Brain Tumor Signs and Symptoms: Analysis of Primary Health Care Records From the UKCCS

WHAT'S KNOWN ON THIS SUBJECT: Good information on symptom clusters seen in secondary care at the time of brain tumor diagnosis is now available, but information on how children present in primary care is poor and subject to recall bias.

WHAT THIS STUDY ADDS: This report describes signs and symptoms recorded in children's general practitioner (primary health care) records between birth and brain tumor diagnosis and for the first time, compares rates of attendance and reasons for consultation with those of unaffected children.

abstract

FREE

OBJECTIVE: To compare the frequency of brain tumor signs and symptoms in children with and without brain tumors.

METHODS: This was a UK population-based retrospective analysis of primary care records. Participants were 195 children (1–14 years) newly diagnosed with brain tumors and 285 controls matched by age, gender, and region. Comparisons included total number of prediagnosis consultations, number with ≥1 symptom suggestive of a brain tumor, total number of symptoms, number of different symptoms, and number of visits with specific combinations of symptoms.

RESULTS: On average, cases consulted more often than controls between birth and diagnosis/pseudodiagnosis with brain tumor signs and symptoms. Their consultation rate with ≥1 suggestive symptom escalated in the 2 years before diagnosis. Symptom prevalence was higher among cases than controls, a relative difference of 3.29 times as many consultations with ≥1 suggestive symptom (95% confidence interval [CI]: 2.82–3.83) and 7.01 as many with more than 1 (95% CI: 5.38–9.13). In each 6-month period in the 4 years before diagnosis, cases had at least twice as many consultations with ≥1 suggestive symptom (20.81 times as many in the 6 months before diagnosis [95% CI: 14.29–30.30]) and 2–3 times more records of suggestive symptoms (28.35 times more in the 6 months before diagnosis [95% CI: 19.05–42.19]). Symptoms rarely or not observed among control children included head tilt, odd head movements, odd posture, back or neck stiffness, and unsteadiness without obvious cause.

CONCLUSION Key to identifying the 1 child among many who merits prompt investigation is recognition of unusual symptoms, or specific symptom patterns. *Pediatrics* 2010;125:112–119

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KEY WORDS

brain tumors, signs and symptoms, primary health care, medical charts

ABBREVIATIONS

UKCCS—UK Childhood Cancer Study
GP—general medical practitioner/primary care physician
ICD-10—*International Classification of Diseases, Tenth Revision*

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Cancer in children is rare, and a general practitioner/primary care physician (GP) in the United Kingdom will, on average, see only 1 child younger than 15 years presenting with cancer in 20 years of practice.[1] Central nervous system tumors are rarer still, comprising ~18% of total cancers, with ~250 children diagnosed in the United Kingdom in 2005.[2] Nonetheless, because of the impact of diagnosis on families, including perceived delays in diagnosis,[3,4] GPs need evidence-based information on early presenting signs and symptoms to help inform their decision-making. Whereas good information on symptom clusters seen in secondary care at the time of diagnosis is now available,[5,6] data on presentation in primary care are poor and subject to recall bias. Previous studies have included only children diagnosed with central nervous system tumors, with the exception of 1 small study of 22 cases.[7] Without unaffected children for comparison, the significance of reported signs and symptoms is unclear.

In this article we describe signs and symptoms recorded in children's GP records between birth and brain tumor diagnosis, and we compare the rates of attendance and reasons for consultation with those of unaffected children. Data were systematically abstracted from routine records compiled contemporaneously, before tumor diagnosis. The ability to access primary health care records in this way is a unique facet of the organization of the UK National Health Service. An individual's records relate to the patient rather than the medical practitioner, and if a patient subsequently moves, his or her records are transferred to the new primary health care practice. Since 1948, health care has been free under the National Health Service; consequently, a majority of children are registered with a GP from birth and remain so throughout life.

METHODS

Participants

Children with primary tumors localized to the brain or head (ICD for Oncology, 3rd edition topography codes 700–729 and 751–753) diagnosed after 12 months of age and a matched control group were included in the study. Tumors were classified according to the *International Classification of Childhood Cancer, 3rd Edition*[8] (see supporting information, which is published at www.pediatrics.org/content/full/125/1/111).

