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ORIGINAL ARTICLE

# Central Nervous System Pathology in Children: A Single-Institution Experience in South-South Nigeria

## *Pathologie du Système Nerveux Central chez l'Enfant : L'expérience d'une Seule Institution dans le Sud-Sud du Nigeria*

**M. O. Udoh**

**ABSTRACT**

**BACKGROUND:** Neuropathology is fundamental to neurology, neurosurgery, and neuroscience practice in general. In parts of Nigeria and other sub-Saharan African countries, Neuropathology is just emerging, and more so Paediatric Neuropathology. Paediatric Neuropathology encompasses diseases of brain, spinal cord, nerves and muscle, affecting infants, children and adolescents, many of which are surgically managed or biopsied for diagnosis.

**AIM:** To determine the pattern of neurosurgical lesions in children diagnosed in Benin-City, Nigeria.

**METHODS:** a retrospective database study of biopsies from paediatric patients with neurosurgical lesions histologically evaluated at the Department of Pathology, University of Benin Teaching Hospital, Benin-City, Nigeria, between January 2007 and December 2020 was done. Demographic and clinical data were extracted from Departmental Records; histopathological diagnoses confirmed; and data analyzed using SPSS 20.0.

**RESULTS:** A total of 178 biopsies reviewed. Ages ranged between 2 days and 16 years. Male: female ratio was 1.02:1. There were 87 spinal; 53 intracranial; 32 skull; and 9 scalp lesions. Commonest were Neural tube defects – 56.7% (mostly myelomeningoceles); Intracranial neoplasms – 20.22% (mostly pilocytic astrocytoma and embryonal tumors); Intracranial suppurative lesions -5.06% and dermoid/epidermoid cysts – 5.06%.

**CONCLUSION:** Most Paediatric neuropathological conditions encountered in our environment can be managed with good outcomes if correctly and promptly diagnosed. There is a need to channel resources into prevention and prenatal diagnoses of NTDs; early diagnosis and management of brain tumors and other intracranial lesions; and better management of otorhinolaryngologic and intracranial infections in children. Neuropathology training and capacity development is also needed. **WAJM 2022; 39(2): 134–139.**

**Keywords:** Africa, Brain tumor, Nigeria, Neuropathology, Paediatric Pathology.

**RÉSUMÉ**

**CONTEXTE:** La neuropathologie est fondamentale pour la neurologie, neurochirurgie et de la pratique des neurosciences en général. Dans certaines régions du Nigeria et d'autres pays d'Afrique subsaharienne, la neuropathologie est tout juste émergente, et plus encore la neuropathologie pédiatrique. La neuropathologie p»diatrique englobe les maladies du cerveau, de la moelle épinière, des nerfs et des muscles. nerfs et des muscles, qui touchent les nourrissons, les enfants et les adolescents. sont traitées chirurgicalement ou biopsiées pour le diagnostic.

**OBJECTIF:** Déterminer le profil des lésions neurochirurgicales chez des enfants diagnostiqués dans la ville de Bénin, au Nigeria.

**MÉTHODES:** Une étude rétrospective de la base de données des biopsies de patients pédiatriques présentant des lésions neurochirurgicales évaluées histologiquement au département de pathologie de l'hôpital universitaire de l'Université du Bénin, Benin-City, Nigeria, entre janvier 2007 et décembre 2020. a été réalisée. Les données démographiques et cliniques ont été extraites des dossiers du département ; les diagnostics histopathologiques ont été confirmés ; et Les données ont été analysées à l'aide du logiciel SPSS 20.0.

**RÉSULTATS:** Un total de 178 biopsies ont été examinées. Les âges variaient entre 2 jours et 16 ans. Le rapport hommes/femmes était de 1,02:1. Il y avait 87 biopsies rachis, 53 intracrâniennes, 32 crâniennes et 9 lésions du cuir chevelu. Les plus fréquentes étaient. Anomalies du tube neural - 56,7 % (principalement des myéloméningocèles). intracrâniens - 20,22 % (principalement astrocytome pilocytique et tumeurs embryonnaires) tumeurs embryonnaires); lésions suppuratives intracrâniennes -5,06% et kystes dermoïdes/ kystes épidermoïdes -5,06 %.

