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THE INCIDENCE AND MORTALITY OF BRAIN AND CENTRAL NERVOUS SYSTEM CANCER AND THEIR RELATIONSHIP WITH HUMAN DEVELOPMENT INDEX IN THE WORLD

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Abstract – *Objective:* *Brain cancer (BC) is one of the most important cancers which have attracted much attention in recent decades. Due to the lack of statistics on the incidence and mortality of this cancer, this study has been performed with the aim of investigating the age standardized incidence and mortality rate of brain and central nervous system malignancy and its relation with human development index (HDI) and its components.*

Materials and Methods: *The study was conducted based on the data obtained from the world data of cancer and the World Bank (including the HDI and its components). Data about the age-specific incidence and mortality rate (ASR) for every country in 2012 were got from the global cancer project. We used a bivariate method for assessment of the correlation between SIR and SMR and HDI. Statistical significance was assumed at $p<0.05$. Statistical analyses were performed using SPSS.*

Results: *In 2012, the incidence and standardized mortality rate of brain and nervous system cancer were 3.4 and 2.5 per hundred thousand people in the world, respectively. Albania had the most incidence and standardized mortality rate of brain and nervous system cancer by 10.4 and 7.5 per hundred thousand people, respectively. There is statistically significant relationship between the standardized incidence rate of brain and nervous system cancer and HDI; this correlation was ($p<0.001$). A positive correlation of 0.645 was observed between the standardized mortality rate of brain and nervous system cancer and HDI, and this association was statistically significant ($p<0.001$).*

Conclusions: *Brain cancer's age-standardized incidence and mortality rate are more increased in higher HDI countries than countries with a low HDI. Educating people about risk factors of brain and nervous system cancer and prevention of these factors is recommended for decreasing the incidence of this disease.*

KEYWORDS: *Incidence, Mortality, Brain Cancer, Development, World.*

INTRODUCTION

Non-communicable diseases have been known as a diseases of long duration with slow progression .These disease are the major cause of mortality and morbidity of adults all around the world[1]. Cancer is one of the most terrifying non-communicable diseases and the major cause of global burden of diseases[1]. Cancer is a public health problem; it is the second cause of death after cardiovascular disease in developed countries and the third leading cause of death in de-

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veloping countries[3,4]. Brain cancer, which is one of the most important cancers as its incidence is increasing in the world, has attracted much attention in recent decades because its survival is low. Several previous studies indicate an increasing trend in the incidence of this cancer[5].

In 2012, the age-specific incidence and mortality rate (ASR) of brain cancer in developed countries were 5.9 and 4 in men, and 4.4 and 0.4 in women, respectively. These rates were 3.3 and 2.6 in men and 2.7 and 9.1 in women, respectively in developing countries[6]. The cause of the central nervous system malignancies is generally unknown[7]. Malignant brain cancer is a catastrophic disease in terms of morbidity and mortality in adults and is the second leading cause of death in children[8]. Primary malignant brain tumors are the most common tumors of dysfunction and fatal types of cancers; although they comprise only 2% of cancers, these brain tumors are related to severe disability and high risk of death. For all ages, average survival time is 9 months and 5 year survival rate is less than 25%. Some patients who have survived more than 5 years, remain with chronic disabilities. Due to a significant increase in incidence and death rates of brain cancer in many developed countries, they have special importance. Some studies[9] demonstrated increased incidence of brain cancer due to improved diagnostic techniques and advancement of medical care. In spite of the significance of this cancer in terms of morbidity and mortality, few epidemiological studies have been conducted in this field[10]. The precise knowledge about distribution of the disease can be effective in familiarity with cause of this disease and its management. One of the most important factors that play a role in the distribution of disease is the development. In this regard, the United Nations Development Program (UNDP) announced Human Development Index (HDI) that is published annually in Human Development Report (HDR). Its main goal was drawing attentions from income to a more comprehensive size of human development program[11,12]. The relationship between human development indexes and various cancers and diseases have been studied in various studies and its possible role has been approved in incidence and mortality of disease. Due to the importance of the incidence and mortality of the disease in planning and the possible role of development indicators in the incidence of this cancer, this study has been done with for investigating the incidence and standardized age-related mortality of brain and central nervous system cancer and its relation with HDI and its components.

METHODS

This study analyzed the correlation between age-specific incidence and mortality rate (ASR) with HDI and life expectancy at birth, mean years of schooling, and gross national income (GNI) per capita. Data about the age-specific incidence and mortality rate (ASR) for every country in 2012 were got from the global cancer project that available in (http://globocan.iarc.fr/Default.aspx)[13] and HDI from Human Development Report 2013[14], that includes information about HDI for every country in the world in 2012.

The method of estimate the age-specific incidence and mortality rates in global cancer project was obtained by International Agency for Research on Cancer reported previously[13,15,16].

