Original Article

Global Cancer Statistics 2018: GLOBOCAN Estimates of Incidence and Mortality Worldwide Prostate Cancers and their Relationship with the Human Development Index

Zaher Khazaei[1], Malihe Sohrabivafa[2], Victoria Momenabadi[3], Leili Moayed[4], Elham Goodarzi[5]

[1]Department of Epidemiology, School of Public Health, Ilam University of Medical Sciences, Ilam, Iran, [2]School of Medicine, Dezful University of Medical Sciences, Dezful, Iran, [3]Candidate of Health Education and Health Promotion, Department of Health Education and Health Promotion, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran, [4]Department of Nursing, Gerontological Care Research Center, Bojnurd University of Medical Sciences, Bojnurd, Iran, [5]Social Determinants of Health Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran

Abstract

Background: Prostate cancer is one of the most common cancers in men and is the second leading cause of death, especially in developed countries. Therefore, the aim of this study was to investigate the incidence and mortality of prostate cancer and its relationship with the human development index (HDI). **Materials and Methods:** This is an ecological review of the incidence of prostate cancer and its relation with HDI and its components in 2018. Data about the incidence and mortality rate of breast cancer for the year 2018 were obtained from the global cancer project for 185 countries. To analyse data, correlation test and regression tests were used to evaluate the correlation between the incidence and mortality with HDI. The statistical analysis was carried out by Stata-14, and the significance level was estimated at the level of 0.05. **Results:** The result showed that there is a positive and significant correlation between the incidence ($R = 0.531$, $P < 0.001$) and mortality ($R = -0.219$, $P < 0.001$) of prostate cancer with HDI. The linear regression model showed that the increase in HDI, mean years of schooling (MYS), expected years of schooling (EYS), life expectancy at birth (LBE) and gross national income was associated with an increase in the incidence of prostate cancer in men, but it was statistically significant only in MYS ($B = 3.6$, $P < 0.05$) and EYS ($B = 4.8$, $P < 0.05$). Furthermore, the increase in life expectancy at birth ($B = -0.45$, $P < 0.05$) significantly decreased mortality. **Conclusion:** By increasing the HDI the incidence of prostate cancer increases, but the mortality rate decreases. Therefore, HDI can be used to provide a clear picture of the distribution of this cancer. Having a comprehensive picture of the epidemiological features and changes of prostate cancer has a significant role to play in preventing, diagnosing and treating early, and reducing mortality.

Keywords: Human development index, incidence, mortality, prostate cancer

INTRODUCTION

Prostate cancer is the most common malignant cancer in men (after skin cancer) and is related to the reproductive system. According to World Statistics in 2012, this cancer accounts for 15% of men's cancers and the second leading cause of cancer death in men (after lung cancer). The root to 70% of prostate cancers is from the peripheral zone, 20% of the transition zone and 10% of the central zone of the prostate. The average age of diagnosis of prostate cancer is 72 years. It can be said that there is a direct relationship between the age and incidence of prostate cancer. Nearly three-quarters of the cases of prostate cancer diagnosed in the world occur in men over 65 years of age.[1-7]

Epidemiologically, the most important risk factors associated with prostate cancer are genetic factors, race, age, family history, diet, alcohol consumption, ultraviolet radiation, male hormones (androgens), sexually transmitted infections and drug use.[8-14]

Address for correspondence: Elham Goodarzi,
Social Determinants of Health Research Center,
Lorestan University of Medical Sciences, Khorramabad, Iran.
E-mail: Elhamgoodarzi.1370@yahoo.com

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Impotence, frequent urination, haematuria, persistent pain in the lower back, seminal outflow with pain and urinary disorders such as difficult urination and a discontinuous and poorly flowed urine are among the most common clinical symptoms of prostate cancer. The cancer has the ability to metastasise to other parts of the body, including the spine, pelvis and ribs. Currently, prostate cancer treatment includes a combination of surgery, radiation therapy, hormone therapy or chemotherapy, depending on the patient's age, the severity of the illness and the presence of other physical problems.[7,15]