**CONCLUSION:** La plupart des conditions neuropathologiques pédiatriques rencontrées dans notre environnement peuvent être gérées avec de bons résultats si elles sont correctement et rapidement diagnostiquées. Il est nécessaire de canaliser ressources dans la prévention et le diagnostic prénatal des ATN, le diagnostic et la prise en charge diagnostic et la gestion précoces des tumeurs cérébrales et autres lésions intracrâniennes intracrâniennes; et une meilleure gestion des infections otorhinolaryngologiques et intracrâniennes chez les enfants. intracrâniennes chez l'enfant. La formation en neuropathologie et le sont également nécessaires. **WAJM 2022; 39(2): 134–139.**

**Mots-clés:** Afrique, Tumeur cérébrale, Nigéria, Neuropathologie, Pédiatrie. Pathologie.

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## INTRODUCTION

While infectious diseases remain major contributors to childhood morbidity and mortality in Africa, there has been a progressive decline in the burden of disease and death in African children due to infections. This situation, attributable to widespread immunization against childhood killer diseases, has resulted in increased contribution to childhood morbidity and mortality by other conditions.[1] The need for Africa to give as much attention if not more, to paediatric subspecialities, as is given to adult medicine, is evident in the fact that worldwide, Africa is the only major region whose population of young people is projected to still greatly outnumber the elderly population by the year 2050.[2] There is evidence to suggest that some attention is already being given to aspects of paediatric practice but, there appears to be more focus on some areas than others.[1,3–9]

Paediatric neuropathology practice is in its early stages in most parts of sub-Saharan Africa.[9] Many African countries lack dedicated paediatric-oncology units and pathology services, and pathologists are non-existent in some places.[9] In a survey involving 24 paediatric oncologists from 14 institutions in Nigeria, only two institutions were found to have a dedicated paediatric oncology ward. There was no population-based paediatric oncology tumor registry, no molecular diagnostic capability, nor efficient radiotherapy support service, and most centers struggle with inadequate blood and blood product support. It is evident that paediatric oncology services in Nigeria are still grappling with weak human capital, poorly developed infrastructure, weak regional and national referral systems, and poor support services.[6] Many pathology laboratories in Nigeria are run by a single pathologist who may not have specialist training in the diagnosis of paediatric conditions. Although outstanding paediatric diagnostic centers with state-of-the-art facilities and highly qualified diagnosticians exist, they are in the minority and are mostly limited to larger centers.[9]

Paediatric neuropathology is even more handicapped than its 'parent specialties', by lack of adequate infrastructure, material resources and personnel. A search of works done in the field of paediatric neuropathology in Nigeria revealed a number of publications on aspects of neuropathology, mostly paediatric neuro-oncology.[1,3–9] A 2016 publication by Olasode and Onyia, addressed broadly paediatric neuropathology practice based on experience at a tertiary center in Ile-Ife, South-western Nigeria, giving an overview of neuropathology as seen in paediatric surgical lesions as well as the state of neuropathology service in the region. According to Olasode and Onyia, paediatric neuropathology in particular, has limited access to resources and few opportunities for professional advancement in Nigeria and Africa in general.[9]

This is a retrospective study of paediatric neurosurgical conditions seen and histologically analyzed at University of Benin Teaching Hospital, Edo state, Nigeria over a 14-year period. We describe patterns observed and highlight common paediatric neuropathologic lesions seen in the Nigerian south-south region. The significance of our findings in the light of previous work done in the Nigerian population and the state of neuropathology services in the country and patterns described elsewhere are discussed.

## MATERIALS AND METHODS

A retrospective study of all paediatric neurosurgical conditions histologically evaluated and diagnosed at the histopathology department of the University of Benin teaching Hospital, Edo State, Nigeria over a 14-year period (January 2007 and December 2020). Demographic and clinical data on all lesions excised from neurosurgery patients between 1–16 years of age, were retrieved from departmental records. The data retrieved include age, gender, histological diagnosis. All diagnoses were made from haematoxylin and eosin stained, 3–5µm sections, of formalin fixed and paraffin embedded samples of tissue specimen. Additional special histochemical and immunohistochemical stains were employed where needed. All retrieved data was reviewed, and some cases reclassified where necessary. Tumours were classified using the 2007 WHO Classification of Tumours of the Central Nervous System, and in later years the 2016 classification of CNS tumors; though extent was at times limited by the non-availability of some immunohistochemical stains. All data obtained was entered into the Statistical Programme for Social Sciences, version 20 (SPSS Inc, IL, USA) and analyzed and our observations compared with findings documented in the literature. Confidentiality of the identity of the patients and personal health information was maintained.

