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PEDIATRIC ONCOLOGY Original Article

# Demographic and histopathologic profile of pediatric brain tumors: A hospital-based study

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## Abstract

**Background:** Very few hospital-based or population-based studies are published in the context to the epidemiologic profile of pediatric brain tumors (PBTs) in India and Indian subcontinent. **Aim:** To study the demographic and histopathologic profile of PBTs according to World Health Organization 2007 classification in a single tertiary health care center in India. **Materials and Methods:** Data regarding age, gender, topography, and histopathology of 76 pediatric patients (0–19 years) with brain tumors operated over a period of 24 months (January-2012 to December-2013) was collected retrospectively and analyzed using EpiInfo 7. Chi-square test and test of proportions (Z-test) were used wherever necessary. **Results:** PBTs were more common in males (55.3%) as compared to females (44.7%) with male to female ratio of 1.23:1. Mean age was 10.69 years. Frequency of tumors was higher in childhood age group (65.8%) when compared to adolescent age group (34.2%). The most common anatomical site was cerebellum (39.5%), followed by hemispheres (22.4%). Supratentorial tumors (52.6%) were predominant than infratentorial tumors (47.4%). Astrocytomas (40.8%) and embryonal tumors (29.0%) were the most common histological types almost contributing more than 2/3$^{rd}$ of all tumors. Craniopharyngiomas (11.8%) and ependymomas (6.6%) were the third and fourth most common tumors, respectively. **Conclusion:** Astrocytomas and medulloblastomas are the most common tumors among children and adolescents in our region, which needs special attention from the neurosurgical department of our institute. Demographic and histopathologic profile of cohort in the present study do not differ substantially from that found in other hospital-based and population-based studies except for slight higher frequency of craniopharyngiomas.


**Key words:** Astocytomas, cerebellum, epidemiologic profile, supratentorial tumors, World Health Organization

## Introduction

Pediatric brain tumors (PBTs) are the leading cause of cancer-related deaths in children. They account for approximately 25% of pediatric cancers. They rank second behind leukemia as the most common pediatric cancers.[1-3] Childhood tumors are a biologically different entity from tumors of adult life. They differ in topographical distribution, biological behavior, clinical presentation, histological features, prognosis and outcome from those that present in later life. In adults, metastases from extracranial malignancies, gliomas, and meningiomas are the common central nervous system (CNS) tumors, whereas in pediatric age group, astrocytomas and embryonal tumors dominate the picture.[4,5] Due to lack of resources, in this context, the adequate epidemiologic data lacks from India. Hence, we conducted this hospital-based study as a primary step toward the subject to characterize the demographic and histopathological types of brain cancers among the pediatric patients presented to us.

## Materials and Methods

This is a retrospective study and is based on the data collected from Neurosurgery Department of one of the major tertiary health care centers in India. The case summaries, histopathological records and discharge reports of all the children up to 19 years of age, were reviewed who were operated for brain tumors during the period from January 2012 to December 2013. Only patients with the proven histopathological diagnosis were included in the study. In addition to the location and histological types of the tumor, patient demographics including age and sex were also recorded. Patients with metastatic tumor, tumor-like cystic lesion (arachnoid cysts, epidermoid cysts and colloid cysts), the secondary tumor, space occupying lesion of infectious etiology and vascular malformation were excluded from the study. Furthermore, patients who were diagnosed as a case of PBT clinically and on imaging (e.g., brain stem gliomas) but not biopsied and treated by chemoradiation were also excluded from the study. All histopathological diagnoses were made according to the 2007 World Health Organization classification system.[6] Thus, with all above considerations we had a cohort of 76 pediatric patients with histopathologically proven brain tumors. We analyzed the data using EpiInfo 7 (version 3.5, CDC website, www.cdc.gov/epiinfo). Chi-square test and test of proportions (Z-test) were used wherever necessary to test for statistical significance.[7]

## Results

During the study period, 744 patients of childhood and adolescence age group (0–19 years) underwent neurosurgical procedures at Neurosurgical Department of our institute. Out of these total cases, 10.21% (76/744) patients were operated for primary PBTs. Furthermore, PBTs accounted for 16.52% (76/460) of total intracranial tumors operated.

### Age-wise and gender-wise distribution

Among these 76 cases, 42 (55.3%) were males and 34 (44.7%) were females. Male:female ratio was 1.23:1 suggesting that, PBTs were more common in males when compared to females. Their ages varied from 3 months to 19 years. Children (0–14 years) accounted for 50 cases (65.8%) with 25 (50%) males and 25 (50%) females. On the other hand, adolescents (15–19 years) accounted for 26 cases (34.2%) with 17 (65.4%) males and nine (34.6%) females. This clears that the frequency of PBTs is higher in childhood age group when compared to adolescent age group. The mean age of patients was 10.69 ± 5.67 years (95% confidence interval [CI]).

