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Intractable pediatric temporal lobe epilepsy in the United States: examination of race, age, sex, and insurance status as factors predicting receipt of resective treatment

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Object. For patients with intractable temporal lobe epilepsy (ITLE), resection of the temporal lobe has been proven to be far superior to continued medical management. The goal of this study was to evaluate on a national level whether race and other sociodemographic factors are predictors of receipt of resective treatment for pediatric ITLE.

Methods. A retrospective cohort study was performed using the Kids' Inpatient Database covering the period of 1997 through 2003. Only children admitted for resection for ITLE (ICD-9-CM 345.41, 345.51; primary procedure code 01.53) were included. Variables studied included patient race, age, sex, and primary payer.

Results. Multivariate analyses revealed no significant difference in the odds of undergoing resection for ITLE for black children compared with nonblack children (odds ratio [OR] 0.66, 95% confidence interval [CI] 0.28–1.53, p = 0.327), or between female and male children (OR 1.11, 95% CI 0.76–1.63, p = 0.586). Older children were more likely to undergo resection for ITLE (OR 1.07, 95% CI 1.03–1.11, $p < 0.001$ per 1 year increase in age), as were children with private insurance (OR 2.21, 95% CI 1.34–3.63, p = 0.002).

Conclusions. In this first nationwide analysis of pediatric ITLE, older age and private insurance status independently predicted which children were more likely to receive surgical treatment for ITLE on a national level, whereas sex did not. Black children with ITLE were no less likely to receive surgical intervention than nonblack children. Future nationwide analyses will be required to determine whether these trends for pediatric ITLE surgery remain stable over time. *(DOI: 10.3171/PED-07/12/469)*

Key Words • pediatric neurosurgery • predictive factor • race • resection • temporal lobe epilepsy

Racial disparities in adult patient care have been well documented for a multitude of medical conditions, including acute myocardial infarction, colorectal cancer, depression, transient ischemic attack, diabetes, and hypertension.[7,13,14,22,26,36] Such disparities have also been reported in the pediatric population, notably in asthma, fractures, tuberculosis, appendicitis, hemodialysis, and preventive care.[10,17,19,24,28,31] Largely as a result of increased awareness of these disparities, the US government initiated legislation, first in 1993 and subsequently in 1996, to address and correct the situation.[29,35]

Defined as two or more unprovoked seizures, epilepsy affects one in every 118 Americans.[12] Persistence of seizures despite at least two adequate trials of antiepileptic medication is known as intractable epilepsy, with epilepsy localized to the temporal lobe being one of the most common intractable epilepsy syndromes.[11,25] The findings of a randomized prospective trial comparing temporal lobectomy to continued medical management for ITLE revealed a marked benefit for surgical intervention in adult patients.[39] Multiple studies have confirmed that when surgery is performed in appropriately selected adult patients with ITLE, between 60 and 80% become seizure free postoperatively.[8,16,21,32,37] Furthermore, this benefit has been demonstrated in a number of studies involving the pediatric population, with minimal surgical morbidity and postoperative rates of seizure freedom ranging from 69 to 100% following temporal lobectomy.[2,5,6,20,23,30,34]

To date, there has been no nationwide examination of the effect of race on the receipt of surgery among pediatric patients with ITLE. Only one previous study, focusing pri-

Abbreviations used in this paper: AHA = American Hospital Association; CI = confidence interval; ITLE = intractable temporal lobe epilepsy; KID = Kids' Inpatient Database; OR = odds ratio; SD = standard deviation.

marily on adult patients and based in a single center, has examined the role of race in the receipt of ITLE surgery.[3] To address this gap, we undertook this study of race and other sociodemographic factors such as age, gender, and insurance status as potential predictors of receipt of surgical treatment for ITLE in the pediatric population on a nationwide level, using data obtained from the time period following the federal initiative to eliminate racial disparities in healthcare.

Clinical Material and Methods

Data Source

The data source for this study was the KID (overview available at http://www.hcup-us.ahrq.gov/kidoverview.jsp), covering the years 1997 through 2003. Containing data pertaining to patients 20 years of age and younger, the KID was obtained from Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.[31] For the years of interest in this study, the KID contains data on 100% of discharges from a stratified random sample of nonfederal hospitals in 22 to 36 states (number of states increased annually from 1997 to 2003), containing data on 2 to 3 million hospital discharges from a sample of 2500 to 3500 US nonfederal hospitals.