## RESULTS

A total of 178 biopsies from paediatric neurosurgery patients were submitted for histologic examination during the period under review. The total number of surgical specimens received in the department within the same period was 40,470. Paediatric Neuropathology Surgical specimens therefore represent 0.45% of surgical specimen received. The 178 lesions evaluated were made up of 84 spinal/paraspinal lesions, 53 intracranial lesions, 32 skull lesions and 9 scalp lesions.

The average number of biopsies per year was 12.7. The lowest number of biopsies (2 cases) was seen in 2007, and highest (22 cases) in 2017. There were 90 males and 88 females giving an approximate male-female ratio of 1:1. The age range of patients was between 2 days and 16 years, and mean age was 3.85 ± 0.39 (5.20) years. Half of cases seen (50.56%) were in the first year of life (Figure 1) and majority of these (76.67%) were less than 6 months of age. These were mostly patients with Neural Tube Defects (NTDs).

Neural Tube Defects (NTDs) constitute 56.7% (101) of all lesions in this series. There were 50 males and 51 females, giving an approximate Male-female ratio of 1:1 for all NTDs. Spinal dysraphism were commoner in males, while encephaloceles were commoner in females with male-female ratios of 1.3:1 and 1:2.25 respectively. Greater than 80% of spinal dysraphism, and 77% of encephaloceles presented before their first birthday, majority of these before 6 months of age. The mean ages for spinal

dysraphism and encephalocele were 1year and 1year 7 months respectively.

Spinal dysraphism was the commonest lesion making up 42.13% of all lesions and 89.3% of spine lesions. Of these, myelomeningoceles made up 78.67%, followed by meningoceles (16%). Likewise, encephaloceles (26) made up 14.61% of all lesions and 81.25% of skull lesions, 69.23% of which were occipital encephaloceles (Table 1).

Intracranial lesions (53) made up 29.78% of all lesions seen. Of these, 67.9% (36) were neoplasms, making up 20.22% of all lesions seen. There were 16 males and 20 females. The ages of children with intracranial neoplasms ranged from 15months to 16 years. Mean age was 8.38 ± 5.5 years. Astrocytic tumors in general made up 41.67% of intracranial tumors. Pilocytic astrocytoma was the commonest tumor making up 25% of intracranial neoplasms seen. Next were embryonal tumors (mostly medullo-blastoma) making up 16.67% (Table 2). At least 50% of tumors were located in the posterior fossa, 16.7% were sellar/ suprasellar, 8.3% were parietal, and 5.6% frontal. In 19.4% of cases, location was uncertain. Low grade lesions (WHO grades I and II) constituted 63.9% of intracranial neoplasms in children while, 36.1% were high grade/malignant lesions.

In combination with spinal/ paraspinal tumors, neoplasms constituted 22.47% of all lesions seen. Other intracranial non-neoplastic lesions are as displayed (Table 1). These were predominantly suppurative lesions (abscesses, subdural empyema), haematoma evacuations, and intracranial cysts. The single most common etiology for intracranial suppurative lesions in this review was chronic frontoethmoidal sinusitis. Intracranial cysts seen included two (2) epidermoid cysts and one (1) ependymal cyst, all in the posterior fossa.

Lesions besides NTDs and intracranial lesions, like fibro-osseous lesions of the skull; spinal/ paraspinal tumors; and scalp lesions, predominantly sub-galeal dermoid/epidermoid cysts, are as displayed (Table 1). Anterior fontanelle dermoid/ epidermoid cysts constituted 77.8% (7 of 9) of our scalp lesions. There were five (5) epidermoid and two (2) dermoid cysts seen in four (4) female and three (3) male patients. Two (2) intracranial epidermoid cysts seen, were also in females, making a total of 9 dermoid/ epidermoid cysts in this series.

