Epidemiological, Clinical, and Pathological Analysis of Children with Central Nervous System Neoplasms Treated with Radiotherapy at the National Cancer Institute

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Análise Epidemiológica, Clínica e Patológica de Crianças com Neoplasias do Sistema Nervoso Central Tratadas com Radioterapia no Instituto Nacional de Câncer

Análisis Epidemiológico, Clínico y Patológico de Niños con Neoplasias del Sistema Nervioso Central Tratados con Radioterapia en el Instituto Nacional de Cáncer

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ABSTRACT

Introduction: Central nervous system neoplasms account for 21% of pediatric cancer cases and are the leading cause of death in this population in developed countries. Advances in neuroimaging have improved diagnosis, and combination therapies have ensured the cure with greater neurological preservation. Surgery is the primary treatment, often combined with radiation therapy and chemotherapy. **Objective:** To describe socioeconomic findings, signs and symptoms, and histological aspects of pediatric brain tumors treated with radiation therapy. **Method:** A cross-sectional and descriptive study was conducted with 257 children and adolescents utilizing medical records with central nervous system neoplasms treated with radiotherapy at the National Cancer Institute, Rio de Janeiro, from 2012 to 2020. The variables were divided into sociodemographic, clinical, and pathological categories. **Results:** White male children were the most prevalent, with a median age at diagnosis of 7.5 years and at radiotherapy, of 8.0 years. The majority lived in their own home with basic infrastructure and family income of up to one minimum wage. The most common symptoms were headache, vomiting, and gait disorders, varying according to tumor location and child's age. Radiation therapy was used in 64% of patients, mainly for medulloblastoma, brainstem tumors, and anaplastic ependymoma. **Conclusion:** Specific studies on children and adolescents with brain neoplasms treated with radiotherapy are rare in the literature. When compared with the general population, they present similar sociodemographic and clinical profiles, with remarkable differences only in the frequency of tumor types.

Key words: neoplasms; child; cerebrum; radiotherapy.

RESUMO

Introdução: As neoplasias de sistema nervoso central representam 21% do câncer infantojuvenil, sendo a principal causa de morte nessa população em países desenvolvidos. Avanços na neuroimagem têm melhorado seu diagnóstico, e a combinação de terapias tem permitido a cura, com maior preservação neurológica. A cirurgia é o principal tratamento, frequentemente combinada com radioterapia e quimioterapia. **Objetivo:** Descrever achados socioeconômicos, sinais e sintomas, e aspectos histológicos dos tumores cerebrais pediátricos, tratados com radioterapia. **Método:** Estudo transversal e descritivo, utilizando prontuários de 257 crianças e adolescentes portadores de neoplasias de sistema nervoso central, tratados com radioterapia no Instituto Nacional de Câncer, no Rio de Janeiro, de 2012 a 2020. As variáveis foram divididas em sociodemográficas, clínicas e patológicas. **Resultados:** Crianças brancas do sexo masculino foram as mais prevalentes, com mediana de idade de 7,5 anos no diagnóstico e de 8,0 anos na radioterapia. A maioria possuía casa própria com infraestrutura básica e renda familiar de até um salário-mínimo. Os sintomas mais comuns foram cefaleia, vômitos e alterações na marcha, variando de acordo com a localização do tumor e a idade da criança. A radioterapia foi utilizada em 64% dos pacientes, principalmente para meduloblastoma, tumores de tronco cerebral e ependimoma anaplásico. **Conclusão:** Estudos específicos sobre crianças e adolescentes com neoplasias cerebrais tratados com radioterapia são raros na literatura. Quando comparados com a população em geral, apresentam perfis sociodemográficos e clínicos semelhantes, com diferenças notáveis apenas na frequência dos tipos tumorais.

Palavras-chave: neoplasias; criança; cérebro; radioterapia.

