noncontagious diseases[7]. The cardiovascular diseases, diabetes, hypertension, and some types of cancer could be considered as the most common cases of chronic and noncontagious diseases. Some one-fourth of mortality rate could be related to the cancers reported as one of the most important healthcare issues of the societies especially following the western life style[8]. The studies reported a 45% rate of mortality related to noncontagious diseases right across the world in the years conducting 2015 while the rate of cancer-related mortality was estimated as 10%[9].

The cancers were considered as the most important Non-communicable diseases constraining the main load of sickness on the society. On the other hand, the relative control of contagious diseases, life expectancy increase, changing the life style, increasing the environmental risk factors, genetic property, and society aging were indicated as the multiplier factors of the disease in the recent and future decades[10 11,].

The cancer results from the abnormal pretension and expression of the gene. The quick growth of cancer cells in the priory location emerges the symptoms by destruction mechanism and filling the available space. They also emerges the specific symptoms and signs in the involved organ by progressing through blood and lymphatic system and metastasis[12]. The cancer might be indicated as one of the most important factors of the disease load in the world in the future decades. The rate of new cases of this disease might be estimated as 15 million people in 2020[7 13,].

More than half of the cancers would be broken out in the developing countries such as Southern-America and Asia countries. Some three-fourth of the people in these countries is living with the low and average salaries. The rate of cancer survivors in the developing countries accounts for one-third of the people living in the developed countries. Some 9 million new cases of cancer break out contributing 4 million people for the developed countries as compared to the 5 million people in the developing ones[13 14,].

Some 54% of the overall mortality might be due to noncontagious diseases till 2015. In this between, the cancer plays an important role and its rate was predicted to 13% of the overall mortality across the world. Furthermore, the studies suggested the cancer as the first and most important cause of mortality in 2030[15]. Therefore, the current study was aimed to evaluate the epidemiology, incidence, and mortality of all cancers in East-Mediterranean region by gender and age differences using the cancer World Bank information.

Methods

In the current study, the incidence and mortality rates of all cancers in East-Mediterranean region related data were extracted on behalf of the Cancer Global Project in 2012 available at .

The methods of estimation are country specific and the quality of the estimation depends upon the

quality and on the amount of the information available for each country. In theory, there are as many methods as countries, and because of the variety and the complexity of these methods, an overall quality score for the incidence and mortality estimates combined is almost impossible to establish. However, an alphanumeric scoring system which independently describes the availability of incidence and mortality data was established at the country level. The combined score is presented together with the estimates for each country with an aim of providing a broad indication of the robustness of the estimation.

Estimation incidence

The methods to estimate the gender- and age-specific incidence rates of cancer for a specific country fall into one of the following broad categories, in priority order: 1. Rates projected to 2012 (38 countries) 2. Most recent rates applied to 2012 population (20 countries) 3. Estimated from national mortality by modelling, using incidence mortality ratios derived from recorded data in country-specific cancer registries (13 countries) 4. Estimated from national mortality estimates by modelling, using incidence mortality ratios derived from recorded data in local cancer registries in neighboring countries (9 European countries) 5. Estimated from national mortality estimates using modelled survival (32 countries) 6. Estimated as the weighted average of the local rates (16 countries) 7. One cancer registry covering part of a country is used as representative of the country profile (11 countries) 8. Age/gender specific rates for "all cancers" were partitioned using data on relative frequency of different cancers (by age and gender) (12 countries) 9. The rates are those of neighboring countries or registries in the same area (33 countries)

Estimation mortality

Depending of the degree of detail and accuracy of the national mortality data, six methods were utilized in the following order of priority: 1. Rates projected to 2012 (69 countries) 2. Most recent rates applied to 2012 population (26 countries) 3. Estimated as the weighted average of regional rates (1 country) 4. Estimated from national incidence estimates by modelling, using country-specific survival (2 countries) 5. Estimated from national incidence estimates using modelled survival (83 countries) 6. The rates are those of neighboring countries or registries in the same area (3 countries)[\[16\]](#). .