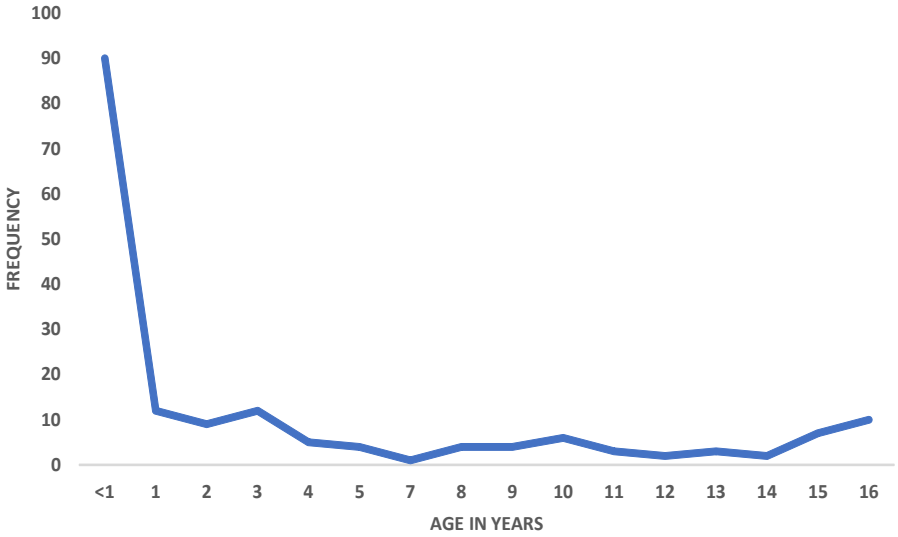


**Fig. 1: Age Frequency Chart.**

**Table 1: Summary of all Histologically Evaluated Paediatric Neurosurgical Lesions**

| Site | Diagnoses | Frequency (%) |
|---|---|---|
| Intracranial lesions | Neoplasms | 36 (20.22) |
| | Acute/chronic suppurative lesions | 9 (5.06) |
| | Hematoma evacuations | 4 (2.25) |
| | Cysts | 3 (1.69) |
| | Post-meningitis meningeal fibrosis | 1 (0.56) |
| Skull lesions | Encephaloceles | 26 (14.61) |
| | • Occipital (18) | |
| | • Frontal (8) | |
| | Fibro-osseous lesions | 4 (2.25) |
| | • Fibrous dysplasia (3) | |
| | • Ossifying fibroma (1) | |
| | Osteomyelitis (mastoiditis) | 2 (1.12) |
| Scalp | Benign neoplasms and epithelial cysts | |
| | • Lipoma (1) | |
| | • Seborrheic keratosis (1) | |
| | • Epidermoid cysts (5) | |
| | • Dermoid cysts (2) | 9 (5.06) |
| Spinal lesions | Spinal dysraphism | |
| | • Myelomeningocele (59) | 75 (42.13) |
| | • Meningocele (12) | |
| | • Lipo-myelomeningocele (1) | |
| | • Myelocele (3) | |
| | Laminotomy/Laminectomy specimens | 5 (2.81) |
| | Spinal/paraspinal tumors | 4 (2.25) |
| | • Neurofibroma (2) | |
| | • Teratoma (2) | |
| | | 178 (100) |

## DISCUSSION

Congenital malformations of the central nervous system have been found to be second only to malformations of the gastrointestinal system.[10] Neural

**Table 2: Intracranial Neoplasms**

| Tumor Class | Diagnoses and Who Grades | Frequency (%) |
|---|---|---|
| Diffuse astrocytic and oligodendroglial tumors | Diffuse astrocytoma NOS WHO grade II (1)<br>Glioblastoma NOS WHO grade IV (2)<br>Oligodendroglioma NOS WHO grade II (1) | 4 (11.11) |
| Other astrocytic tumors | Pilocytic astrocytoma WHO grade I (9)<br>Pilomyxoid astrocytoma WHO grade II (1)<br>Anaplastic pleomorphic xanthoastrocytoma WHO grade III (1) | 11 (30.56) |
| Ependymal tumors | Ependymoma WHO grade II (2)<br>Anaplastic ependymoma WHO grade III (2) | 4 (11.11) |
| Embryonal tumors | Medulloblastoma WHO grade IV (4)<br>Primitive neuroectodermal tumor (WHO 2007) grade IV (1) | 6 (16.67) |
| Tumors of cranial and paraspinal nerves | Schwannoma | 1 (2.78) |
| Meningiomas | Meningioma WHO grades I | 4 (11.11 |
| Germ cell tumors | Teratoma | 2 (5.56) |
| Tumors of the sellar region | Craniopharyngioma WHO grade I | 3 (8.33) |
| Metastatic tumors | Extradural extension of Intra-orbital embryonal rhabdomyosarcoma | 1 (2.78) |
| | | 36 (100) |

