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**Research Article**

# Epidemiological Characteristics of Primary Tumors of the Central Nervous System According to Anatomical Location and Type of Lesion in a Level IV Hospital in Colombia in the Period Between 2008-2019

**Erik Munoz Rodriguez[1*], Robinson Trujillo Cabanilla[2], Duvan Trujillo Cabanilla[3], Pablo Vargas Ardila[4], Kael Sanchez[5], Jhonier Osorio[6] and Eliana Ramirez[7]**

## Abstract

**Introduction:** According to figures from GLOBOCAN 2020, tumors of the central nervous system have an incidence of 1.6% with a mortality of 2.5%. For Colombia, 1,901 new cases were registered, with an incidence of 1.7% and 1,650 deaths, with a mortality of 3%.

**Aim:** To describe the epidemiological characteristics of patients diagnosed with primary tumors of the central nervous system at a central military hospital in the period between 2008-2019.

**Materials and methods:** A cross-sectional descriptive study was proposed, collecting data from the period between 2008 and 2019. 177 cases met these criteria, of which the sociodemographic variables were estimated, and the survival for these was determined through the Kaplan-Meyer analysis of the tumors.

**Results:** The average 5-year survival for men is 22% and for women 27%. 18.6% of the 177 patients diagnosed with primary brain tumors in the study died after histopathological diagnosis, of which 60.6% were men and 39.4% women.

[1]Neurosurgeon, Hospital Military Central, Head of Postgraduate studies, Nueva Granada, Military University, Bogota, Colombia

[2]Medical Epidemiologist, University Antonio Narino, Bogota, Colombia

[3]Fifth year medical student, University Antonio Narino, Bogota, Colombia

[4]Fifth year medical student, Nueva Granada, Military University, Bogota, Colombia

[5]Head of Nursing, Hospital Military Central, Bogota, Colombia

[6]Sixth year medical student, Nueva Granada, Military University, Bogota, Colombia

[7]Pediatrician, Dean Faculty of Medicine Military University New Granada, Bogota, Colombia

[*]**Corresponding Author:** Erik Munoz Rodriguez, Neurosurgeon, Hospital Military Central, Head of Postgraduate studies, Nueva Granada, Military University, Bogota, Colombia.

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**Conclusions:** The highlighted sociodemographic aspects represent a contribution to the generation of new evidence for primary tumors of the central nervous system in our country.

**Keyword:** Tumors; Central nervous system; WHO; Primary tumors.

## Introduction

Cancer is currently one of the leading causes of death in the world [1]. According to the World Health Organization (WHO), in 2019, cancer was the first or second leading cause of death before the age of 70 in 112 of 183 countries [2]. Likewise, according to GLOBOCAN's 2020 figures on cancer incidence and mortality produced by the International Agency for Research on Cancer, tumors of the central nervous system have an incidence of 1.6% with a mortality of 2.5%, figures compared to the previous study carried out in 2018 [3,4]. In Colombia, for the year 2020, according to GLOBOCAN, 1901 new cases were registered with an incidence of 1.7% and 1650 deaths with a mortality of 3% [5-7]. The differences in incidence and mortality in different populations present difficulties in their study because a single form of data reporting is not used. In ancient times, brain tumors caused the death of patients with this pathology. Until now, the main symptoms described were headaches, seizures, and coma, as a result of increased intracranial pressure. Histological type and age are strong prognostic factors for patients with brain tumors. The degree of tumor malignancy, the extent of resection, its location, the administration of radiotherapy, and chemotherapy protocols were directly linked to increased survival. It has also been described that having another neoplastic lesion may be related to the development of an intracranial tumor, such as a breast tumor or a glioma, in which it is considered that genetic and environmental risk play a role in this pathological state [8-10]. It is, therefore, of great importance to continue and strengthen epidemiological studies whose principal focus is central nervous system tumors, as in Colombia, a country with a high incidence of neoplastic pathology, there is a lack of epidemiological studies and clinical reports on the area [11,12]. Given the above, a retrospective cross-sectional descriptive study was carried out in which the sociodemographic, histological and anatomical location characteristics were analyzed using the World Health Organization (WHO) 2021 classification of central nervous system tumors [10,12,13]; In addition, the type of management used in each tumor presentation and its respective survival period is described in order to determine the different variables studied and describe the epidemiological characteristics of the population selected in a Level IV Hospital in Colombia in a period of 11 years [11,12,14].