HDI

The HDI is a composite measure of indicators along three dimensions: life expectancy, educational attainment, and command over the resources needed for a decent living. All groups and regions have seen notable improvement in all HDI components, with faster progress in low and medium HDI countries. On this basis, the world is becoming less unequal. Nevertheless, national averages hide large variations in human experience. Wide disparities remain within countries of both the North and the South; income inequality within and between many countries has been rising [\[17 18\]](#).

Statistical analysis

. In this study, we used the correlation bivariate method for assessment of the correlation between the incidence and mortality rates of cancer and the HDI. We also used linear regression models for assessment of the HDI effect on cancer occurrence rates. The significance level of 0.05 was considered. Data were analyzed by Stata computer software version 12.

Results

In East-Mediterranean region, some 555318 cases of cancer were registered in 2012. The highest

incidence ratios of cancer in East-Mediterranean region were reported in Lebanon, Jordan, Egypt, and Syrian Arab Republic being 197.7, 155.4, 152, and 145.9 cases per 100000 people, respectively. The lowest incidence ratios of the overall cancers were reported in Yemen, and Oman being 80.4, and 82.1 cases per 100000 people, respectively (Fig.1).

Fig 1 Distribution of the Standardized Incidence Rate of all Cancer in EMRO at 2012 (Extracted from Globocan)

The highest incidence rates of cancer in males were reported for lung, bladder, liver, prostate gland, and colo-rectum being 12.6%, 10.9%, 7.9%, 7.9%, and 8.3%, respectively as compared to the highest incidence rates of cancer for breast, colo-rectum, cervix uteri, and ovary in females being 41.9%, 6.6%, 6.4%, and 5.3%, respectively.

Fig 2 Distribution of the Standardized Mortality Rate of all Cancer in EMRO at 2012 (Extracted from Globocan)

The highest rates of cancer in both genders were related to breast, colorectum, lung, liver, and bladder being 17.9%, 5.9%, 5.9%, 5.3%, and 5%, respectively (Table1).

Both Sexes	Female	Male	Cancer site
ASR(W)	%	Number	ASR(W)
122.2	100.0	555318	126.2
4.6	3.7	20681	4.1
0.9	0.8	4363	0.6
1.1	0.9	4793	0.8
4.0	3.1	17043	3.7
5.5	4.2	23454	3.9
7.4	5.9	32769	6.6
7.1	5.3	29367	4.5
1.3	1.0	5509	1.7



1.9	1.4	7686	1.5
2.5	1.9	10576	0.7
7.9	5.9	32542	3.3
0.4	0.3	1815	0.4
41.9	17.9	99284	41.9
9.7	3.3	18585	--
0.9	0.5	2843	--
6.4	2.7	14861	6.4
3.5	1.4	7609	3.5
5.3	2.2	12354	5.3
1.9	1.6	8952	1.5
6.8	5.0	27690	2.8
3.9	3.5	19572	3.4
2.3	2.1	11840	3.5
1.5	1.5	8374	1.1
5.6	4.8	26636	4.6

1.0	0.8	4261	0.8
4.4	4.2	23392	3.7

Tab 1 Incidence of all Cancer in EMRO by Sex

The highest incidence rates of breast cancer were reported in Lebanon, Jordan, and Pakistan being 87.7%, 61%, and 50.3%, respectively. The highest incidence rates of colorectal cancer were reported in Jordan, Syrian Arab Republic, and Lebanon being 25.6%, 16.2%, and 16.1%, respectively.

Fig 3 Correlation between the Human Development Index and Breast cancer incidence and Mortality Rates

Also, the highest incidence rates of lung cancer were reported in Lebanon, Tunisia, Libyan Arab Jamahiriya, and Jordan being 19.8%, 16%, 15.7%, and 15.7%, respectively. The highest incidence rates of liver cancer were reported in Egypt, Qatar, and Afghanistan being 25.6%, 7.9%, and 5.2%, respectively.

Fig 4 Correlation between the Human Development Index and Colorectal cancer incidence and Mortality Rates

Moreover, the highest incidence rates of bladder cancer were reported in Lebanon, Egypt, and Iraq being 16.6%, 13.1%, and 11.4%, respectively (Table 2).

