Monthly variation in pediatric visits for headache to US emergency departments

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ABSTRACT

Headache is a common pediatric symptom often associated with stress and fatigue which may be more common during the school year. The purpose of this study is to determine if visits for headache are more common during the months of the school year. This study is a secondary analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS) database from 2001 to 2010. Patient visits in those aged 18 years or younger not associated with injury were examined. Only visits with an International Classification of Diseases, ninth revision (ICD-9) code consistent with headache were included. Data were analyzed using cumulative binomial probabilities. This statistic was used to establish the chance of seeing up to the observed number of visits for headache in a given month assuming that all months have an equal number of visits. A total of 660 unweighted visits representing 3.2 million patient encounters met the inclusion and exclusion criteria. Visits for headache were more common during the months of January, September, and October and less common in March, April, July, and November. Subgroup analysis was performed for children aged 13–18 years. In this subgroup, headaches were more common in January, September, and October. They were less common in July and December. Headache is more common during the first 2 months back to school in the fall as well as after the winter break in January. While we are not able to establish causality, we propose that children with headache require additional attention during the school year, particularly in the months following summer and winter breaks.

Significance of this study

What is already known about this subject?

- Headache is a common pediatric symptom.
- Headache is often associated with stress and fatigue.
- Care for headache is often sought in the emergency department.

What are the new findings?

- Emergency department visits by children for headache were more common during September, October, and January.
- These months represent the first months back from Summer and Winter breaks.

How might these results change the focus of research or clinical practice?

- The increase in headaches may be related to reduced sleep and increased stress during those times.
- Primary prevention strategies during the critical times may decrease the burden of disease.

INTRODUCTION

Headache is a common pediatric symptom. It is estimated that up to 75% of children will experience a headache by age 15 and more than 90% of adults report having had a headache during their lifetime.[1] One recent study reported that the average cost of an emergency department (ED) visit in the USA for headache in adults was $1727.[2] Headache comprises 0.7–1.3% of visits to pediatric EDs each year.[3 4] This represents a significant and expensive burden on pediatric EDs.

Seasonal variation of migraine headache has previously been described in adults.[5–10] Many of these studies have included populations near the Arctic Circle where seasonal variations of midnight sun and polar darkness exist. It has been hypothesized that prolonged exposure to sunlight may trigger migraine headaches.[5–7] The results in outpatient adult populations have been mixed with some studies showing increased incidence during particular seasons while others have documented no such relationship.[5–10]

Several studies have retrospectively identified a similar seasonal phenomenon in children. In a headache clinic-based study, a greater incidence of migraine headaches was reported between November and January, with a nadir in July. This was thought to be related to the stresses and fatigue of scholastic work.[11] If this variation exists in ED visits, identifying it would be an initial step in understanding the factors that cause children to seek resource-intense emergency care for headaches. Primary care providers could potentially recognize the increased risk of headache during the school year and intensify recognition and prevention efforts.

The purpose of this study is to validate previous single-center findings using a national database and determine monthly trends in pediatric ED visits. We hypothesize that visits for

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headache are more common in September, October, and November and less common in May and June.

METHODS

Study design and setting

This study is an analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS) database from 2001 to 2010. The NHAMCS is an annual national probability sample of ambulatory visits made to non-federal, general, and short-stay hospitals in the USA conducted by the Center for Disease Control and Prevention, National Center for Health Statistics (NCHS). NHAMCS used a four-stage probability design with samples of primary sampling units (PSUs), hospitals within PSUs, emergency service areas within EDs, and patient visits within emergency service areas. It included 112 PSUs from which eligible EDs were selected for participation in the database. Eligible EDs included hospitals with an average length of stay for all patients of <30 days, general or pediatric hospitals, and those staffed 24 hours per day. Trained staff at each of the selected sites completed the data collection forms over a randomly selected 4-week period.

Data collection and processing

NHAMCS data for the years 2001 through 2010 were included in the study. Only patient visits in those aged 18 years or younger were examined. Patient visits with an International Classification of Diseases, ninth revision (ICD-9) code of 307.81 (tension headache), 339 (other headache syndromes), 346.x (migraine headache), or 784.0 (headache not otherwise specified (NOS)) associated with the encounter were included. ICD-9 codes for all four ED diagnoses were analyzed. Visits were excluded if they were associated with an injury. Data were combined for all years studied and analyzed en bloc.