Tube Defects (NTDs) constitute 56.7% of all lesions in this series. Spinal dysraphism were the most common (42.13%) especially myelomeningoceles and meningoceles, followed by encephaloceles (14.61%). In their review of Paediatric Neuropathology cases in Ile-Ife, Olasode and Onyia found NTDs to be very common, myelomeningoceles being the most common.[9] In Lagos, Bankole, *et al* found that meningo-myelocele accounted for 96% of the cases in their review of one hundred and eight (108) patients with congenital midline swellings of the back, and spina bifida was the commonest indication for neurosurgical clinic referral apart dam of trauma.[11]

Anyawu, *et al* in their study of 1456 neonates recorded a birth prevalence of NTDs of 2.75/1000 live births in Northwestern Nigeria.[12] Nnadi, *et al* also found a prevalence of 2.2/1000 live births.[13] A systematic review and meta-analysis of forty-three studies on NTDs in Africa, by Oumer, *et al,* with a total of 6,086,384 participants found the pooled birth prevalence of NTDs in Africa to be 21.42 per 10,000 births. This is rather high. Nigeria was found to have an even higher pooled birth prevalence of 32.77 per 10,000 births.[14]

Amongst patients with NTDs male-female ratio was 1:1, similar to the finding of some authors,[12] although other authors document female preponderance amongst NTDs.[13] In this study spinal dysraphism was slightly more common in males with male-female ratio of 1.3:1, while encephaloceles were more common in females and with a female-male ratio of 2.25:1.

NTDs include anencephaly which have been found to have varying birth prevalence in different studies.[12,13,15] No case of anencephaly formed part of this study. Anencephalic babies and those with craniorachischisis tend to die during the perinatal period, whereas less severe NTDs get referred to the neurosurgical team for management.[13,16] Greater than 80% of spinal dysraphism, and 77% of encephaloceles presented before their first birthday, majority of these before 6months of age. This is similar to reports by other authors that half of patients present within the first two weeks of life even when not prenatally diagnosed.[11]

Encephaloceles made up 14.61% of all lesions and 81.25% of skull lesions. Majority (69.23%) of encephaloceles were occipital, the rest frontal. Olasode *et al* also found a greater proportion of occipital encephaloceles in their study.[9] Frontal encephaloceles are rare and generally known to have a higher incidence in Asian countries (1/5000 live births) than western countries (1/35,000 to 1/40,000 live births).[17] In Africans, evidence suggest that frontal encephaloceles are more common in East, then West Africa.[18]

Children with severe birth defects have a 15-fold increased risk of death during the first year of life, with 9–10% of such children dying during this period.[12,16] Data from Northwestern Nigeria shows that perinatal mortality for NTDs could be as high as 81.3% despite established prenatal diagnosis in up to 50% of patients.[13] NTDs like anencephaly and craniorachischisis are invariably lethal perinatally, whereas open spina bifida is compatible with postnatal survival but frequently results in serious handicap.[16] Children with encephaloceles have been successfully managed with acceptable outcomes even in resource-constrained settings.[9] In a Ugandan study of 110 patients with encephaloceles, surgery-related mortality was 3% and one-year and 5-year survival rates were 87% and 61% respectively.[18]

Intracranial lesions made up 29.78% of cases. Of these 67.9% were neoplastic lesions, making up 20.22% of all lesions. In combination with spinal/paraspinal tumors, neoplasms constitute 22.47% of all lesions seen. Previously published data from our center has shown that intracranial tumours in children are less common than congenital anomalies of the neuraxis.[3] Childhood brain tumors constitute 5% of all childhood tumors.[19,20] Astrocytic tumors made up 41.67% of intracranial childhood tumors studied. Pilocytic astrocytoma was the commonest making up 25% of intracranial neoplasms seen. Embryonal tumors (mostly medulloblastoma), meningioma, and craniopharyngioma were the other common histologic types. At least 50% of our tumors were located in the posterior fossa. In a previous study, we found almost equal numbers of supra- and infratentorial tumours in children, majority (54%) being gliomas.[3] Publications from other centers in Nigeria have documented findings similar to this. Uche, *et al,* in Ibadan found low-grade

astrocytoma -25 %; and medulloblastoma -25 % as the most common tumors.[21] Ndubuisi, *et al,* in Enugu found 51.9% supratentorial tumours, and 48.1% infratentorial tumours, their commonest histological types also being glioma-37.0%, medulloblastoma-24.1%, craniopharyngioma-20.4%, and meningioma-3.7%.[19] The most common supratentorial tumours were glioma and craniopharyngioma, and the most common infratentorial tumour was medulloblastoma.[19]