Bladder	Liver	Lung	Colorectal	Breast	Areas
Both Sexes	M	F	Both Sexes	M	F
3.3	5.1	1.5	5.2	6.6	3.8
6.3	9.6	2.1	3.5	3.6	3.4
2.2	3.5	1.1	3.2	4	2.5
13.1	21.8	5.6	25.6	38.1	14.1
8.4	13.2	3.4	2.5	2.8	2.1



11.4	19.9	5.2	4	4.4	3.7
7.1	12.3	1.8	4.2	5.4	3
5.5	7.1	2.7	4.0	5.3	1.9
16.6	29.1	6.1	2.5	3.3	1.9
8.6	15.3	2.3	4.8	5.4	4.1
1.3	10.8	1.3	1.0	1.5	1.0
4.8	6.7	2.3	3.9	4.6	2.8
3.4	5.1	1.6	3.6	4.7	2.5
5.3	6.7	1.9	7.9	8.9	5.0
3.6	5.7	1.2	4.7	6.4	2.8
2.1	3.0	1.2	3.7	4.1	3.3
2.3	3.5	1.2	4.5	6.5	2.7
9.6	16.1	3.5	4.1	4.9	3.4
8.3	15.3	1.8	1.1	1.4	0.8
4.3	5.2	2.4	3.4	3.5	3.0
1.8	3.6	0.3	2.9	4.1	2.0

Tab 2 Distribution incidence of 5 common cancers in EMRO by country and sex

The highest mortality ratios of the overall cancers in East-Mediterranean region were reported in Somalia, Egypt, Lebanon, and Afghanistan being 106.2, 103.4, 103.2, and 97.7 cases per 100000 people, respectively as compared to the lowest mortality ratios in Saudi Arabia, Bahrain, and Kuwait being 53.9, 54.3, and 54.8 cases per 100000 people, respectively (Fig. 2).

Fig 5 Correlation between the Human Development Index and Lung cancer incidence and Mortality Rates

The highest mortality rates in Bothe sexes were reported for breast, colorectal, lung, liver, and bladder cancers being 11.5%, 5.8%, 5.9%, 7.6%, and 3.8%, respectively (Tab 3).

Fig 6 Correlation between the Human Development Index and Liver cancer incidence and Mortality Rates

Both Sexes	Female	Male	Cancer Site
ASR(W)	%	Number	ASR(W)
84.3	100.0	367441	79.4
2.5	3.0	10997	2.3
0.6	0.7	2641	0.4
0.9	1.1	3979	0.7
3.8	4.3	15707	3.5
4.9	5.7	20789	3.5
4.9	5.8	21291	4.3
6.8	7.6	27949	4.3
1.3	1.4	5133	1.6
1.8	2.0	7440	1.5



1.3	1.5	5399	0.3
7.1	7.9	28977	2.9
0.2	0.2	910	0.2
18.6	11.5	42228	18.6
6.2	3.3	12141	--
0.5	0.4	1438	--
3.6	2.1	7791	3.6
1.2	0.7	2440	1.2
4.1	2.4	8708	4.1
1.5	1.8	6628	1.1
3.4	3.8	13822	1.4
2.9	3.7	13672	2.5
1.1	1.2	4488	1.6
1.01	1.3	4884	0.8
4.1	4.9	18046	3.3
0.9	1.0	3500	0.7



			3.2

Tab 3 Mortality of all Cancer in EMRO by Sex

Bladder	Liver	Lung	Colorectal	Breast	Areas
Both Sexes	M	F	Both Sexes	M	F
2.2	3.8	1.1	5.2	6.6	3.8
2.4	3.9	0.8	4.4	5.6	3.5
1.6	2.6	8.0	3.2	4.0	2.5
6.5	11.1	2.7	24.5	37.0	13.3
3.5	5.5	1.4	2.3	2.6	2.0
6.3	11.5	2.9	3.9	4.3	3.5
3.2	5.5	0.9	4.1	5.2	2.9
2.1	2.5	1.6	4.8	5.1	4.2
6.3	11.0	2.4	2.4	3.1	1.7
3.2	5.8	0.8	4.5	5.2	3.8
3.1	6.0	0.7	1.2	1.5	0.9
2.5	3.4	1.2	3.8	4.6	2.8
2.1	3.1	1.0	3.5	4.5	2.5