RESUMEN

Introducción: Las neoplasias del sistema nervioso central representan el 21% del cáncer infantil y juvenil, siendo la principal causa de muerte en esta población en países desarrollados. Los avances en neuroimagen han mejorado su diagnóstico y la combinación de terapias viene permitiendo la cura, con una mayor preservación neurológica. La cirugía es el tratamiento principal, a menudo combinada con radioterapia y quimioterapia. **Objetivo:** Describir los hallazgos socioeconómicos, los signos y síntomas, y los aspectos histológicos de los tumores cerebrales pediátricos tratados con radioterapia. **Método:** Estudio transversal y descriptivo utilizando las historias clínicas de 257 niños y adolescentes con neoplasias del sistema nervioso central, que fueron tratados con radioterapia en el Instituto Nacional del Cáncer en Río de Janeiro entre 2012 y 2020. Las variables se dividieron en sociodemográficas, clínicas y patológicas. **Resultado:** Los niños blancos y de sexo masculino fueron los más prevalentes, con una mediana de edad de 7,5 años en el momento del diagnóstico y de 8,0 años en el momento de la radioterapia. La mayoría poseía una vivienda propia con infraestructura básica y un ingreso familiar de hasta un salario mínimo. Los síntomas más comunes fueron dolor de cabeza, vómitos y alteraciones en la marcha, que variaban según la ubicación del tumor y la edad del niño. Se utilizó radioterapia en el 64% de los pacientes, principalmente para meduloblastoma, tumores del tronco cerebral y ependimoma anaplásico. **Conclusión:** Los estudios específicos sobre niños y adolescentes con neoplasias cerebrales tratados con radioterapia son raros en la literatura. Cuando se comparan con la población en general, presentan perfiles sociodemográficos y clínicos similares, con diferencias notables solo en la frecuencia de los tipos tumorales.

Palabras clave: neoplasias; niño; cerebro; radioterapia.

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INTRODUCTION

Neoplasms of the central nervous system (SNC) are solid tumors most common in childhood and the main cause of death attributed by cancer for this age range. The incidence is approximately 5.65 per 100 thousand children between 0 and 14 years and 6.19 per 100 thousand adolescents from 15 to 19 years[1]. In 2023 in USA, 5,260 new cases of malignant and non-malignant brain tumors between 0 and 19 years of age are estimated[2]. In Brazil, according to the estimates of the National Cancer Institute (INCA), 7,930 new cases of childhood and adolescent cancer are anticipated for each year of the triennium 2023-2025, being 4,230 in males and 3,700 in females and the incidence depends on the country region, most common in the South and Southeast regions. CNS neoplasms contribute with nearly 19% to 27% of the neoplasms in the most developed countries[3].

Despite neuroimaging, molecular biology and genetics advances had fostered earlier diagnosis and patient-centered treatment[3], CNS neoplasms are one of the main causes of childhood death in developed countries[4]. The etiology of these tumors is poorly understood and, contrary to adults', environmental and behavioral factors do not have as much importance as genetics'. Many syndromes like Li-Fraumeni, neurofibromatosis types 1 and 2, tuberous sclerosis and Von-Hippel Lindau[5,6] have been associated.

Identify risk factors can be difficult and those well-established are restricted to the exposure to ionizing radiation and certain syndromes. There are evidences of positive associations with parent's advanced age, congenital defects, exposure to computed tomography, maternal intake of N-nitrous compounds, prenatal vitamin supplements and household exposure to pesticides[6-10].

Brain tumors are heterogeneous with incidence depending on age, sex and ethnicity. According to the Central Brain Tumor Registry of the United States - CBTRUS[2] for children and adolescents diagnosed between 2015 and 2019, the tumors are more frequent in White and female children. However, INCA's estimates[3] reveal the predominance of the disease in males: brain, cranial nerves, spinal nerves and meninges tumors, including nearly 100 histological types based in the origin cell and other pathological characteristics[2].

Intracranial tumors are more prevalent in the infratentorial region but a slight increase of incidence of tumors in the supratentorial region in up to three-years old children was found[11].

Genomics made mapping genetic profiles of pediatric brain tumors possible, starting a new era of more accurate diagnosis and targeted therapies. These molecular profiles revealed distinct tumor entities in nearly every group of pediatric brain tumors, allowing the stratification of patients' risk and the development of customized therapies. These novel insights will change the care to children with brain tumors[12,13].

The diagnosis of childhood brain tumors is quite challenging and most of the times is late due to unspecified symptoms in children as headaches, nausea, vomits, weakness or seizures that can be confounded with other more common conditions as viral infections or visual difficulties[14-16]. Older children usually present headache, especially at night and early morning together with intracranial hypertension. Nealy 20% of the children can present behavioral, visual and school issues. Due to its rarity, many health professionals may not be familiarized with early symptoms of the disease which can cause delayed diagnosis. More knowledge and awareness about the onset of these tumors in children are more than necessary[11,14,17].

