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RESEARCH ARTICLE

Global Prostate Cancer Incidence and Mortality Rates According to the Human Development Index

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Abstract

Background: Prostate cancer (PC) is one of the leading causes of death, especially in developed countries. The human development index (HDI) and its dimensions seem correlated with incidence and mortality rates of PC. This study aimed to assess the association of the specific components of HDI (life expectancy at birth, education, gross national income per 1000 capita, health, and living standards) with burden indicators of PC worldwide. Materials and Methods: Information of the incidence and mortality rates of PC was obtained from the GLOBOCAN cancer project in year 2012 and data about the HDI 2013 were obtained from the World Bank database. The correlation between incidence, mortality rates, and the HDI parameters were assessed using STATA software. Results: A significant inequality of PC incidence rates was observed according to concentration indexes=0.25 with 95% CI (0.22, 0.34) and a negative mortality concentration index of -0.04 with 95% CI (-0.09, 0.01) was observed. Conclusions: A positive significant correlation was detected between the incidence rates of PC and the HDI and its dimensions including life expectancy at birth, education, income, urbanization level and obesity. However, there was a negative significant correlation between the standardized mortality rates and the life expectancy, income and HDI.

Keywords: Human development index - prostate cancer - correlation - GLOBOCAN cancer project

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Introduction

Cancer is the leading causes of death in whole the world. In either developing or developed countries with high or very high levels on the Human Development Index (HDI), prostate cancer (PC) explains a great part of the overall cancer incidence burden (Ferlay et al., 2010). PC is the fourth most common cancer in both sexes combined and the second most common cancer in men. An estimated 1.1 million men worldwide were diagnosed with PC in 2012, accounting for 15% of the cancers diagnosed in men. PC is the fifth leading cause of death from cancer in men (6.6% of the total men deaths) with an estimated 307,000 deaths in 2012 (International Agency for Research on Cancer, 2012). PC is a disease of increasing significance worldwide. Incidence rates of PC have been increasing in almost all countries, irrespective of HDI level, with average increases varied between 3.2% and 7% (Bray et al., 2012). Of course, PC incidence rates are higher in more developed regions because the practice of prostate specific antigen (PSA) testing and subsequent biopsy has become available for PC screening in developed countries and those regions have experienced a huge increase in PC incidence (Brawley, 2012). Almost 70% of the cases worldwide living in developed countries, despite such regions comprising only 15% of the world's population, in contrast, the increase in PC mortality rates mainly occurred in lower resource settings (Center et al., 2012).

Because PSA testing has a much greater effect on incidence than on mortality, there is less variation in mortality rates worldwide than is observed for incidence, with the number of deaths from PC larger in less developed than in more developed regions (International Agency for Research on Cancer, 2012). PC seems to be positively

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associated with the level of macroeconomic development factors. The reasons for this association are not clear and there are few researches examining how socioeconomic determinants correlate with PC incidence and mortality. The aim of this study is to assess the association of the specific components of HDI (life expectancy at birth, education, gross national income per 1000 capita, health, and living standards) with burden indicators of PC. We used the data of International Agency for Research on Cancer (IARC) that represents the most up to date information on the incidence of PC around the world (Ferlay et al., 2014).

Materials and Methods

Present ecological study used dataset regarding the incidence and mortality rates of PCs and some related health factors in the world. Data of the incidence and mortality rates of cancers was obtained from the global cancer project for 172 countries in year 2012 (Ferlay et al., 2014). Data about the HDI 2013 and its gradient including life expectancy at birth, mean years of schooling, and gross national income (GNI) per capita and also other health related variables were obtained from the World bank database for 169 countries (Malik, 2013).

Data analysis was restricted to 169 countries that both the epidemiologic data from the GLOBOCAN database and the HDI were available. These countries categorized into four categories including (1) Very High Human Development (27 countries), (2) High Human Development (37 countries), (3) Medium Human Development (89 countries) and (4) Low Human Development (16 countries). We defined inequality in the age-specific incidence and mortality rates (ASR) of PCs according to the HDI by using concentration index. The value of concentration index is ranged from -1 to +1, the negative value is indicating that the health variable is more concentrated in the poor population and the positive value indicates in rich population. We also used linear regression models for assessment of the HDI effect and other variables on PC occurrence rates. Data were analyzed by STATA software version 12 (StataCorp, College Station, TX, USA).