## Materials and methods

A cross-sectional descriptive study was proposed for which data were to be collected according to the statistical registry of the Central Military Hospital. Those related to space-occupying lesions in the central nervous system were filtered, obtaining a total of 475 patients. Subsequent inclusion criteria were evaluated. This corresponded to individuals who had had an initial diagnosis of a suspected tumor lesion of the nervous system performed in our institution and who had undergone biopsy or surgical management to determine the histological characteristics of the tumor lesion to distinguish primary tumor from a


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metastatic one, in addition to having received treatment or follow-up. During the period between 2008 and 2019, 177 cases met these criteria. Sociodemographic variables such as sex and age were used to divide the group into categories: pediatrics, adults and older adults. The aforementioned age ranges were assigned according to WHO classifications. The anatomical location was described through diagnostic images described by Fossa, the histological properties categorized according to the report of pathology were grouped according to the 2021 WHO classification for purposes of association and data management, but the degree of malignancy was not taken into account, since this will be included in a second publication. Likewise, the survival period was determined from the moment of diagnosis until death or until it exceeded the range evaluation time of this study, for which a Kaplan-Meyer analysis was performed using statistical software R version 4.1.3 comparing survival at 11 years for men and women, to determine a follow-up of the cases in which it was known that survival exceeded the established limit. In the same way, mortality was evaluated according to the histological characteristics of each tumor and its behavior concerning sex. The complications associated with the management received by the patients were taken into account. Patients, the reports of recurrence, and remnants of the tumors in the patients were also analyzed. A comparison using the database was also made of these variables, including the presentation of sequela and the symptomatology that each type of tumor presented. It was shown that these variables do not depend on the histological characteristics, but directly on the anatomical location, for which statistical analysis was not carried out.

**Results**

From the total of 177 patients who met the inclusion criteria and from whom data were obtained, it was determined that 57% were women compared to 43% men. In the group of women, 64% showed that the adult age group had the highest percentage of patients, followed by older adults with 27%. The lowest percentage were the pediatric patients with 8%. In the group of men, 52% showed that the adult age group had the highest percentage of patients, followed by older adults with 37%. The lowest percentage were the pediatric patients with 9% (Table 1).

The anatomical location of primary central nervous system tumors is divided into three zones: The first zone refers to the anterior fossa formed by the frontal bone and the lesser wings of the sphenoid; however, tumors located between this location up to the frontal bone in the coronal suture was included. For this location, it was found that 41% of the tumors are located in that area, for which 66.2% are male patients and the female population corresponds to the remaining 33.8%. For the middle fossa, with an anterior limit that is related to the posterior border of the anterior fossa and a posterior limit formed by the dorsum sella, the posterior clinoid processes and cephalad to the frontal and parietal bones, 38% of the study tumors were located in this area. Of these, 50% were in the female population and the other 50% in the male population.

Finally, in the posterior fossa, which is formed anteriorly by the posterior limits of the middle cranial fossa and its posterior limit corresponds to the occipital bone up to its cephalic limit, 66% of the cases were found.


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| | | Male (N) | Female (N) |
|---|---|---|---|
| **Age Group** | Adults | 43 | 61 |
| | Elderly | 31 | 26 |
| | Pediatrics | 8 | 8 |
| **Anatomical Location** | Anterior Cerebral Foss | 49 | 25 |
| | Middle Cerebral Foss | 19 | 19 |
| | Posterior Cerebral Foss | 34 | 32 |
| **Classification of Tumors of the Central Nervous System WHO 2016** | Diffuse Astrocytic and Oligodendroglial Tumors | 53 | 16 |
| | Ependymal Tumors | 5 | 3 |
| | Neuronal and Mixed Neuronal Glial Tumors | 1 | 1 |
| | Embryonal Tumors | 3 | 2 |
| | Tumors of the Cranial and Paraespinal Nerves | 6 | 6 |
| | Choroid Plexus Tumors | 0 | 1 |
| | Meningiomas | 20 | 34 |
| | Mesenchymal Non-Meningothelial Tumors | 6 | 1 |
| | Lymphomas | 1 | 1 |
| | Germ Cell Tumors | 1 | 0 |
| | Tumors of the Sellar Regions | 7 | 9 |

**Table 1:** Distribution by age, anatomical location, and histological type according to the 2021 WHO classification concerning sex.