Approximately 50% of the patients with cancer will submit to radiotherapy along the course of the treatment, especially CNS neoplasms[18]. Radiotherapy is often indicated as adjuvant treatment but can be utilized exclusively in inoperable tumors or combined with chemotherapy[18].

There are scarce data about socioeconomic, demographic and clinical characteristics of children with CNS neoplasms treated with radiotherapy who are often enrolled in studies addressing every modality of treatment in Brazil.

The present study can expand the radio-oncologist's knowledge about the disease and contribute to the development of children and their families centered health strategies to improve the prognostic and quality-of-life. The objectives are to describe the main socioeconomic findings and identify most frequent signs and symptoms and determine the histological characteristics of brain tumors in children and adolescents treated with radiotherapy as part of the treatment.

METHOD

Retrospective and observational study with pediatric patients with CNS neoplasms treated at INCA with radiotherapy from January 2012 to December 2020. INCA is a reference of cancer treatment in Rio de Janeiro, RJ, Brazil both for adults and children and is part of SUS' (National Health System) high complexity network.

According to INCA's Hospital-Based Cancer Registries (HBCR)[19], 403 children were enrolled with diagnosis of CNS neoplasm at the Pediatric Oncology Service, 257 of which were referred for radiotherapy treatment (63.8%).

Among them, 209 (81.6%) were submitted to surgery and 144 (56%) to chemotherapy, and most of them (n=135; 52.5%) received trimodal treatment, a combination of surgery, radiotherapy and chemotherapy.

The inclusion criteria were diagnosis of CNS neoplasm in children hospitalized at INCA or referred from other private or public oncology services of Rio de Janeiro or elsewhere. The exclusion criteria were patients older than 18 years of age consulted at INCA Pediatric Oncology Service and unavailable charts for any reason.

Cases of 257 children with CNS neoplasms treated with radiotherapy sequentially were analyzed, comprehending all the treatments conducted at the Radiotherapy Service in the period.

One of the authors migrated the data to a spreadsheet and the final database was analyzed by another investigator for consistency and/or missing data. Corrective measures as imputation or other methods for possible conformities of the variables analyzed were not utilized.

The variables were divided in sociodemographic – referral hospital, neighborhood, municipality, Federative Unit, age at diagnosis (stratified in months and age ranges), age at radiotherapy, sex, race, weight, height, education level of the child and parents, housing conditions, type of transportation to the hospital, family income –, clinic – associated diseases, main complaint, CNS-related tumor site, presence of leptomeningeal and/or liquoral spread at the diagnosis – pathological: histopathological diagnosis.

The posterior fossa is formed by the brainstem, cerebellum and fourth ventricle. As brainstem tumors are uniformly aggressive with high lethality they are usually evaluated separately. Tumors of the posterior fossa were represented by those located at the cerebellum or fourth ventricle.

The tumors were collected by histological types and grouped according to the WHO – World Health Organization classification of CNS tumors of 2016[20]. The WHO classification was utilized as reference for the present study because INCA does not perform the molecular analysis of CNS tumors on a regular base.

The variables related to the socioeconomic profile had the highest number of missed data at the charts: own home (n=33; 16.3%), piped water (n=31; 15.3%), sewage (n=34; 16.7%), electric light supply (n=29; 14.3%), type of transportation to the hospital (n=39; 19.2%), parent's level of education (mother, n=75; 36.9% and father, n=104; 51.2%) and family income (n=37; 18.2%).

The qualitative variables were expressed in absolute and relative values. Multiple response analyzes were adopted for the main complaint because it offers more than one response option for each patient. The cross-reference table was utilized for the study of age range in relation to symptomatology. The quantitative variables were expressed as absolute values, means, median, minimum, maximum, confidence interval (CI) and standard deviation (SD) and Kolmogorov-Smirnov test for normality to define whether parametric tests should be used.

Based in the generalized linear model, the association between age at diagnosis in months (dependent variable), location of the tumor and 2016 WHO's classification of histological types was investigated utilizing the Bonferroni *post-hoc* test. The value of $p < 0.05$ was utilized as reference in addition to the software IBM SPSS Statistics for Windows® version 24.0[21].

INCA's Institutional Review Board (IRB) approved the study, report number 2622404 (CAAE (submission for ethical review): 83601618.2.0000.5274), in compliance with ethical guidelines for studies with human beings of Resolution 466/12[22] of the National Health Council.

