

# Assessing the Risk of Brain Tumors in Young Populations: A Review

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## ABSTRACT

Brain tumors represent a significant health burden globally, with their incidence steadily rising. India, as a populous country, bears a considerable share of this burden. Epidemiologically, brain tumors present a complex scenario in India, with variations in incidence rates across different regions and demographic groups. Factors such as age, gender, socioeconomic status and geographic location influence the prevalence and distribution of brain tumors within the Indian population. Prospects in the field of brain tumor research and treatment in India are promising, with ongoing efforts focused on personalized medicine, targeted therapies, immunomodulation and precision oncology. In conclusion, brain tumors represent a significant healthcare challenge in India, necessitating a comprehensive understanding of their epidemiology, etiology, diagnosis and treatment. Addressing the multifaceted challenges associated with brain tumor management requires collaborative efforts and innovative approaches to improve patient outcomes and quality of life.

**Keywords:** Brain tumors, Epidemiology socioeconomic, Socioeconomic, Geographic location.

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## INTRODUCTION

According to a recent World Health Organization (WHO) report, brain tumor incidence is rising in India, contributing to the country's high brain tumor burden. This development has been attributed to several factors, including changing lifestyles, improved diagnostic opportunities, populations aging and population growth. Brain tumors are among the top ten most prevalent cancers in India, according to the World Health Organization (WHO), highlighting the critical need for focused therapy and support during treatment. There is complexity and variation in medical issues. Brain cancer patients' diagnosis, course of treatment and prognosis are impacted by variations in health outcomes, access to care and care practices across different geographic areas. Individuals frequently struggle to get appropriate diagnosis and specialist care, which can lead to treatment delays and poor prognoses, especially in rural locations.<sup>1</sup> Their communities and families. Stress in families, particularly those with a history of sickness, is brought on by financial issues relating to medical expenditures, lost wages and caregiving obligations. To develop a cohesive strategy for

cancer care in India, it is critical to address these socioeconomic challenges. Enhancing access to care and fostering innovation in neurooncologist research are two of the main goals of the collaboration between government agencies, non-profits, doctors and research facilities. Innovations in technology and therapeutic approaches present excellent chances to enhance the results of mental health care.<sup>2,3</sup> Advancements in neuroimaging, surgery, radiation therapy and targeted therapy provide promise for improving treatment precision and efficacy while lowering patient morbidity. A thorough and well-rounded strategy is necessary for success. To achieve this, funds for healthcare facilities and medical research must be allocated, together with addressing the wider determinants of health and promoting cooperation for shared gain. India can lead the way for improved results in 2024 and beyond and raise the standard of living for brain tumor patients through cooperation, innovation and advocacy. 38.7% of illnesses affect the central nervous system of the body. Grade III and IV high-grade varieties made up 59.5% of the total, while Grade I and II low-grade variants made up 33.1%.<sup>4</sup> The average age of gliomas in India is years younger than in other countries, according to research. Gliomas are more common in men (66.6%) than in women. Glioblastoma was the predominant histological finding (41.4%) in the majority of individuals. Diffuse astrocytoma ranks second in frequency of tumors (22.8%). Perhaps as a result of improved diagnostic technologies or an increase in carcinogens in the surrounding



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air, the number of gliomas is rising.<sup>5</sup> Several characteristics of histology, in addition to age and molecular markers, influence the fate of malignant cancers. Because there are no registries like CBTRUS in underdeveloped nations, particularly India, it is challenging to ascertain the actual incidence of this malignancy. On the other hand, the cancer registry of a hospital might offer details regarding the type and spread of cancer inside that specific facility.<sup>6</sup> Certain brain tumors can impair one's ability to see, think, move, behave and think clearly. As a result, it's critical to monitor symptoms and provide therapy as soon as possible. Brain tumors are quite uncommon. In India, there are five to ten incidences of Central Nervous System (CNS) malignancies for every 100,000 individuals. Every year on June 8<sup>th</sup>, people throughout the world mark World Brain Tumor Day to increase awareness and advance knowledge of brain tumors.<sup>7</sup>

### Types of Brain Tumors

There are various classifications for brain tumors, such as cell type, location, behavior and grade. This classification identifies a few crucial elements, including tumors of the brain.<sup>8-11</sup>

#### Gliomas

Proliferate from glial cells, which shield and sustain neurons. A malignant, aggressive type of glioma is called Glioblastoma Multiform (GBM). Astrocytes can vary in severity from low grade (less aggressive) to high grade (more aggressive).