The data collected included information on patient demographics (age, race, gender), reasons for visit, vital signs, cause(s) of injury, diagnoses rendered, diagnostic tests ordered, procedures provided, medications prescribed, providers consulted, and disposition including hospital discharge information if admitted (since 2005). For the study period, an average of ~91.3% of sampled hospitals participated annually in the survey, and about 93.9% of sampled EDs provided complete information on their sample visits for a total unweighted response rate of 85.7%.

Statistical analysis

The survey data were analyzed using the sampled visit weight which is the product of the corresponding sampling fractions at each stage in the sample design. The sampling weights have been adjusted by the NCHS for survey non-response within time of year, geographic region, urban/rural and ownership designations, yielding an unbiased national estimate of ED visit occurrences, percentages, and characteristics. Owing to the complex sample design, sampling errors were determined using SPSS Statistics V.21 (SPSS, Chicago, Illinois, USA). The SPSS complex samples module was used to take into account the clustered nature of the sample.

All statistics were calculated using SPSS Statistics V.21. The χ^2 contingency tables were used to analyze the demographic data for differences among the races and genders. Cumulative data for the study period were analyzed using cumulative binomial probabilities. The cumulative binomial probability was used to establish the chance of seeing up to the observed number of visits for headache in a given month assuming that all months have an equal number of visits. A value of 0.95 or greater means this is very likely while a number of 0.05 or less means that this is unlikely. Subanalysis was performed on the group of visits associated with school-aged children (5–18 years) and adolescents (13–18 years). Care was taken to ensure that there were a minimum of 30 unweighted patient visits for each month in each of the age groups that were analyzed.

The SPSS Statistics V.21 with the complex samples module was used to determine the overall demographics of the data set. The mean age was calculated for all ages as well as for each of the age groups. In addition, the frequencies of race and gender were determined for all ages and each age group.

RESULTS

A total of 660 unweighted visits representing 3.2 million patient encounters met the inclusion and exclusion criteria. The mean age of the patient visits in this study was 12.68 years (table 1). The mean age of patient encounters with tension headaches was 13.90 years, migraine headaches was 14.38 years, and headache NOS was 12.05 years. The mean ages were further broken down in the two age groups analyzed. There was no difference in the distribution of race between the different headache types. There was a significant difference in the breakdown of gender between the different headache types ($p=0.037$) with a higher proportion of women experiencing migraine headaches compared with the other headache groups. Overall, there was also a higher percentage of women (59%) with headaches compared with men (table 1). The race and gender of the patient visits were further broken down by age group.

Figure 1 shows graphically the monthly variation of visits for headaches during the study period. Table 2 demonstrates that visits for headache were more common during the months of January, September, and October and less common in March, April, July, and November.

A subgroup analysis was performed on the group comprising only children aged 5–18 years. This group was selected because it encompasses the ages of mandatory schooling in the USA. There was an estimated total of 3.0 million encounters in this subgroup. Headaches were more common in January, September, and October. They were less common in March, April, July, November, and December (table 2 and figure 2).

Further subgroup analysis was performed on the group comprising only children aged 13–18 years. This was done to include teenagers specifically, a group that may be more prone to the stressors and sleep deprivation associated with attending school. There were a total of 1.9 million encounters in this subgroup. Headaches were more common in January, September, and October. They were less common in July and December (table 2 and figure 3).

DISCUSSION

Since there is likely to be increased stress and decreased sleep during the school year, we postulated that there

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Table 1 Demographics

Headache type	Mean age (years)	Race (percent)				Gender (percent)		
		Black	White	Other	p Value	Female	Male	p Value
All ages					0.472			0.037
Total	12.68	24.3	71.6	4.0		59.0	41.0	
Tension	13.90	28.5	69.8	1.7		51.1	48.9	
Migraine	14.38	18.6	76.3	5.1		68.8	31.2	
NOS	12.05	26.1	70.1	3.8		56.0	44.0	
Age 5–18 years					0.409			0.068
Total	13.31	24.5	71.4	4.0		59.7	40.3	
Tension	13.90	28.5	69.8	1.7		51.1	48.9	
Migraine	14.70	18.9	75.8	5.2		68.8	31.2	
NOS	12.78	26.4	69.9	3.7		56.8	43.2	
Age 13–18 years					0.417			0.097
Total	15.96	23.7	72.9	3.4		65.6	34.4	
Tension	15.58	32.4	65.4	2.2		53.8	46.2	
Migraine	16.26	20.6	73.7	5.7		74.1	25.9	
NOS	15.84	24.6	73.0	2.4		62.2	37.8	

NOS, not otherwise specified.