Inclusion and Exclusion Criteria

Using a combination of patient age and the International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis and treatment codes, the KID was searched to identify admissions for temporal lobectomy for ITLE. Admissions with a primary diagnosis code of 345.41 (intractable partial epilepsy with impairment of consciousness) or 345.51 (intractable partial epilepsy with mention of impairment of consciousness), and a primary procedure code of 01.53 (brain lobectomy) were included. Patients with ITLE who received surgical treatment were compared with those meeting diagnoses codes 345.41 and/or 345.51 who did not undergo surgery.

Characteristics of Patients

In addition to race, patient age, sex, and primary payer (Medicare, Medicaid, private insurance, self-pay, no charge, or other) were coded in the KID. Only patients for whom data on race were provided in the database were included in the analysis, and the analysis was focused on comparisons between black and Caucasian patients. For the purposes of this study, the entire nonblack population is referred to as Caucasian, consistent with the methodology of previous studies.[1,15]

Statistical Analysis

Rao–Scott modified chi-square tests for univariate comparisons were performed using PROC SURVEYFREQ from SAS version 8.0 (SAS Institute). This method allowed the discharge weights based on the 2003 AHA Annual Survey Database files to be taken into account, with subsequent extrapolation to the entire US population from which our sample was drawn.

For sampling, pediatric discharges were stratified by the following: uncomplicated in-hospital birth, complicated in-hospital birth, and all other pediatric cases. To further ensure an accurate representation of each hospital's pediatric case mix, discharges were also sorted by state, hospital, and diagnosis-related group, and a diagnostic code chosen randomly from within each diagnosis-related group. Systematic random sampling was then used to select 10% of uncomplicated in-hospital births and 80% of complicated in-hospital births as well as other pediatric cases from each hospital in the sampling frame. National estimates were obtained using discharge weights using the AHA database.

Weights utilized were based on five characteristics used to define the sampling strata for the Nationwide Inpatient Sample. These hospital characteristics were: bedsize (assessment of the number of short-term acute-care beds), teaching status, rural/urban location, ownership/control, and US region. Added to these characteristics was a stratum for freestanding children's hospitals. Limited strata (defined as those with fewer than two frame hospitals, 30 uncomplicated births, 30 complicated births, and/or 30 nonbirth pediatric discharges) were merged with an adjacent stratum containing hospitals with similar characteristics. Discharge weights were calculated for each stratum for newborn and older patients in proportion to the total number of AHA newborns and non-newborn discharges respectively.

Other statistical methods used were two-sample t-tests and ordinary logistic and multiple logistic regression. For the logistic regression analyses, the sample was treated as a simple random draw from an infinite possible population, with no weighting taken into account. All probability values shown are two-tailed (alpha = 0.05).

Results

Patient Characteristics

The KID contained data on 2353 admissions for pediatric patients with a diagnosis of ITLE from 1997 through 2003. The mean age of these patients was 10.1 years (SD 5.9 years, median 10 years, range 0–20 years). Of these patients, 1131 (48.1%) were female, 2130 (90.5%) were Caucasian (Table 1), 1583 (67.3%) had private insurance, and 112 (4.8%) underwent temporal lobectomy. A comparison of the clinical characteristics of the black and Caucasian patients and of patients who received and those who did not

TABLE 1

Clinical characteristics of 2353 pediatric patients with a diagnosis of ITLE

Characteristic	Value
patient age (yrs)	
mean	10.1
SD	5.9
median	10
range	0–20
female sex (%)	48.1
race (%)	
black	9.5
Caucasian	90.5
primary payer (%)	
private insurance	67.3
all others*	32.5

* Includes Medicare, Medicaid, self-pay, no charge, and all other payer categories.

TABLE 2

*Clinical characteristics of 2353 pediatric patients with a diagnosis of ITLE stratified separately by race and by receipt of surgical treatment**

Characteristic	Race		Treatment	
	Black	Caucasian	Resection	No Resection
patient age (yrs)				
mean	10.2	10.1	12.2	10.0
SD	6.0	5.9	5.6	5.9
median	9	10	13.5	10
range	0–20	0–20	0–20	0–20
female sex (%)	46.2	48.3	50	48
primary payer (%)				
private insurance	40.5	70.3	82.1	66.8
all others	59.5	29.7	17.9	33.2
black (%)	NA	NA	5.4	9.7
underwent resection (%)	2.7	5.0	NA	NA

* Results of the Rao–Scott modified chi-square test were significant for comparison of primary payer by race ($p < 0.001$). The results of all other univariate comparisons of characteristics by race were not significant ($p > 0.05$). Univariate comparisons of characteristics by treatment status can be seen in Table 4. Abbreviation: NA = not applicable.

receive surgical treatment are depicted in Table 2. Table 3 shows clinical characteristics by receipt of surgical treatment within race group.