#### Oligodendroglioma

It is made up of glial cells known as oligodendrocytes. Ependymal cells present in the spinal cords root canal or the brain's ventricles are the source of ependymomas. Meningiomas, the covering that protects the brain and spinal cord, are what make meningiomas. Most are benign; however, because of where they are, some may cause symptoms.

#### Pituitary gland

The pituitary gland, which controls hormones, is where it happens. Benign pituitary adenomas may impact hormone levels. The most prevalent location for medulloblastoma is the cerebellum and it typically affects children. Primitive Neuroectodermal Tumor (PNET) was identified as the condition.

### Stages of brain tumors

**Stage 1:** Tumors are often confined and little at this stage. Usually progressing slowly, it may or may not create symptoms. Optional treatments for treating the tumor include routine surveillance exams or, if safe and feasible, surgical excision. **Stage 2:** This is a slightly advanced stage of the tumor. They may become larger or spread to neighboring tissues. Their growth is still sluggish yet. As much of the tumor as possible is typically

removed surgically and other therapies, including radiation therapy or chemotherapy, which target different tumors, are then administered.

**Stage 3:** The tumor is now regarded as malignant or cancerous. It can spread and impact brain-related structures. To reduce the tumor's size and slow its growth, treatment typically consists of radiation therapy, chemotherapy and surgery.

**Stage 4:** This stage of cancer is the most aggressive and advanced and is also referred to as brain cancer or glioblastoma. They frequently spread to other areas of the brain and even other body organs due to their rapid growth. Since most instances cannot be cured, treatments are confined to managing symptoms and enhancing quality of life. At this time, palliative care-which aims to reduce pain and discomfort-becomes crucial.

