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BRAIN CANCER IN THE WORLD: AN EPIDEMIOLOGICAL REVIEW

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Abstract – *Objective:* *Cancer of the nervous system is one of the most common types of cancers in the world, since the nervous system regulates the functions of the body. Consequently, damage to this system will disrupt the entire body's functioning. The aim of this study was to investigate the epidemiology and risk factors of neural cancer in the world.*

Patients and Methods: *The present study was conducted on published English studies by June 2018 by searching in the databases PubMed, Scopus, and Web of Science. The search strategy included key words "neurological cancer", "epidemiology", "incidence", "mortality", "risk factors" without time and place constraints. Studies related to the incidence, mortality, and risk factors for cancer of the nervous system were investigated.*

Results: *The incidence of the brain tumors has been increasing in all ages in recent decades, indeed, the standardization of age in different countries is between 0.01 and 12.7 in males and 0.01 and 10.7 in women, per 100,000 people. The lowest incidence is in Africa and the highest level is in northern Europe. In addition, the mortality rate of the cancers of the nervous system is estimated at about 3.4 per one hundred thousand in the world.*

Conclusions: *The incidence of brain cancer is increasing. As the trend of brain cancer in the world is increasing, preventive and protective measures to reduce the risk factors of this cancer are recommended to reduce the incidence of disease.*

KEYWORDS: *Brain Cancer, Epidemiology, Risk factor, Incidence, Mortality.*

INTRODUCTION

The nervous system tumors are a kind of neoplasms, which form several morphological subgroups with different behavior patterns[1], Nervous system cancers account for about 3% of all cancers in the world and are more common among men than women[2].

Globally, large variability in the magnitude of the diagnosis of new cases of brain and CNS cancer was found, with a 5-fold difference between the highest rates (mainly in Europe) and the lowest (mainly in Asia)[3,4]. Previous reports demonstrated that the incidence of Brain tumor is different among countries worldwide. In general, the incidence of Brain tumor is higher in the West than the East and it is also higher in the developed countries than in developing countries. The age-standardized distribution of these diseases is also different worldwide, with

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the highest incidence in Australia, North America, and North Europe and the lowest incidence in Africa. The incidence is far more among the Caucasians than African Americans[5].

According to the last report from National Vital Statistics Systems (NVSS), the mortality from 1975 to 2016 was higher among men, higher in older individuals, and higher in Whites compared to other races. People with age 65+ years had a significant increase in mortality for all tumors, while people aged <20 years had no significant changes in mortality. This study reports up-to-date the mortality rates by histology groupings, age, race, and sex for malignant Brain tumors. There have been no significant changes in the overall mortality due to these tumors from 1975 to 2016. There have been significant increases in mortality in the elderly (age 65+ years), especially those age 75–84 years[6].

The improvement in the imaging methods, like imaging with radioisotope, has increased the detection rate of tumors in the nervous system[7]. With the early diagnosis[8,9] and improvement in therapeutic methods, the survival rate of these patients elevated and, at the same time, the probability of an increase in patients with cerebral metastasis also would be extended[10]. Brain metastases are one of the most common types of brain tumors and have a significant relationship with mortality and morbidity[11]. Age standardized incidence rate in primary brain tumors is between 4.3 and 18.6 per thousand years[5].

During 2012, 37762, 84061, and 10147 deaths due to this disease occurred in countries with high, moderate, and low human developmental index (HDI), respectively. China, America, India, Brazil, and Russia have the highest rates of death from neural tube cancer[12].

According to the incidence and mortality studies, cancer in the world has a wide geographical variation and its risk factors are various in different regions. Since the epidemiology of this disease is essential for prevention planning, the present study was conducted to investigate the incidence, mortality, and risk factors for brain cancer in the world.

MATERIALS AND METHODS

This review study was conducted on published English publications by October 2018 by searching in the databases of PubMed, Scopus and Web of Science. The search strategy included the key words "brain tumor", "brain cancer", "brain neoplasm", "epidemiology", "incidence", "mortality", "risk factors", "the world".

Articles related to the incidence, mortality, and causes of brain tumor have been reviewed and the studies with a focus on treatment have been excluded.

RESULTS

Incidence

The incidence of brain tumors in the last 20 years is increasing in all ages; however, it has grown more than 40 percent in adult person[13]. Global findings indicate a wide variation in the incidence of tumors of the nervous system in such a way that the standardization of age in different countries is between 0.01 and 12.7 in males and 0.01 and 10.7 in women, per 100,000 people. The lowest incidence is in Africa while its highest level is in northern Europe[1]. As a consequence, the difference in the diagnosis of the disease and the registration and reporting system in different countries can be due to these disparities[1].

The increase in the incidence of neuronal cancer in Western countries may be due to improvements in CT scan and MRI in the 1980s compared to other countries. Also a difference in the incidence between different regions is due to genetic backgrounds and ethnic differences among different populations[2]. The highest incidence rates in the men of Armenia, Albania, Macedonia, Serbia, Georgia were 12, 12.7, 10.3, 10.8, 11.9 per 100,000, respectively. In women, the highest incidence is seen in Sweden (10.7), Albania (8.8), Serbia (7.9), Latvia (7.9), Norway (7.7), per one hundred thousand people[12]. At the same time, the annual rate in Saudi Arabia is 6.5 per 100,000[14].