All children were enrolled in the United Kingdom Childhood Cancer Study (UKCCS), a national population-based case-control study, full details of which are described elsewhere (www.ukccs.org).[9] Briefly, children (0–14 years of age) newly diagnosed with cancer between 1992 and 1996 in Great Britain were eligible to take part. Children with brain tumors were recruited from 1992 to 1994. For each case child, 2 controls matched by gender, month and year of birth, and region of residence were randomly recruited from primary care population registers. At the interview, parents were asked for consent to access their child's medical charts.

Four of the 10 UKCCS regions (coordinating centers in Leeds, Manchester, Oxford, and Southampton) systematically collected data from GP records for children with brain tumors from across all, or specific parts of, their region.[10,11] One center (Oxford) routinely abstracted data on each case and both controls; others opted for 1 control per case at varying times as the study progressed. It is important to note that, as with other components of the UKCCS that only collected additional data on 1 of the 2 individually matched controls, this control (the first randomly selected interviewed control) was identified in advance of abstraction.[12] GP records were abstracted for 195 of 221 (88%) children with brain tumors and for 285 controls. Forty-six percent of case children were from regions that targeted 1 control per case.

Data

A national coordinator with primary health care experience had oversight of the data-entry and data-collection process, with centrally trained research nurses responsible for data collection in each region.[10,11] During the relevant time period, GP records were mostly detailed handwritten notes, although a few practices had a combination of handwritten records and more recently introduced computerized information. All details recorded in children's records from birth to diagnosis/pseudodiagnosis were systematically abstracted onto specially designed forms. The data included:

- consultations with a GP or practice nurse, including recording of symptoms, signs, and diagnoses plus drugs and treatments prescribed;
- referrals to hospital consultants and other specialists, reasons for referral and, usually, eventual outcome;
- summaries of hospital admissions and outpatient consultations;
- results of investigations, including blood tests, radiographs, and screening tests; and
- general health information (eg, immunizations and routine health checks).

Disease and drug coding are key issues in the handling and analysis of such data. A unified approach facilitates coding and was achieved by using a sophisticated system of computerized, searchable "pick lists" embedded in the data-entry program. Illnesses and symptoms were centrally coded according to the *International Classification of Diseases, Tenth Revision* (ICD-10; www.who.int/

TABLE 1 Definition of Signs and Symptoms That Could Be Suggestive of a Brain Tumor ("Relevant" Symptoms)

Description	Examples of Details in General Practitioner Records	ICD-10 Codes
Anorexia	Not eating, off food/feeds, poor appetite, anorexia	F50.0, R63.0
Abnormal movements	Tremor, spasms, twitching, abnormal involuntary movements	R25 (excluding R25.0)
Back problems	Back pain, back stiffness, odd posture	M54.5, M54.9, R29.3
Cognitive impairment	Learning disability, severe developmental delay, attends special school	F70–79, F80, F83, R62.0, Z50.5, Z55.9
Congenital anomalies	Congenital anomaly of brain (unspecified), congenital ptosis, neurofibromatosis, tuberous sclerosis	Q04.3, Q04.9, Q10.0, Q85.0, Q85.1
Drowsiness	Drowsy, sleepy, reduced level of consciousness	R40
Emotional problems	Sleep problems, school phobia/refusal, unhappy, worries, bedwetting	F50 (excluding anorexia), F51, F90, F93, F95, F98 (excluding F98.8), F99
Focal weakness	Arm paralyzed, monoplegia, muscle weakness	G83.2, G83.3, M62.9
Growth problems	Physical delay, small for age, failure to thrive, disorder of puberty	E23.0, E30, E34, R62.8, R63.4
Head tilt	Head tilt, torticollis, wry neck, neck stiff, odd head movement	M43.6, M54.2, Q68.0, R25.0, R29.1
Headache	Headache (all types), migraine	G43, G44, R51
Hearing problems	Deafness, failed hearing test, noises in ear, tinnitus	H91.9, H93.1
Hydrocephalus	Hydrocephalus, including congenital (onset before tumor diagnosis)	G91, Q03, + increasing head circumference (no ICD code)
Incontinence	Incontinence in children who had attained bladder/bowel control	R15, R32
Papilloedema	Papilloedema	H47.1
Problem behavior	Behavior problems, personality change, confused, behaving oddly, referred to child psychologist	F91, F98.8, R41, R44, R46.2, Z50.4
Seizures	Seizures, fits, convulsions, epilepsy, funny turns, blackouts	G40, R55, R56 (excluding R56.0, febrile convulsions)
Unsteady on feet	Unsteady, ataxia, abnormal gait, clumsy, keeps falling over	F82, R26, R27, R42
Visual problems	Visual impairment, squint, diplopia, eye pain, referred to orthoptist	H02.4, H05, H47.2, H47.3, H50–57, Z50.6
Vomiting	Vomiting without diarrhea; vomiting not specified as gastroenteritis	R11
Other neurological	Neurological signs and symptoms not included above	G11.1, G31.9, G47.0, G51.0, G52.9, G71.0, G72.9, G80–81, G90.2, G93.0, G93.3, G96, G98, R20, R29 (excluding R29.1), R47, + query meningitis and will not use arms (no ICD codes)