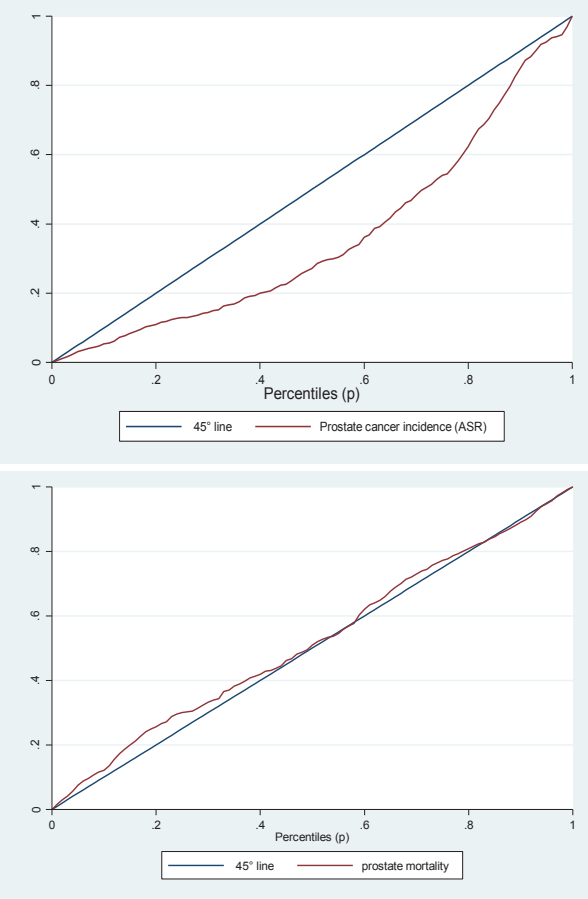

Figure 1. Incidence and Mortality of Prostate Cancer Ranked by Human Development Index in World (2012)

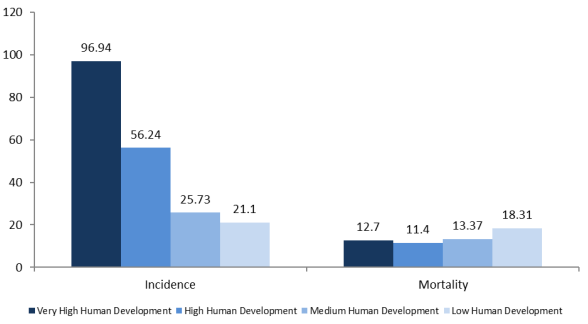

Figure 2. Incidence and Mortality of Prostate Cancer in Different HDI Regions in 2012 (per 100,000 pop)

Table 1. Concentration Indexes for Inequality of Incidence and Mortality of Prostate Cancer According to HDI

Cancer type	New cases diagnosed in 2012 (1,000s)	Death form PC in 2012 (1,000s)	Incidence concentration index (95%CI)	Mortality concentration index (95%CI)	Incidence/Mortality concentration index (95%CI)
Prostate	1,112	307	0.28 (0.22,0.34)	-0.04(-0.09,0.01)	0.32(0.27,0.36)

Table 2. Effect of HDI Components And Demographic Variables on Prostate Cancer Incidence and Mortality Rates

Variables	Prostate cancer incidence			Prostate cancer mortality		
	B	CI	P-value	B	CI	P-value
Life expectancy at birth	1.58	(1.12, 2.05)	<0.001	-0.25	(-0.42, -0.1)	0.002
Mean years of schooling	5.7	(4.42, 6.98)	<0.001	-0.19	(-0.67, 0.29)	0.44
Gross national income per 1000 capita	0.76	(0.52, 1)	<0.001	-0.09	(-0.17, -0.01)	0.026
HDI	111	(85.8, 136.3)	<0.001	-10.18	(-19.56, -0.8)	0.034
Urbanization level (%)	0.58	(0.4, 0.77)	<0.001	-0.05	(-0.12, 0.01)	0.1
Age standardized obesity in adults	0.97	(0.54, 1.4)	<0.001	0.02	(-0.12, 0.16)	0.86

Results

The study analyses constitute the global overview of the current patterns of cancer incidence and mortality in relation to predefined levels of HDI. Positive value of concentration index in Table 1 and also results from Figure 2 for incidence of PC indicated that this cancer in more concentrated in High HDI countries. Negative value of concentration index in Table 1 and also results from Figure 2 for death from PC indicated that this cancer in more concentrated in low HDI countries. The concentration index and %95confidence interval for incidence, mortality and incidence/mortality rates of PC is presented in detail in Table 1.