It was found that 51.5% were in the male population, and with only a very small difference, 48.5% were found in the female population. Evaluating the histological characteristics of primary tumors of the central nervous system, it is evident that diffuse astrocytoma and oligodendroglioma are the most frequent tumors in men and the second in women. Based on these results, this particular histological type has a prevalence 3 times greater in men. However, meningiomas are 1.7 times more prevalent in women than in men. The other histological type of tumors has similar presentations, both in the number of cases, distribution, and frequency by sex. The next thing to note is that the prevalence of diffuse astrocytomas and oligodendroglial tumors are more frequently located in the anterior fossa and mainly affect men in adulthood. Additionally, they are also more frequently located in the anterior fossa in the case of older adults. As a result, a relationship between age and the development of these tumors of the central nervous system can be established. In the case of meningiomas, the location in which they occur most frequently corresponds to the anterior fossa, conserving the tendency to appear in women in adulthood, and the tendency for astrocytic and oligodendroglia tumors to appear in men in adulthood is also conserved (Table 2). As described in the literature to date. No statistically significant data were found to associate the development of tumors associated with exposure to substances; therefore, it is considered that this association cannot be determined through this study. 18.6% of the 177 patients diagnosed with primary brain tumors included in the study died after the histopathological diagnosis, of which 60.6% correspond to men and 39.4% correspond to women.


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| Tumor Location | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Classification of Tumors of the Central Nervous System WHO 2016 | Male | | | Female | | |
| | | Pediatrics | Adults | Elderly | Pediatrics | Adults | Elderly |
| Anterior Cerebral Foss | Diffuse astrocytic and oligodendroglial tumors | 1 | 20 | 11 | | 3 | 3 |
| | Ependymal tumors | 1 | 1 | | | | |
| | Neuronal and mixed neuronal glial tumors | 1 | | 1 | | | |
| | Embryonal tumors | | | | | | |
| | Tumors of the cranial and paraespinal nerves | | | | | | |
| | Choroid plexus tumors | | | | | | |
| | Meningiomas | | 6 | 4 | 1 | 10 | 4 |
| | Mesenchymal non-meningothelial tumors | | 2 | 1 | | | 1 |
| | Lynphomas | | 1 | | | | 1 |
| | Germ cell tumors | | | | | 1 | |
| | Tumors of the sellar regions | | | | | | 1 |
| Middle Cerebral Foss | Diffuse astrocytic and oligodendroglial tumors | | 2 | 1 | 1 | 1 | 1 |
| | Ependymal tumors | | | | | | |
| | Neuronal and mixed neuronal glial tumors | | | | | | 1 |
| | Embryonal tumors | | | | | | |
| | Tumors of the cranial and paraespinal nerves | | | | | | |
| | Choroid plexus tumors | | | | | | |
| | Meningiomas | | 5 | 3 | | 5 | 3 |
| | Mesenchymal non-meningothelial tumors | | | | | | |
| | Lynphomas | | | | | | |
| | Germ cell tumors | | | | | | |
| | Tumors of the sellar regions | | 6 | 1 | | 6 | 1 |
| Posterior Cerebral Foss | Diffuse astrocytic and oligodendroglial tumors | 3 | 9 | 3 | 3 | 4 | 2 |
| | Ependymal tumors | 1 | 1 | 1 | | | 2 |
| | Neuronal and mixed neuronal glial tumors | | | | | | |
| | Embryonal tumors | 1 | 2 | | 1 | 1 | |
| | Tumors of the cranial and paraespinal nerves | | 5 | 1 | 1 | 5 | 1 |
| | Choroid plexus tumors | | | | 1 | | |
| | Meningiomas | | 1 | 2 | | 4 | 7 |
| | Mesenchymal non-meningothelial tumors | | 1 | 2 | | | |
| | Lynphomas | | | | | | |
| | Germ cell tumors | | | | | | |
| | Tumors of the sellar regions | | | | | 1 | |

**Table 2:** The number of cases is described for each histological type according to 2021 WHO classification regarding the anatomical location concerning the age group based on sex.


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The table shows the frequency with which tumors, according to their cellular characteristics, tend to relapse compared to the frequency with which they tend to present remnants (Table 3) (Figure 1). It is considered that this depends mainly on the cell line of the tumor, with the recurrence of meningiomas and tumors derived from glial cells being more frequent, although an important characteristic is that this behavior depends on the degree of malignancy that each of these presents.

| Mortality according to histological type | | | | | | |
|---|---|---|---|---|---|---|
| **Classification of Tumors of the Central Nervous System WHO 2016** | **Male** | | | **Female** | | |
| | **Pediatrics** | **Adults** | **Elderly** | **Pediatrics** | **Adults** | **Elderly** |
| Diffuse astrocytic and oligodendroglial tumors | 1 | 5 | 9 | 1 | 1 | 5 |
| Ependymal tumors | | | 1 | | | |
| Neuronal and mixed neuronal glial tumors | 1 | | | | | |
| Embryonal tumors | | | | | | |
| Tumors of the cranial and paraespinal nerves | | | | | | |
| Choroid plexus tumors | | | | | | |
| Meningiomas | | 2 | 1 | | 1 | 4 |
| Mesenchymal non-meningothelial tumors | | | | | | |
| Lynphomas | | | | | | |
| Germ cell tumors | | | | | | |
| Tumors of the sellar regions | | | | | 1 | |