Annually, about 300,000 new cases of prostate cancer are detected and discovered, of which nearly 41,000 are fatal.[16] The number of deaths range from 156,000 in 1990 to 254,000 in 2007 and 256,000 deaths in 2010.[17]

Although prostate cancer is widely reported across the world from different countries, its prevalence is more common in southern and eastern Asia, Europe, North America, Australia and New Zealand.[18] More than 50% of deaths from prostate cancer have occurred in more developed countries.[19,20]

The contradictions in the incidence of prostate cancer and its mortality in different parts of the world are due to genetic factors, the environment and the community.[21] According to some sources, the incidence of prostate cancer is 1 out of 6 men. Others have estimated the incidence of 50 cases per 100,000 people to 178.8 per 100,000 black people.[19,22,23]

Health is directly linked to the level of development, social, economic and human development in a country. The human development index (HDI) is one of the world's leading indicators showing the economic and social well-being of the community under review.[24] HDI is a set of three components of health, education and income and shows quality of life (QoL). To measure the health component, we used the life expectancy at birth (LEB), for the education component, mean years of schooling (MYS) and expected years of schooling (EYS) and for the income component, we used the per capita gross national income (GNI) index.

In sum, cancer can be considered as a major health problem that is associated with massive mortality and disability worldwide, especially in developing countries, with significant social implications.[18,25,26] Given the significant increase in the risk of prostate cancer and its association with ageing in developed societies, this study was conducted to fill the academic gap. Therefore, considering the effect of prostate cancer on QoL and given the importance of the issue at hand, to better understand the epidemiologic process of this type of cancer and its relation with the developmental index of the societies, this study was conducted in 2018.

MATERIALS AND METHODS

Caution must be exercised when interpreting these estimates, given the limited quality and coverage of cancer data worldwide at present, particularly in low- and middle-income countries. International agency for research on cancer (IARC's)

approach is not only to evaluate, compile and use the data from the Agency's collaborators in these estimates but also to work alongside national staff to improve local data quality, registry coverage and analytical capacity. The clear need for investment in population-based cancer registration in low- and middle-income countries led to the launch of the Global Initiative for Cancer Registry Development (GICR), coordinated by IARC. The goal of the GICR is to inform cancer control through defined improvements in the coverage, quality and use of population-based cancer registration data worldwide. A summary of the steps used to generate the current set of cancer incidence, mortality and prevalence estimates is provided below.

The methods of estimation are country-specific, and the quality of the national estimates depends on the coverage, accuracy and timeliness of the recorded incidence and mortality data in a given country.

Incidence
The methods used to estimate the sex- and age-specific incidence rates of cancer in a specific country fall into the following broad categories, in order of priority: (1) observed national incidence rates were projected to 2018 (45 countries), (2) the most recently observed incidence rates (national or regional) were applied to the 2018 population (50 countries), (3) rates were estimated from national mortality data by modelling, using mortality-to-incidence ratios derived from cancer registries in that country (14 countries), (4) rates were estimated from national mortality estimates by modelling, using mortality-to-incidence ratios derived from cancer registries in neighbouring countries (37 countries), (5) age- and sex-specific national incidence rates for all cancers combined were obtained by averaging overall rates from neighbouring countries. These rates were then partitioned to obtain the national incidence for specific sites using available cancer-specific relative frequency data (7 countries) and (6) rates were estimated as an average of those from selected neighbouring countries (32 countries).

Mortality
The methods used to estimate the sex- and age-specific mortality rates of cancer in a specific country fall into the following broad categories, in order of priority, (1) observed national mortality rates were projected to 2018 (81 countries), (2) the most recently observed national mortality rates were applied to the 2018 population (20 countries), (3) rates were estimated from the corresponding national incidence estimates by modelling, using incidence-to-mortality ratios derived from cancer registries in neighbouring countries (81 countries) and (4) rates were estimated as an average of those from selected neighbouring countries (3 countries)[27,28]

