Neuro-Oncology Advance Access published January 26, 2014

Neuro-Oncology

Neuro-Oncology 2014; **0**, 1–4, doi:10.1093/neuonc/not301

Incidence of glioma in a northwestern region of England, 2006–2010

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Background. Gliomas are important because they affect disproportionately high numbers of people of working age and have a poor prognosis. Neurosurgeons were concerned about a possible recent cluster of glioma cases in a northwestern region in England.

Methods. All patients aged 18–89 years in Lancashire and South Cumbria with a histologically confirmed glioma diagnosed at the Royal Preston Hospital between January 1, 2006, and December 31, 2010, were ascertained. Clinical information was extracted from hospital records. Completeness of case referral to Royal Preston Hospital was checked against the National Cancer Registry and National Brain Tumour Registry records for the same period. For a comprehensive assessment of regional incidence, age-standardized incidence rates of all gliomas diagnosed in adults (aged 15 years and older) in the study area were then compared with those for the North West region and England as a whole. Rates for the North West region in defined small area-units ("Middle Super Output Areas") were also investigated to assess any small-area variation in the region during the decade to 2010.

Results. There were 435 glioma patients from Lancashire and South Cumbria diagnosed at the Royal Preston Hospital between 2006 and 2010, with case ascertainment verified to be complete by the National Cancer Registration Service. The age-standardized incidence rate of gliomas in the study area was 7.10 per 100 000 in 2006–2010, which was minimally different from the rate for all cancer networks in England over the 10 years from 2001. Small-area analysis confirmed lack of major variation in glioma rates in the North West region of England.

Conclusion. Glioma incidence rates in England have remained stable by region and over time during the last decade.

Keywords: brain tumors, England, glioma, incidence, regional variation.

Primary brain cancer and other tumors of the central nervous system are relatively rare but are important because of their poor prognosis. For example, in the United Kingdom (UK), the overall annual incidence is about 7 per 100 000 people. They account for 2% of all cancers diagnosed, but the 5-year survival rates are the fourth lowest of the 21 most common cancers in England.[1] Moreover, brain tumors affect a disproportionately high number of people of working age (less than aged 65 years)[2] and are the third most common cause of cancer death in the age group 15–34 years. The majority (86%) of brain tumors are gliomas,[3,4] and these have a poor prognosis with median survival of around 12 months and <3% of patients surviving for 5 years.[5]

Very few studies of occurrence of glioma have been carried out in the UK, especially since the implementation of routine use of CT scanning for diagnosis, yet accurate and up-to-date incidence rates are essential for monitoring variations over time and by age group, sex, or socio-economic status. Incidence trends are also important for assessing the emergence of potential new causes such as mobile phones.[6] At a national level, the Surveillance of Rare Cancers in Europe collaborative project among European cancer registries showed that the highest annual age-standardized incidence rates of astrocytic tumors were in the UK and Ireland at 5.1 cases per 100 000 in the period 1995–2002, while the lowest reported rate, 3.1 per 100 000, was in Eastern Europe.[3] At a regional level, there have been 2 studies in the UK in the last 2 decades. In 1989 and 1990, the incidence of primary intracranial tumors diagnosed by CT or histology was assessed in the Lothian region of southeast Scotland, with the crude incidence of gliomas estimated

Received 16 March 2013; accepted 30 November 2013

to be 7.7 per 100 000.[7] In the second survey, a review of all CT scans with contrast and magnetic resonance imaging of the head was performed for the population of Devon and Cornwall from April 1992 to March 1997 in order to define the incidence of brain tumors and assess case-finding methods.[8] This gave an age-standardized incidence of neuroepithelial tumors of 9.8 per 100 000, of which 69% were histologically verified.