### TNM CLASSIFICATION OF BRAIN TUMOR

T1: Tumor visible,

T2: Enlarged,

T3: Near blood,

T4: Near lymph nodes,

NX: Cancer near lymph nodes,

No: No lymph nodes visible,

N1: Nearby lymph nodes present,

N2: Many lymph nodes involved,

N3: Almost all lymph nodes in the region Effect,

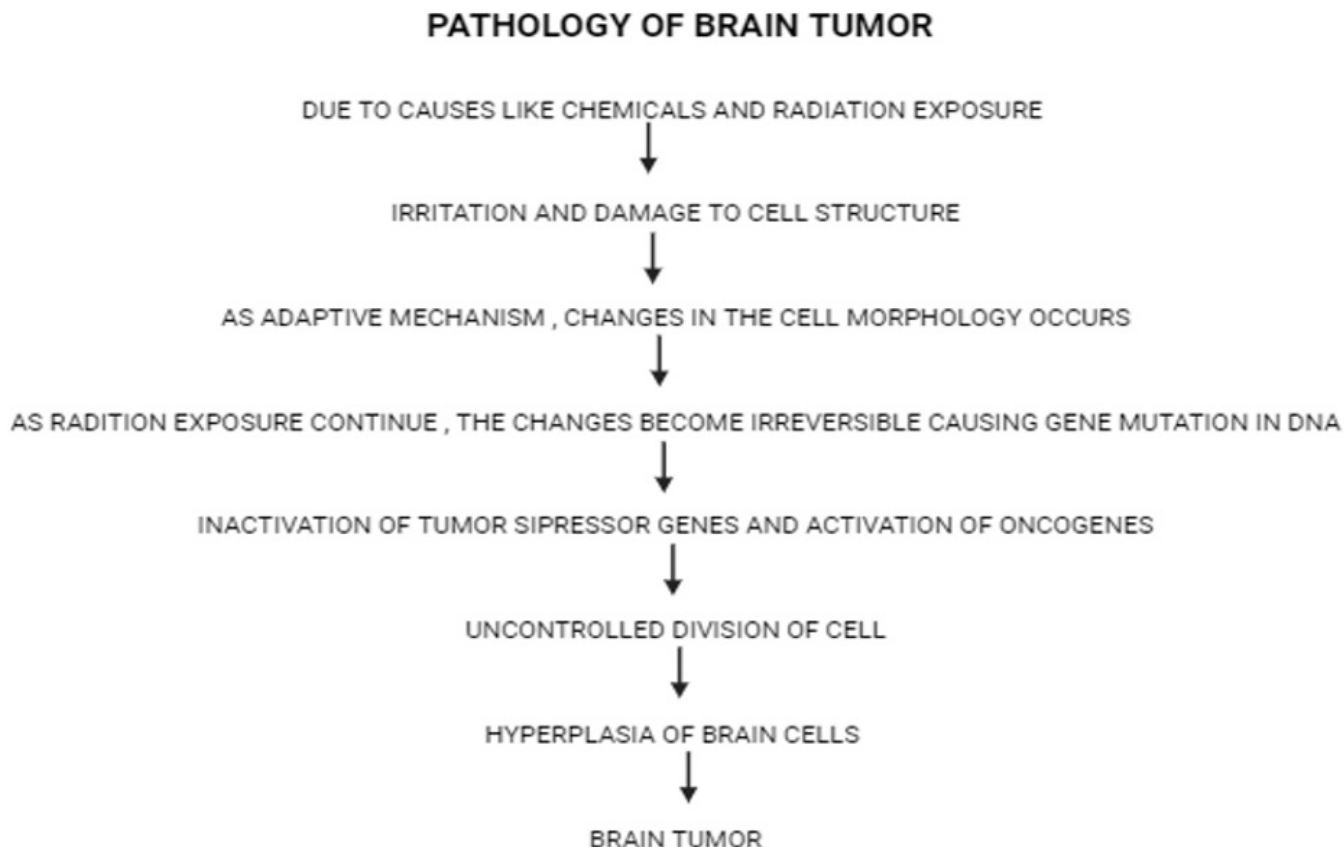
MX: Metastasis cannot be measured,

MO: Not seen,

M1: Metastasis.

### Prevalence of brain tumor

Main spinal cord or brain Brain and spinal cord cancers are classified as tumors. In the US, 24,811 persons (14,281 men and 10,531 women) are expected to receive a brain and spinal cord cancer diagnosis by 2023. An individual has less than a 1% probability of ever having this tumor. Of all the cancers in the Central Nervous System (CNS), brain tumors make up 85-90%. In 2020, there were 308,102 cases of brain or spinal cord cancer reported globally. The remainder of this guide addresses adult brain tumors. Study up on pediatric brain cancers. The tumor starts to spread to the brain at this point from other parts of the body. Leukemia, lymphoma, melanoma, lung, breast and kidney cancers are the most common tumors that metastasize to the brain only primary adult brain tumors are covered by these guidelines. In the United States, brain and central nervous system cancer is predicted to claim the lives of 18,990 persons (11,020 men and 7,970 women) by 2023. Central Nervous System Tumors and the



**Figure 1:** Pathophysiology of Brain Tumors (Self-Created).

Ministry of Health.<sup>12</sup> Pathophysiology of Brain tumor discussed in Figure 1.

## Diagnostic Evaluation

### *Medical history and physical examination*

First, the doctor will take a thorough medical history, noting any past illnesses or symptoms, as well as their length.<sup>14,15</sup> This is followed by a physical examination. After that, a thorough physical examination will be conducted, along with a brain exam to assess cognitive function, reasoning and coordination. Route. An MRI can offer precise images of the brain and provide information on the location, size and features of tumors.<sup>16</sup>

### **Computed Tomography (CT) scans**

When an MRI is unavailable or necessary in an emergency, CT scans can also be utilized to assess brain malignancies. Comprehensive cross-sectional images of the brain are provided by CT scans, which can be used to detect anomalies. A blood test, which includes removing a tiny sample of the tumor for microscopic inspection, is typically necessary for a precise diagnosis of a brain tumor. This can be accomplished

during tumor excision surgery or by less invasive methods like stereotactic biopsy.<sup>17</sup>

### **Blood tests**

Tests for specific hormones, tumor markers, liver and kidney function and general health may all be performed on blood samples. However, diagnosing brain disease usually requires more than blood testing.<sup>18</sup>

### **Functional Imaging**

Using functional imaging methods like Magnetoencephalography (MEG), Positron Emission Tomography (PET), or functional Magnetic Resonance Imaging (fMRI), one can quantify brain activity and map it to critical brain functions like speech and language. Surgical planning can be guided by these concepts to lower the chance of functional impairment.<sup>19,20</sup>

## Symptoms of Brain Tumour

### *Neurological symptoms*

Depending on the tumor's location, a variety of neurological issues may be present, including headache, seizures, cognitive decline, limb weakness or numbness, trouble speaking or understanding

**Table 1: Symptoms and Causes/Risk Factors.<sup>13</sup>**

Clinical symptoms of brain tumors	Causes/Risk Factors of Brain Tumors
Brain tumor clinical signs include: Seizures of headaches, Pneumonia and vomiting Elevated ICP Symptomatic dysfunction weakened muscles, Sense of Aphasia: Speech impairment, Brain edema, Modifications in mode, Control of body temperature, Changes in the pustular alterations in breathing pattern Perplexity.	Unknown Congenital-at birth Heredity-by the birth Encephalitis-inflammation of the brain, usually caused by bacteria Obesity-problems with the production of brain fat History of epilepsy Age (old) Smoking/drinking Mutation.

words and problems seeing or understanding. Abnormalities in hearing, balance and coordination. Symptoms and Causes/ Risk Factors<sup>13</sup> will be discussed in (Table 1).