Human development index
HDI is a compound index of indices in three dimensions: life expectancy, degree of studies and dominance over required sources for a proper sensible life. All the groups and regions which have had a remarkable progress in all HDI components have developed more rapidly in comparison with low or moderate HDI countries. As this index says, the world is

unequal because national average hides most of the different experiences in human's life. There exits a lot of inequalities in northern and southern countries. Income inequality has risen inside every country and also between many countries.[26,29,30]

RESULTS

Based on the results of the cancer record in 2018, 18,078,957 (197.9 per 100,000) were reported in both genders, of which 9,456,418 cases (21.6% in 100,000) occurred in males and 8,622,539 cases (182.6 in 100,000) were in women. The number of deaths due to cancer in 2018 was 9,555,027 (1.101 per 100,000), which was estimated to be 5,385,640 men (12.72 per 100,000) and 4,169,387 (83.1 per 100,000) for women. The results revealed that, after lung cancer (31.5% in 100,000), prostate cancer has the highest incidence in

men with 1,276,106 cases (29.3% in 100,000). With mortality of 6.7 per 100,000, this cancer type is the sixth cause of death from cancer in men [Figure 1].

Table 1 shows the incidence and mortality rate of prostate cancer in different countries. The results of the study showed that the highest incidence of prostate cancer were related to France, Guadeloupe (189.1 in 100,000), France, Martinique (158.4 in 100000) and Ireland (132.5 in 100,000), respectively. The highest mortality rate of prostate cancer was in Barbados (48 per 100,000), Jamaica (41.7 per 100,000) and Benin (36.3 per 100,000), respectively [Figures 2 and 3].

The results showed that there was a positive and significant correlation between the incidence rate ($R = 0.531$, $P < 0.001$) and mortality ($R = -0.219$, $P < 0.001$) of prostate cancer with HDI [Figure 4].

Table 1: Prostate cancer incidence, mortality and Human Development Index components in different Human Development Index regions in 2018

Variable	Incidence		Mortality		HDI component				
	CR	ASR	CR	ASR	LEB	MYS	GNI	EYS	HDI
Very high human development	114.5	60.77	26.57	10.55	79.55	11.5	39,613	16.2	0.876
High human development	47.88	38.96	20.05	14.69	74.1	9.36	13,420	13.71	0.746
Medium human development	13.81	21.98	6.23	10.23	68.35	6.49	7803	11.68	0.629
Low human development	11.9	26.68	6.81	16.97	59.71	4.36	3498	9.18	0.468
P (F-test)	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	-

CR: Crude rate, ASR: Age-standardised rates per 100,000, HDI: Human Development Index, LEB: Life expectancy at birth, MYS: Mean years of schooling, GNI: Gross national income per capita, EYS: Expected years of schooling
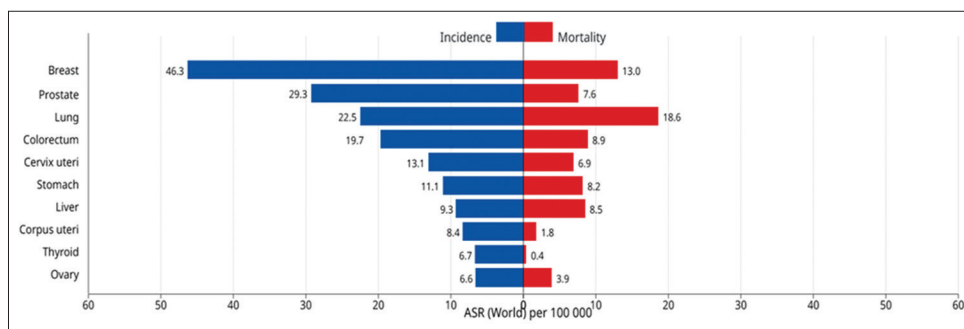