classifications/icd/en). To bridge the gap between ICD-10 and the regional idiom used in medical charts, a specialist coding scheme was developed by listing ~4000 items and their appropriate ICD-10 code. Drugs were coded according to a schema based on the British National Formulary (www.bnf.org/bnf).

Strict quality-control procedures, including duplicate data entry of ~1 in 4 randomly selected records, were used throughout. Data collection and entry were structured around dated "events" (eg, a single consultation, hospital visit, or screening procedure), with all data entered centrally under the supervision of experienced primary care research nurses.

Each event was classified according to whether a "relevant" sign or symptom was recorded, and the number of relevant signs and symptoms recorded at each event was determined. Relevant signs and symptoms were defined as those that might be suggestive of a brain tumor, a judgment based on a combination of clinical experience and previous reports in the literature[5,6] (Table 1). The 21 relevant signs and symptoms identified ranged from common childhood symptoms with a variety of possible causes, not necessarily neurologic (eg, vomiting), to unusual symptoms sometimes observed at the time of brain tumor diagnosis (eg, head tilt), to signs almost certainly having an intracranial cause (eg, papilloedema).

Statistical Analysis

The objective of the analyses was to compare primary care attendance patterns of children in the case and control groups, including the total number of consultations, consultations with an infection recorded, those with at least 1 relevant symptom, those with more than 1 relevant symptom, the number of relevant symptoms, and the number of different relevant symptoms. All measures were compared by using log-linear negative binomial regression,[13] adjusted for gender, age at diagnosis, and region of residence as frequency-matching factors (Genmod procedure, SAS System [SAS Institute, Cary, NC]) (see supporting information).

In alternative analyses, the total number of visits was considered a measure of the propensity to visit a GP and was included as an adjustment ($\log_e$-transformed) in regression models of the numbers of visits with an infection, relevant symptom, multiple relevant symptoms, or number of relevant symptom records. Conditional analyses accounting for the matching of cases and controls were also performed. Conclusions drawn from these alternative analyses did not differ from those reported.

To examine the relationship between the number of consultations and time, the 5-year period before diagnosis/pseudodiagnosis for each child was divided into ten 6-month periods. The numbers of each outcome occurring in

TABLE 2 Numbers of Case and Control Children With Primary Care Data (GP Records) According to Gender and Age at Diagnosis/Pseudodiagnosis

Gender/Age	Controls, *n* (%)	Children With Brain Tumors, *n* (%)			
		Total	Astrocytoma	Medulloblastoma	Other
Total	285	195	78	46	71
Gender					
Female	143 (50)	102 (52)	46 (59)	20 (43)	36 (51)
Male	142 (50)	93 (48)	32 (41)	26 (57)	35 (49)
Age, y					
1–3	47 (16)	31 (16)	8 (10)	10 (22)	13 (18)
>3–5	45 (16)	31 (16)	17 (22)	5 (11)	9 (13)
>5–10	118 (41)	81 (42)	26 (33)	25 (54)	30 (42)
>10–<15	75 (26)	52 (27)	27 (35)	6 (13)	19 (27)
Mean (SE)	7.25 (0.22)	7.31 (0.27)	7.74 (0.44)	6.63 (0.50)	7.28 (0.45)

each 6-month period were determined. Cases and controls were compared by using log-linear negative binomial regression, adjusted for gender and age at diagnosis with a time-by-case/control designation interaction term to assess differences in the numbers of events between the 2 groups. Correlation between repeated observations on the same child in different time periods was estimated (and adjusted for) by using generalized estimating equations.[14]

The occurrence of pairs of relevant symptoms recorded at single GP visits was determined for all children. Using Bayes' theorem, we estimated the probability that a child in the general population would have a newly diagnosed brain tumor given that the child presented with a specific combination of symptoms (see supporting information). We obtained the population estimates required from our study sample and incidence and population data from the Office for National Statistics ("The Health of Children and Young People" [www.statistics.gov.uk/children]).

