Cancer Incidence and Mortality Pattern in Eastern Mediterranean Regional Office Countries and its Association with the Human Development Index

Abstract

Purpose: Cancer is one of the main causes of death in the Eastern Mediterranean Regional Office (EMRO) region. The aim of this study was to determine the correlation between cancer incidence and mortality with the Human Development Index (HDI) in the EMRO region. **Materials and Methods:** The incidence and mortality rates of all cancers were obtained from the GLOBOCAN cancer project, and the data about the HDI were obtained from the United Nations Development Program database. The correlation between incidence, mortality rates, and the HDI parameters was analyzed by SPSS software. **Results:** The highest age-standardized incidence and mortality rates of cancers in the EMRO region were shown for colorectal cancer (10.19 ± 5.30) and lung cancer (8.92 ± 4.63), respectively, and the lowest was Kaposi's sarcoma in the incidence (0.20 ± 0.14) and mortality rate (0.10 ± 0.09), respectively. The lowest and highest incidence of all cancers in the region pertained to Yemen (80.40) and Lebanon (197.40), respectively. In addition, the lowest and highest mortality from all cancers were in Saudi Arabia (53.90) and Egypt (103.40), respectively. In examining the components of the HDI, gross national income per capita was related to mortality rate of all cancers ($P = 0.02$). The HDI was related between the incidence rates of colorectal, gallbladder, kidney, lip and oral cavity, multiple myeloma, esophagus, pancreas, and thyroid cancer and the mortality rates of lip and oral cavity, skin melanoma, multiple myeloma, nasopharynx, esophagus, larynx, and pancreas cancers ($P < 0.05$). **Conclusion:** The findings of the present study showed that the incidence and mortality rates of some cancers were related to HDI, and the highest correlation was found between the incidence of kidney cancer and the mortality of pancreatic cancer with HDI.

Keywords: *Cancer, Eastern Mediterranean Regional Office, Human Development Index, incidence, mortality*

Saeid Sabzalizadeh
-Ardabili[1],
Reza
Alizadeh-Navaei[2],
Akbar Hedaytizadeh
-Omran[2],
Ghasem Janbabaei[2]

[1]*Student Research Committee, Mazandaran University of Medical Sciences,* [2]*Gastrointestinal Cancer Research Center, Mazandaran, University of Medical Sciences, Sari, Iran*

Introduction

Noncommunicable diseases, including cancer, have emerged in recent years as a global pandemic and one of the most important causes of mortality worldwide. The number of new cancer cases is expected to rise by about 20 million in 2025, compared to 14.1 million cases in 2012.[1-3] The increasing incidence and mortality rates of cancer in developing countries are attributed to many factors such as changes in lifestyle (smoking, diet, and exercise), socioeconomic level, and demographic factors. Several studies demonstrated that the differences in the incidence and mortality rates of cancer between countries affected by factors such as life expectancy, mean and expected years of schooling, gross national income (GNI), and access to medical care.[4-6] Furthermore, due to infectious diseases and low socioeconomic status, in countries with low-to-median income, the risk of developing cancer is increasing.[7,8]

The Human Development Index (HDI) is a key indicator of health and socioeconomic status in each country, consisting of three main subtypes, life expectancy, education, and GNI per capita. The United Nations Development Programme (UNDP) first introduced HDI in 1990 in three dimensions as an indicator for a comparison between countries' human status. This is a numeric index between zero and one. The countries were classified into the HDI levels as very high (HDI $\geq$ 0.8), high ($0.7 <$ HDI < 0.8), medium (HDI $< 0.5 < 0.5$), and low (HDI ≤ 0.55).[9]

The Eastern Mediterranean Regional Office (EMRO) is one of the six World Health Organization offices, which serves 21 countries in the Middle East, the

Address for correspondence:
Dr. Reza Alizadeh-Navaei,
Gastrointestinal Cancer Research Center, Mazandaran University of Medical Sciences, Sari, Iran.
E-mail: reza_nava@yahoo.com

How to cite this article: Sabzalizadeh-Ardabili S, Alizadeh-Navaei R, Hedaytizadeh-Omran A, Janbabaei G. Cancer incidence and mortality pattern in Eastern Mediterranean Regional Office Countries and its association with the human development index. Clin Cancer Investig J 2019;8:15-20.

