Siedlecki Zygmunt, Szafrańska Małgorzata, Główczewska-Siedlecka Emilia, Śniegocki Maciej. Brain tumors risk factors - current state of knowledge review. Journal of Education, Health and Sport. 2021;11(9):101-107. eISSN 2391-8306. DOI http://dx.doi.org/10.12775/JEHS.2021.11.09.014
https://apcz.umk.pl/czasopisma/index.php/JEHS/article/view/JEHS.2021.11.09.014
https://zenodo.org/record/5473571

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8. 2) and § 12. 1. 2) 22.02.2019.

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 21.08.2021. Revised: 26.08.2021. Accepted: 06.09.2021.

Brain tumors risk factors - current state of knowledge review

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Abstract

Brain tumors cause widespread apprehension in society, associated with poor prognosis and death. Laymen most often associate them with glioblastoma multiforme which is in fact the most common malignant primary brain tumor (formerly it was considered the most common primary brain tumor, now it is thought that meningiomas are the most common). The interest of both the public and physicians is aroused by potential brain tumors risk factors. The only evidence based risk factor is ionizing radiation of head and neck. Other risk factors are also under consideration, however are not conclusive and different studies give different results. Given the widespread apprehension of brain tumors, knowledge of the risk factors seems obvious. In this manuscript, we have reviewed the current state of knowledge aboutf risk factors based on research. They confirm that apart from ionizing radiation, the existence of other risk factors is considered: cell phones, electromagnetic field, occupational exposure to raw meat, viruses. However, all these risk factors are not confirmed by reference results.

Key words: brain tumors, risk factor

Risk factors - literature review

Brain tumors risk factors are divided into external - environmental and individual, related to genetic conditions or coexisting chronic diseases.

The best studied and, at the same time, the only evidence based external brain tumor risk factor is exposure to ionizing radiation of head and neck. Literature data indicate a correlation between even low doses of radiation and an increased incidence of primary brain tumors: meningiomas, gliomas, and neuroblastomas [1,2]. Exposure to ionizing radiation is either occupational or as medical procedures result: radiotherapy or diagnostics. In the case of occupational exposure, exposure to radiation of head and neck is rather avoided and radiation protection is used [3]. Health care employers constitute the largest professional group of people exposed to ionizing radiation. In particular, dentists, radiologists, orthopedists, neurosurgeons, urologists, vascular surgeons, X - ray technicians and some nurses [4]. However, there are no literature date confirming an increased incidence of brain tumors in these health care staff [3]. Literature data indicate that hypothetically, low doses received by medical personnel may have a stimulating effect on the body. In such a situation, it would be cognitively valuable to conduct further, extensive research on the health condition of this

rather homogeneous professional group 5]. Workers employed under ionizing radiation exposure were classified into two categories: "A" and "B", due to the degree of exposure, according to Article 17 of the Atomic Law, and workplaces were divided into either controlled areas or supervised areas [3,6]. Exposure to ionizing radiation as medical procedures result is brain radiotherapy in cancer patients and diagnostic imaging procedures – computed tomography (CT). The most common tumors induced by prior brain radiotherapy are meningiomas, although such association is observed in glioblastomas or low - grade gliomas [7]. A similar risk, although confirmed by fewer reports, occurs between X-rays exposure during diagnostic imaging [7-9]. Davis et al. (2011) confirmed higher incidence of gliomas after multiple CT scans of the head, but only in patients with familial cancer burden [7]. In 2012, a report by experts in radiology was issued, which stated that exposure to X - rays used in CT increases the risk of nervous system cancer [8,9].

The epidemiological interest is whether there is correlation between the brain tumors morbidity and the widespread use of mobile phones. Research results are inconclusive and divergent. The largest study performed to date is the 2011 analysis of the International Agency for Research on Cancer (IARC). Other publications available until 2020 are essentially based on its results [10,11]. The IARC has shown that the radiation emitted by mobile phones during their use can be considered as a potential carcinogenic factor [10]. These conclusions were based on the incidence of brain tumors in people who used cell phones very often. It should be noted that the available literature on the potentially harmful effect of mobile phones on the risk of developing brain tumors concerns most often gliomas [11,12]. There are reports showing different conclusions from those published by IARC. Swerdlow et al. (2011), Frei et al. (2011) and Benson et al. (2013) showed that there is a relationship between the use of mobile phones and increased incidence of gliomas [13-15]. Hardell et al. (2013), on the other hand, showed a possible higher risk of malignant gliomas (WHO IV) in people who frequently use mobile phones, and did not confirm it for low-grade gliomas [16].

There is a similar epidemiological interest in the topic if there is occupational exposure and occupational risk factors that increase the incidence of brain tumors. The analysis was carried out by the multicentre INTEROCC study. This study included exposure to various chemical factors such as solvents, formaldehyde, heavy metals, dusts, and sulfur compounds [17]. No relationship has been demonstrated between all these factors and an increased incidence of brain tumors. In turn, the Upper Midwest Health Study (2012) showed that exposure to raw

meat and non - ionizing radiation in slaughterhouse workers is associated with an increased risk of gliomas formation [18].

Regarding individual brain tumors risk factors, it should be noted that about 5% of these tumors occur in patients with genetic syndromes, with neurofibromatosis (NF) mentioned as first and most important. The most common intracranial neoplasms occur in the course of NF1 and are optic gliomas, astrocytomas, ependymomas, meningiomas and schwannomas [19]. Tuberous sclerosis, von Hippel-Lindau, Gorlin, Turcot and Li Fraumeni syndromes are other genetic syndromes predisposing to brain tumor formation [20]. It is also assumed that about 5% of brain gliomas occur in patients with family anamnesis. Although these tumors occur most frequently, some epidemiological studies have shown an increased incidence of them in patients relatives [20]. Interestingly, some reports indicate that relatives of people with brain tumors have an increased risk of developing neoplasms of a different location, such as melanoma and sarcoma [19,20]. Epidemiological studies on brain tumors etiology have also shown that allergic and atopic diseases such as asthma, hay fever and food allergies significantly reduce the risk of many primary intracranial neoplasms, such as gliomas, meningiomas, and neuroblastomas. Allergies are associated with up to a 40% reduction in the risk of developing glial neoplasms [21]. The suggested mechanism is probably complex and involves the secretion of immunoglobulins (Ig) and interleukins (IL). It has been shown that the blood level of IgE, which is a marker of allergies, is reduced in patients with gliomas, while the polymorphism of the IL13 gene, which plays a role in allergic reactions, may turn out to be a genetic marker of glial tumors [22].

Conclusions

Brain tumor risk factors are an interesting and promising topic in the future, but apart from ionizing radiation, there are no other clearly determined risk factors. Moreover, the vast majority of diagnosed brain tumors are sporadic, with no obvious risk factors, or these factors are difficult to determine. They are irrelevant in treatment and prognosis. Brain tumors risk factors do not affect the practical oncological and neurosurgical management, and understanding them may be important in the brain tumors potential prevention.

Abbreviations

- CT - computed tomography
- IARC - the International Agency for Research on Cancer
- NF – neurofibromatosis

Competing Interests: The authors declare that they have no conflict of interest.

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