RESULTS

Cases and Controls

The mean age of case and control children was 7.31 years (SE: 0.27) and 7.25 years (SE: 0.22), respectively (Table 2). Approximately 40% of the children were 5 to 10 years old of the age at diagnosis/pseudodiagnosis.

Relevant Signs and Symptoms

Relevant signs and symptoms were recorded to varying degrees in the notes of both case and control children, with nearly all case children (98%) having at least 1 relevant symptom recorded in their GP history compared with 68% of controls. Four case children were diagnosed with congenital anomalies known to be associated with brain tumors (3 neurofibromatosis type 1, 1 tuberous sclerosis), although in only 1 child was the diagnosis made in infancy. The remaining 3 were diagnosed after their brain tumor symptoms began causing concern.

The prevalence of all individual symptoms was higher among case children than controls, with at least 1 occurrence of vomiting (in the absence of diarrhea or a diagnosis of gastroenteritis) being the most prevalent symptom in both groups (74% and 43%, respectively; Fig 1A). For case children, this was followed by headaches (59%), visual problems (44%), unsteadiness (42%), and anorexia (31%) and for con-

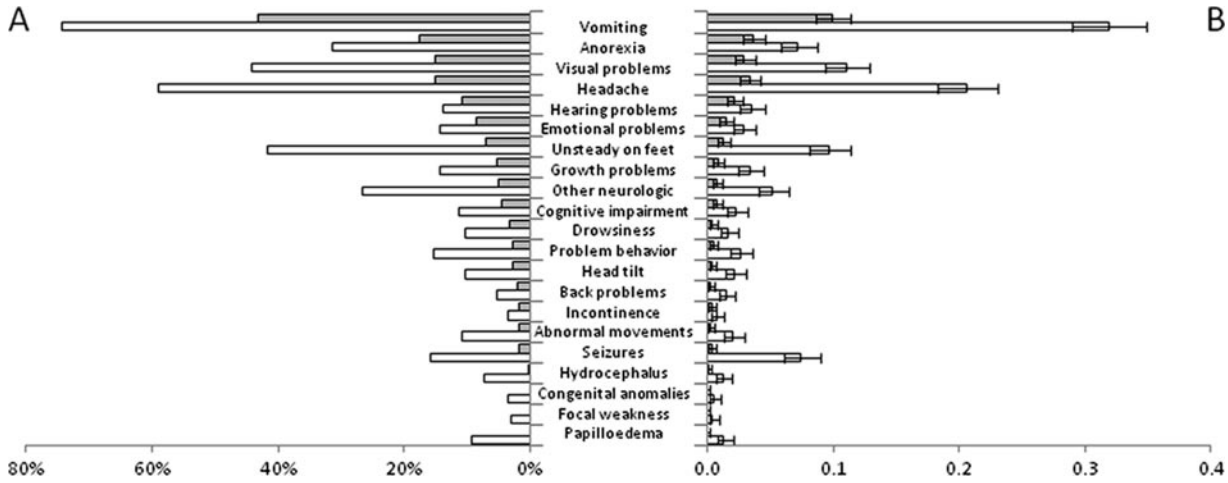

FIGURE 1
Proportions of children (case children, open bars; controls, solid bars) for whom each relevant symptom was recorded at least once (A) and incidence rate of GP visits (± exact 95% confidence limits) when each relevant symptom was recorded per child-year at risk for the period between birth and diagnosis/pseudodiagnosis (B).