HUMAN DEVELOPMENT INDEX (HDI)

HDI is a composite measure of indicators along three components, including life expectancy, educational attainment, and command over the resources needed for a decent living. According to HDI, countries in the world are divided into four categories as follows: countries with very high HDI (HDI≥0.80), countries with a high HDI (0.80>HDI>0.710), medium HDI countries (0.710≥HD≥0.535), and countries with a low HDI (HDI<0.535)[14].

STATISTICAL ANALYSIS

In this study, we used correlation bivariate method for assessment of the correlation between age-specific incidence and mortality rate (ASR) with HDI and its details, which include life expectancy at birth, mean years of schooling, and GNI per capita. Statistical significance was assumed if $p<0.05$. All reported p-values are two-sided. Statistical analyses were performed using SPSS 15.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The incidence number of brain and nervous system cancer

In 2012, 256134 cases of brain and nervous system cancer have been reported around the world; 80162 cases were in very high HDI countries, 51858 cases in countries with high HDI, 111548 in countries with medium HDI and 12566 cases were in low HDI countries. Highest numbers of brain and nervous system cancer occurred in 5

countries, included China (65627 cases), America (21611 cases), India (18831 cases), Brazil (11737 cases), and the Russian Federation (7377 cases). 5 countries with the highest number of brain and nervous system cancer in men were China with 34611 cases, America with 11897 cases, India with 11855 cases, Brazil with 6129 cases, and Germany with 3977 cases, respectively. In women, 5 countries had the highest numbers included China with 31016 cases, America with 9714 cases, India with 6976 cases, Brazil with 5608 cases, and 3615 cases in the Russian Federation.

Age standardized incidence rate of brain and nervous system cancer

Standardized incidence rate of brain and nervous system cancer was 3.4 per hundred thousand people and this rate was 5 per hundred thousand people in very high HDI countries, 4.7 per hundred thousand people in countries with high HDI, 3.1 per hundred thousand people in countries with average HDI and 1.3 per hundred thousand people in countries with low HDI level. 5 countries that had the highest age-standardized incidence included Albania with 10.4 per hundred thousand people, Sweden with 9.8 per hundred thousand people, Armenia with 9.6 per hundred thousand people, Serbia with 9.4 per hundred thousand people, and Macedonia with 8.7 per hundred thousand people, respectively. 5 countries that had the highest age-standardized incidence for men included Armenia with 12.7 per hundred thousand people, Albania with 12 per hundred thousand people, Macedonia with 11.9 per hundred thousand people, Serbia with 10.8 per hundred thousand people, and Georgia with 10.3 per hundred thousand people. Also, 5 countries that had the highest age-standardized incidence for women included Sweden with 10.7 per hundred thousand people, Albania with 8.8 per hundred thousand people, Serbia with 7.9 per hundred thousand people, Latvia with 7.9 per hundred thousand people, and Norway with 7.7 per hundred thousand people.

Number of deaths from brain and nervous system cancer

In 2012, 189382 cases of deaths from brain and nervous system cancer occurred all around the world. 57356 deaths were in countries with very high HDI, 37762 deaths in countries with high HDI, 84061 deaths in countries with average HDI, and 10147 deaths occurred in countries with low HDI. Five countries which had the highest number of deaths from brain and nervous system cancer included China with 49942 deaths, America with 15746 deaths, India with 15152 deaths, Brazil with 9659 deaths, and the Russian Federation with 7022 deaths. Five countries that had the higher number of deaths from brain and nervous system cancer in men included China with 28680 deaths, India with 9574 deaths, America with 8858 deaths, Brazil with 5003 deaths, and the Russian Federation with 5168 deaths. Also, 5 countries that had the highest numbers of deaths from brain and nervous system cancer for women were China with 21262 deaths, America with 6888 deaths, India with 5578 deaths, Brazil with 4656 deaths, and Russia with 3458 deaths.

Age standardized mortality rate of brain and nervous system cancer

In 2012, the standardized mortality rate of brain and nervous system cancer was 2.5 per hundred thousand people in the world that this amount was 3 for countries with very high HDI per hundred thousand people, 3.3 per hundred thousand people in countries with high HDI, 2.3 per hundred thousand in countries with an average HDI, and 1.1 per hundred thousand people in countries with low HDI. 5 countries that had the most amount of standardized mortality rate of brain and nervous system cancer, were Albania with 7.5 per hundred thousand people, Serbia with 6.1 per hundred thousand people, Macedonia with 5.9 per hundred thousand people, Armenia with 5.8 per hundred thousand people, and Bulgaria with 5.3 per hundred thousand people, respectively. 5 countries with the highest standardized mortality rate for men were Albania with 9.1 per hundred thousand people, Macedonia with 7.9 per hundred thousand people, Armenia with 7.7 per hundred thousand people, Serbia with 7.2 per hundred thousand people, and Bulgaria with 6.5 people per hundred thousand people, respectively. 5 countries with the highest standardized mortality rate for women included Albania with 5.9 per hundred thousand people, Serbia with 5 per hundred thousand people, Egypt with 4.6 per hundred thousand people, Latvia with 4.4 per hundred thousand people, and Croatia with 4.4 per hundred thousand people. The most of the countries of developed regions have higher incidence and mortality rates in comparison to countries in underdeveloped areas, and countries of less developed regions have lower incidence and mortality than the global average amount.