In Figure 1 also we showed the concentration index for incidence and mortality of PC graphically.

Linear regression model showed that increasing of HDI had a positive effect on increasing the incidence (B=111, P<0.001) and a negative effect on mortality (B=-10.18, P=0.034) rates of PC. The mean of life expectancy at birth, mean years of schooling, GNI per capita, percent of urbanization, and age standardized obesity had also a positive effect on increasing in incidence rates (Table 2). But life expectancy at birth and GNI per capita had a negative effect on PC mortality.

Discussion

In this study, we used the Human Development Index (HDI) as an indicator of socioeconomic development, and PC incidence and mortality rates as markers of the extent of the cancer transition globally. Results showed PC burden estimates vary from developing to developed countries. The world's populations were classified by broad levels of human development index. However, this classification is not deterministic and some countries are rapidly transiting from lower to higher levels of human development.

Results showed that the incidence rates of PC in developing countries may be less common, while its incidence and mortality has been on the rise (Ekeke et al., 2012). However, incidence rates are influenced by the intensity of diagnostic efforts. PC can be diagnosed from a variety of methods. Several decades ago, suspected patients for benign prostatic hyperplasia (BPH) were operated but during the pathological examination of specimens from transurethral prostatectomies, up to 25 percent of cases were discovered to have PC. Another test is digital rectal examination (DRE), which is easy. Recently, PSA came into existence and the frequency of finding new cases of PC has precipitously increased (Ørsted and Bojesen, 2013). The increasing burden of cancer in developing countries seems to be as a result of increased life expectancy and may be attributed to a westernized diets effect and other cancer associated behavioral determinants including smoking, alcohol consumption, physical inactivity, and reproductive, dietary and hormonal risk factors (Bray et al., 2012).For example, PC is the most common cause of cancer death in men in several sub-Saharan African countries-both that contributes to both environmental and lifestyle exposures in these regions (Jemal et al., 2012). In low HDI level countries, poor access to cancer control and prevention and late diagnosis lead to higher mortality rates. Most researchers believe that the reduction in PC mortality rates in developed regions over the last several years is attributed to early detection initiatives (Baade et al., 2013). These findings are in accordance with national trends in incidence and mortality rates. There are a large numbers of men who diagnosed with PC in United States and relatively few die of the disease that suggests they may be either diagnosed earlier or in a more curable state of the disease. In contrast, the incidence rates may be lower in many Asian and African countries. These patients may be diagnosed later, with advanced stage and incurable diseases (Cullen et al., 2012).

Results of the linear regression model showed a significant association of PC incidence and mortality rates with HDI dimensions including life expectancy, education, GNI, urbanization level, and age standardized obesity.

Life expectancy at birth is one of the dimensions of HDI. There is a positive association between incidence of PC and older ages. Almost 75% of new cancer cases occur in people older than 85 years (Plata and Concepcion, 2014). Reports revealed that developed countries have the higher life expectancy at birth (Salomon et al., 2013) that is in accordance with our findings, higher incidence rate in more developed regions at the same countries with higher life expectancy, we found a significant negative association with PC mortality rates that is attributed to better cancer control facilities in developed areas.

Education and years of schooling is another dimension of HID that can effect on screening and early detection in individuals. As a result, many subclinical cases are detected and the incidence of the disease increases. In addition, in several studies, awareness was accounted as an important factor that influenced treatment of disease and the distribution of mortality from this type of cancer (Hassona et al., 2015; Bloodgood, 2016), but in our study, a significant association was not seen between education and PC mortality rates.

Adequate income is specified by Gross national income per 1000 capita which is one of HDI dimensions. Several studies suggest the impact of income level on cancer treatment. People with low incomes are more likely to die from PC (Decker et al., 2016). People in developed areas with increasing income levels and improved socioeconomic status have better access to diagnostic services and screening tests, such as PSA (Bray et al., 2012; Morris et al., 2013).

Such results were seen in other study conducted for comparison of PC burden within Asian countries with different HDI level. It was showed that countries such as Israel, Turkey, Lebanon, Singapore, Japan, and Republic of Korea with highest life expectancy, income and education level in Asia had the highest incidences of PC (Pakzad et al., 2015).

According to other researches, as the urbanization level increasing, the incidence of PC is also increasing. This may be attributed to individuals' lower physical activities in urban areas in comparison with rural areas. Urban residents are also more likely to consume western

foods with high calories and fat that is a risk factor of PC (Hebert et al., 2006). In accordance with our findings; several articles have shown an association between age standardized obesity in adults and the development of newly PC incidences (Möller et al., 2013) but we didn't find any association between obesity and PC mortality rates.