Incidence data also allow assessment of possible disease clusters, and indeed there was concern among neurosurgeons about a possible regional focus of glioma in a region of northwestern England, namely Lancashire and South Cumbria, that led to the present study. Our primary aim was to assess whether there was a higher than average incidence of glioma in this defined region of England. We therefore performed a detailed investigation of newly diagnosed and confirmed glioma cases in Lancashire and South Cumbria in the previous 5 years by review of hospital-based histological records for the region concerned, with verification by the National Brain Tumour Registry. We then extended this investigation to explore the variability of incidence of gliomas in recent years in all small districts in the North West region and across England.

Materials and Methods

All patients aged 18–89 years living in Lancashire and South Cumbria who had a glioma newly diagnosed and histologically confirmed at the Royal Preston Hospital (the regional center) between January 1, 2006, and December 31, 2010, were ascertained. Gliomas that were presumptively diagnosed by radiology and grade I gliomas were excluded from the hospital-based study. Clinical information was extracted in standard format from hospital records including each patient's National Health Service number, date of birth, sex, postcode of residence, date of pathological diagnosis, histological subtype, grade of tumor, and location in the brain. Chi-square tests were used to assess differences in distributions of age and sex of patients and differences in the histological subtypes, grades, and location of the tumors.

In order to verify completeness of referral and ascertainment of eligible glioma patients in Lancashire and South Cumbria through Royal Preston Hospital records, the hospital's data were compared with the corresponding records of gliomas diagnosed in Lancashire and South Cumbria as registered by the National Cancer Registry Service, North West Office, and compiled by the National Brain Tumour Registry, based at the National Cancer Registry Service, Eastern Office, Cambridge, England.

To more comprehensively examine the overall incidence of gliomas in the study area and compare this rate with rates in the rest of the country, we considered all gliomas diagnosed with and without histological verification and calculated incidence rates of gliomas in adults (aged 15 years or over) diagnosed in the Lancashire and South Cumbria Cancer Network, in the North West region of England, and in England as a whole for the period 2006 to 2010, using data from the National Cancer Data Repository.[9] All rates were age-standardized to the European Standard Population, and their 95% confidence intervals were calculated.

Age-standardized incidence rates for the North West region of England from 2001 to 2010 were further analyzed at the level of middle super output area (MSOA) to look for small-area differences in glioma incidence. MSOAs are stable geographic areas derived from 2001 census data comprising approximately similar-sized populations of 5 000 to 15 000.[10] They are thus sufficiently large for at least one tumor to be diagnosed in the majority of areas in the 10-year period. Small-area analysis of incidence at MSOA level was undertaken for the period 2001–2010 on a year-by-year basis and on a 10-year aggregation of cases. We used Joinpoint regression software version 4.04[11] to calculate average annual percentage change (AAPC)[12] over the period. Age-standardized incidence rates for each MSOA in the North West region for 2001–2010 are presented as a funnel plot.[13] To take account of the large number of geographical areas being tested and the subsequent increased risk of generating positive findings

Table 1. Characteristics of 435 patients diagnosed with histologically confirmed glioma in Lancashire and South Cumbria, 2006–2010, and characteristics of 435 tumors

Patient characteristics	*n* (%)	*P* value
Sex		<.001
Male	281 (65)	
Female	154 (35)	
Age at surgery (years)		<.001
<40	30 (7)	
40–59	110 (25)	
60–79	264 (61)	
80+	27 (6)	
Missing	4 (1)	
Tumor characteristics		
Histological subtype (ICD-O morphology code)		<.001
Astrocytoma, NOS (M9400/3)	9 (2)	
Anaplastic astrocytoma (M9401/3)	33 (8)	
Glioma, NOS (M9380/3)	3 (0.7)	
Glioblastoma (M9440/3)	376 (86)	
Gliosarcoma (M9442/3)	1 (0.2)	
Oligoastrocytoma (M9382/3)	10 (2)	
Oligodendroglioma (M9450/3)	2 (0.5)	
Missing	1 (0.2)	
WHO grades		<.001
II	9 (2)	
III	45 (10)	
IV	379 (87)	
Missing	2 (0.5)	
Laterality		<.001
Left side	206 (47)	
Right side	200 (46)	
Midline	6 (1)	
Missing/unspecified	23 (5)	
Location		<.001
Basal ganglia	3 (0.7)	
Brainstem	2 (0.5)	
Cerebellar	3 (0.7)	
Corpus callosum	6 (1)	
Frontal	113 (26)	
Frontoparietal	23 (5)	
Frontotemporal	11 (3)	
Frontotemporoparietal	2 (0.5)	
Intraventricular	1 (0.2)	
Occipital	14 (3)	
Parietal	112 (26)	
Parieto-occipital	19 (4)	
Temporal	76 (17)	
Temporoparietal	29 (7)	
Thalamic	5 (1)	
Missing/unspecified	16 (4)	