The relation between standardized incidence rate and the human development index

A positive correlation of 0.704 was seen between the standardized incidence rate of brain and nervous system cancer and human development in-

dex that this relationship is statistically significant (p<0.001). Also, a positive correlation was seen between components of the human development index and the standardized incidence rate of brain and nervous system cancer. So that, a positive correlation of 0.668 was seen between the standardized incidence rate and life expectancy at birth (p<0.001), a positive correlation of 0.696 with mean age of education (p<0.001), and a positive correlation of 0.376 with the level of income per person of population (p<0.001).

The relationship between standardized mortality rate and the human development index

A positive correlation of 0.645 was seen between the standardized mortality rates of brain and nervous system cancer and the human development index; this association was statistically significant (p<0.001). Also, a significant positive correlation was observed between components of the human development index and the standardized mortality rate of brain and nervous system cancer. A positive correlation of 0.619 was seen between the standardized mortality rates with life expectancy at birth (p<0.001), with mean years of education it equaled to 0.642 (p<0.001) and with income level per person of the population equaled to 0.33 (p<0.001).

DISCUSSION

Cancer occurs in any part of the body and is one of the most important health problems in the world[16]. Mortality rates and standardized incidence of brain and nervous system cancer were 3.4 and 2.5 per hundred thousand people, respectively, in the world in 2012. Most of the countries of developed regions have more incidence and mortality compared to countries of undeveloped regions. Countries of less developed regions have less incidence and mortality of global average. Disease incidence and mortality are rising by increasing life expectancy, urban sprawl and lifestyle changes in developing countries[16,17].

Increased risk of brain cancer is associated with male being, state of being elderly and living in big cities[5]. Brain cancer has attracted much attention in recent decades because survival rate of this disease is low and several reports show increasing trend in incidence of this cancer[5]. A study conducted by Davis et al[18] estimated 2 and 5-year survival rates of 36.2 and 27.6% for patients with malignant brain tumors that indicates high mortality of this disease[18]. In the present study, a positive correlation was found between the brain and nervous system cancer and HDI. In another study, a positive relationship was seen between the HDI and cancer. In this study, it was shown that enhancing growth and development affect the incidence of cancers[19]. In another study that examined the relationship between HDI and kidney cancer, a negative correlation was seen between HDI and kidney cancer incidence and mortality rate[20].

In the present study, a positive correlation was found between the brain and nervous system cancer incidence and educational stage. The conducted study in China showed a significant relationship between knowledge and behavior of individuals and self-care[21]. This study shows that as much as the level of awareness and knowledge is higher, the probability of handling and self-care is more and it is more likely to prevent it.

Standard of living is a component of HDI, which is measured by income that a positive correlation between income and the incidence of brain and nervous system cancer was seen in this study. In a study, a continuous pattern of increasing risk with increasing economic and social conditions for all types of brain tumors has been observed[22]. Of course, whether people with higher socioeconomic status are more likely to confirm the diagnosis and dissection, or whether it is related to lifestyle or other factors, is not clear. Another reason may be the confounding role of socio-economic status[22].

In a research conducted in America, it has been shown that people with low incomes have a lower incidence of brain tumors, which can be due to the ethnic differences or because of pathogenetic differences[23]. Ward et al[24] showed that poor people have higher mortality rates and lower survival for all cancers; both men and women's mortality is higher in comparison to people from rich countries. 5 year survival rate for people in poorer regions was lower than richer countries. These differences may be due to differences in access to care and quality of treatment. To reduce this difference and prevent cancer, we should identify and reduce risk factors and provide a condition to make the disease early diagnosed and treated[24]. A positive correlation was seen between income and brain and nervous system cancer mortality in this study. It was showed that people who live in poverty have higher incidence and mortality of cancer than people who are richer[25]. Most of the differences in mortality were due to late diagnosis by poor people. Although lifestyle and behavior are also effective in reduction of survival, a potential escalation factor among poor people was the inadequate knowledge about cancer and its treatment.

CONCLUSIONS

Brain cancer's age-standardized incidence and mortality rate is higher in higher HDI countries than countries with a low HDI. Educating people about risk factors of brain and nervous system cancer and prevention of these factors, is recommended for decreasing the incidence of this disease.

Conflict of interests

The authors declared no conflict of interests.

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