TABLE 3 Comparison of Numbers and Types of GP Visits Between Birth and Diagnosis/Pseudodiagnosis With Results of Negative Binomial Regression Models[a]

Type of Visit	Mean (SE)	Case vs Control Relative Difference in Nos. of Events (95% CI)
All visits		1.22 (1.09–1.36)
Cases	31.5 (1.55)	
Controls	25.6 (1.11)	
Visits with at least 1 relevant[b] symptom recorded		3.29 (2.82–3.83)
Cases	6.4 (0.34)	
Controls	1.9 (0.13)	
Total relevant[b] symptoms recorded		4.15 (3.53–4.88)
Cases	9.6 (0.51)	
Controls	2.3 (0.17)	
Visits with >1 relevant[b] symptom recorded		7.01 (5.38–9.13)
Cases	1.9 (0.12)	
Controls	0.3 (0.04)	
No. of distinct relevant[b] symptoms recorded		2.80 (2.48–3.16)
Cases	4.3 (0.15)	
Controls	1.5 (0.09)	
Visits with an infection recorded		1.08 (0.96–1.21)
Cases	13.6 (0.7)	
Controls	12.6 (0.59)	

[a] Regression models adjusted for age at diagnosis, gender, and region of residence.
[b] See Table 1.

trols by anorexia (18%), headaches (15%), and visual (15%) and hearing (11%) problems. The rates of visits to a GP with each symptom showed similar patterns (Fig 1B).

GP Visits

On average, between birth and diagnosis/pseudodiagnosis, case children consulted a GP more often than controls (31.5 vs 25.6 visits; 1.22 times more often [95% confidence interval (CI): 1.09–1.36]), an excess that is largely a result of attendance with relevant symptoms (Table 3). The presence of at least 1 relevant symptom was recorded more than 3 times as often for case children as for controls (95% CI: 2.82–3.83). Case children also had 4 times as many relevant symptoms recorded (95% CI: 3.53–4.88) and 7 times as many consultations when more than 1 relevant symptom was recorded (95% CI: 5.38–9.13). The number of different relevant symptoms recorded for case children (mean: 4.2) was also greater than for controls (mean: 1.5; 2.80 times as many symptoms [95% CI: 2.48–3.16]). There was no difference between case and control children in the numbers of visits with an infection recorded (Table 3).

Time Before Diagnosis

Control children visited a GP about once every 4 months (0.25 visits per child per month), and this remained relatively constant in the years leading up to pseudodiagnosis (Fig 2A). Similarly, they had a relatively constant rate of visits when 1 of the relevant symptoms was recorded (~0.02 visits per child, or 1 visit per 50 children per month [Fig 2B]). In case children, GP attendance became more frequent from ~2 years before tumor diagnosis (Fig 2A), and their rate of consultation with at least 1 relevant symptom seemed higher for most of the 5 years, with this difference increasing in the 2 years before diagnosis (Fig 2B).

Results of regression models based on data split into 6-month periods before diagnosis showed that case children had consultations more frequently than controls in each 6-month period

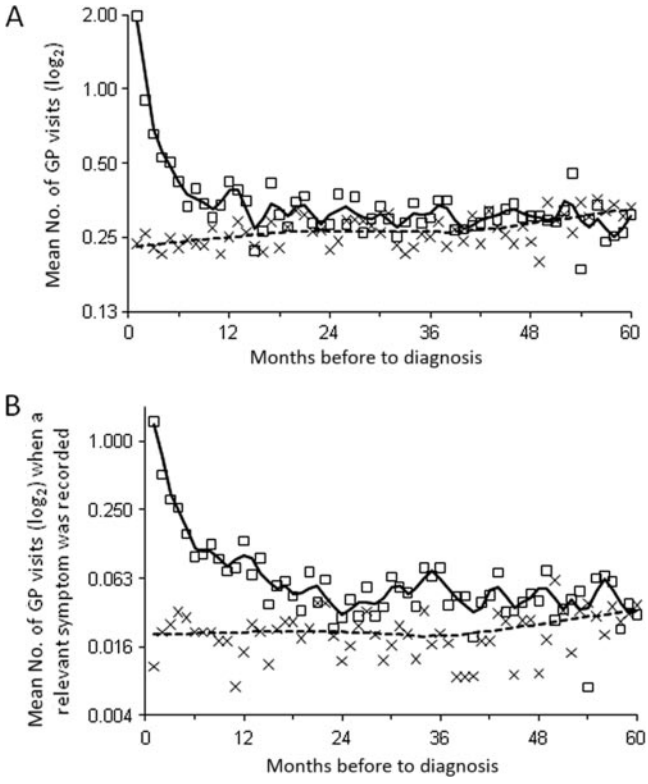

FIGURE 2
Mean numbers of GP visits (A) and GP visits when at least 1 relevant symptom was recorded (B) for case (squares) and control (crosses) children for each month in the 5 years before diagnosis/pseudodiagnosis. Lines are smoothed fits to the data (Loess procedure, SAS system).