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### Location wise distribution

In the present study, the most common anatomical site for PBT was cerebellum (39.5%) followed by cerebral hemispheres (22.4%), ventricles and sellar region (13.2% each). Diencephalic region constituting optic apparatus, hypothalamus and thalamus was involved in 7.8% of patients. The distribution of PBTs according to anatomical location in the present series is shown in Figure 1.

Out of 76 PBTs, 52.6% (40/76) were supratentorial, and 47.4% (36/76) were infratentorial tumors. In children, 52% (26/50) cases had tumors in the infratentorial region, whereas 48% (24/50) had in the supratentorial region. On the other hand, in adolescents, 61.5% (16/26) tumors were supratentorial and 38.5% (10/26) were infratentorial in location. Mean age for supratentorial tumors was 11.48 ± 5.60 years (95% CI) and the mean age for infratentorial tumors was 9.67 ± 5.68 years (95% CI).

### Histopathological distribution

The most common histological entities encountered were medulloblastomas accounting for 22.4% of all PBTs, and then Grade-I astrocytomas (18.4%), Grade-II astrocytomas (14.5%), craniopharyngiomas (11.8%), ependymomas (6.6%), high-grade astrocytomas and primary neuroectodermal tumors (5.3% each). Grade-I astrocytomas included pilocytic astrocytomas (17.1%) and subependymal giant cell astrocytomas (1.3%). Grade-II astrocytomas included pleomorphic xanthoastrocytomas (2.6%), pilomyxoid astrocytomas (1.3%) and diffuse fibrillary astrocytomas (10.5%). Less common entities included anaplastic astrocytomas, nerve sheath tumors, oligodendrogliomas and choroid plexus tumors (2.6% each), whereas, meningiomas, gangliogliomas, pituitary adenomas and atypical teratoid/rhabdoid tumors (AT/RT) constituted rare histological entities (1.3% each). Thus, astrocytomas (40.8%) and embryonal tumors (29.0%) were the most common histological types almost contributing more than 2/3rd of all PBTs as shown in Figure 2. We did not find any case of germ cell tumor and pineal region tumor in this cohort.

The frequencies of various PBTs except few at our institute were well in a range of national and international data. Data of this study was comparable to the data of various hospital-based and population-based studies quantifying PBTs, which were carried out in different developed and developing nations.

## Discussion

Pediatric neuro-oncology has emerged as one of the fastest developing subspecialty under Neurosurgery. Now-a-days most of the neurosurgeons are taking keen interest in the management of PBTs due to their high incidence, challenging aspects of surgery and high mortality. This was the hospital-based study hence the incidence rate of PBTs could not be estimated, however, the frequency of PBTs in total pediatric neurosurgical cases was 10.2%. Most of the published literature from India is hospital-based because of inconsistent maintenance of regional cancer registries. Hence, the hospital-based data forms the basis to study the demographics, clinical and histologic profile and the outcome of PBTs. With the tremendous development in the field of radiodiagnosis and histopathology and easy availability of these services at major regional tertiary centers has possibly up-surged the incidence of brain tumors both in adults and pediatric patients in recent times.

In the present study, we retrospectively analyzed the data regarding demographics and histological profile of 76 pediatric patients operated for brain tumors at one of the major tertiary health care centers in India over a period of 24 months.

### Age and gender

Consistent with the findings of other international hospital and population-based studies on PBTs, we found the slightly higher proportion of brain tumors in males as compared to in females with male to female ratio of 1.23:1. The male to female ratio in pediatric patients varies from as low as 1.03 to as high as 2.52, with Pakistan reporting the highest ratio.[8-14] Mean age at diagnosis in our study was 10.69 years, which was bit higher than the mean age reported from Nigeria[7] (9.75 years), Morocco[8] (9.3 years), Pakistan[14] (8.8 years) and Iran[15] (8.8 years), but lower than that reported in Chinese study[12] (12.68 years). This could be attributed to the delayed presentation of cases to our referral center or to the genetic and environmental differences of the study cohort. In our study, males and females with PBT were evenly distributed among different age groups and observed differences were not statistically significant ($\chi^2$ = 5.21, df = 3, $P$ = 0.15), which was in line with the findings of other studies.[8,16,17] The frequencies of PBTs in children and adolescents were comparable to the frequencies observed in other studies, which were higher among childhood age group when compared to the adolescent age group.[17,18] Statistically, no significant gender difference was found in the distribution of cases between childhood and adolescent age groups ($Z$ = 1.30, $P$ > 0.05).