**Table 3:** Distribution of mortality according to histological type concerning age group and sex.

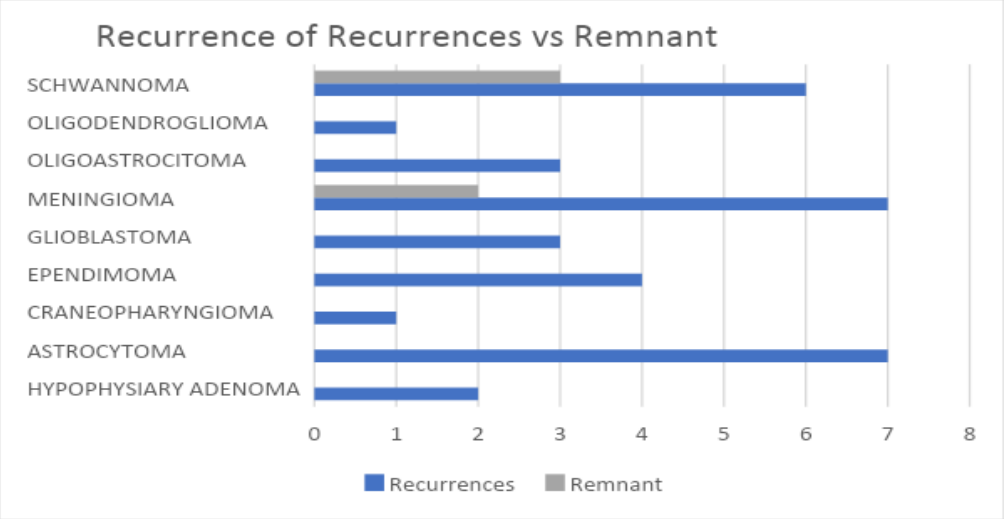


**Figure 1:** Incidence of Remnants Compared to Tumor Recurrences.

The average survival rate at 5 years for men is 22% and for women 27% (Figure 2). However, it is evident that despite the progressive decrease in survival over time, there are cases in which survival increases. It is believed that an important factor for


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this to happen depends on the low grades of malignancy, the anatomical location, and receiving timely treatment. It is also evident that there is no statistically significant difference over time between the sexes (Table 4).

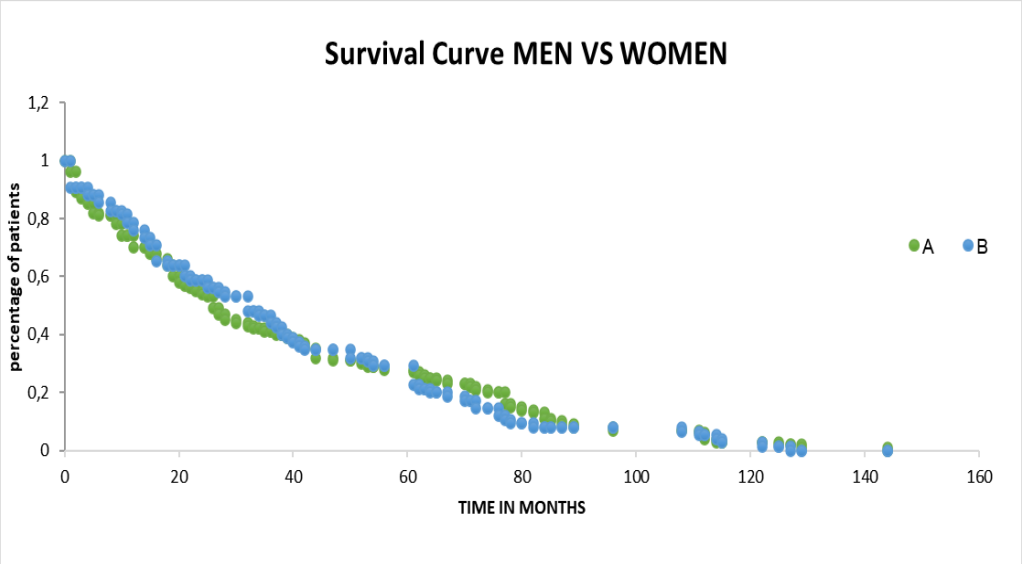


**Figure 2:** Kaplan-Meier Survival Analysis Compared Men and Women.

| Hypothesis Testing | | |
|---|---|---|
| | **Stat** | **p-value** |
| Log-rank 1 | 0.06901688 | 0.79277361 |
| Log-rank 2 | 0.07252253 | 0.78769878 |
| Wilcoxon | 0.05362494 | 0.81687154 |
| Tarone-Ware | 0.00132519 | 0.97096084 |