RESULTS

White (n=130; 50.6%) males (n=150; 58.4%) were prevalent in the sample of 257 patients, with low frequency of brain tumors in Black children (n=15; 5.8%). The mean weight was 31.48 kg (CI 95%: 29.11-33.83; median: 26.00; SD: 17.55; min: 5.10; max: 107.50) and height, 127.80 cm (CI 95%: 124.07-131.52; median: 124.30; SD: 27.70; min: 40.50; max: 191.00), both variables with non-normal distribution. Most of the cases (n=135; 52.5%) was diagnosed between four and ten years of age with only 17.9% occurring before three years old. The median of age at radiotherapy was 97.00 months (mean: 109.12 months, CI 95%: 102.18-116.05; SD: 56.47; min: 17.00; max: 336.00), with predominance of children between four and ten years (n=154; 59.9%). Only 5.8% received therapy with radiation up to three years of age.

Tumors of the posterior fossa (n=97; 37.7%) were more prevalent than in brainstem (n=44; 17.1%). Sellar (n=23; 8.9%) and pineal tumors (n=17; 6.6%) were uncommon (Table 1).

Most of the children who received radiotherapy was referred to INCA by public health services (n=226; 87.9%), the main referral hospitals were "*Instituto Estadual do Cérebro Paulo Niemeyer*" (n=89; 34.6%) and "*Hospital Municipal Jesus*"(n=27; 10.5%), originally from 181 neighborhoods and 41 municipalities of Rio de Janeiro.

The majority of the families lived in their own houses (n=131; 62.7%), with piped water (n=192; 91.0%), sewage (n=193; 92.8%) and electric light (n=212; 99.5%). More than half of the mothers (70.2%) and fathers (68.2%) have completed elementary school, complete high school was more prevalent among mothers (n=50;

Table 1. Characteristics of the patients and disease

Characteristics	N (%)
Patients (total)	257 (100)
Age at diagnosis	91 months (min: 1; max: 214)
< 3 years	46 (17.9)
4 to 10 years	135 (52.5)
Older than 10 years	76 (29.6)
Age at radiotherapy	97 months (min: 17; max: 336)
< 3 years	15 (5.8)
4 to 10 years	154 (59.9)
Older than 10 years	88 (34.2)
Sex	
Male	150 (58.4)
Female	107 (41.6)
Race/ethnicity	
White	130 (50.6)
Brown	112 (43.6)
Black	15 (5.8)
Associated syndromes	
Neurofibromatosis type 1	2 (0.8)
Sturge-Weber Syndrome	1 (0.4)
Tumor Location	
Supratentorial	103 (40.1)
Infratentorial	141 (54.8)
Medullar	11 (4.3)
Localized/metastatic	
Localized	201 (78.2)
Metastatic	56 (21.8)
Liquor +	26 (10.1)
Magnetic resonance (MR) +	37 (14.4)
Both (liquor and MR)	6 (2.3)

35.5%) and incomplete elementary school was more prevalent among fathers (n=31; 28.2%). College degree was uncommon for parents (mother: n=5; 3.5%; father: n=7; 6.4%). Most of the children were in the age range from four to ten years old (n=135; 52.5%) and failed to complete elementary school (n=144; 56.0%). 75.9% of the families utilized public transportation to reach the hospital and more than half of the families (n=122; 58.9%) claimed they earned up to one minimum wage.

Most common signs and symptoms at the diagnosis were headache and vomits and nearly half of the children presented a combination of both (n=127; 49.4%) These two symptoms were the most common in embryonal tumors (n=52/127; 41.0%) and ependymal tumors (n=28/127; 22.0%). A combination of headache and vomits was more frequent in tumors of the posterior fossa (n=71/127; 55.9%), followed by supratentorial (n=23/127; 18.1%) and pineal tumors (n=12/127; 9.4%).

For the multiple response analysis, 760 initial oncology complaints have been collected, nearly three symptoms per patient and the most prevalent were headache (22.0%), vomits (19.6%), gait disorders (8.2%), strabismus (5.8%), seizures (5.1%) and hemiparesis (4.3%) (Figure 1).

Symptomatology was related to tumor location and children's age.