North Africa, the Horn of Africa, and Central Asia with a population about 583 million people.[10] In addition, the cancer incidence and mortality rates were rising in the Eastern Mediterranean region, by 46% and 33%, respectively, between 2005 and 2015.[11] The large difference in factors such as income, age structure, and political stability between these countries, as well as the increasing incidence and mortality rates of cancer in the region in recent years, has resulted in this study and hence this study is aimed to investigate the relationship between the HDI and the incidence and mortality rates of cancer in the EMRO region.

Materials and Methods

This is an ecological study in the incidence and mortality rates of cancer and HDI data of 21 countries in the EMRO region. The cancer incidence and mortality rates were extracted from the 2012 Global Cancer Project (GLOBOCAN).[12] In addition, HDI data were extracted from the 2013 UNDP database.[9]

Notably, Somalia is excluded from the study because of the lack of HDI data. As a result, the analysis was carried out in 20 countries in the EMRO region. The obtained data included the cancer age-standardized incidence and mortality rates (ASR) and the HDI, which includes three subtypes: education, life expectancy, and GNI per capita for each country. The maps were created by Microsoft Office Excel. The data were analyzed using SPSS version 19 (SPSS Inc., Chicago, IL, USA). Pearson's correlation coefficient and *t*-test were used for analysis. $P < 0.05$ was considered statistically significant.

Results

The results of this study showed that colorectal cancer (mean = 10.19 ± 5.30) and Kaposi's sarcoma (mean = 0.20 ± 0.14) had highest and lowest incidence rate for all cancers in the EMRO region, respectively. The highest mortality rate was from lung cancer with 8.92 ± 4.63 and the lowest was Kaposi's sarcoma with 0.10 ± 0.09. However, in the mortality-to-incidence rate (MIR), lip and mouth cancer with 0.42 ± 0.22 and liver cancer with 1.00 ± 0.08 were lowest and highest, respectively, among all types of cancers.

The lowest and highest incidence of all cancers in the region pertained to Yemen (80.40) and Lebanon (197.40), respectively. In addition, the lowest and highest mortality from all cancers were in Saudi Arabia (53.90) and Egypt (103.40), respectively. Furthermore, the lowest and highest MIRs for all cancers were in the United Arab Emirates (0.483) and Qatar (0.848), respectively.

The lowest HDI belongs to Djibouti (0.46), and the highest was in Qatar (0.84). In the subgroups of the HDI, the lowest life expectancy at birth was for Afghanistan (59.7 years),

and the highest was Lebanon (78.8 years). The highest and lowest mean years of schooling were for Jordan (9.90 years) and Djibouti (6.3), respectively. GNI per capita for Afghanistan (1850) and Qatar (124,506) was lowest and highest levels, respectively [Table 1].

Based on the tests carried out in this study, there was no significant relationship between the HDI and the incidence and mortality rates of all cancers. However, in examining the components of the HDI, GNI per capita was related to mortality rate of all cancers ($P = 0.02$) [Table 2]. The relation between all cancers' incidences, mortality, and MIR with HDI of EMRO countries is shown in Figures 1-3.

The HDI and cancer relation is shown in Table 3; HDI was related between colorectal, gallbladder, kidney, lip and oral cavity, multiple myeloma, esophagus, pancreas and thyroid cancer incidence rates, and the mortality rates of lip and oral cavity, skin melanoma, multiple myeloma, nasopharynx, esophagus, larynx, and pancreas cancers ($P < 0.05$).

Discussion

The results of this study showed that there was no significant relationship between incidence and mortality ASR of all cancers with HDI in the EMRO region, but GNI of countries had a significant relationship with the mortality rate of all cancers. However, in Pervaiz and Faisal study, an inverse correlation was shown between cancer "mortality-to-incidence ratio" with both HDI ($r = -0.897$, $P < 0.001$) and "health system attainment" ($r = -0.750$, $P < 0.001$) in the Africa region.[13]

The strong negative relationship between the incidence of lip, oral and esophageal cancers, and mortality rate of lip, oral, melanoma, nasopharynx, esophagus, and larynx cancers with HDI in EMRO countries observed in this study. Almost all of these cancers were associated with the digestive tract, and ASR of these cancers was lower in countries with higher HDI compared to countries with low and middle HDI. The etiology could be the impact of factors such as socioeconomic conditions, lifestyle (especially diet and tobacco use), and genetic differences among individuals and races.[14] In Fidler *et al*.'s study, a negative dose–response relationship was observed for cervical and other pharyngeal cancers and Kaposi sarcoma in females.[15]