1.7	2.4	0.0	8.3	9.5	5.0
1.4	2.3	0.5	4.6	6.3	2.7
1.3	2.0	0.8	3.5	3.9	3.1
1.6	2.5	0.8	4.3	6.2	2.6
4.9	8.3	1.8	3.9	4.7	3.2
3.5	6.5	0.7	1.0	1.3	0.7
1.5	1.9	0.7	3.7	3.7	3.3
1.2	2.4	0.2	2.9	4.0	1.9

Tab 4 Distribution Mortality of 5 common cancers in EMRO by country and sex

According to the findings, HDI and incidence of lung cancer had significant correlation with each other; however, there wasn't significant correlation between HDI and incidence of breast, colorectal, liver and leukemia cancer ($P > 0.05$).

Fig 7 Correlation between the Human Development Index and Bladder cancer incidence and Mortality Rates

Moreover, results of the study showed that mortality rates of breast, colorectal, lung and liver cancer and HDI had significant correlation with each other, but significant correlation wasn't seen between mortality rate of leukemia cancer and HDI in EMRO. ($P > 0.05$)

HDI	GNI per capita (\$)	Mean year of schooling (years)	Life expectancy at birth	Country
0.47	1000	3.1	60.5	Afghanistan
0.815	19154	9.4	76.5	Bahrain
0.464	3109	---	61.3	Djibouti
0.681	10400	---	64.2	Egypt
0.769	10695	7.8	73.7	Iran
0.659	3557	5.6	69.2	Iraq
0.737	5272	8.6	73.7	Jordan
0.769	52793	6.1	74.2	Kuwait

0.766	12364	7.9	79.7	Lebanon
0.634	6905	---	70.7	Morocco
0.796	24092	5.5	76.3	Oman
0.538	2566	4.9	66.4	Pakistan
0.843	87478	7.3	78.2	Qatar
0.83	22616	7.8	75.3	Saudi Arabia
0.417	3428	---	61.9	Sudan
0.635	4674	5.7	74.5	Syrian Arab Republic
0.72	10440	---	75.9	Tunisia
0.829	42716	8.9	76.7	United Arab Emirates
0.498	928	5.3	62.9	Yemen

Tab 5 HDI and Its Component in EMRO Countries

Amounts related to HDI and each of its components (life expectancy at birth in 2012, the average years of schooling in 2010, and the level of income for each one of the country’s population in 2012) for each of the EMRO countries is shown in [Table 5](#).

Discussion

The cancer was considered as one of the most common types of disease reported as one of the causes of mortality all around the world[19]. Some 14.1 million new cases of cancers were reported globally with the mortality rate of 8.2 million people. The studies suggested the incidence rate of cancer as 21.7 million people until 2030 with the mortality rate of 13 million people[20]. Thereupon, cancer was considered as one of the most important health problems in the world accounting for 55% of diseases’ load in the developed countries[21].

The rate of incidence and prevalence of cancer were differently reported the East-Mediterranean countries as for the different levels of salary, age, risk factor difference, and various type of cancer prophylactic programs[22]. The rate of mortality and Disability-Adjusted Life Year (DALY) related to cancer in East-Mediterranean countries were estimated as 9.4% (ranged from 8.9% to 9.9%) and 5.1% (ranged from 4.1% to 5.8%), respectively as compared to the global rates of mortality and DALY as 15.7% (ranged from 15.5% to 15.9%) and 8.5% (ranged from 7.8% to 9.2%) (14).

The cancer was considered as the third cause of mortality and the eighth one of DALY in East-Mediterranean region. Lack of meritorious healthcare personnel, patients’ financial issues, weak healthcare systems in time of war, immigrants increase and inaccessibility to the healthcare services were reported as the pivotal factors of health weakness in some countries of East-Mediterranean region[23]. The incidence rate of cancer in East-Mediterranean countries was ranged from 50% to 215% owing to different methods of incidence and mortality estimations as well as rudimentary cancer registration system[16 22,].