TABLE 4 Comparisons of the Numbers and Types of GP Visit According to Cases and Controls in the 5 Years Before Diagnosis/Pseudodiagnosis With the Results of Negative Binomial Regression Models[a]

Months Before Diagnosis	Case vs Control Relative Difference in Nos. of Events (95% CI)[b]				
	GP Visits	Visits With a Relevant Symptom[b]	No. of Relevant Symptoms[b]	Visits With ≥1 Relevant Symptom[b]	Visits With an Infection
0–6	3.79 (3.19–4.50)[c]	20.81 (14.29–30.30)[c]	28.35 (19.05–42.19)[c]	41.63 (20.78–83.4)[c]	1.72 (1.35–2.18)[c]
7–12	1.49 (1.22–1.83)[c]	6.15 (3.83–9.87)[c]	7.3 (3.94–13.52)[c]	12.7 (3.62–44.53)[c]	1.12 (0.87–1.45)
13–18	1.29 (1.04–1.61)[c]	2.74 (1.75–4.28)[c]	3.93 (2.21–6.99)[c]	9.17 (2.06–40.87)[c]	1.01 (0.77–1.34)
19–24	1.09 (0.86–1.38)	1.66 (1.01–2.73)[c]	1.79 (1.06–3.04)[c]	1.93 (0.79–4.71)	1.05 (0.80–1.37)
25–30	1.14 (0.91–1.43)	1.97 (1.23–3.16)[c]	2.23 (1.24–4.00)[c]	7.43 (1.72–32.12)[c]	1.12 (0.85–1.48)
31–36	1.17 (0.93–1.47)	2.69 (1.63–4.45)[c]	3.16 (1.88–5.30)[c]	5.82 (2.00–16.95)[c]	1.15 (0.87–1.51)
37–42	1.11 (0.88–1.40)	2.7 (1.43–5.08)[c]	2.73 (1.34–5.6)[c]	1.82 (0.28–11.87)	1.08 (0.83–1.40)
43–48	1.07 (0.82–1.40)	1.83 (1.00–3.37)[c]	2.06 (1.03–4.12)[c]	2.03 (0.53–7.73)	1.06 (0.80–1.42)
49–54	0.99 (0.79–1.23)	1.08 (0.63–1.83)	1.04 (0.59–1.84)	1.02 (0.34–3.05)	0.91 (0.68–1.22)
55–60	0.83 (0.67–1.04)	1.45 (0.83–2.53)	1.5 (0.86–2.63)	2.68 (0.49–14.53)	0.84 (0.63–1.10)

[a] Regression models were adjusted for age at diagnosis, gender, and region of residence and for correlation between repeated observations over time by using generalized estimating equations.
[b] See Table 1.
[c] 95% CI excludes no effect.

in the last 18 months before diagnosis (Table 4). In the previous 6 months, they had consultations almost 4 times as often and had almost twice as many visits with an infection recorded. For each 6-month period in the 4 years before diagnosis, case children had at least twice as many consultations with at least 1 relevant symptom recorded (20 times as many in the 6 months before diagnosis) and 2 to 3 times more records of relevant symptoms (30 times as many in the 6 months before diagnosis). In the last 3 years before diagnosis, consultations with more than 1 relevant symptom were more frequent among case children (Table 4).

Symptom Combinations

Compared with children subsequently diagnosed with brain tumors, few unaffected children had visits with specific combinations of relevant symptoms (Fig 3). The most frequently observed symptoms for case children were vomiting combined with headache (38%), unsteadiness on feet (13%), visual problems (13%), or anorexia (8%); headache combined with visual problems (15%) or unsteadiness on feet (12%); and visual problems combined with unsteadiness on feet (8%). Most of these were rare in control children, the most frequent symptom being vomiting and headache (5%) or anorexia (4%; Fig 3).