## HERNIATION

A condition where the brain pushes against its natural position is brought on by an increase in intracranial pressure. This needs emergency medical attention since it may be fatal. Hydrocephalus: When a tumor obstructs the flow of Cerebrospinal Fluid (CSF), it can result in hydrocephalus. Headache, nausea, blurred vision and trouble walking are some of the symptoms of this illness, which is caused by an accumulation of fluid in the brain.<sup>21,22</sup>

## Stroke

The symptoms of a stroke can be induced by tumors that obstruct blood flow to the brain. This may result in loss of coordination, speech difficulties, vision problems, weakness, or paralysis. Behavior and cognition: Tumors can have an impact on behavior and cognition, leading to changes in mood, stress, pressure and memory. Endocrine dysfunction: Hormone levels can be upset by tumors close to the pituitary gland or in other hormone-producing regions of the brain. This can result in symptoms like weight fluctuations, irregular menstrual bleeding, aberrant growth and exhaustion. Electrical faults trigger seizures. Seizures; These could show up as convulsions, jerking of the muscles, altered awareness, or eyesight problems. Treatment side effects: Complications might also arise from procedures including radiotherapy, chemotherapy and surgery. These include tissue damage, weariness, hemorrhage, infection and cognitive decline. Psychological and social effects: Patients and their families may experience stress, worry, depression, financial hardships and

alterations in relationships as a result of brain cancer therapy and the consequences that accompany it.

## Radiation therapy

1. External Beam Radiation Therapy (EBRT) is one type of radiation therapy.
2. Radiation Therapy with Stereotactic Effects.

## Radiation Therapy with new External Beams (EBRT)

For brain cancers, it is the most often used type of radiation therapy. It entails delivering radiation from outside the body to the tumor site. Tumors can be targeted with minimal harm to healthy tissue using contemporary techniques like Stereotactic Radiosurgery (SRS) and Magnetic Resonance Imaging (IMRT). Direct Treatment: Electrodes may occasionally be positioned directly on or close to the tumor. This method, also known as internal radiation treatment or direct radiation therapy, exposes the tumor to high doses of radiation while it is still near the tissue.

## Immune Therapy

### *Pembrolizumab: Increase the power of T cells*

Nivolumab or pidiva: also known as pidiva: fortifies the immune system. Numerous symptoms include headache, seizures, disorientation and weakness. Or numbness in the extremities, problems with balance and coordination, difficulties speaking or understanding words and changes in vision or hearing. Shifts in awareness as well as papilledema, or eye disc swelling. Herniation: A condition where the brain pushes against its natural position is brought on by an increase in intracranial pressure. This can be fatal, so you should get medical help right away.

## Hydrocephalus

By obstructing the Cerebrospinal Fluid (CSF), certain malignancies can result in hydrocephalus. This disorder results in an accumulation of fluid in the brain, which can produce symptoms like headache, nausea, impaired vision and trouble walking. This may result in loss of coordination, speech difficulties, vision problems, weakness, or paralysis. Behavior and cognition: Tumors can have an impact on behavior and cognition, leading to changes in mood, stress, pressure and memory.

## Endocrine Dysfunction

Tumors close to the pituitary gland or other hormone-producing regions are indicative of endocrine dysfunction. Hormone imbalances brought on by brain disorders might result in symptoms like growth anomalies, irregular menstruation, exhaustion and weight fluctuations. Seizures: Because of electrical irregularities in the brain, several neurological illnesses can result in seizures. Seizures; These could show up as convulsions, jerking of the muscles, altered awareness, or eyesight problems. Adverse reactions to therapy: Complications can also arise from treatments

**Table 2: Chemo Drugs Used to Treat Brain and Spinal Cord Tumors.<sup>24</sup>**

Sl. No.	Brand name	Composition	Dosage Form	M.R.P (in Rupees)
1.	Shree Pharma	Carboplatin (450 mg)	Injection (liquid)	1300
2.	GLS Pharma	Carmustine (100 mg)	Injection (liquid)	3999
3.	Cipla	Cisplatin (50 mg)	Injection (liquid)	250
4.	Cadila	Etoposide (50 mg)	Capsule	400/Box

including chemotherapy, radiation therapy and surgery. These include tissue damage, weariness, haemorrhage, infection and cognitive decline. And social effects, such as relationship changes, financial hardship, anxiety, sadness and stress. Chemo Drugs Used to Treat Brain and Spinal Cord Tumors discussed in Table 2.<sup>24</sup>