In recent decades, the global pattern and cancer incidence and mortality rates have changed. The incidence and mortality rates of many cancers were higher in developed countries compared to less developed countries.[16] In our study, HDI has a strong positive correlation with the incidence of colorectal, kidney, multiple myeloma, pancreas and thyroid cancers, and mortality rates of multiple myeloma and pancreatic cancers. The increased incidence of cancers in developed countries may be due to the greater number of screening programs, diagnostic modalities, and accurate cancer data registry systems, which results in more cancers diagnosis.[17] However,

Table 1: Human Development Index components and cancer incidence and mortality rates

Index	Minimum	Maximum	Mean±SD
Life expectancy at birth	59.7 (Afghanistan)	78.8 (Lebanon)	5.77±71.25
Expected years of schooling	6.3 (Djibouti)	15.2 (Saudi Arabia)	2.70±12.04
Mean years of schooling	3 (Yemen)	9.90 (Jordan)	2.23±6.81
GNI per capita	1850 (Afghanistan)	124,506 (Qatar)	32,009.46±25,829.45
HDI value	0.46 (Djibouti)	0.84 (Qatar)	0.13±0.68
All cancers incidence excl. nonmelanoma skin cancer	80.40 (Yemen)	197.40 (Lebanon)	28.99±117.32
All cancers mortality excl. nonmelanoma skin cancer	53.90 (Saudi Arabia)	103.40 (Egypt)	17.34±76.52
Cancer incidence			
Bladder	1.80 (Yemen)	16.60 (Lebanon)	3.88±6.58
Brain, nervous system	0.30 (Djibouti)	7.40 (Egypt)	1.62±3.25
Colorectal	4.00 (Pakistan)	25.60 (Jordan)	5.30±10.19
Gallbladder	0.10 (Yemen)	2.40 (Jordan)	0.64±1.31
Hodgkin's lymphoma	0.20 (Djibouti)	3.70 (Lebanon)	0.69±1.59
Kaposi sarcoma	0.00 (Djibouti, Kuwait, Pakistan)	0.50 (Tunisia)	0.14±0.20
Kidney	0.60 (Yemen)	3.50 (Qatar)	0.76±2.25
Larynx	0.50 (Djibouti)	5.50 (Iraq)	1.23±2.40
Leukemia	2.30 (Afghanistan)	7.00 (Lebanon)	1.36±4.94
Lip, oral cavity	1.30 (Libya)	9.80 (Pakistan)	1.95±2.70
Liver	1.10 (Tunisia)	25.60 (Egypt)	5.06±4.84
Lung	2.00 (Sudan)	19.80 (Lebanon)	5.28±9.98
Melanoma of skin	0.00 (Djibouti, Kuwait)	1.10 (Lebanon)	0.26±0.40
Multiple myeloma	0.10 (Yemen)	2.60 (Jordan)	0.62±1.28
Nasopharynx	0.20 (Bahrain)	2.30 (Libya, Sudan, Morocco, Tunisia)	0.72±1.05
Non-Hodgkin's lymphoma	4.20 (Afghanistan, Bahrain)	13.00 (Lebanon)	1.88±6.00
Esophagus	0.50 (Tunisia)	9.60 (Afghanistan)	2.57±2.69
Other pharynx	0.00 (Kuwait)	2.20 (Pakistan)	0.54±0.66
Pancreas	0.20 (Djibouti)	4.70 (Libya)	1.13±2.40
Stomach	1.80 (Sudan)	15.20 (Iran)	3.29±5.07
Thyroid	0.70 (Afghanistan)	4.50 (Jordan)	0.95±2.67
Cancer mortality			
Bladder	1.20 (Yemen)	6.50 (Egypt)	1.69±3.05
Brain, nervous system	0.30 (Djibouti)	5.20 (Egypt)	1.23±2.32
Colorectal	3.00 (Pakistan)	15.50 (Jordan)	2.96±6.22
Gallbladder	0.10 (Yemen)	2.20 (Jordan)	0.63±1.21
Hodgkin's lymphoma	0.10 (Bahrain, Kuwait)	2.00 (Yemen)	0.53±0.89
Kaposi sarcoma	0.00 (Afghanistan, Bahrain, Djibouti, Kuwait, Pakistan, the UAE)	0.30 (Qatar, Sudan)	0.09±0.10
Kidney	0.50 (Yemen)	2.30 (the UAE, Iraq)	0.48±1.54
Larynx	0.30 (Oman, Saudi Arabia)	2.80 (Iraq)	0.63±1.15
Leukemia	2.00 (Bahrain)	6.50 (Iraq)	1.30±3.95
Lip, oral cavity	0.30 (Libya)	5.90 (Pakistan)	1.55±1.35
Liver	1.00 (Tunisia)	24.50 (Egypt)	4.88±4.82
Lung	1.80 (Sudan)	17.50 (Lebanon)	4.63±8.92
Melanoma of skin	0.00 (Djibouti, Kuwait, Qatar, the UAE)	0.50 (Afghanistan, Sudan)	0.14±0.17
Multiple myeloma	0.10 (Yemen)	2.00 (Jordan)	0.49±1.03
Nasopharynx	0.10 (Bahrain, Kuwait)	1.80 (Sudan)	0.50±0.65
Non-Hodgkin's lymphoma	0.60 (Bahrain)	7.50 (Lebanon)	1.39±4.05
Esophagus	0.50 (Tunisia)	9.00 (Afghanistan)	2.40±2.53
Other pharynx	0.10 (Djibouti, Kuwait)	1.90 (Pakistan)	0.49±0.55
Pancreas	0.20 (Djibouti)	4.60 (Libya)	1.12±2.39
Stomach	1.60 (Kuwait)	12.90 (Iran)	3.02±4.54
Thyroid	0.40 (Kuwait)	1.80 (Yemen, Jordan)	0.44±1.16