Estimated probabilities of a child having a brain tumor given a visit to a GP with both vomiting and either unsteadiness or visual difficulties or with both headache and unsteadiness were 0.15%, 0.088%, and 0.085%, respectively. This means that ~1 in 654 children younger than 15 years of age presenting with vomiting and unsteadiness, or 1 in 1142 children with vomiting and visual difficulties, or 1 in 1172 children with headache and unsteadiness at a single visit will have an undiagnosed brain tumor (Fig 3) compared with a 1-year-period prevalence of new brain tumors of 0.003% (~1 in 33 000 children) in the general population. All other symptom combinations (except vomiting or headache with anorexia) had a predictive probability of between 1 in 1500 and 1 in 8000 children (Fig 3). Confidence limits for the estimated probabilities associated with different symptom combinations were not calculated, because estimates were intended to be considered qualitatively rather than quantitatively. Indeed, because of the relative infrequency of most symptom combinations among control children, any confidence limits would be expected to be wide. The absence of certain symptom combinations among the control children precluded calculations for these combinations.

DISCUSSION

The multiplicity of signs and symptoms identified in the primary care records of our case children was broadly similar to those previously reported at the time of presentation and diagnosis in secondary care. There were, however, marked differences in the relative frequency and rank of individual symptoms. Although headache predominates as the most frequently reported symptom in hospital-based studies, reported for 33% to 41% of children,[5,6] our primary care data identified vomiting (in the absence of diarrhea or gastroenteritis) as the most common symptom. It was recorded at least once for almost three quarters of the case children between birth and diagnosis but also, it is important to note, for 15% of the unaffected controls. The remainder of the top 5 symptoms for case children (headaches, visual difficulties, unsteadiness, and anorexia) were also recorded more frequently than has been reported previously from hospital-based studies.[5,6] This may reflect differences in

