JAMA Network Open

Research Letter | Pediatrics

Global Burden of Pediatric Central Nervous System Tumors

Jordan T. Roach, MD, PhD; Nickhill Bhakta, MD, MPH; Ibrahim Qaddoumi, MD, MSc; Eric Bouffet, MD; Giles W. Robinson, MD; Carlos Rodriguez-Galindo, MD; Eva Steliarova-Foucher, PhD; Freddie Bray, PhD; Daniel C. Moreira, MD, MEd

Introduction

Despite their heterogeneity, pediatric central nervous system (CNS) tumors share a common requirement for multidisciplinary management and a highly coordinated infrastructure to ensure comprehensive quality care. Historically, pediatric CNS tumors have received less global attention and prioritization due to the substantial resources required.[1] Due to unique characteristics needed for their management and specific elements relevant for cancer control, pediatric CNS tumors should be analyzed as a unique disease group. Although analyses of the global burden of pediatric cancers overall have been published,[2-5] to our knowledge, a comprehensive evaluation specific to pediatric CNS tumors has not been undertaken. We conducted a global analysis of the incidence of pediatric CNS tumors based on GLOBOCAN 2022 estimates to inform cancer-control policies and activities.

Methods

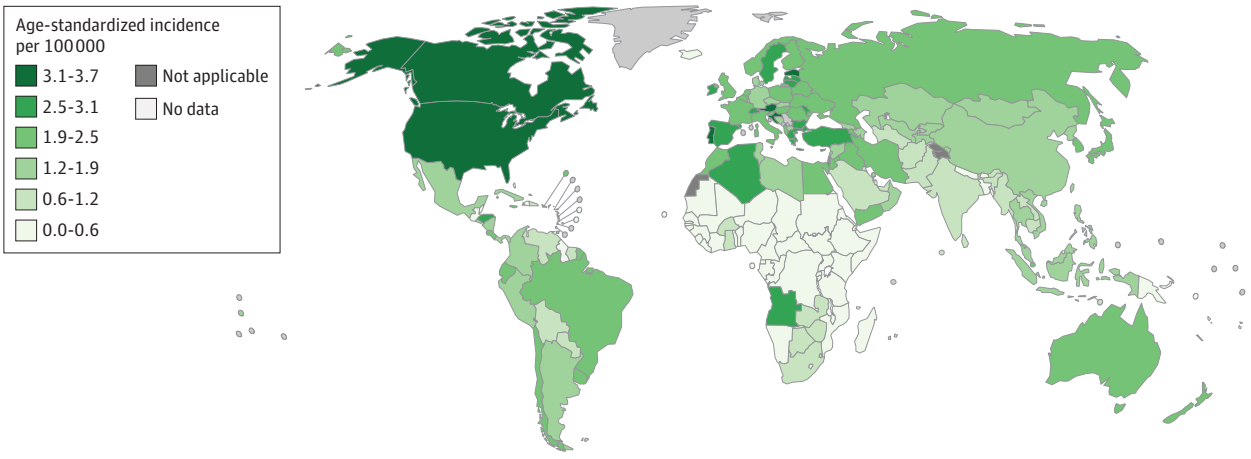
For this cross-sectional ecological study, we extracted pediatric CNS tumors worldwide from the GLOBOCAN 2022 database.[6] This database is publicly available, created and maintained by the International Agency for Research on Cancer, with national estimates derived from the best available sources of cancer incidence and mortality in a given country.[7] Methods to derive the GLOBOCAN estimates for incidence rates have previously been described.[6]

Of 185 countries with detailed global cancer statistics in GLOBOCAN 2022, 159 included data on CNS tumors in patients ages 0 to 14 years. Incident cases and truncated age-standardized rate (ASR) for incidence were extracted. The 26 countries for which no cases were estimated were excluded. We calculated incidence ASR per 100 000 youths at risk based on the World Health Organization world

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Figure 1. Map of Age-Standardized Incidence of Pediatric Central Nervous System Tumors



The estimated incidence age-standardized rate of pediatric central nervous system tumors in patients aged 0 to 14 years in 2022 is shown.