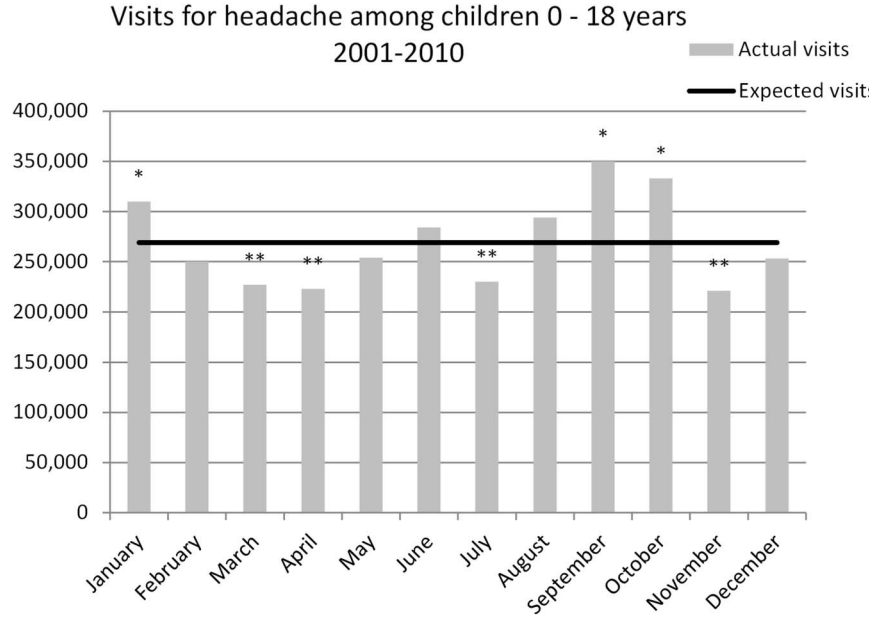

Figure 1 Visits for headache among children aged 0–18 years. '*' Indicates that the number of visits is significantly higher than expected. '**' Indicates that the number of visits is significantly lower than expected.

would be a greater incidence of ED visits for headache during the school year, particularly in adolescents who may be more prone to these stressors and behaviors. Our data demonstrated this to be the case and imply that headache may be more common or more severe during the first 2 months back to school in the fall as well as the return to school after the winter break in January.

Our data also suggest that headache frequency is decreased during the month of July. This further supports and justifies a previous NHAMCS pediatric ED headache study in which the authors used July as a reference in their analysis of headache frequency with assumption, but there are no clear data that July has less pediatric ED headache visits.[12] The goal of the study was to compare the school months to the summer months rather than to just look at all the months equally for trends. The authors showed an increase in adolescent ED visits for headache-related symptoms during the months of January and September.[12] They speculated that this was a result of the stress and decreased sleep associated with the schedule change coinciding with return to school. We found similar results to the previous study using a different statistical analysis approach, further suggesting the increased incidence of pediatric headaches in the months of January and September. Using our analysis, we were also able to identify months with decreased headache frequency than expected. This addresses a limitation of the previous study.

We also found that women are more likely to present to the ED with the symptom of headache. One recent

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Table 2 Binomial probabilities by month and age grouping—probabilities of having up to the number of visits observed in each month if visits were distributed equally across months during the study period

Month of year	Expected percentage of total	Age 0–18 years			Age 5–18 years			Age 13–18 years		
		Observed frequency	Expected frequency*	Cumulative binomial probability†	Observed frequency	Expected frequency*	Cumulative binomial probability†	Observed frequency	Expected frequency*	Cumulative binomial probability†
January	8.33	310,000	269,000	0.995	306,000	253,000	1.0	183,000	157,000	0.985
February	8.33	250,000	269,000	0.119	240,000	253,000	0.199	148,000	157,000	0.243
March	8.33	227,000	269,000	0.003	225,000	253,000	0.032	157,000	157,000	0.524
April	8.33	223,000	269,000	0.001	210,000	253,000	0.002	152,000	157,000	0.360
May	8.33	254,000	269,000	0.178	245,000	253,000	0.304	150,000	157,000	0.299
June	8.33	284,000	269,000	0.838	251,000	253,000	0.454	141,000	157,000	0.098
July	8.33	230,000	269,000	0.006	206,000	253,000	0.001	96,000	157,000	<0.001
August	8.33	294,000	269,000	0.946	271,000	253,000	0.882	154,000	157,000	0.425
September	8.33	350,000	269,000	1.0	336,000	253,000	1.0	225,000	157,000	1.0
October	8.33	333,000	269,000	1.0	316,000	253,000	1.0	206,000	157,000	1.0
November	8.33	221,000	269,000	<0.001	208,000	253,000	0.001	143,000	157,000	0.131
December	8.33	253,000	269,000	0.162	228,000	253,000	0.049	129,000	157,000	0.010
Total		3,228,000‡	3,228,000		3,041,000‡	3,036,000§		1,883,000‡	1,884,000§	

All entries are rounded to the nearest thousand.
*Total observed divided by 12; included for reference only.
†Cumulative probability that the actual number of headaches is less than or equal to the observed number with the given expected percent in the total number of trials.
‡Total of months does not equal point estimate due to rounding.
§Total expected does not equal total observed due to rounding.