SD: Standard deviation, HDI: Human Development Index, GNI: Gross national income
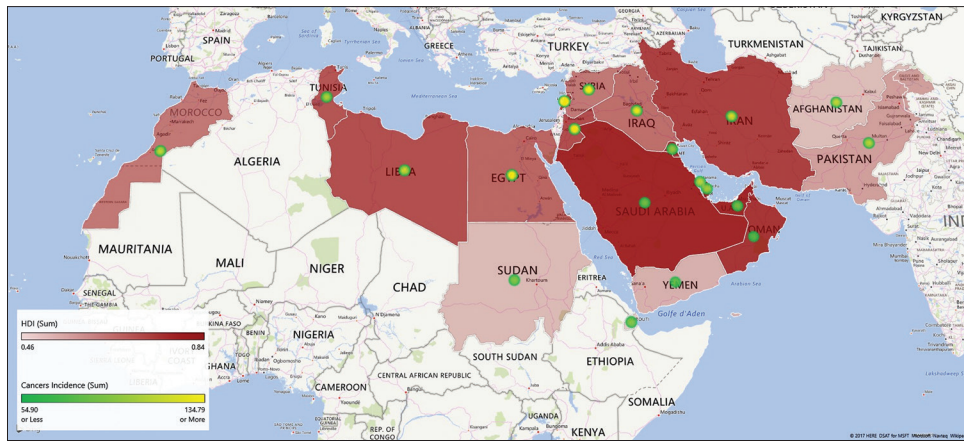
Figure 1: Cancer incidence pattern and Human Development Index in the Eastern Mediterranean Regional Office region countries
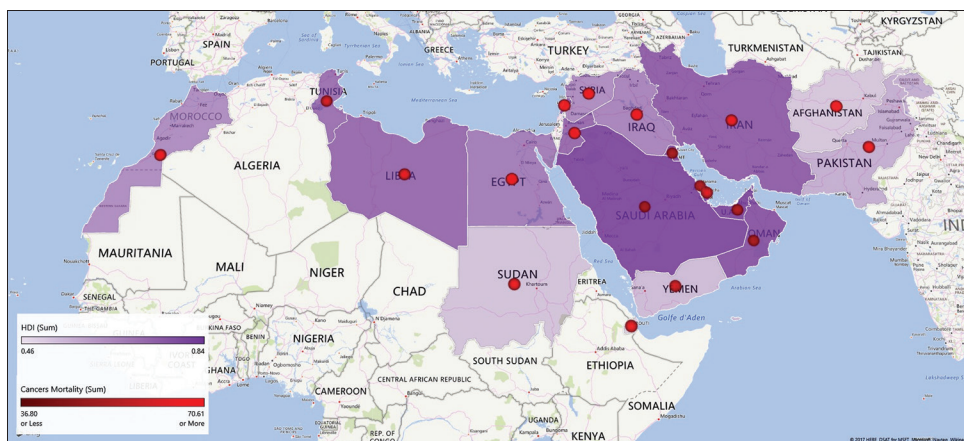