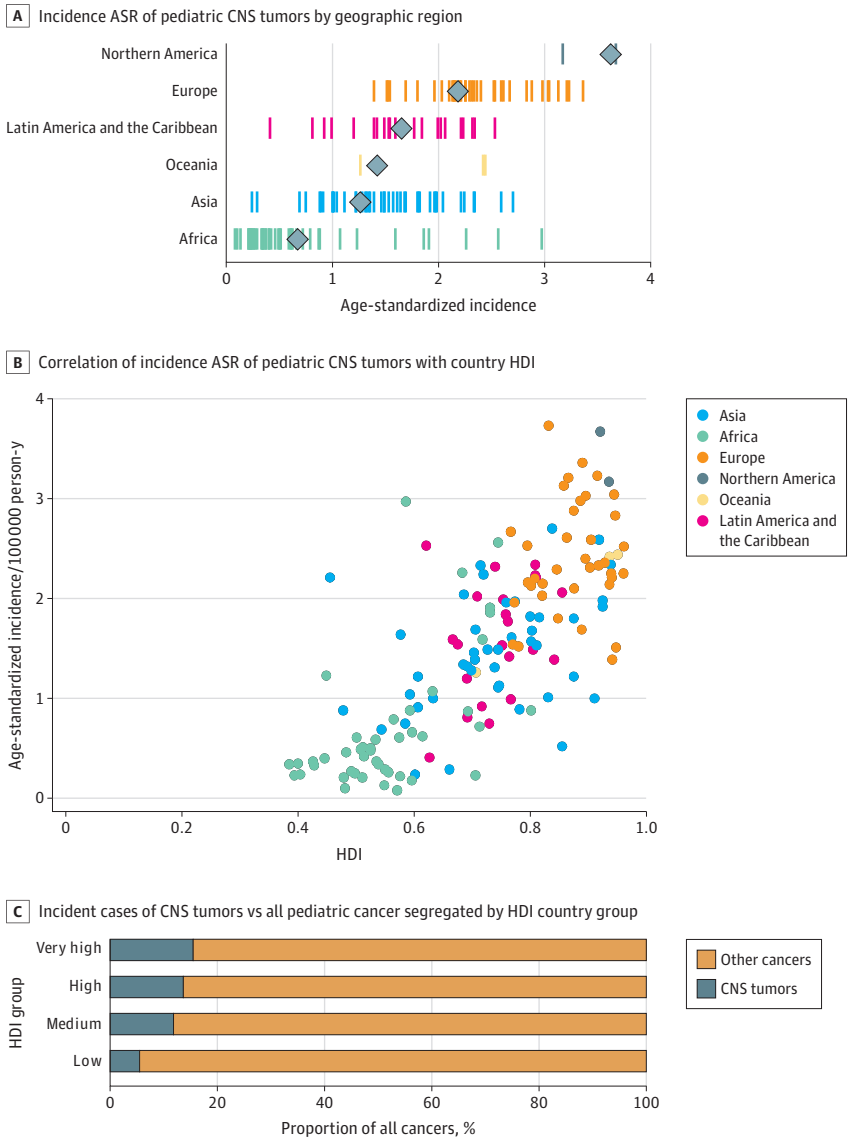
standard population. The World Bank Open Data and United Nations Development Programme were used for country income group and human development index (HDI) in 2022, respectively. Because this study used exclusively publicly available data, St. Jude Children's Research Hospital determined that no ethical approval or consent were required. This study is reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

To evaluate the association between ASR and HDI, the Spearman rank correlation coefficient was used due to nonnormal distribution of country ASR. A 2-sided $P < .05$ was considered significant. Statistical analyses were conducted using Prism version 9.0 (GraphPad). Data were analyzed from July to December 2025.