While 63.9% of intracranial neoplasms in this series were low grade lesions (WHO grades I and II) for which surgery is usually adequate treatment with low to moderate risk of recurrence, 36.1% of tumors were high grade/ malignant lesions. Malignancies in Africa are usually first seen at advanced stages, and fewer than 20% of children have access to curative treatment.[22] Globally, the survival rate of children with malignancies has increased dramatically in recent years, in part because of improved diagnostic accuracy.[9] But in low-middle income countries, the survival rates is still approximately 20%, compared to survival rates greater than 80% for most cancers in the developed world.[6] Problems with diagnostic testing, including long delays in pathology reporting, limited immunohistochemistry capabilities, and lack of expertise in the histologic diagnosis of paediatric malignancies, are contributing factors to the poor overall survival of children with cancer in Africa.[22]

Intracranial abscesses are significant health-care concern, especially in low resource settings like ours. The mortality and morbidity of brain abscesses range from 10% to 25%.[23] Disease outcomes are however changing due to improvements in diagnosis and therapy, antibiotics use, the HIV/AIDS epidemic and other immune deficiencies.[23] The single most common etiology in this review was chronic frontoethmoidal sinusitis. Previous work from our center has shown that the most common predispositions for intracranial abscesses are otolaryngologic and traumatic factors.[24] They occur most commonly in the second decade of life, but the most susceptible single year of life is infancy.[24]

Though uncommon, intracranial abscesses remain life threatening in children especially in resource-poor settings.[25] The mortality and morbidity of brain abscesses range from 10% to 25%.[26] In the series by Olorunmoteni, *et al,* case fatality rate was as high as of 33.3%.[25] Early presentation and treatment of local infections will improve outcome.

Fibro-osseous lesions of the skull, though only 2.25% of lesions seen, formed a significant 12.5% of skull lesions. There was no fibro-osseous lesion of the skull reported in the study from Ile-Ife by Olasode and Onyia although a case of reparative fibroma of the spine was reported.[9] Conversely a significantly larger percentage of osteomyelitis of the skull was reported by them (6 of 111) compared to the findings in this study (2 of 178).

Congenital inclusion cysts of the anterior fontanelle, also known as Adeloye-Odeku cysts constituted 77.8% (7 of 9) of our scalp lesions. When first described by two Nigeria Neuro-surgeons, Adeloye and Odeku in 1971. It was considered a disease of African children.[27] They described 18 cases of a congenital cystic swelling located over the anterior fontanelle in Nigerian patients who were otherwise clinically normal; 17 of which turned out to be dermoid cysts, with female-male ratio of 2:1.[27] Other authors across the globe have subsequently reported similar lesions in various races.[28–31] Reports have also shown these cysts could be Dermoid or epidermoid cysts and may be seen in locations other than the anterior fontanelle[32]. Calvaria involvement is well recognized; as well as intracranial and intraspinal ones.[33–35] We report in this study 5 epidermoids and two dermoid cysts from 4 female and 3 male patients. Two intracranial posterior fossa epidermoid cysts in 2 females, were also encountered, making a total of 9 dermoid/ epidermoid cysts in this series. Olasode documented a rather small fraction of 4 subgaleal cysts constituting 16% of scalp lesions amongst childhood cases seen in Ile-Ife.[9] The prognosis for this condition is good, complete surgical resection usually being curative.[29,36]

## CONCLUSION

Paediatric neuropathological conditions can be managed with good outcomes if correctly and promptly diagnosed. Most of the world's children live in areas such as Africa, with few neuropathologists,[9] yet many paediatric diseases are individually rare enough to pose a diagnostic challenge to the general pathologist. Paediatric pathology in general, and paediatric neuropathology more specifically, are faced with the challenges of limited access to resources and few opportunities for professional advancement in Africa. This relative non-availability of specialized training makes the provision of a high-quality service difficult.[24]

There is a need to channel resources into prevention and prenatal diagnosis of NTDs, and early diagnosis and management of brain tumors and other intracranial lesions. Better management of otorhinolaryngologic and intracranial infections in children is advocated, and Neuropathology training and capacity development is crucially needed.