**Table 4:** Kaplan-Meier Survival Analysis Compared Men and Women (Confidence interval %=95).

## Discussion

Through this study, it is determined the sociodemographic characteristics of our hospital for the patients who were diagnosed with primary brain tumors, to compare it with the worldwide and Latin American epidemiology described so far for this pathology, since, as has been Until now, primary tumors mostly represent a very high risk of mortality [13-15]; however, it was able to determine that this type of neoplasms mainly affect 57% of women compared to 46% of men. In addition, it is evident that the mean age has decreased since the finding was made and represents a data that accompanies what has been described by recently published epidemiological studies [16-18], such as in the CBTRUS Statistical Report of the present year. However, the debate on these data is still ongoing [19-21], since until a few years ago it was believed that these types of tumors were more prevalent in men, with mortality also higher in men. It is shown, however, that for both sexes, this index is higher in the group of older adults [22-24], irrespective of the fact that the mortality described for this study of Colombian subjects is 18.6% of all patients compared to


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20% for the US population [25-28]. Authors believe that this is mainly due to the different comorbidities in this group of patients and that the incidence of high-grade tumors occurs more frequently in this group of older adults such as glioblastomas or high-grade astrocytomas, as well as high-grade meningiomas [28-31] (Figure 3).

However, compared to previous studies, it draws our attention that mortality [32-34] is maintained and with a tendency to decrease as a result of the implementation of new therapeutic regimens [35-37] included in those considered to present better outcomes for patients who undergo some type of radiotherapy in combination with new surgical approaches within which it is suggested that they be minimally invasive and before performing the procedure, they are also accompanied by very good interdisciplinary planning.

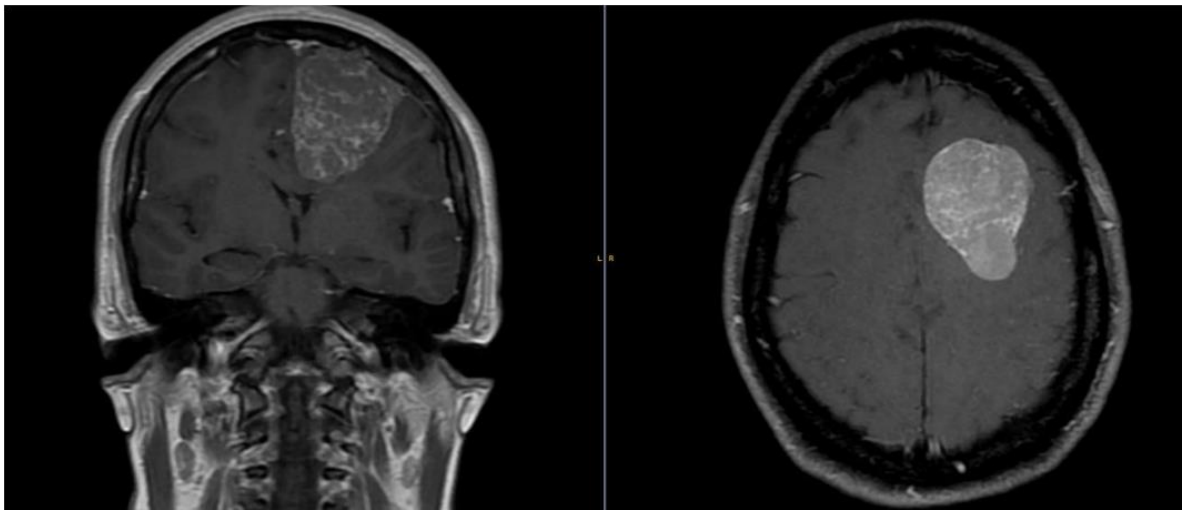

**Figure 3:** Contrast-enhanced T1 brain MRI in coronal and axial section showing extra-axial lesion in the left frontal region with compressive signs on the adjacent parenchymal associated with vasogenic edema, findings compatible with left frontal meningioma.

On the other hand, a higher incidence of meningiomas had been described [38-40], however, it was able to denote that although it continues to be high in our study, it was surpassed by tumors derived from glia [41-43]. The most frequent location of brain tumors, in what was show, is the anterior fossa, wherein gliomas and meningiomas are most frequently seen.

On the other hand, the description of the clinical manifestations was not included within the statistical analysis. It is shown that headaches, and seizures [17,20,42,43] are frequent, presenting in more than 70% of the patients as soon as the tumors occur.