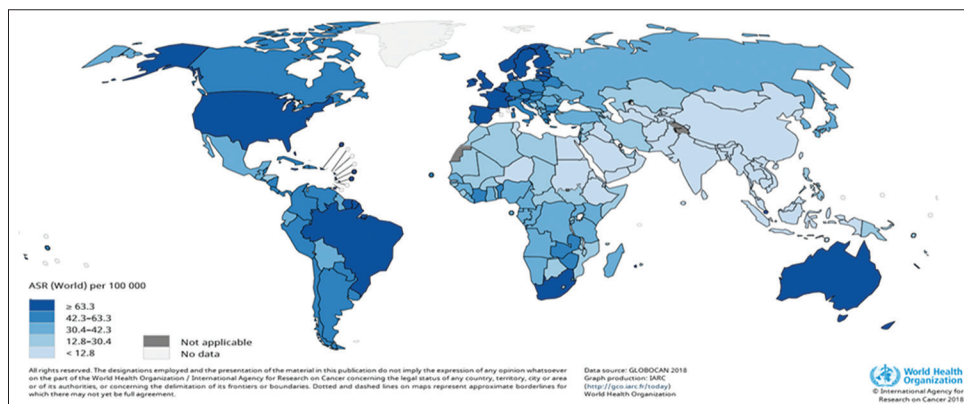**Figure 1:** The highest incidence of cancer in the world (extracted from GLOBOCAN 2018).

Figure 2: Estimated age-standardised incidence rates (world) in 2018, prostate, males, all ages (extracted from GLOBOCAN 2018).
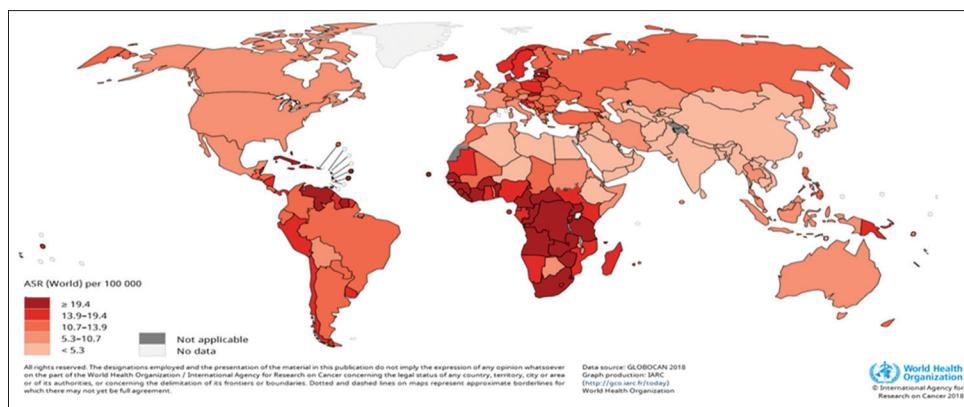
Figure 3: Estimated age-standardised mortality rates (world) in 2018, prostate, males, all ages (extracted from GLOBOCAN 2018).
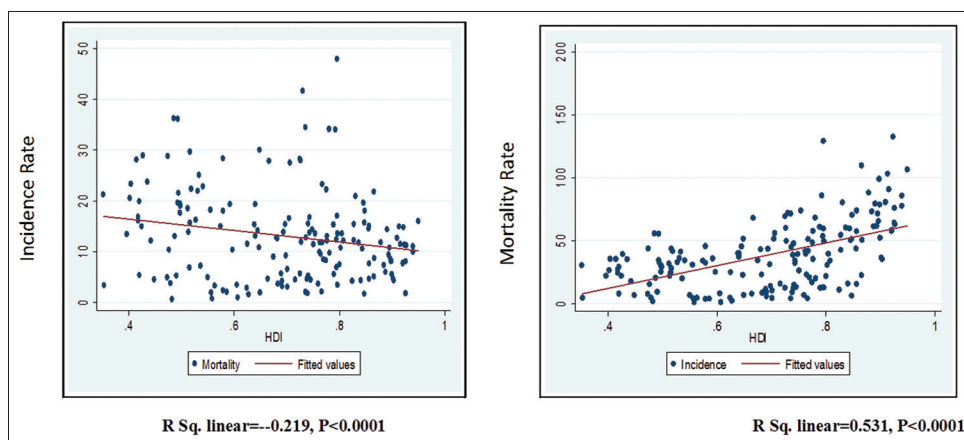

Figure 4: Correlation between the human development index, incidence and mortality rates of cancer prostate in world in 2018.