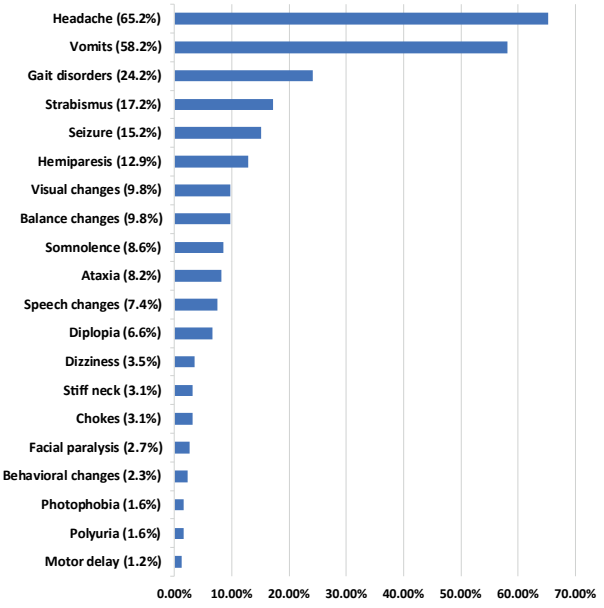

Figure 1. Initial main signs and symptoms

Headache and vomits were the most common symptoms for all intracranial sites. Gait, balance, visual disorders and ataxia were most common in tumors of the posterior fossa. Seizure, hemiparesis, gait and balance disorders and strabismus were associated with supratentorial location. For brainstem tumors, gait disorders, strabismus, hemiparesis and choke were the most frequent. Pain, hemiparesis and loss of strength were associated with medullar tumors. Initial signs and symptoms were most evident in children between four and ten years of age, with predominance of headache and vomits for all age ranges. For children below three years of age, the main symptoms were vomits, headache, gait disorder, seizure, strabismus, ataxia, somnolence and balance change in order of frequency. Headache, vomits, gait disorder, strabismus, seizure, speech and visual changes were more predominant in four to ten years old children. For older than 10 years, headache, vomits, hemiparesis, visual change, seizure and gait change.

According to WHO classification[17], 30 different childhood histology of CNS neoplasms were identified and grouped (Figure 2).

Males were predominant in almost all groups of tumors, except meningeal, craniopharyngiomas, and mesenchymal tumors. No difference was found related to sex for pilocytic astrocytoma.

Embryonal tumors were the most frequent followed by ependymal tumors. The most common histological type among embryonal tumors was medulloblastoma (88.2%). For ependymal tumors, those with high indication for radiotherapy were anaplastic ependymoma (61.5%) and grade II (34.6%). Pure germinoma were the most frequent among germ cell tumors (60%) and brainstem tumors were most frequent of the group other glioma (14.0%). Tumors were analyzed according to their histological types (Table 2).

The most frequent tumors of the posterior fossa are embryonal-derived (62.8%) and the most common histological type is medulloblastoma (61.8%). Among ependymal-derived tumors (31.9%), anaplastic ependymoma (17.5%) and grade II (14.4%) were the most prevalent. The predominant histological types in the supratentorial region were anaplastic ependymoma (22.2%) and high-grade glioma (15.8%). Among the 44 brainstem tumors, most of them (81.8%) was diagnosed through imaging tests and the most common histological type was anaplastic astrocytoma (4.5%) for those submitted to biopsy.

Children with germ cell and glioneuronal tumors had the highest means of age at diagnosis (142 months and 140 months, respectively) while younger children at the diagnosis presented pilocytic astrocytoma (53 months) and ependymal tumors (77 months).

According to 2016 WHO classification of different histological types, it was noticed a significant difference of age at diagnosis (in months, dependent variable) between the mean age at diagnosis for pilocytic astrocytoma and the mean of glioneuronal tumors ($p = 0.035$), high-grade glioma ($p = 0.002$) and glioneuronal tumors ($p = 0.004$). Unique cranial nerve tumors (age, 164 months) and mesenchymal tumors (age: one month) were excluded from this analysis.

Posterior fossa was predominant in up to ten years old children and the supratentorial region predominated from 11 years onward while analyzing tumor location according to the age range (Table 3).

No significant difference among the mean ages at diagnosis regarding tumor location was found, the lowest means were in the brainstem (87.11 months) and posterior fossa (89.44 months) and the highest for tumors located in the spinal cord (130.64 months) and pineal (126.82 months).

The highest means of age at diagnosis were in children with spinal nerves and germ cell tumors and the lowest in ependymal and pineal tumors.