## REFERENCES


1. Tanko NM, Echejoh G, Manasseh N, Mandong B, Uba F. Paediatric solid tumours in Nigerian children: A changing pattern? *African Journal of Paediatric Surgery: AJPS.* 2009; **6:** 7–10.
2. United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, Volume II: Demographic Profiles (ST/ESA/SER.A/427). https://population.un.org/wpp/Publications/Files/WPP2019_Volume-II-Demographic-Profiles.pdf.
3. Udoh DO, Usiholo AE, Udoh MO. Clinicopathological pattern of childhood intracranial tumours in the Niger Delta. *Journal of Medical and Applied Biosciences.* 2019; **11:** 1–10.
4. Ayoade OG, Amadi C, Adesina SB, Essien SI, Udoh EN, Umoh OO. Retrospective survey of paediatric diabetes at a Tertiary Healthcare Center in Uyo, South-South Nigeria. *American Journal of Paediatrics.* 2020; **6:** 327–333.
5. Raphael S, Ezike KN. Histological pattern of breast diseases in children and adolescents in North Central Nigeria. *N Niger J Clin Res.* 2020; **9:** 39–43.

6. Akinsete AM, Odugbemi BA, Ogundowole GE, Anene-Nzelu UU, Temiye E, Akinsulie A. Paediatric Oncology in Nigeria: A panoramic view. *Journal of Global Oncology.* 2019; **5:** 1–7
7. Uwaezuoke NA, Uche EO, Eke CB, Aronu AE, Ukekwe FI, Eze JN, Ojinnaka N. Childhood brain tumors in Southern Nigeria: A multicenter experience. *Int J Med Health Dev.* 2021; **26:**128–134.
8. Utuk EO, Ikpeme EE. Childhood cancers in a referral hospital in south-south Nigeria: a review of the spectrum and outcome of treatment. *Pan Afr Med J.* 2015; **22:** 325.
9. Olasode BJ, Onyia CU, Paediatric Neuropathology in Africa: Local experience in Nigeria and challenges and prospects for the continent. *Journal of Neuropathology & Experimental Neurology.* 2016 75; **11:** 1000–1004.
10. Adeniran JO, and Odebode TO. Congenital malformations in paediatric and neurosurgical practices: Problems and pattern (A preliminary report). *Sahel Medical Journal.* 2005; **8:** 4–8.
11. Bankole OB, Arigbabu SO, Kanu OO. Spinal neural tube defects in Lagos University Teaching Hospital, Nigeria. *Nig Q J Hosp Med.* 2012; **22:** 22–24.
12. Anyanwu LJC, Danborno B, Hamman WO. The prevalence of neural tube defects in live born neonates in Kano, North-Western Nigeria. *Sub-Saharan Afr J Med.* 2015; **2:** 105–109.
13. Nnadi DC, Singh S. The prevalence of neural tube defects in North-West Nigeria. *Saudi J Health Sci.* 2016; **5:** 6–10.
14. Oumer M, Tazebew A, Silamsaw M. Birth prevalence of neural tube defects and associated risk factors in Africa: a systematic review and meta-analysis. *BMC Pediatr.* 2021; **21:** 190. https://doi.org/10.1186/s12887-021-02653-9
15. Bello M, Abubakar AM, Akuhwa RT, Yahaya SJ, Adamu S, Mava Y. Neural tube defects: Epidemiologic factors, clinical presentation and outcome in Northeastern Nigeria. *Sahel Medical Journal.* 2008; **11:** 34–37.
16. Copp AJ, Greene ND, (), Genetics and development of neural tube defects. *J Pathol.* 2010; **220:** 217–230.
17. Dinesh B. Frontal Encephalocele – A rare case report with review of literature. *Scholars Journal of Medical Case Reports.* 2016; **4:** 822–824.
18. Warf BC, Stagno V, Mugamba J. Encephalocele in Uganda: ethnic distinctions in lesion location, endoscopic management of hydrocephalus, and survival in 110 consecutive children, *Journal of Neurosurgery: Paediatrics PED.* 2011; **7:** 88–93.