The other symptoms that may occur were determined to depend on the location of the tumors. For example, vestibular symptoms are frequent in individuals with schwannomas, while visual disturbances are frequent in patients with tumors in the sellar region [44-46] or middle fossa as in the case of pituitary adenomas or craniopharyngiomas [45,47-49]. An important aspect to highlight is the incidence of glial-derived tumors, as well as meningiomas. On the other hand, it is believed that the frequency of remnants of meningiomas, and schwannomas is due to the surgical techniques used accompanied by the degree of malignancy and the edges


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of the stromal compromise. It is thought that more studies should be undertaken regarding this phenomenon, since it is something reported in different management centers of this type of tumor worldwide [50-52], but about which not enough is known.

## Conclusion

The highlighted sociodemographic aspects of this study represent a contribution to the generation of new evidence for the occurrence of primary tumors of the central nervous system in our country, where contribution of this type of data is scarce. Since it is a retrospective analysis of a single institution, it can be an important indication of the epidemiology of these tumors in our environment.

In addition, it highlights the importance of applying the latest updates for this type of neoplasm and the application of this tool in future studies. Doubts were also generated about the cases of tumor recurrence in contrast to tumor remnants, which implies the need for the generation of new studies to determine these characteristics that represent a great unknown in the surgical context in terms of appropriate management.

## References


1. Piñeros M, Sierra MS, Izarzugaza MI, Forman D. Descriptive Epidemiology of Brain and Central Nervous System Cancers in Central and South America. Cancer Epidemiol. 2016;44(Suppl1):141-149. PubMed | CrossRef
2. Gupta T, Achari R, Chatterjee A, Chen ZP, Mehta M, Bouffet E, et al. Comparison of Epidemiology and Outcomes in Neuro-Oncology Between the East and the West: Challenges and Opportunities. Clin Oncol. 2019;31(8):539-548. PubMed | CrossRef
3. Almutrafi A, Bashawry Y, AlShakweer W, Al-Harbi M, Altwairgi A, Al-Dandan S. The Epidemiology of Primary Central Nervous System Tumors at the National Neurologic Institute in Saudi Arabia: A Ten-Year Single-Institution Study. J Cancer Epidemiol. 2020:1429615. PubMed | CrossRef
4. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021;71(3):209-249. PubMed | CrossRef
5. GBD 2016 Brain and Other CNS Cancer Collaborators. Global, Regional, and National Burden of Brain and Other CNS Cancer, 1990-2016: A Systematic Analysis for the Global Burden of Disease Study 2016. Lancet Neurol. 2019;18(4):376-393. PubMed | CrossRef
6. Mrak G, Korent V, Mišir Krpan A, Bitunjac A, Štenger M, Kordić A, et al. Malignant Brain Neoplasms Incidence and Mortality Trends in Croatia from 2001 to 2014. Croat Med J. 2019;60(1):33-41. PubMed | CrossRef
7. Gómez Vega JC, Ocampo Navia MI, De Vries E, Feo Lee O. Sobrevida de los tumores cerebrales primarios en Colombia. Univ Médica. 2020;61(3). CrossRef
8. Heras FL, Diocares G. Neuropatología: Diagnóstico Con Biología Molecular. Rev médica Clín Las Condes. 2017;28(3):352–9. CrossRef
9. Robertson T, Koszyca B, Gonzales M. Overview and recent advances in neuropathology. Part 1: Central nervous system tumours. Pathology. 2011;43(2):88-92. PubMed | CrossRef
10. Leece R, Xu J, Ostrom QT, Chen Y, Kruchko C, Barnholtz-Sloan JS. Global Incidence of Malignant Brain and Other Central Nervous System Tumors by Histology, 2003-2007. Neuro Oncol. 2017;19(11):1553-1564. PubMed | CrossRef
11. Salami AA, Okunlola AI, Ajani MA, Onakpoma F. WHO Classification of Meningiomas-A Single Institutional Experience. Neurochirurgie. 2021;67(2):119-124. PubMed | CrossRef
12. Buerki RA, Horbinski CM, Kruser T, Horowitz PM, James CD, Lukas RV. An Overview of Meningiomas. Future Oncol. 2018;14(21):2161-2177. PubMed | CrossRef