However, the incidence and mortality rates reported for any geographic area depend on the reliability of cancer registries. There are not high quality population-based cancer registries in Africa, Asia, and Latin America, and there are few national vital registration systems with adequate mortality data in low resource and medium-resource countries. The incidence and mortality estimates from GLOBOCAN for 2012 are also subject to precision limitations because a hierarchy of accuracy, quality and availability of the GLOBOCAN information sources at a given time in different countries.

In conclusion, in countries with greater development, the incidence of PC is higher and in lower developed countries, the mortality rates of the cancer are higher. We observed a positive significant correlation between the burden indicators of PC and the HDI, life expectancy at birth, education, and gross national income per 1000 capita, urbanization level and obesity. However, there was a negative significant correlation between the standardized mortality rates and the life expectancy, GNI and HDI. Information on the incidence and mortality of PC can be useful for medical planning and research activities.

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References

Baade PD, Youlden DR, Cramb SM, et al (2013). Epidemiology of prostate cancer in the Asia-Pacific region. *Prostate Int*, **1**, 47-58.

Bloodgood JC (2016). Cancer of the Breast: Figures Which Show That Education Can Increase the Number of Cures. *JAMA*, **315**, 709.

Brawley OW (2012). Prostate cancer epidemiology in the United States. *World J Urol*, **30**, 195-200.

Bray F, Jemal A, Grey N, et al (2012). Global cancer transitions according to the Human Development Index (2008–2030): a population-based study. *Lancet Oncol*, **13**, 790-801.

Center MM, Jemal A, Lortet-Tieulent J, et al (2012). International variation in prostate cancer incidence and mortality rates. *Eur Urol*, **61**, 1079-92.

Cullen J, Elsamanoudi S, Brassell SA, et al (2012). The burden of prostate cancer in Asian nations. *J Carcinogenesis*, **11**, 7.

Decker KM, Demers AA, Nugent Z, et al (2016). Reducing income-related inequities in colorectal cancer screening: lessons learned from a retrospective analysis of organised programme and non-programme screening delivery in Winnipeg, Manitoba. *BMJ Open*, **6**, 9470.

Ekeke O, Amusan O, Eke N (2012). Management of prostate cancer in Port Harcourt, Nigeria: Changing patterns. *J West African College Surg*, **2**, 58.

Ferlay J, Shin HR, Bray F, et al (2010). Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *Int J Cancer*, **127**, 2893-917.

Hassona Y, Sawair F, Baqain Z, et al (2015). Oral cancer early detection-a pressing need for continuing education in Jordan. *Asian Pac J Cancer Prev*, **16**, 7727.

Hebert JR, Ghumare SS, Gupta PC (2006). Stage at diagnosis and relative differences in breast and prostate cancer incidence in India: comparison with the United States. *Asian Pacific J Cancer Prev*, **7**, 547.

International Agency for Research on Cancer (2012). Prostate cancer estimated incidence, mortality and prevalence worldwide in 2012. *Retrieved September*, **6**, 2014.

Jemal A, Bray F, Forman D, et al (2012). Cancer burden in Africa and opportunities for prevention. *Cancer*, **118**, 4372-84.

Malik K (2013). Human development report 2013. United Nations Development Programme, New York.

Möller E, Adami HO, Mucci LA, et al (2013). Lifetime body size and prostate cancer risk in a population-based case–control study in Sweden. *Cancer Causes Control*, **24**, 2143-55.

Morris LG, Sikora AG, Tosteson TD, et al (2013). The increasing incidence of thyroid cancer: the influence of access to care. *Thyroid*, **23**, 885-91.

Ørsted DD, Bojesen SE (2013). The link between benign prostatic hyperplasia and prostate cancer. *Nature Reviews Urol*, **10**, 49-54.

Pakzad R, Mohammadian-Hafshejani A, Ghoncheh M, et al (2015). The incidence and mortality of prostate cancer and its relationship with development in Asia. *Prostate Int*, **3**, 135-40.

Plata BA, Concepcion MT (2014). Prostate cancer epidemiology. *Archivos Espanoles De Urologia*, **67**, 373-82.

Salomon JA, Wang H, Freeman MK, et al (2013). Healthy life expectancy for 187 countries, 1990–2010: a systematic analysis for the Global Burden Disease Study 2010. *Lancet*, **380**, 2144-62.