Results

There were an estimated 24 677 incident cases of CNS tumors (13 658 males [55.3%] and 11 019 females [44.7%]) diagnosed among youths aged 0 to 14 years in 2022. Accounting for 12.3% of all

Figure 2. Line, Dot, and Bar Plots of Pediatric Central Nervous System (CNS) Tumors and Country Human Development Index (HDI)



A, Incidence age-standardized rates (ASRs) of pediatric CNS tumors are shown by geographic region. Gray diamonds indicate the ASR in continents, while vertical lines represent ASRs in individual countries. B, Correlation of incidence ASR of pediatric CNS tumors with country HDI is shown ($r = 0.75$; $P < .001$). C, Incident cases of CNS tumors are compared with all pediatric cancers segregated by HDI country group.

cancer cases, CNS tumors were the second most common cancer in this age group after leukemia. Globally, the incidence ASR of CNS tumors was estimated at 1.3 per 100 000, with the ASR varying markedly by country, from 0.08 in the Republic of Congo to 3.7 in Montenegro and the US (**Figure 1**). Geographically, the estimated incidence ASR was lowest in Africa (0.67) and highest in Europe (2.2) and Northern America (3.6) (**Figure 2**A).

Considering national income grouping, 19 648 estimated incident cases (79.6%) occurred in low- and middle-income countries. The estimated incidence (range) ASR varied from 0.52 (0.1-2.2) in low-income to 0.99 (0.08-3.0) in lower middle–income, 1.7 (0.18-3.7) in upper middle–income, and 2.6 (0.52-3.7) in high-income countries. A positive correlation between country-level estimated incidence ASR and HDI was observed (r = 0.70; 95% CI, 0.60-0.77; P < .001) (Figure 2B). Based on aggregated ASR, pediatric CNS tumors constituted a smaller percentage of the overall number of pediatric cancer cases in low- and medium-HDI groups (Figure 2C).CNS tumors represented 15.9% of cases for all pediatric cancers in very high–HDI countries and 5.8% in low-HDI countries.

Discussion

Pediatric cancer represents an emerging public health priority, and marked disparities in incidence and outcomes worldwide have been described.[2-5] The global variability of estimated incidence of pediatric CNS tumors sheds light on deficiencies in health information systems and health systems more broadly. In this cross-sectional study, incidence rates for pediatric CNS tumors were not only highest in high-resource settings, but they were also underrepresented compared with other cancers in low-resource settings. Although this variability could be influenced by biologic factors, this is most likely associated with the strength of health systems across resource settings and access to the required diagnostic infrastructure for CNS tumors.[8]

Furthermore, this disparity is also likely associated with the strength of health information systems and quality of data from population-based cancer registries (PBCRs). Less than 15% of the global pediatric population is covered by a quality PBCR.[4] Building capacity and standardizing process in cancer registration is essential to provide more accurate data for pediatric CNS tumors.[9]

We acknowledge study limitations. First, although GLOBOCAN estimates preferentially use data from representative PBCRs, in the absence of high-quality data, model-based approaches are required for individual country estimates. Second, critical for pediatric CNS tumors, benign tumors are inconsistently reported in PBCRs,[10] further contributing to disparities in estimates.

This study seeks to better inform cancer-control policies, including strategies to expand access to diagnostic and treatment services and provide more robust cancer registries. Due to the multifaceted care required to diagnose and successfully treat CNS tumors, evidence-based decisions to enhance access to care are needed for this at-risk population by using more precisely allocated resources.

ARTICLE INFORMATION

Accepted for Publication: May 15, 2026.

Published: July 24, 2026. doi:10.1001/jamanetworkopen.2026.25174

Corresponding Author: Daniel C. Moreira,, MD, MEd, Department of Global Pediatric Medicine, St Jude Children's Research Hospital, 262 Danny Thomas Pl, Memphis, TN 38105 (daniel.moreira@stjude.org).

Author Affiliations: College of Medicine, University of Tennessee Health Science Center, Memphis (Roach); Graduate School of Biomedical Sciences, St Jude Children's Research Hospital, Memphis, Tennessee (Roach); Department of Developmental Neurobiology, Division of Brain Tumor Research, St Jude Children's Research Hospital, Memphis, Tennessee (Roach); Department of Global Pediatric Medicine, St Jude Children's Research Hospital, Memphis, Tennessee (Bhakta, Qaddoumi, Rodriguez-Galindo, Moreira); Department of Oncology, St

Jude Children's Research Hospital, Memphis, Tennessee (Bhakta, Qaddoumi, Robinson, Rodriguez-Galindo, Moreira); Hospital for Sick Children, Toronto, Canada (Bouffet); Cancer Surveillance Branch, International Agency for Research on Cancer, Lyon, France (Steliarova-Foucher, Bray).