### Hydration

Drink lots of liquids, especially water, to stay hydrated. Headaches and weariness are two indicators of dehydration. It's crucial to modify calorie intake by any changes in appetite or metabolism that certain brain cancer patients may experience. Rice aids in digestion and avoids constipation, which may occur as a side effect of certain drugs or therapies. Walnuts, chia seeds and seeds. Omega-3 fatty acids may benefit the brain and have anti-inflammatory qualities. These foods may impair general health and vitality, as well as induce pain. Others, however, may feel more energized and attentive if they consume less caffeine from beverages like tea or coffee. Personalized Meal Planning: Consult a nutritionist to develop a meal plan that is tailored to your diet, tastes and medical conditions you are treating. Include it to address dietary inadequacies or enhance general well-being. However, since supplements may interfere with prescription drugs or therapies, it's crucial to see a doctor before beginning any new regimen.

### Treatment of brain tumors

1. Drilling: This procedure uses a drill to open the skull and remove blood and local fluid from behind the dura.<sup>20</sup>
2. To remove a wound, mend the injured area, drain blood and lower intracranial pressure, a craniotomy involves opening the skull, removing the bone marrow and opening the dura mater.
3. Remove the head to remove the bones (craniotomy).
4. Cranioplasty: The use of prostheses to replace missing or damaged bones to repair the cranium as a result of prior surgery, Trauma, or deformity.<sup>23</sup>

### Prevention of Brain Tumours

Brain tumor prevention involves dealing with modifiable risk factors, living a healthy lifestyle and early identification. Some measures may reduce the risk of brain tumors.<sup>25-27</sup>

### Reduce environmental toxins

Ionizing radiation, particularly in children, is a known brain tumor risk factor. This risk may be reduced by avoiding unneeded medical imaging like CT scans. Pesticides, solvents and industrial chemicals: Long-term exposure increases risk. Occupational safety measures decrease exposure.

### Healthy Eating and Living

Antioxidant-Rich Diet: Fruits, vegetables and antioxidants lessen cancer risk, especially brain tumors. These nutrients reduce tumor-causing oxidative stress.

### CONCLUSION

In India and around the world, brain tumors are a serious health concern due to their rising frequency and evolving epidemiological patterns. This burden is exacerbated by variables like population increase, aging populations, changing lifestyles and access to healthcare. Although there is hope for better results from reforms in mental health research and treatment, there are still major obstacles to overcome, particularly in developing nations like India. Innovative uses of artificial intelligence are developing to offer fresh perspectives on the identification, diagnosis and therapy planning of cancer. Treatments that are tailored to the patient's needs and goals can be achieved by targeted drug delivery, nanotechnology, gene therapy, immunotherapy and precision medicine techniques. However, these improvements must be within the reach and budget of every patient, particularly in underserved areas. Tumor control is impacted by numerous brain issues. Improved access to prompt diagnosis, expert care and innovative therapies should be the main priorities of efforts, particularly in underprivileged areas. In addition, actions aimed at resolving socioeconomic problems, raising public awareness and providing patient support are essential components of comprehensive cancer care.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## ABBREVIATIONS

**WHO:** World Health Organization; **CNS:** Central nervous system; **GBM:** Glioblastoma multiform; **PNET:** Primitive neuroectodermal tumor; **CT:** Computed tomography; **MEG:** Magnetoencephalography; **PET:** Positron emission tomography; **EBRT:** External Beam Radiation Therapy; **SRS:** Stereotactic radiosurgery; **IMRT:** Magnetic resonance imaging.

## SUMMARY

Brain tumors represent a considerable health challenge in India, with increasing frequency linked to variables such as age, lifestyle modifications and enhanced diagnostic capabilities. They are among the top 10 malignancies in the nation; nonetheless, obstacles include discrepancies in diagnosis and access to treatment, particularly in rural regions. Gliomas, particularly glioblastoma, are prevalent in India, with a greater prevalence in males and a younger mean age of onset relative to other nations. Brain tumors may impact several neurological processes and diagnosis often utilizes imaging modalities such as MRI and CT scans. Treatment includes surgery, radiation treatment and immunotherapy, with breakthroughs in precision medicine providing optimism for improved results. Socioeconomic determinants, healthcare accessibility and pioneering research are essential for enhancing brain tumor treatment in India.

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