For histological types analyzes, children with rhabdoid-teratoid, anaplastic ependymoma, malignant papillary glioneuronal tumors, pineoblastoma and brainstem tumors were diagnosed at younger age at radiotherapy.

Leptomeningeal spread was noticed in 21.8% of the cases and the main tumors diagnosed by resonance of the neuroaxis were medulloblastoma and anaplastic ependymoma. Medulloblastoma and pure germinoma were diagnosed by oncotic cytology of liquor. Mixed germinoma and medulloblastoma presented both dissemination pattern.

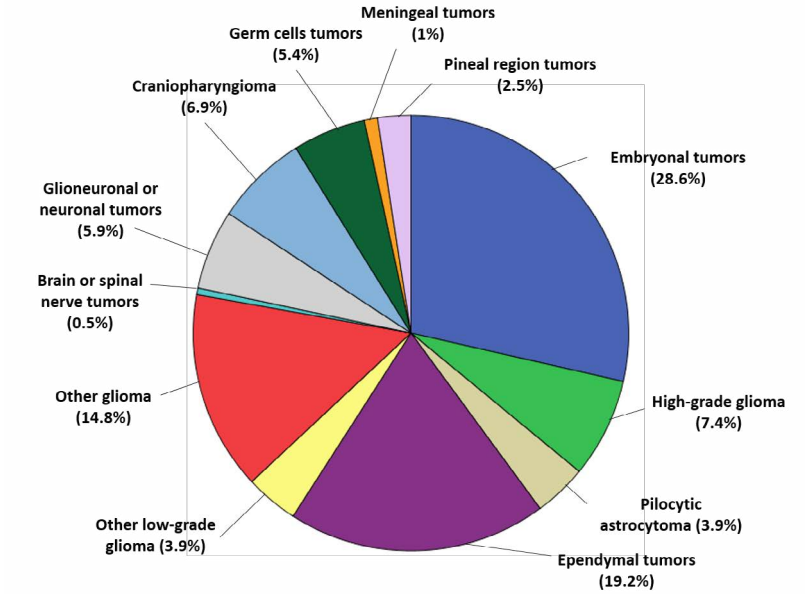

Figure 2. CNS tumors treated with radiotherapy according to 2016 WHO classification

Table 2. Histological types and main location

	n (%)	Location (%)
Medulloblastoma	60 (23.3%)	Posterior fossa (100.0%)
Brainstem without biopsy	36 (14.0%)	Brainstem (100.0%)
Anaplastic Ependymoma	32 (12.5%)	Posterior fossa (53.1%)
High-grade glioma	20 (7.8%)	Supratentorial (71.4%)
Grade II Ependymoma	18 (7.0%)	Posterior fossa (77.8%)
Craniopharyngioma	17 (6.6%)	Sellar region (94.1%)
Low-grade glioma	11 (4.3%)	Supratentorial (50%)
Pure germinoma	9 (3.5%)	Pineal (66.7%)
High-grade ganglioglioma	9 (3.5%)	Supratentorial (66.7%)
Pilocytic astrocytoma	8 (3.1%)	Supratentorial (50.0%)
Pinealoblastoma	7 (2.7%)	Pineal (100.0%)
Mixed germinoma	6 (2.3%)	Pineal (66.7%)
Rhabdoid-teratoid tumor	5 (1.9%)	Supratentorial (80.0%)
Low-grade ganglioglioma	3 (1.1%)	Supratentorial (100.0%)
Malignant papillary glioneuronal tumor	2 (0.8%)	Supratentorial (100.0%)
Primitive neuroectodermal tumor	2 (0.8%)	Supratentorial (100.0%)
Meningioma	2 (0.8%)	Supratentorial (50.0%)
Ependymoblastoma	1 (0.4%)	Supratentorial (100.0%)
Myxopapillary ependymoma	1 (0.4%)	Spinal cord (100.0%)
Other	8 (3.1%)	

Table 3. Tumor location according to the age range at diagnosis

	Pineal	Supratentorial Region	Posterior fossa	Brainstem	Sellar region	Spinal cord	Meningis	Optic pathway	Total
< 3 years	1 2.2%	11 23.9%	24 52.2%	6 13.0%	3 6.5%	1 2.2%	0 0.0%	0 0.0%	46
4 to 10 years	9 6.7%	27 20.0%	52 38.5%	29 21.5%	12 8.9%	5 3.7%	0 0.0%	1 0.7%	135
> 10 years	7 9.2%	25 32.9%	21 27.6%	9 11.8%	8 10.5%	5 6.6%	1 1.3%	0 0.0%	76
Total	17 6.6%	63 24.5%	97 37.7%	44 17.1%	23 8.9%	11 4.3%	1 0.4%	1 0.4%	257

DISCUSSION

A recent study carried out by INCA showed that radiotherapy is part of the multidisciplinary treatment of childhood cancer in 43% of the cases[23] and this result increased to 64% in CNS tumors.