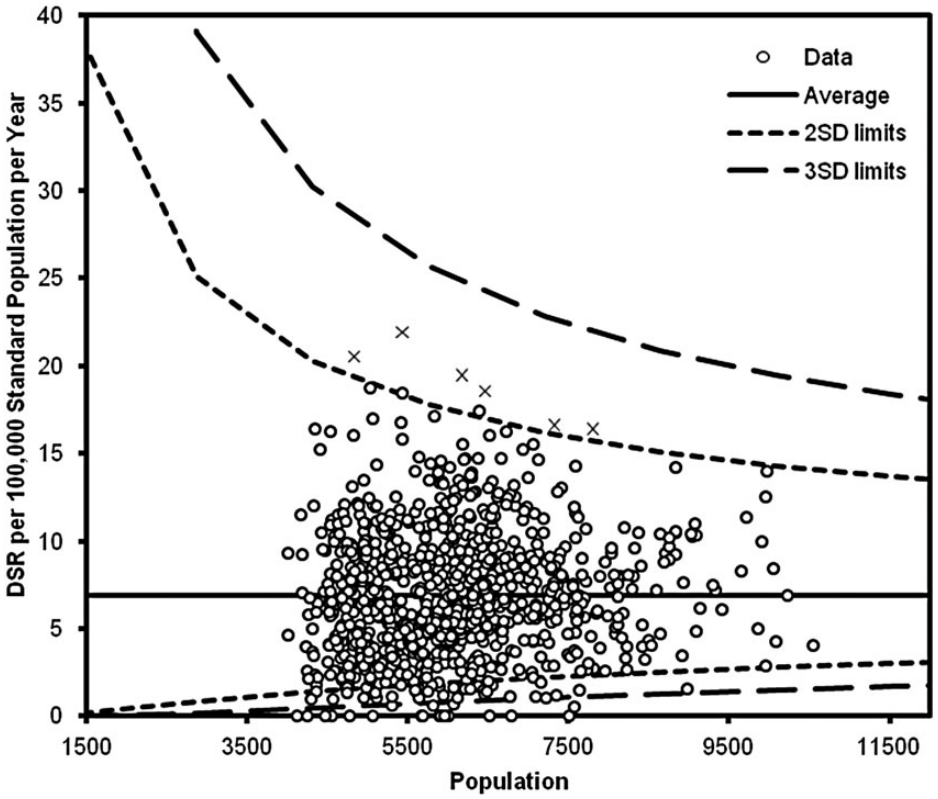

Fig. 1. Age-standardized incidence rates of glioma in the North West region of England by Middle Level Super Output Area (MSOA), 2006–2010. *Note:* Population is adjusted due to standardization calculations. *Source:* National Cancer Data Repository.

due to chance,[14] we applied a Bonferroni correction[15] and considered areas with incidence rates more than 3 standard deviations above the North West region's average to be statistically significant. Finally, we examined the potential for spatial-temporal clustering of higher than expected incidence at MSOA level over the period 2001–2010 using the software Satscan version 9.1.1.[16,17] We applied a discrete Poisson model, with age as a covariate, using MSOA centroid Cartesian coordinates and a maximum reporting cluster size of 50% of the population at risk. For secondary clusters, we specified "no geographical overlap".