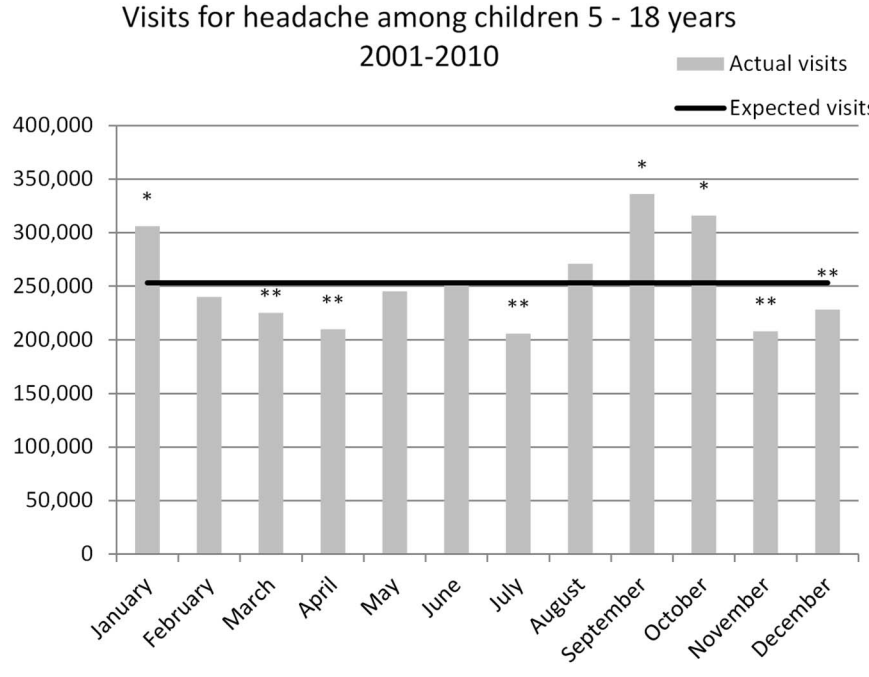

Figure 2 Visits for headache among children aged 5–18 years. '*' Indicates that the number of visits is significantly higher than expected. '**' Indicates that the number of visits is significantly lower than expected.

epidemiological study of headache in children found an overall prevalence of 54.4% with 59.2% of those being female. This gender distribution mirrors our findings for ED visits.[13] This implies that stressors associated with the initiation of school attendance seem to affect both genders equally. Focused interventions can perhaps help prevent or decrease the frequency and intensity of the headaches in both genders.

Our conclusions are based on a generalization of the school calendar in the USA. Figure 4 is a graphical representation of the times of year when school is in and out of session. In general, there are major breaks from school

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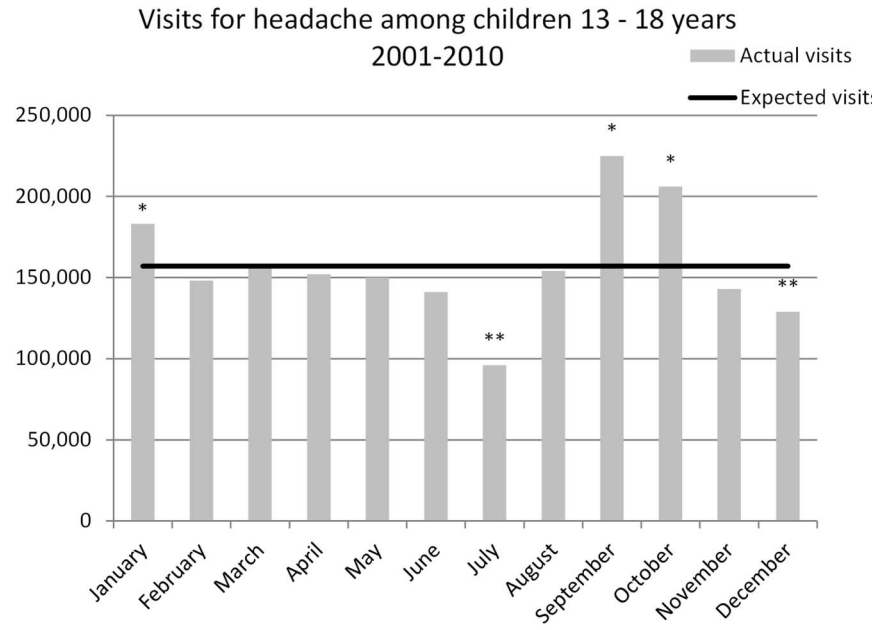