The highest incidence rate (60.77 case per 100000) of prostate cancer were in very high human and highest mortality rate (16.97 case per 100000) of prostate cancer were in low human development. Furthermore, the lowest incidence and mortality rates of prostate cancer were indicated in medium human development as 21.98 and 10.23 cases per 100,000 people, respectively; highest value of LEB, MYS, GNI, EYS and total HDI were estimated to be 79.55, 11.5, 39613, 16.2 and 0.876, respectively [Table 1].

The linear regression model showed that the increase in HDI, MYS, EYS, LBE and GNI was associated with an increase in the incidence of prostate cancer in men, but it was statistically significant only in MYS ($B = 3.6$, $P < 0.05$) and EYS ($B = 4.8$, $P < 0.05$). The results of regression analysis showed that increasing HDI reduced mortality, but this decrease was not statistically significant ($P > 0.05$). Meanwhile, the increase in MYS ($B = 1.2$, $P < 0.05$) significantly increased mortality ($B = 0.24$) and LEB increase ($B = −0.45$, $P < 0.05$) significantly decreased mortality [Table 2].

DISCUSSION

Prostate cancer is one of the most common cancers in men with a high mortality rate. The long duration of this type of cancer and its potential threads will require a more serious attention to the environmental and lifestyle of individuals.[31]

In 2012, the number of deaths from prostate cancer in Asia was 8229. A positive correlation was observed between the incidence of prostate cancer and HDI. Furthermore, the relationship between prostate cancer and HDI components (including LEB, MYS and individual income levels) was reported to be positive. Findings indicate that most cases of prostate cancer occur in older men, especially after 85 years. The prevalence of prostate cancer in urban areas is higher than in rural areas. Countries with high levels of HDI and high GDP such as Israel, Turkey, Lebanon, Singapore, Japan and the Republic of Korea have the most hope for life at birth, and cases of prostate cancer are reported higher in these countries. In contrast, Tajikistan, Turkmenistan, Uzbekistan, Bangladesh, Nepal and Bhutan have the lowest incidence of prostate cancer. The causes of high prostate cancer in these countries include factors such as lifestyle, diet (high calorie and high fat foods) and most importantly, the general availability of prostate-specific antigen (prostate cancer screening) and the disease registration system.[25]

In 2008 prostate, breast, and colorectal cancers accounted for more than half of the cancers in areas with high HDI. The most common cancer among 184 countries was prostate,

Table 2: Effect of Human Development Index components on prostate cancer incidence and mortality in world in 2018

Variable	Incidence			Mortality		
	B	95% CI	*P*	*B*	95% CI	*P*
HDI	9.9	−12.8-32.8	0.1	−24.8	−67-17.7	0.2
GNI per 1000 capita	0.002	−0.004-0.004	0.1	0.003	−0.001-0.006	0.4
MYS	3.6	1.07-6.2	0.006	1.2	0.31-2.2	0.01
LEB	0.01	−0.9-1.01	0.9	−0.45	−0.8-−0.08	0.01
EYS	4.8	1.9-7.8	0.001	0.86	−0.2-1.9	0.1

CI: Confidence interval, HDI: Human Development Index, LEB: Life expectancy at birth, MYS: Mean years of schooling, EYS: Expected years of schooling, GNI: Gross national income

lung and liver cancer. The number of cases of prostate cancer was 766,000. The risk of prostate cancer is higher than 3% in the long-term life of each person in areas with high HDI. Some cancers are positively associated with the level of socioeconomic development, exposure to environmental factors and lifestyle. These include colorectal and prostate cancers.[22]