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13. Asa SL, Mete O, Perry A, Osamura RY. Overview of the 2022 WHO Classification of Pituitary Tumors. Endocr Pathol. 2022;33(1):6-26. PubMed | CrossRef
14. Berthold F, Spix C, Kaatsch P, Lampert F. Incidence, Survival, and Treatment of Localized and Metastatic Neuroblastoma in Germany 1979-2015. Paediatr Drugs. 2017;19(6):577-593. PubMed | CrossRef
15. Darlix A, Zouaoui S, Rigau V, Bessaoud F, Figarella-Branger D, Mathieu-Daudé H, et al. Epidemiology for Primary Brain Tumors: A Nationwide Population-Based Study. J Neurooncol. 2017;131(3):525-546. PubMed | CrossRef
16. Nassiri F, Liu J, Patil V, Mamatjan Y, Wang JZ, Hugh-White R, et al. A Clinically Applicable Integrative Molecular Classification of Meningiomas. Nature. 2021;597(7874):119-125. PubMed | CrossRef
17. Stiller CA, Bayne AM, Chakrabarty A, Kenny T, Chumas P. Incidence of Childhood CNS Tumours in Britain and Variation in Rates by Definition of Malignant Behaviour: Population-Based Study. BMC Cancer. 2019;19(1):139. PubMed | CrossRef
18. J Strong M, Garces J. Brain Tumors: Epidemiology and Current Trends in Treatment. J Brain Tumors Neurooncology. 2016;1(1). CrossRef
19. Bell JS, Koffie RM, Rattani A, Dewan MC, Baticulon RE, Qureshi MM, et al. Global Incidence of Brain and Spinal Tumors by Geographic Region and Income Level Based on Cancer Registry Data. J Clin Neurosci. 2019;66:121-127. PubMed | CrossRef
20. Kim J, Radjadurai S, Rahman Z, Hitos K, Ghattas S, Gomes L, et al. Outcomes of Tumour Related Epilepsy in a Specialised Epilepsy Surgery Unit. J Clin Neurosci. 2019;59:265-269. PubMed | CrossRef
21. Yolcu Y, Wahood W, Kerezoudis P, Alvi MA, Habermann EB, Bydon M. Primary Central Nervous System Tumors: Comparing Two National Cancer Registries. World Neurosurg. 2019;128:719-e731. PubMed | CrossRef
22. Nieder C, Andratschke NH, Grosu AL. Re-irradiation for Recurrent Primary Brain Tumors. Anticancer Res. 2016;36(10):4985-4995. PubMed | CrossRef
23. Politsky JM. Brain Tumor-Related Epilepsy: A Current Review of the Etiologic Basis and Diagnostic and Treatment Approaches. Curr Neurol Neurosci Rep. 2017;17(9):70. PubMed | CrossRef
24. He Z, Wong ST, Yam KY. Newly-Diagnosed, Histologically-Confirmed Central Nervous System Tumours in a Regional Hospital in Hong Kong : An Epidemiological Study of a 21-Year Period. J Korean Neurosurg Soc. 2020;63(1):119-135. PubMed | CrossRef
25. McNeill KA. Epidemiology of Brain Tumors. Neurol Clin. 2016;34(4):981-998. PubMed | CrossRef
26. Fuentes-Raspall R, Solans M, Roca-Barceló A, Vilardell L, Puigdemont M, Del Barco S, et al. Descriptive Epidemiology of Primary Malignant and Non-Malignant Central Nervous Tumors in Spain: Results from the Girona Cancer Registry (1994-2013). Cancer Epidemiol. 2017;50(Pt A):1-8. PubMed | CrossRef
27. Ostrom QT, Gittleman H, Xu J, Kromer C, Wolinsky Y, Kruchko C, et al. CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2009–2013. Neuro Oncol. 2016;18(5);v1–v75. CrossRef
28. Ostrom QT, Cioffi G, Waite K, Kruchko C, Barnholtz-Sloan JS. CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2014-2018. Neuro Oncol. 2021;23(12 Suppl2):iii1-iii105. PubMed | CrossRef
29. Lapointe S, Perry A, Butowski NA. Primary Brain Tumours in Adults. Lancet. 2018;392(10145):432-446. PubMed | CrossRef
30. Contreras LE. Epidemiología De Tumores Cerebrales. Rev médica Clín Las Condes. 2017;28(3):332–8. CrossRef
31. Sinning M. Clasificación De Los Tumores Cerebrales. Rev médica Clín Las Condes. 2017;28(3):339–42. CrossRef
32. Ho CY, Bornhorst M, Almira-Suarez MI, Donev K, Grafe M, Gordish-Dressman H, et al. Clinicopathologic Features of Diencephalic Neuronal and Glioneuronal Tumors. J Neuropathol Exp Neurol. 2020;79(1):67-73. PubMed | CrossRef
33. Maggio I, Franceschi E, Tosoni A, Nunno VD, Gatto L, Lodi R, et al. Meningioma: Not Always a Benign Tumor. A Review of Advances in the Treatment of Meningiomas. CNS Oncol. 2021;10(2):CNS72. PubMed | CrossRef
34. Aguirre-Cruz L, Rodríguez-Pérez CE, de la Cruz-Aguilera DL, Acosta-Castillo GI, Ruano-Calderón L, Martínez-Moreno M, et al. Descriptive Epidemiology and Frequency Variations of Astrocytic Tumors in the