### Anatomical location

Topographically, the cerebellum was found to be the most common site for PBTs followed by cerebral hemispheres and ventricles. Medulloblastomas and most of the pilocytic astrocytomas, which comprise the major histological entities of PBTs were frequently found involving the cerebellum. These findings were in line with the results of other published data.[9,17,19] In this study, supratentorial and infratentorial tumors were evenly distributed among different age groups without a statistical significant difference ($\chi^2$ = 1.5, df = 3, $P$ = 0.67). Overall, supratentorial locations predominated slightly in the present series which complemented the data in the literature.[12,18,19] When we considered childhood age group, infratentorial tumors were bit predominant whereas, in adolescent age group, supratentorial tumors were more common, which was consistent with the findings of other studies.[5,7,17,18]

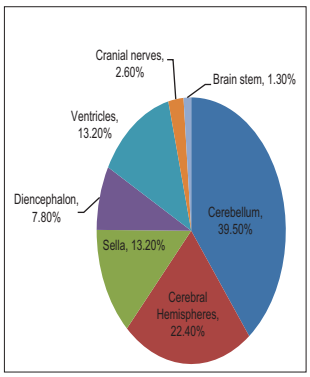


**Figure 1: Distribution of pediatric brain tumors according to anatomical location**

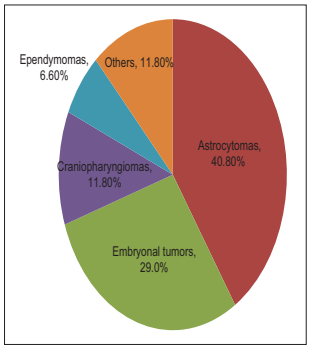


**Figure 2: Distribution of major histological types of pediatric brain tumors**

However, statistically, we could not find any significant difference in the distribution of supratentorial and infratentorial tumors among children and adolescents ($Z = 1.13$, $P > 0.05$). However, the actual frequency of infratentorial tumors may be slightly higher than shown in the present study because the majority of the brain stem tumors were not biopsied.

### Histopathology

In the present study, medulloblastoma was the single most common histological entity, followed by pilocytic astrocytomas (Grade-I) and Grade-II astrocytomas. However, overall, astrocytomas were the most common tumors followed by embryonal tumors including medulloblastomas, supratentorial PNETs, and AT/RT. Astrocytomas and embryonal tumors almost constituted more than 2/3rd of all PBTs in the study population. Craniopharyngiomas appeared to be the third most common tumor in our series which contradicted the results of major international studies,[8,9,16-18] but was in line with the multi-institutional study carried out in India.[4] Ependymomas followed next to craniopharyngiomas accounting for the fourth most common histological type in the study complementing the findings from Indian,[4] Brazilian[19] and Korean studies.[20] In most of the published literature, ependymomas were third most common tumors.[8,9,19] Both observations suggest intra-regional differences in the epidemiology of PBTs. Some studies with an upper age limit of 14 years had reported a preponderance of medulloblastoma in their series[5,14] whereas studies, which reported astrocytomas as the most common tumors mostly had upper age limit up to 20 years. In our series, we too had a predominance of astrocytomas, which was in line with the published studies with a similar age limit.[8,17-19] In the present study, we did not find a single case of germ cell tumor, but it constituted a major histological entity from other Asian countries suggesting the environmental factors and genetic differences to play a role in the cause of PBTs.[10,12,20] We could find very few cases of intracranial nerve sheath tumors and meningiomas, which form the predominant entities in adulthood.

Though this was a hospital-based study with small cohort and data collection was restricted to short duration, results were comparable to those observed in other mentioned hospital-based and population-based studies. The current study is a single tertiary care center study and needs cautious interpretation. The population-based studies are required to study the demographics and determine the burden of CNS malignancies among the pediatric patients in India. This is only possible if regional cancer registries are maintained meticulously, which is quite difficult in developing countries like India where doctors in such major referral institutes are overworked. Hence, such hospital-based studies have a major role to play in estimating the disease load in a particular geographical region and subsequent planning of healthcare infrastructure toward the disease.

## Conclusion

From the present series, we conclude that, the frequencies of major histologic types of PBTs found in the study do not differ substantially from that found in other developed and developing countries except for slight higher frequency of craniopharyngiomas. Medulloblastomas and astrocytomas, which form the major histologic types in pediatric patients need special attention. Epidemiological surveillance of various histological types of PBTs is of great importance from public health perspective. It helps in planning the distribution of infrastructure and resources toward the disease management and preventive programs. In countries like India where there is a scarcity of data because of inadequacies in tumor registration, such hospital-based studies have a major role to play in such planning.

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### Conflicts of interest

There are no conflicts of interest.

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