Figure 3 Visits for headache among children aged 13–18 years. '*' Indicates that the number of visits is significantly higher than expected. '**' Indicates that the number of visits is significantly lower than expected.

during much of the summer as well as for a few weeks from mid–late December to early–mid January.

These results differ somewhat from what was found in a previous single-center study which demonstrated the existence of seasonal variation in children.[13] The authors examined visits for headache in children aged 4–17 years and showed a decreased incidence of visits in May and June and an increase in September, October, and November. They also speculated that this coincided with increased stress and decreased sleep during the school year leading to more frequent severe headaches in those prone to get them.[14] In the current study, the subgroup analysis of children aged 5–18 years shows that headaches are more common in January, September, and October.

Some of the difference is explained by the slight difference in the age range. We sought to analyze the subgroup that was school aged, which is 5–18 years in the USA. We believe this to be a clinically relevant manner in which to cluster the data. This study is based on a national sample. The data are more heterogeneous and less prone to referral bias compared with data from a single center. The NHAMCS data include both general and pediatric hospitals. Notably, the single-center study site is not a participant in the NHAMCS database. We believe that these differences explain much of the variation in the results between the two studies.

Limitations

The primary limitations with this study are based on the data set we studied. As with any NHAMCS analysis, there is the possibility of incorrect data collection by survey abstractors.[15] In addition, there could have been incorrect coding of the diagnosis which may have led to the inappropriate inclusion or exclusion of patient visits in the overall study or misclassification in the different headache groups. There were coding changes of some of the variables within

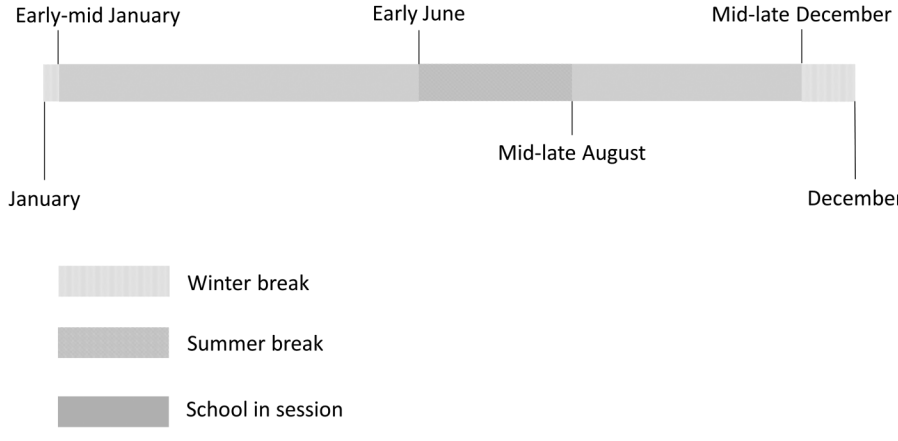

Figure 4 Representative school year timeline in the USA.

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the NHAMCS data set during different years included in the study. However, we were careful to eliminate any bias introduced by coding changes across the study period by recoding any variables with coding changes to maintain consistency throughout the years. NHAMCS is also limited because there must be at least 30 patient visits to obtain accurate population estimates. We included enough years in the study to assure that we achieved this minimum number of raw patient visits in the analysis to avoid this limitation.

The type of data set and analysis that we performed could not include weather patterns or seasonal variation of sunlight exposure which may have contributed to headaches. In addition, we were not able to specifically assess sleep patterns, travel/vacations, or stress to determine which, if any, of these could have contributed to the frequency of headache visits in pediatrics.

CONCLUSION

Visits to the ED for headaches are more common in the months immediately following school breaks. While we are not able to establish causality, we propose that children with headache require additional attention during the school year, particularly in the first 2 back to school months as well as the first month back from the winter break. Possible primary prevention interventions would include stress reduction techniques, attention to hours of sleep, or pharmacological prophylaxis during the time period in question.

Contributors KC conceptualized and designed the study, carried out the cumulative binomial probability analyses, drafted the initial manuscript, revised the manuscript, and approved the final manuscript as submitted. AR performed the demographics and complex sample portions of the analysis, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

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