National Institute of Neurology and Neurosurgery of Mexico. Salud Publica Mex. 2020;62(3):255-261. PubMed | CrossRef
35. Ostrom QT, Francis SS, Barnholtz-Sloan JS. Epidemiology of Brain and Other CNS Tumors. Curr Neurol Neurosci Rep. 2021;21(12):68. PubMed | CrossRef
36. Goldbrunner R, Stavrinou P, Jenkinson MD, Sahm F, Mawrin C, Weber DC, et al. EANO Guideline on the Diagnosis and Management of Meningiomas. Neuro Oncol. 2021;23(11):1821-1834. PubMed | CrossRef
37. Ravindra VM, Schmidt MH. Management of Spinal Meningiomas. Neurosurg Clin N Am. 2016;27(2):195-205. PubMed | CrossRef
38. Nakasu S, Notsu A, Nakasu Y. Prevalence of Incidental Meningiomas and Gliomas on MRI: A Meta-Analysis and Meta-Regression Analysis. Acta Neurochir (Wien). 2021;163(12):3401-3415. PubMed | CrossRef
39. Yusuf MB, Gaskins J, Amsbaugh MJ, Woo S, Burton E. Survival Impact of Prolonged Postoperative Radiation Therapy for Patients with Glioblastoma Treated with Combined-Modality Therapy. Neurooncol Pract. 2019;6(2):112-123. PubMed | CrossRef
40. García-Espinosa PG, Botello-Hernández E, Pérez-García L, Guerra-Maldonado P, Fabela-Rodríguez JH. Tumores primarios de alto grado del sistema nervioso central: análisis clínico y epidemiológico de la experiencia de un centro. Gac Mex Oncol. 2022;21(2). CrossRef
41. Orman G, Mohammed S, Tran HDB, Lin FY, Meoded A, Desai N, et al. Neuroimaging Appearance of Cerebral Malignant Epithelioid Glioneuronal Tumors in Children. AJNR Am J Neuroradiol. 2020;41(9):1740-1744. PubMed | CrossRef
42. Boetto J, Peyre M, Kalamarides M. Meningiomas from a Developmental Perspective: Exploring the Crossroads Between Meningeal Embryology and Tumorigenesis. Acta Neurochir. 2021;163(1):57-66. PubMed | CrossRef
43. Park CK, Phi JH, Park SH. Glial Tumors with Neuronal Differentiation. Neurosurg Clin N Am. 2015;26(1):117-38. PubMed | CrossRef
44. Demir MK, Yapıcıer O, Yılmaz B, Kılıç T. Magnetic Resonance Imaging Findings of Mixed Neuronal-Glial Tumors with Pathologic Correlation: A Review. Acta Neurol Belg. 2018;118(3):379-386. PubMed | CrossRef
45. Moreno A, de Felipe J, García Sola R, Navarro A, Ramón y Cajal S. Neuronal and Mixed Neuronal Glial Tumors Associated to Epilepsy. A Heterogeneous and Related Group of Tumours. Histol Histopathol. 2001;16(2):613-22. PubMed | CrossRef
46. Slegers RJ, Blumcke I. Low-grade Developmental and Epilepsy Associated Brain Tumors: A Critical Update 2020. Acta Neuropathol Commun. 2020;8(1):27. PubMed | CrossRef
47. Chen DY, Chen CC, Crawford JR, Wang SG. Tumor-Related Epilepsy: Epidemiology, Pathogenesis and Management. J Neurooncol. 2018;139(1):13-21. PubMed | CrossRef
48. Blumcke I, Budday S, Poduri A, Lal D, Kobow K, Baulac S. Neocortical Development and Epilepsy: Insights from Focal Cortical Dysplasia and Brain Tumours. Lancet Neurol. 2021;20(11):943-55. PubMed | CrossRef
49. Rubino F, Martinez-Perez R, Vieira S, Voscoboinik DS, Mural M, Orr AJ, et al. Granular Cell Tumors of The Sellar Region: What Should Be Done After Subtotal Resection? A Systematic Review. Pituitary. 2020;23(6):721-32. PubMed | CrossRef
50. Müller HL. The Diagnosis and Treatment of Craniopharyngioma. Neuroendocrinology. 2020;110(9-10):753-66. PubMed | CrossRef
51. Ntali G, Wass JA. Epidemiology, Clinical Presentation and Diagnosis of Non-Functioning Pituitary Adenomas. Pituitary. 2018;21(2):111-8. PubMed | CrossRef
52. Lopes MB. The 2017 World Health Organization Classification of Tumors of the Pituitary Gland: A Summary. Acta Neuropathol. 2017;134(4):521-35. PubMed | CrossRef


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