Mortality

The mortality rate of the neural system cancers is estimated at 3.4 per 100,000 everywhere in the world[12]. In England, 11 cases of brain cancers are diagnosed daily, of which nine of them lost their lives[13]. The prevalence of tumors in the nervous system in the United States has risen from 11.5 in 1994 to 20.1 in 2008[4]. The increasing trend registered in prevalence among the elderly can be due to an increase in their life expectancy[4]. The global prevalence of tumors in the nervous system among males and females was 3.6 and 2.5 per 100,000, respectively, which is 5.9 and 4.1 in males and females, respectively, while in less developed countries, 2.8 in males and 2 in women[15]. In developed countries, in comparison with other countries of the world, the factors such as increased life expectancy, urbanization, and lifestyle changes, are associated with an increase in the incidence and death of the brain tumor[12].

Risk Factors

Related factors to brain cancer listed in Table 1.

Rays

Although exposure to moderate and high doses of ionization radiation is an effective environmental risk for the development of tumors in the nervous system, the attention should also be paid to other

TABLE 1. Related factors to brain cancer.

Variable	*Risk factor*	*Protective*	*Controversial*
Host or non-modifiable factors			
Hormonal factors	*		
Family history	*		
Immune system	*		
Environmental or modifiable factors			
Rays	*		
Nutrition			
Fruits and vegetables		*	
Processed meat	*		
Alcohol	*		
Smoking	*		
Aspartame	*		
Mobile	*		

factors such as gender and age, or exposure to radiation[16]. The 1.5 mg magnetic field in commercial and residential applications and 0.3 mg in the environment near the power lines and electronic equipment can be dangerous[17]. In a study in the United States, the presence of a magnetic field in the workspace, the electric power staff was associated with the incidence of brain tumors[18].

Hormonal Factors

Epidemiologic investigations refer to the role of hormones in the incidence of some brain tumors, as an illustration, the incidence of meningioma in women is 2 times more than in men. On the other hand, glioma is present in women two times more than males. The incidence of neuralgia cancers initiates in adolescence, rises to 50-54, and then decreases[19]. Indeed, Cowppli-Bony et al[20] showed that the incidence of cerebral tumors increased in menarche and menopause and decreased in the period of hormone therapy.

Nutrition

There is an inverse relationship between the consumption of fruits and vegetables and brain tumors[21]; in addition, vitamin C, E, and the phenylol in fruits and vegetables play an important role in developing brain tumors[22]. These foods contain carotenoids and folate. On the other hand, antioxidants and some phytoestrogens[23] decrease tumor growth. Other food groups, like processed meat, are associated with an increased risk of infection[24]. In a systematic study, it was found that the consumption of processed meat during pregnancy could cause tumor growth. In another meta-analysis, the results showed that meat consumption increased the risk of developing brain cancer by up to 48%[23]. Nitrosamines are produced in the process of baking meat. Sodium nitrite in the meat used for meat can be converted to nitrosamine, which causes nerve tumors[25].

Alcohol

About 3.6% of all cancers in the world or 389 out of 100 cases of cancer are associated with alcohol consumption. Alcohol consumption, on the other hand, is associated with reduced survival and tumor growth in cancer patients[26]. The results of a research conducted in Australia suggest that increased alcohol consumption is associated with a reduction in the survival of patients with brain tumors[27].

Smoking

Smoking is one of the most important causes of cancer in humans. In countries with high incomes, smoking accounts for 25-30% of all causes of death from cancer[28]. As a matter of fact, smoking induces the adsorption of polycyclic aromatic hydrocarbons (PAHS) and nitrous compounds[29].

Aspartame

Aspartame is an artificial sweetener that is consumed by more than 200 million people worldwide[30]. A daily dose of 20 mg of aspartame increases the risk of tumors of the nervous system[31]. Hence, its long-term consumption, with degenerative changes related to myelin, increases the risk of developing a tumor[30].

Mobile

Using mobile phones causes problems like headaches, sleep disturbances, short-term memory impairment, blood pressure, and brain strokes in users (32). As the use of mobile phones increases, the risk of developing brain tumors in age groups older than 20 years also increases. As an example, in a study conducted in Japan, the risk of malignancies in the nervous system, is 0.08 per 100,000 men talking with mobile for 20 seconds, and 0.03, every 100,000 for women. Also, for every 30 seconds at mobile phones the relative risk was reported to 0.15 in men, and 0.05 in women[33].

Family History

The family history of the disease could determine the role of genes for the onset of cancer, having similar environment conditions among family members[34]. In a study on the role of family history in brain tumours developing in North Carolina, the odds ratio for the first-degree relatives of patients with Meningioma (OR 4.4, 95% CI 1.6-11.5) was significantly more than the control group, but in the second-degree afflicted patients, the odds ratio (OR 3.2, 95% CI 0.7-15.5) was reported not to show significant statistical significance. These results can indicate the importance of the family history of tumors in the nervous system incidence[35].

Immune System

Understanding the exact role of the immune system in the emergence and improvement of the diseases depends on the interaction between genetic composition and environmental factors[36]. It is still unknown the exact level of the immune reduction which causes a growth of cancer cells in patients. Most cancer cells produce a high level of immunosuppressive cytokines, which cause a reduction in the immunity of the body and then, provides the potential for tumor growth in the body[37].

CONCLUSIONS

The incidence of this type of cancer is increasing; its incidence and mortality rate has been reported to be 3.4 and 2.5 per 100,000 people in the world. Albania, with an incidence of 10.4 and a death rate of 7.5 per 100,000, is the country which has the highest incidence of neurological cell death among other nations. Instead, the incidence rate in the less developed countries is much lower than in other regions. The most important risk factors for brain cancer include family history, hormones, immune deficiency, nutrition, alcohol consumption, cigarette and aspartame, radiation, and cell phone use. Since the trend of brain cancer in the world is increasing, preventive and protective measures to reduce the risk factors of this cancer are recommended to reduce the incidence of the disease.

Conflict of interest:

The Authors declare that they have no conflict of interests.

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