The rate of cancer-related mortality was increased in East-Mediterranean countries as 32.9% from 2005 to 2015. The rate of cancer incidence was higher in the females as compared to the higher mortality rate in the males might be due to the breakout of less invasive cancers in females (e.g. breast and cervix cancers) and more invasive cancers in males (e.g. lung and stomach)[22, 24, 25].

Some 555318 cases of cancer were registered in East-Mediterranean region in 2012. The highest rates of cancer in both genders were related to breast, colo-rectum, lung, liver, and bladder being 17.9%, 5.9%, 5.9%, 5.3%, and 5%, respectively.

The highest incidence ratios of cancer in East-Mediterranean region were reported for Lebanon, Jordan, Egypt, and Syrian Arab Republic being 197.4, 155.4, 152, and 145.9 cases per 100000 people, respectively as compared to the lowest incidence ratios in Yemen, and Oman being 80.4,

and 82.1 cases per 100000 people, respectively. Moreover, the highest mortality ratios of cancer were reported for Somalia, and Egypt being 106.2, and 103.4 cases per 100000 people, respectively as compared to the lowest mortality ratios in Saudi Arabia, and Bahrain being 53.9, and 54.3 cases per 100000 people, respectively.

Studies reported the tobacco, inappropriate nutritional regimen, Body Mass Index, occupational dangers, and weather contamination as the cancer determinants in East-Mediterranean region [26, 27]. The lung cancer was reported as the third cause of mortality in East-Mediterranean region in which tobacco usage was indicated as the main risk factor of it [28 29,]. Inappropriate life style and physical inactivity were reported as the main causes of colorectal cancer [30]. Obesity was indicated as the risk factor of esophagus, colon, rectum, kidney, and pancreas cancers. Gall bladder cancer was demonstrated as the risk factor of breast, ovary, and uterus cancers [31].

The breast cancer was reported as the most common type of cancer in East-Mediterranean region. Colorectal cancer was indicated as the second commonest type of cancer emphasizing on the appropriate health programs, environmental policies, physical activity increase, and healthy life style. Other primary prophylactic approaches are including Human Papilloma Virus (HPV) vaccination to prevent cervix cancer and Hepatitis B vaccination as well as Hepatitis B and C treatment especially in countries with high rates of Hepatitis C like Egypt so as to reduce the incidence of liver cancer [32]. Accessible screening programs for cervix, colorectal, breast, mouth, and stomach cancers are being performed could play an important role in diagnosing the disease in primary stages and reducing the mortality rate consequently [33].

Our study indicated that to increase in HDI causes reduction in mortality rate of breast cancer; however, increasing in HDI leads to higher incidence and mortality rate of colorectal cancer. Many studies have represented that mortality rate of breast cancer is lower in developed countries compared to developing and underdeveloped countries due to screening programs, proper treatment, availability of health and medical services and changing in lifestyle [34, 35]

Distribution of cancer based on HDI can be used for prevention of cancer in each country.

Cancer was reported in all of age groups although generally indicated in old-aged people. Therefore, the rate of cancer might significantly be higher in regions with elder population. The standard age range of cancer incidence varies in East-Mediterranean countries. The highest incidence rates of cancer in both genders in East-Mediterranean region were reported for 75- and over-75 year-old age group in 2012. The population aging and increasing life expectancy in the most countries of East-Mediterranean region could be considered as the factors of this increase.

Conclusion

Cancer was considered as one of the main causes of mortality in the most countries of East-Mediterranean region. The breast and colorectal cancers were reported as the most common types of cancer in East-Mediterranean region. As for the alarming trend and remarkable distribution of cancer to the disease load in East-Mediterranean countries, controlling the cancer should be considered as one of the priorities of health policy. Performing the screening programs, Hepatitis and Papilloma viruses' vaccination, changing life style, increasing physical activity and using the healthy nutritional regimen could decrease the rate of cancers. Thereupon, the rates of cancer incidence and mortality could be declined in East-Mediterranean countries through performing the 1st-level prophylactic programs, screening programs, early diagnosis and treatment as well as 3rd-level prophylactic programs.

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CONFLICT OF INTEREST

None.

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