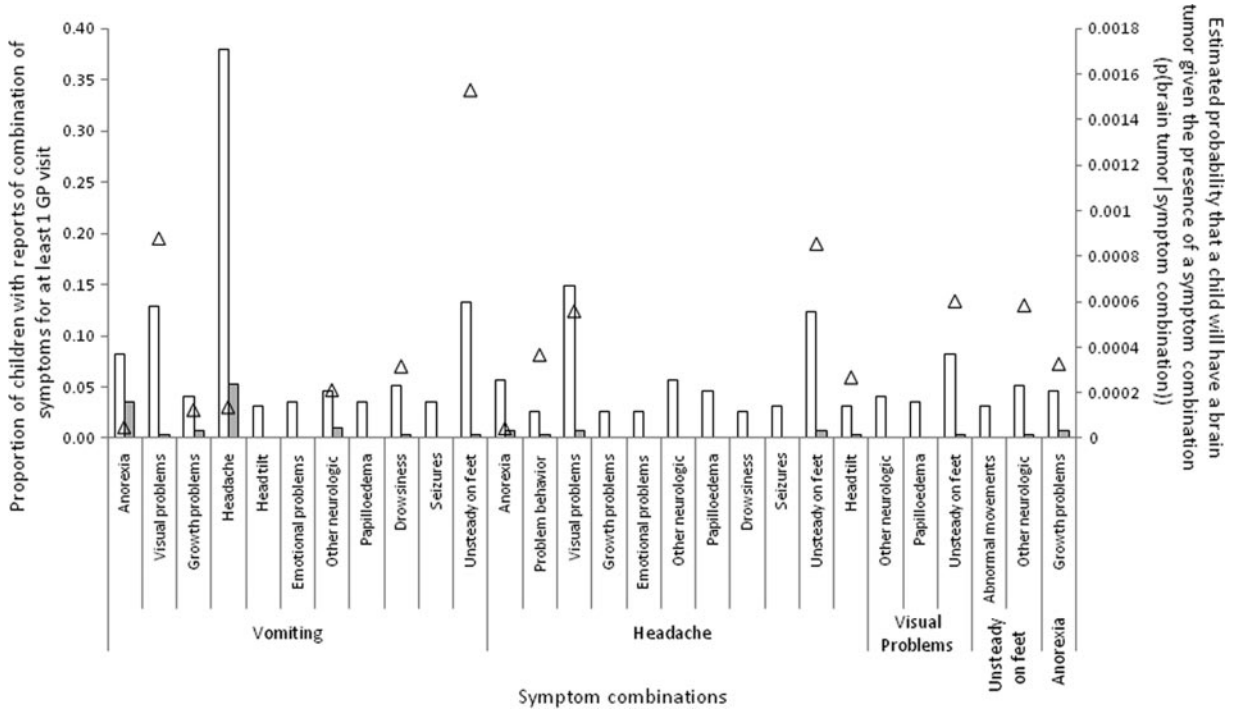

FIGURE 3

Percentage of case (open bars) and control (solid bars) children having specific symptom combinations recorded at least once between birth and diagnosis/pseudodiagnosis and the estimated probability that a child will have a brain tumor given the presence of a symptom combination at a single GP visit (triangles).

time frames, because symptoms reported in our study were recorded from birth onward.

As would be expected, the proportions of control children with any 1 relevant symptom recorded and the number of visits in which a relevant symptom was recorded remained stable for up to 5 years before diagnosis/pseudodiagnosis. Conversely, for case children, the consultation rate with at least 1 relevant symptom was higher for most of this time period, escalating in the 2 years before diagnosis.

Although remarkably little is known about the etiology of brain tumors in children, for a minority, there are well-established associations with familial cancer syndromes, in particular, with neurofibromatosis type 1 and tuberous sclerosis.[15–17] There is marked clinical variability in both, even among relatives, and careful monitoring of children who present with cutaneous features (café au lait spots, angiofibromas) is often recommended.[15,18,19] However, monitoring would not have influenced the timing of tumor diagnosis in 3 of the 4 children with familial cancer syndromes reported in our study, because the syndrome was not diagnosed until their brain tumor symptoms began causing concern. In addition, although each child had an apparently more mildly affected mother, only 1 mother was known to be affected before her child's diagnosis, the latter triggering testing of other family members.

The difficulty for GPs is to identify the 1 child among many with a relatively common symptom, such as vomiting, who merits referral for additional investigation. Because very few control children had combinations of relevant symptoms or signs in their records, the much more frequent reporting of multiple symptoms among cases, and of specific combinations of symptoms, is probably important. This is especially true because up to 3 years before diagnosis, primary care attendance with more than 1 suggestive symptom was higher for children subsequently diagnosed with a brain tumor. Low-grade tumors are known to have a longer, more insidious onset and to have a good outcome in terms of survival. However, early diagnosis can have a big impact on minimizing subsequent morbidity, particularly visual outcome.[20]

In this report, children with brain tumors were considered as 1 group. Symptoms and signs are known to vary according to tumor location; although these differences may be important for diagnostic accuracy in secondary care, they are less so in primary care. The most frequently observed combination of symptoms, vomiting with headache, was observed in more than one third of the case children but was also recorded for 1 in 20 controls. Most other combinations were rare in

controls. Other features noted included more frequent attendance with relevant symptoms, although not with infections, and unusual symptoms without obvious cause.

There was little evidence of findings from neurologic examination in our data. Although it may be unrealistic to expect GPs to carry out a complete neurologic examination on a possibly uncooperative child in a short consultation, our findings argue for at least a limited examination, including evaluation of optic fundus, eye movements, walking, and pronator drift. In addition to the specific symptom combinations reported here, symptoms such as head tilt, odd head movements, odd posture, back or neck stiffness, and unsteadiness without obvious cause merit referral to a pediatrician for assessment. Visual problems are often diagnosed by others, particularly opticians. A clear referral pathway directly to the GP or pediatrician is needed if concerns are raised.

CONCLUSIONS

Comprehensive data on the signs and symptoms children present to GPs are sparse; yet, to recognize children with rare conditions such as brain tumors, GPs first need to know what is normal for, and what to expect from, a child of any given age. To help provide this information, we are currently compiling a large data set from children's primary health care records. A strength of our data is that they come from a unique time period in the United Kingdom when symptom details are most complete, having been written by hand at the time of consultation. Key to identifying the 1 child among many who merits prompt referral to a pediatrician for investigation is recognition of unusual or unexpected symptoms or specific symptom patterns.

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