Association Between Analyzed Variables and Receipt of Surgical Treatment

Among Caucasian patients with ITLE, 5% underwent resection procedures compared with 2.7% of black patients. Univariate analysis (Rao–Scott modified chi-square) revealed the difference to be marginally statistically significant ($p = 0.056$, adjusted for discharge weights). Analysis on the basis of sex revealed that 4.6% of male patients with ITLE received surgery compared with 5% of female patients, a difference that also was not found to be statistically significant on univariate analysis ($p = 0.985$). With regard to primary payer group, 5.8% of patients with private insurance received surgery compared with 2.6% of patients with any other primary payer type. Univariate analysis showed this difference to be statistically significant ($p < 0.001$, adjusted for discharge weights). Finally, the mean age of patients who were treated surgically was 12.2 years (SD 5.6 years) compared with 10.0 years (SD 5.9 years) in the group that did not receive surgical treatment, a difference also found to be statistically significant ($p < 0.001$, two-sample t-test) on univariate analysis. Details of all univariate analyses are shown in Table 4.

TABLE 3

*Clinical characteristics of 2353 pediatric patients with a diagnosis of ITLE stratified by receipt of surgical treatment within race groups**

Characteristic	Black		Caucasian	
	Resection	No Resection	Resection	No Resection
patient age (yrs)				
mean	15.5	10.1	12.0	10.0
SD	5.5	5.9	5.5	5.9
median	18	9	13	10
range	8–20	0–20	0–20	0–20
female sex (%)	50	46.1	50	48.2
primary payer (%)				
private insurance	50	40.3	84.0	69.6
all others	50	59.7	16	30.4

* Results of the Rao–Scott modified chi-square test were significant for comparison of primary payer by race ($p < 0.001$). The results of all other univariate comparisons of characteristics by race were not significant ($p > 0.05$).

TABLE 4

Effect of patient characteristics on odds of receiving surgical treatment: results of univariate analysis

Characteristic	Adjusted OR* (95% CI)	p Value†
patient age (for 1 yr increase)	1.07 (1.03–1.10)	<0.001
female sex	1.00 (0.96–1.03)	0.985
black (compared w/ Caucasian)	0.55 (0.0–0.82)	0.056
primary payer (private insurance vs other)	2.19 (1.87–3.11)	<0.001

* The OR for age was calculated on the basis of logistic regression; all other ORs were calculated from adjusted frequencies.

† The p value for age is from a two-sample t-test. All other p values are from the Rao–Scott modified chi-square test.

The results of multivariate logistic regression (Table 5) correlated with the results of univariate analysis, revealing neither female sex (OR 1.11, 95% CI 0.76–1.63, $p = 0.586$) nor black race (OR 0.66, 95% CI 0.28–1.53, $p = 0.327$) as an independent factor affecting the odds of receiving surgical treatment. Private insurance status (OR 2.21, 95% CI 1.34–3.63, $p = 0.002$) and older age (OR 1.07, 95% CI 1.03–1.11, $p < 0.001$ per 1 year increase in age) were each found to be independent predictors of receipt of surgical treatment. These findings remained stable over time, with no significant differences from 1997 though 2003 ($p > 0.15$ for all pairwise year comparisons). Although initial analysis showed a significant association between primary payer type and race (40.5% of black children had private insurance compared with 70.3% of Caucasians; $p < 0.001$, Rao–Scott modified chi-square), when we adjusted for other factors we found the interaction was not significant; therefore, the association was not considered significant in the final model. Additional analyses of patients with ITLE as a nonprimary diagnosis (within either the top three or top 15 diagnoses) revealed results that were all consistent with those of the multivariate analysis, as did analysis focusing solely on patients 18 years of age or younger.

