

ABSTRACT NO:25
RESEARCH ARTICLE**Urban–Rural Disparities in Malignant Brain Tumour Mortality in the United States, 1999–2020: A CDC WONDER Join point Analysis with Relevance to Neurosurgical Access in Pakistan**Muhammad Barakat ¹, Hadi Ftouni ², Maryam Ali Ahmed ³, Ruham Fatima ⁴, Madona Akhobadze ⁵**Abstract**

Objective: Outcomes for malignant brain tumours depend on timely access to neurosurgery and specialized oncology, which are concentrated in urban centers. Whether mortality differs along the urban–rural gradient is rarely quantified at population scale. Pakistan, where neurosurgical capacity is heavily urban and national surveillance is absent, lacks such data. We examined United States brain tumour mortality by urbanization, 1999–2020, as a transferable model.

Methods: Serial cross-sectional, ecological analysis was carried out on CDC WONDER with Underlying Cause of Death data (1999–2020, bridged-race) for decedents with ICD-10 C71. Age-adjusted mortality rates (AAMR; 2000 US standard) per 100,000 were computed across the six-level 2013 NCHS urbanization classification, from Large Central Metro to Noncore (nonmetropolitan) on 29-June-2026. Join point regression (version 6.0.1) estimated APC and AAPC with 95% CIs, and pairwise tests of parallelism and coincidence compared trajectories. Reporting followed STROBE/RECORD.

Results: Across 1999–2020, 315,538 deaths were recorded. Mortality increased along the urban-to-rural gradient: in 1999 AAMR was lowest in Large Central Metro (4.34) and highest in nonmetropolitan areas (Noncore 4.81; Micropolitan 4.80), a gradient that persisted to 2020 (Large Central Metro 4.08; Noncore 4.71). Most strata showed a significant decline to the mid-2000s then a plateau or modest rise (e.g. Large Central Metro: 1999–2006 APC –1.49%, 2006–2020 +0.22%; AAPC –0.35%), while Medium Metro and Micropolitan areas stayed essentially flat (0 join points). Trajectories were largely parallel (13 of 15 pairwise comparisons failed to reject parallelism) but differed in level (coincidence rejected, $p < 0.001$), so the urban–rural gap did not close.

Conclusion: US malignant brain tumour mortality followed a persistent urban-to-rural gradient from 1999 to 2020, where it was lowest in large metropolitan cores and highest in nonmetropolitan areas, with parallel trends that left the gap intact. As an ecological analysis, it cannot establish causation. This reproducible CDC WONDER Join point method offers a template for mapping neurosurgical-access disparities in settings such as Pakistan.

Keywords: CDC WONDER, Malignant brain tumours, Urban to Rural disparities.

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