According to Khanolkar et al.[24], high socioeconomic position is strongly associated with the risk of children developing CNS tumors than those at lower socioeconomic levels[22]. Because all the patients were treated at a SUS oncology reference center with similar sociodemographic profiles it was not possible to confirm this trend.

Diagnosis can be difficult to reach because the clinical presentation of childhood brain neoplasms are heterogeneous with initial unspecified symptoms that can be common to more prevalent benign neoplasms. Wilne et al.[25], in a review of 200 cases of these tumors identified headache, vomits, visual difficulties, behavioral disorders and seizures in order of frequency as the most common symptoms[23], similar to the present study whose most prevalent signs and symptoms were headache, vomits, gait disorder, strabismus and seizure.

These clinical conditions may vary according to the tumor location, histological type and age of the child. In

2010, these same authors issued a guideline to help health professionals to evaluate children with suspicion of brain tumors associating the main signs and symptoms with tumor location[26]. The main symptoms in descending order in the supratentorial region were seizures, papilledema, focal neurologic signs, headache and vomits.

The children investigated in the present study presented headache, vomits, seizures, hemiparesis and gait disorder. For the posterior fossa, vomits, headache, motor coordination changes and papilledema were found by Wilne et. al.[26] and vomits, headache, gait, balance and sight disorders in the current analysis.

For brainstem tumors, the symptoms related were motor coordination changes, paralysis of cranial pairs, pyramidal signs, headache and facial paralysis and the symptoms found were gait disorder, headache, strabismus, vomits and speech changes. The results herein were similar to the guideline with similarity of symptoms but at different frequency.

Thirty histological types of CNS tumors in children who received radiotherapy were identified among more than 100 types known. According to CBTRUS[2], the most common tumors in 0-14 years children are pilocytic astrocytoma, embryonal tumors, low-grade and high-grade glioma and ependymal tumors. However, for children treated with radiotherapy, the most common were embryonal, ependymal and brainstem tumors. As pilocytic astrocytoma are indolent with good response to surgery and/or chemotherapy they were not treated with radiotherapy.

As described by Pollack et al.[1], CNS tumors were more frequent in the posterior fossa, mainly embryonal and ependymal tumors, however, for older than 10 years old children, supratentorial tumors were predominant.

According to INCA[3] estimates published in 2023, these tumors were more prevalent in 4-7 years old White male children[3,27-29]. Most of the cases occurred in children younger than 10 years old as described in two Brazilian epidemiological studies carried out in the States of Piauí and Tocantins[30,31].

Many genetic syndromes have been associated with high risk of brain tumors, the most frequent is neurofibromatosis type 1 (NF-1) with prevalence of nearly one case per three thousand individuals associated with increased risk of glioma, but the current investigation found only two cases of low-grade NF-1. It was also identified one case of a child with medulloblastoma with Sturge-Weber syndrome.

CONCLUSION

CNS neoplasms encompass tumors with different histological characteristics and behavior. Their incidence can be influenced by genetic and environmental factors, which makes epidemiology of these tumors complex. The clinical and epidemiological profile of children receiving radiotherapy is similar to the general profile of the childhood population affected by brain tumors, except for the prevalence related to histological types.

Despite its low incidence, these tumors may have a significant impact on children's quality-of-life and their families. Epidemiological studies play a key role in improving prevention, diagnosis and treatment, in addition to contributing to expand the awareness of the population and primary attention physicians about this disease.

It is important to consider the CNS tumors separately while preparing the differential diagnosis of 4-10 years old children with good socioeconomic conditions, especially glioma and embryonal-derived tumors.

CONTRIBUTIONS

All the authors contributed substantially to the study design, acquisition, analysis and interpretation of the data, wording and critical review. They approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interests to declare.

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None.

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