19. Ndubuisi CA, Ohaegbulam SC, Ejembi GO. Paediatric brain tumours managed in Enugu, Southeast Nigeria: Review of one centre experience. *Niger Postgrad Med J.* 2018; **25:** 186–190.
20. Steliarova-Foucher E, Colombet M, Ries LAG, Moreno F, Dolya A, Bray F, *et al.* IICC-3 contributors. International incidence of childhood cancer, 2001-10: A population-based registry study. *Lancet Oncol.* 2017; **18:** 719–731.
21. Uche E, Shokunbi M, Malomo A, Akang E, Lagunju I, Amanor-Boadu S. Paediatric brain tumors in Nigeria: Clinical profile, management strategies, and outcome. Child's nervous system: ChNS : official journal of the International Society for Paediatric Neurosurgery 2013; **29:** 1007.
22. Darcy A. Kerr, Ronald Otto Christian Kaschula. Paediatric Pathology Services in Africa. Arch Pathol Lab Med. 1 June 2013; 137 (6): 767–774. doi: https://doi.org/10.5858/arpa.2011-0588-RA
23. Ndubuisi CA, Ohaegbulam SC, Mezue WC, Chikani MC, Nkwerem SP, Ozor II. Management of brain abscess: changing trend and experience in Enugu, Nigeria. *Niger J Surg.* 2017; **23:** 106–110.
24. Udoh DO, Ibadin E, Udoh MO. Intracranial abscesses: Retrospective analysis of 32 patients and review of literature. *Asian J Neurosurg.* 2016; **11:** 384–391.
25. Olorunmoteni OE, Onyia CU, Elusiyan JBE, Ugowe OJ, Babalola TE, Samuel I. Intracranial abscesses in children at Ile-Ife, Nigeria: a case series and review of literature. *Childs Nerv Syst.* 2020; **36:** 1767–1771.
26. Emejulu JK, Shokunbi MT, Malomo AO. Intracerebral abscesses: outcome following management in the CT era. *West Afr J Med.* 2004; **23:** 54–57.
27. Adeloye A, Odeku EL. Congenital subgaleal cysts over the anterior fontanelle in Nigerians. *Arch Dis Child.* 1971; **46:** 95–98.
28. Dadlani R, Furtado S, Ghosal N, Hegde A. Adeloye-Odeku Disease: An African disease in the Indian child? *Turkish Neurosurgery.* 2012; **22:** 515–520.
29. Wong TT, Wann SL, Lee LS. Congenital dermoid cysts of the anterior fontanelle in Chinese children. *Childs Nerv Syst.* 1986; **2:** 175–178.
30. Hashiguchi K, Morioka T, Yokoyama N, Mihara F, Sasaki T. Subgaleal dermoid tumors at the anterior fontanelle. *Pediatr Neurosurg.* 2005; **41:** 54–57.
31. Parízek J, Nmecek S, Nmecková J, Cernoch Z, Sercl M. Congenital dermoid cysts over the anterior fontanel. Report on 13 cases in Czechoslovak children. *Child's Nerv Syst.* 1989; **5:** 234–237.
32. Chaudhari AB, Ladapo F, Mordi VPN, Choudhury KJ, Naseem A, Obe JA. Congenital inclusion cyst of the subgaleal space. *Journal of Neurosurgery.* 1982; **56:** 540–544.
33. Engler J, Bassani L, Ma T, Tanweer O, Elliott RE, Harter DH, Wisoff JH. Open and endoscopic excision of calvarial dermoid and epidermoid cysts: a single center experience on 128 consecutive cases. *Child's Nerv Syst.* 2016; **32:** 2351–2356.
34. Caldarelli M, Massimi L, Kondageski C, Di Rocco C. Intracranial midline dermoid and epidermoid cysts in children. *J Neurosurg.* 2004; **100:** 473–480.
35. Siller S, Egensperger R, Szelenyi A, Tonn JC, Zausinger S, Schichor C. Intraspinal epidermoid and dermoid cysts-tumor resection with multimodal intraoperative neurophysiological monitoring and long-term outcome. *Acta Neurochir (Wien).* 2020; **162:** 2895–2903.
36. Udina C, Calligaris L, Berti I, *et al.* Inclusion cyst of anterior fontanelle. *Archives of Disease in Childhood.* 2020; **105:** 95.