Author Contributions: Dr. Moreira had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Drs Bray and Moreira are cosenior authors.

Concept and design: Bhakta, Qaddoumi, Bouffet, Robinson, Rodriguez-Galindo, Bray, Moreira.

Acquisition, analysis, or interpretation of data: Roach, Bouffet, Steliarova-Foucher, Bray, Moreira.

Drafting of the manuscript: Roach, Robinson, Moreira.

Critical review of the manuscript for important intellectual content: Roach, Bhakta, Qaddoumi, Bouffet, Robinson, Rodriguez-Galindo, Steliarova-Foucher, Bray.

Administrative, technical, or material support: Bhakta, Bouffet, Robinson, Steliarova-Foucher, Bray, Moreira.

Supervision: Robinson, Rodriguez-Galindo, Moreira.

Conflict of Interest Disclosures: Dr Moreira reported receiving grants from Roche/Genentech outside the submitted work. No other disclosures were reported.

Funding/Support: This study was supported by the American Lebanese Syrian Associated Charities.

Role of the Funder/Sponsor: The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: Where authors are identified as personnel of the International Agency for Research on Cancer/World Health Organization, the authors alone are responsible for the views expressed in this article, and they do not necessarily represent the decisions, policy, or views of the International Agency for Research on Cancer/World Health Organization.

Data Sharing Statement: See the Supplement.

REFERENCES

1. Moreira DC, Rajagopal R, Navarro-Martin Del Campo RM, et al. Bridging the gap in access to care for children with CNS tumors worldwide. *JCO Glob Oncol*. 2020;6:583-584. doi:10.1200/GO.20.00047

2. Ward ZJ, Yeh JM, Bhakta N, Frazier AL, Atun R. Estimating the total incidence of global childhood cancer: a simulation-based analysis. *Lancet Oncol*. 2019;20(4):483-493. doi:10.1016/S1470-2045(18)30909-4

3. Ward ZJ, Yeh JM, Bhakta N, Frazier AL, Girardi F, Atun R. Global childhood cancer survival estimates and priority-setting: a simulation-based analysis. *Lancet Oncol*. 2019;20(7):972-983. doi:10.1016/S1470-2045(19)30273-6

4. Steliarova-Foucher E, Colombet M, Ries LAG, et al; IICC-3 contributors. International incidence of childhood cancer, 2001-10: a population-based registry study. *Lancet Oncol*. 2017;18(6):719-731. doi:10.1016/S1470-2045(17)30186-9

5. Allemani C, Matsuda T, Di Carlo V, et al; CONCORD Working Group. Global surveillance of trends in cancer survival 2000-14 (CONCORD-3): analysis of individual records for 37 513 025 patients diagnosed with one of 18 cancers from 322 population-based registries in 71 countries. *Lancet*. 2018;391(10125):1023-1075. doi:10.1016/S0140-6736(17)33326-3

6. Bray F, Laversanne M, Sung H, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2024;74(3):229-263. doi:10.3322/caac.21834

7. Filho AM, Laversanne M, Ferlay J, et al. The GLOBOCAN 2022 cancer estimates: data sources, methods, and a snapshot of the cancer burden worldwide. *Int J Cancer*. 2025;156(7):1336-1346. doi:10.1002/ijc.35278

8. Moreira DC, Bouffet E, Qaddoumi I. The greatest challenge for pediatric low-grade glioma. *Neuro Oncol*. 2024;26(5):975-976. doi:10.1093/neuonc/noae004

9. Moreira DC, Znaor A, Santana VM, et al. Expanding the global capacity for childhood cancer registration: the ChildGICR Masterclass. *JCO Glob Oncol*. 2024;10:e2300334. doi:10.1200/GO.23.00334

10. Dean F, Henrikson H, Xu R, et al. Challenges in determining the global burden of non-malignant central nervous system tumors: an analysis of international incidence and mortality data sources. *Neuro Oncol*. 2025;27(6):1654-1664. doi:10.1093/neuonc/noaf006

SUPPLEMENT.

Data Sharing Statement