In 2012, the common age for prostate cancer is 80 years. The number of cases of prostate cancer worldwide is 1,094,916, and the number of deaths associated with it is estimated to be 307,481 cases. The highest incidence of prostate cancer is observed in 10 countries as follows: United States (233,159 cases), Brazil (72,536 cases), Germany (68,262 cases), France (56,841 cases), Japan (55,970 cases), China (46,745 cases), United Kingdom (45,406 cases), Italy (44,525 cases), Spain (27,853 cases) and Canada (27,087 cases), representing 61.95% of the total cases. The incidence and mortality rate of prostate cancer is much higher in the advanced countries. For example, France and Norway, as countries with high HDI, are the highest, and Bhutan and Nepal, as low-HDI countries, have the lowest incidence and mortality. A positive and significant relationship was found between prostate cancer and HDI. There was also a positive and significant relationship between prostate cancer and HDI components, such as life expectancy, MYS and per capita GNI.[18]

In 2012, more than 70% of new cases of prostate cancer occurred in older men above 85 years of age. The number of newly diagnosed prostate cancer cases was 112,000, and the number of deaths from it was 307,000 (new and old). There was a positive and significant relationship between the incidence of prostate cancer and HDI and its components, including LEB, MYS and income. Urban life and obesity also had a positive relationship with prostate cancer in men.[32]

Prostate cancer is on the rise, and its prevalence has changed geographically. The difference in the rate of prostate cancer among men in developed and in Asian countries is a feedback on their different lifestyles. Other causes of differences in these two categories include diet, pattern of sexual behaviour, alcohol consumption, obesity, occupational and sports activities, male hormones, vasectomy, marital status and number of children, smoking and exposure to ultraviolet rays.[23,31,33]

In the current study conducted in 2018, prostate cancer was the second highest in men worldwide after lung cancer, with 1,276,106 cases reported. In terms of the ranking, cancer is the sixth cause of death in men. The highest incidence of prostate cancer In Guadeloupe, France, Martinique and Ireland. The highest mortality rate for prostate cancer was in Barbados, Jamaica and Benin, respectively. One of the important results of this study was a positive and significant correlation between incidence and mortality of prostate cancer with HDI. In the linear regression model, the increase of HDI components including MYS, EYS, LBE and GNI was associated with an increase in prostate cancer in men. However, this increase was significant only in MYS and EYS. Increased LEB significantly reduced mortality.

The results of recent studies have shown that the number of new cases of prostate cancer is rising in countries with a high and very high HDI. Meanwhile, mortality rates in these countries are lower than in poor countries or countries with lower HDI (such as African and Caribbean countries).[26] One of the main reasons for this difference is the easier access to screening and treatment methods in countries with a high and very high HDI. A high percentage of deaths from prostate cancer in many African and Asian countries also indicates late detection or diagnosis in advanced and non-treatable stages.[23,34]

LEB is one of the components of HDI, which is associated with a reduction in the mortality rate of prostate cancer. One of the main reasons for this connection is the increase in the ageing population in the community, because, as mentioned, the prevalence of prostate cancer is higher in people over 85 years of age.

Other components of the HDI are MYS and EYS, which has been directly linked to prostate cancer. In countries with a high and very high HDI, the levels of education and awareness of the community are higher, resulting in having more and more health information about prostate cancer. In previous literature, the lack of sufficient knowledge, no access to diagnostic tests and screening programs in low literacy and low-income countries have been identified as leading causes of increased mortality associated with prostate cancer.

Finally, there is a need for further cooperation between health professionals and public and private institutions, more specialised healthcare infrastructure and stronger monitoring systems, raising community awareness, lifestyle modification, reducing risk behaviours and more recent cancer screening programs.

Conclusion

The impact of the HDI on the incidence of prostate cancer is important and worthwhile. In countries with better social conditions, people are more likely to participate in early

detection and screening programs because of their income, better access to health facilities and higher education levels. However, people with a disadvantaged socioeconomic status are at increased risk of mortality due to poor access to health care and diagnostic services, poor health habits and poor health information.

Suggestion

In future epidemiological studies, the association of indices other than social and economic indicators, with the incidence and mortality of prostate cancer should be considered.

Acknowledgement

Conflicts of interest

There are no conflicts of interest.

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