Results

In the overall study period from January 1, 2006, to December 31, 2010, there were 435 patients aged 18–89 years living in Lancashire and South Cumbria who were newly diagnosed with a grade II to IV glioma at the Royal Preston Hospital. Of these, 65% were male, and 61% were aged 60–79 years (Table 1). The majority (86%) of these gliomas were histologically classified as glioblastoma (Table 1). Of the 60% of tumors whose location was recorded, there was no dominant laterality, and the main affected lobes were frontal and parietal (both 26%) (Table 1).

Practically all (97%) of the cases had been registered by National Cancer Registration Service, North West Office, and the number of cases identified for the Lancashire and South Cumbria network geographic area was very similar (442), confirming the close to complete capture by Royal Preston Hospital of glioma cases diagnosed in the Lancashire and South Cumbria catchment area. As a corollary, the corresponding National Cancer Registry data were considered entirely representative of the underlying cancer rates in the Lancashire and South Cumbria Cancer Network.

The age-standardized incidence rate of glioma in the Lancashire and South Cumbria Cancer Network for the period 2006 to 2010 was 7.10 per 100 000 (95% CI, 6.47–7.80). This was similar to the age-standardized incidence rates for the North West region of England at 7.19 per 100 000 (95% CI, 6.89–7.50) and England as a whole at 6.93 per 100 000 (95% CI, 6.82–7.04). In the Lancashire and South Cumbria regions (AAPC = −1.54 [−4.3–1.3], the North West region of England (AAPC = 0.92 [−1.2–3.1]), and in England overall (AAPC = 0.24 [−0.3–0.8]), there was no statistically significant trend in standardized incidence rates over the 10-year period at $P < .05$.

Age-standardized incidence rates for 7 MSOAs (none geographically adjacent) were more than 2 SDs above the North West regional average (Fig. 1), but no MSOA had an incidence rate more than 3 SDs above the North West regional average. These results were confirmed by spatial-temporal cluster analysis, with no MSOA clusters significantly higher or lower than expected.

Discussion

We found no evidence of any material variation in incidence rates of glioma within Lancashire and South Cumbria in the North West region of England including after fine-area investigation by MSOA. Moreover, the incidence of glioma in the Lancashire and South Cumbria Cancer Network was in no way anomalous in comparison

with other cancer networks in England. Trends in gliomas over the last 10 years appear to be stable for this region and throughout all cancer networks in England. This stability and consistency are confirmed by published reports of regional incidence of glioma across England and Scotland during the last 2 decades.[2,7,18] Indeed, the observed lack of any increase in rates is in line with trends of gliomas in Nordic countries[6] and in the United States.[19,20] These stable trends are interpreted as evidence of a lack of association between mobile phone use, which has risen rapidly in this period, and the occurrence of malignant brain tumors.[6,20]

The demographic characteristics of glioma patients in the Lancashire and South Cumbria region are similar to those of glioma patients in other populations, with significantly more males than females affected[21] and onset often in middle adulthood in men and women of working age.[2] Predominance of glioblastomas is seen universally, and the site distribution within the brain is similar to that reported in other series with respect to frontal and parietal lobe dominance, although some differences are noted in comparison with a detailed single-center study in Finland,[22] which may not have been a representative series.

The strengths of this study are the population-based nature of the primary data and their recency. Such small-area analyses of glioma incidence in England are uncommon and grounding the results in the context of the national incidence of glioma and comparing incidence in the study area with that in other small areas of North West England for the immediate past, and against longer-term trends, give further reassurance of the validity of the findings. Study weaknesses include a proportion of tumors in the National Brain Tumour Registry for England that were not specified as gliomas per se but rather as malignant brain tumors; however we believe this would have influenced our findings only slightly since the vast majority of malignant brain tumors are gliomas.[3,4]

In summary, we have investigated in detail a clinically suspected cluster of gliomas in Lancashire and South Cumbria in the North West region of England and found no evidence of variation in the region itself or when compared with other regions of England over the last 10 years.

Funding

ACG and SCW were supported by a Fellowship from the Medical Research Council (No. 89912).

Conflict of interest statement. None declared.

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