Figure 2: Cancer mortality pattern and Human Development Index in the Eastern Mediterranean Regional Office region countries
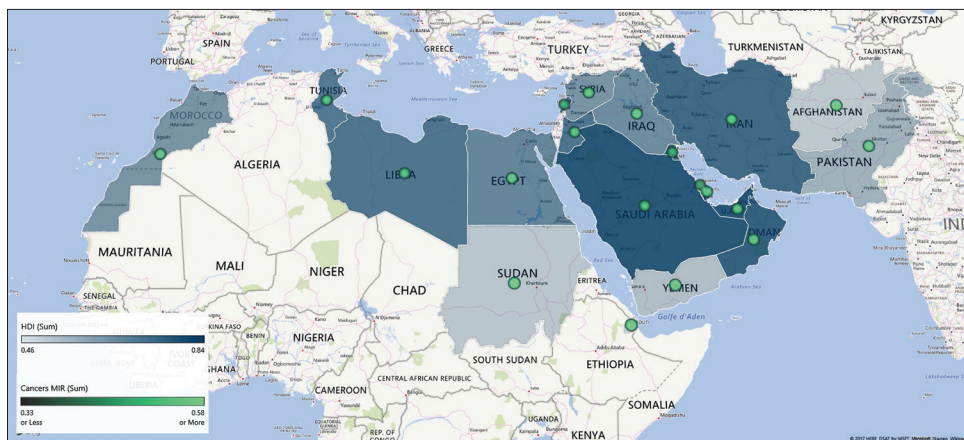

Figure 3: Cancer mortality-to-incidence rate pattern and Human Development Index in the Eastern Mediterranean Regional Office region countries

mortality rates of some cancers have been reported higher in these countries. Another reason for the increase in the incidence and mortality rates of cancers in high HDI countries is their common risk factors. HDI increasing results in a higher prevalence of obesity and consumption of alcohol, cigarettes, fruits and vegetables, and red meat in different populations.[18] This information shows that, despite the increased HDI in EMRO countries, there are

urging interventions to modify risk factors, especially lifestyle, including diet and tobacco consumption. In Fidler *et al*.'s study, there was a positive dose–response relationships between the ASR and HDI level which were observed in both sexes for the following cancer types: lung, pancreas, leukemia, gallbladder, colorectal, brain/nervous system, kidney, multiple myeloma, and thyroid.[15]

Table 2: Association between the Human Development Index and all cancer incidence and mortality rates

	All cancers incidence rate		All cancers mortality rate	
	r	P	r	P
Life expectancy at birth	0.29	0.2	-0.22	0.33
Expected years of schooling	0.26	0.26	-0.17	0.46
Mean years of schooling	0.3	0.19	-0.16	0.5
GNI per capita (2011 PPP$)	-0.25	0.29	-0.51	0.02*
HDI value	0.15	0.5	-0.33	0.14

*Significant at 0.05 level. HDI: Human Development Index, GNI: Gross national income

Table 3: Association between the Human Development Index and incidence and mortality rates of cancers

Cancer	HDI			
	Incidence rate		Mortality rate	
	r	P	r	P
Bladder	0.35	0.12	0.09	0.67
Brain, nervous system	0.03	0.87	-0.19	0.4
Colorectal	0.53	0.015*	0.34	0.13
Gallbladder	0.51	0.019*	0.41	0.06
Hodgkin's lymphoma	0.23	0.32	-0.39	0.08
Kaposi sarcoma	0.15	0.51	0.04	0.84
Kidney	0.71	0.00**	0.26	0.26
Larynx	-0.02	0.91	-0.41	0.06
Leukemia	0.26	0.25	-0.019	0.39
Lip, oral cavity	-0.52	0.017*	-0.74	0.00**
Liver	0.03	0.89	0.05	0.8
Lung	0.44	0.051	0.44	0.053
Melanoma of skin	0.07	0.75	-0.53	0.016*
Multiple myeloma	0.67	0.001**	0.56	0.010**
Nasopharynx	-0.25	0.27	-0.52	0.017*
Non-Hodgkin's lymphoma	0.216	0.36	-0.23	0.32
Esophagus	-0.51	0.019*	-0.54	0.013*
Other pharynx	-0.49	0.27	-0.55	0.011
Pancreas	0.57	0.008**	0.58	0.006**
Stomach	0.38	0.87	-0.05	0.81
Thyroid	0.47	0.036*	-0.24	0.29