Discussion

Racial disparities have historically played a prominent

TABLE 5

Effect of patient characteristics on odds of receiving surgical treatment: results of multivariate analysis

Characteristic	OR (95% CI)	p Value
patient age (for 1 yr increase)	1.07 (1.03–1.11)	<0.001
female sex	1.11 (0.76–1.63)	0.586
black (compared w/ Caucasian)	0.66 (0.28–1.53)	0.327
primary payer (private insurance vs other)	2.21 (1.34–3.63)	0.002
year		
1997 compared w/ 2003	1.38 (0.85–2.24)	0.194
2000 compared w/ 2003	1.38 (0.87–2.16)	0.168

role in the healthcare system, particularly with regard to access to surgical care.[9,18,27,38] Despite extensive evidence of trends of racial disparity throughout the medical profession, there have been only two previous reports evaluating the potential impact of racial disparities on treatment of ITLE, despite evidence revealing underutilization of state-of-the-art therapies by patients in minority groups.[3,4,33] Both of these previous studies were localized with regard to patient focus (one single-center and one dual-center) and were focused predominantly on adult patients.[3,4] We performed the current study—the first to examine pediatric temporal lobe epilepsy on a nationwide level—to address the dearth of studies involving the pediatric epilepsy population. Our primary goal in this study was to determine which factors independently predicted receipt of resective treatment for ITLE in the pediatric population, utilizing the KID for 1997 through 2003.

The major findings from this study were fourfold. The first finding was that private insurance status was a strong independent predictor of receipt of resective treatment, which may be due to the cost and invasiveness involved with any surgical procedure, particularly a procedure proven only recently by Class I data as superior to nonsurgical treatment in patients with ITLE.[39] A child with private insurance is 121% more likely to receive surgery than a child in the Medicare, Medicaid, self-pay, no charge, or other type of primary payer category (OR 2.21, $p = 0.002$). The second major finding was that increasing age was an independent predictor for receipt of surgical treatment, as the likelihood of a patient's undergoing surgery for ITLE increased exponentially with each additional year of life (OR 1.07, $p < 0.001$). These findings indicate that an 8-year-old patient is 7% more likely to receive ITLE surgery than a 7-year-old patient, while a 17-year-old patient is 97% more likely to receive surgery than a 7-year-old patient (surgery likelihood $= 1.07^{\text{age of older child} - \text{age of younger child}}$). The rationale for this phenomenon is unclear and warrants further investigation.

The third finding was that sex was not an independent predictor of receipt of surgical treatment ($p = 0.586$); the percentage of girls receiving surgery was comparable to that of boys (5.0 and 4.6%, respectively) and the overall percentage of the pediatric ITLE population who were girls was 48.1%. Although this finding is encouraging, further evaluation of the outcomes of these patients is required, as the results of a previous study involving adult patients with ITLE indicated that female gender is an independent predictor of increased seizure recurrence 1 year postoperatively.[4] The fourth major finding was that although black children appeared to be marginally less likely to receive surgical treatment for pediatric ITLE than Caucasian children (2.7% compared with 5.0%, adjusted OR 0.55, $p = 0.056$), multivariate analysis with adjustment for factors other than race showed that race was not an independent predictor ($p = 0.327$). This finding has several implications, most notably that the initiatives instituted by the US federal government to address healthcare disparities may have had an impact on this area of medicine,[29,35] given that the time period of this study began after these initiatives were adopted in 1996.

Nevertheless, it is important that interpretation of these findings be tempered with caution, as the sample size of both black and Caucasian patients who underwent surgery was relatively small (six and 106, respectively), and may obscure a statistically significant difference despite the fact that Caucasian children received surgery nearly twice as often as black children (5.0% compared with 2.7%). Furthermore, the results of univariate analysis showed that black children were significantly less likely to have private insurance than Caucasian children (40.5% compared with 70.3%, $p < 0.001$), a disparity of great importance given the findings in this study of private insurance status as an independent predictor for receipt of resective ITLE surgery (Table 2). Consequently, it will be important for this issue to be explored further in future studies to determine whether this lack of disparity persists. Moreover, it is important to be aware that the results of this study may not be generalizable to other areas of medicine, as findings of racial disparities in healthcare continue to be reported broadly in the modern literature.[8,10,13,14,17,19,22,24,26,28,31,36,39]

Finally, the relatively small proportion of both black and Caucasian children with ITLE who received surgical treatment may be due to the relative deficiency of quaternary centers, which often require travel and selective referral in order for temporal lobe resection to be performed. We hope that the information provided in this paper will help contribute to extending the availability of resective treatment to a larger percentage of the ITLE population, regardless of race, age, gender, or insurance status.

Conclusions

In the first nationwide analysis of ITLE, older age and private insurance status were independent predictors of which children were more likely to receive surgery for ITLE, while sex was not. There was a nonsignificant trend for black children with ITLE to be less likely to receive surgical intervention than Caucasian children. Given the time period of this analysis (1997–2003), the results may indicate that the increased federal government initiatives to eliminate racial health care disparities in the mid-1990s have made progress in this area of healthcare for the pediatric population. Future nationwide analyses involving larger sample sizes will be necessary before success can be definitively determined.

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