*Significant at 0.05 level, **Significant at 0.01 level. HDI: Human Development Index

Due to the lack of Cancer Registry systems in the region, the accuracy of the results was affected by the GLOBOCAN database used in this study, which is the main limitation of this study.

Conclusion

The results of this study showed that the incidence and mortality rates of some cancers were related to HDI, and the highest correlation was found between the incidence of kidney cancer and the mortality of pancreatic cancer

with HDI. Because of differences in pattern, HDI, and association observed, different prevention programs should be considered for each country.

Financial support and sponsorship

Conflicts of interest

There are no conflicts of interest.

References

1. Terzic A, Waldman S. Chronic diseases: The emerging pandemic. Clin Transl Sci 2011;4:225-6.
2. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D, *et al.* Global cancer statistics. CA Cancer J Clin 2011;61:69-90.
3. Stewart BW, Wild CP. World Cancer Report 2014: International Agency for Research on Cancer; 2014.
4. Myers ER, Moorman P, Gierisch JM, Havrilesky LJ, Grimm LJ, Ghate S, *et al.* Benefits and harms of breast cancer screening: A systematic review. JAMA 2015;314:1615-34.
5. Coughlin SS, Berkowitz Z, Hawkins NA, Tangka F. Breast and colorectal cancer screening and sources of cancer information among older women in the United States: Results from the 2003 Health Information National Trends Survey. Prev Chronic Dis 2007;4:A57.
6. Akinyemiju TF. Socio-economic and health access determinants of breast and cervical cancer screening in low-income countries: Analysis of the World Health Survey. PLoS One 2012;7:e48834.
7. Bray F, Jemal A, Grey N, Ferlay J, Forman D. Global cancer transitions according to the human development index (2008-2030): A population-based study. Lancet Oncol 2012;13:790-801.
8. Cancer.org. The Cancer Atlas, Human Development Index Transitions: As Countries Develop, Their Cancer Burden Changes in Scale and Type; 2017. Available from: http://www.canceratlascancerorg/the-burden/humandevelopment-indextransitions/.
9. United Nations Development Programme. Human Development Report 2013: The Rise of the South: Human Progress in a Diverse World. United Nations Development Programme; 2013.
10. World Health Organization. EMRO: WHO Regions. World Health Organization; 2017. Available from: http://www.emro.who.int/entity/about-us/index.html.
11. GBD 2015 Eastern Mediterranean Region Cancer Collaborators. Burden of cancer in the Eastern Mediterranean Region, 2005-2015: Findings from the global burden of disease 2015 study. Int J Public Health 2018;63:151-64.
12. Cancer IAfRo, World Health Organization. GLOBOCAN: Estimated Cancer Incidence, Mortality, and Prevalence Worldwide in 2012. IARC; 2014.
13. Pervaiz R, Faisal F. Cancer incidence and mortality are associated with human development index and health setups in Africa. J Egypt Natl Canc Inst 2017;29:123-6.
14. Hu QD, Zhang Q, Chen W, Bai XL, Liang TB. Human development index is associated with mortality-to-incidence ratios of gastrointestinal cancers. World J Gastroenterol 2013;19:5261-70.
15. Fidler MM, Soerjomataram I, Bray F. A global view on cancer incidence and national levels of the human development index.

Int J Cancer 2016;139:2436-46.

16. Alizadeh-Navaei R, Hedayatizadeh-Omran A, Janbabaei G. Cancer incidence pattern in Iran provinces and association with human development index. World J Cancer Res 2017;4:e913.

17. Hébert JR, Daguise VG, Hurley DM, Wilkerson RC, Mosley CM, Adams SA, *et al.* Mapping cancer mortality-to-incidence ratios to illustrate racial and sex disparities in a high-risk population. Cancer 2009;115:2539-52.

18. Ferrari F, Reis MA. Study of risk factors for gastric cancer by populational databases analysis. World J Gastroenterol 2013;19:9383-91.