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ORIGINAL CONTRIBUTION

CME

Disparities in the emergency department management of pediatric migraine by race, ethnicity, and language preference

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Abstract

Background: There are disparities in pain management for children presenting to the emergency department (ED) according to their racial and ethnic backgrounds. It is not known if there are differences in the treatment of pain associated with pediatric migraines by race, ethnicity, and language for care (REaL).

Methods: We analyzed treatment patterns and outcomes in our ED for acute migraine in pediatric patients by REaL. Retrospective data on treatments, length of stay (LOS), and charges were collected from the electronic medical record for pediatric patients on the ED migraine pathway from October 2016 to February 2020. Patient race/ethnicity and language for care were self-reported at registration. We analyzed two treatment groups: receipt of oral (PO) or intranasal (IN) medications only or intravenous (IV) ± IN/PO medications. A total of 833 patients (median age 14.8 years, interquartile range [IQR] 12.3–16.5 years; 67% female, 51% non-Hispanic White (nHW), 23% Hispanic, 8.3% Black or African American, 4.3% Asian) were included. A total of 287 received PO/IN medications only and 546 received IV medications.

Results: Initial pain scores in the two groups were similar. Patients who were Asian, Black or African American, and Hispanic or had a language for care other than English (LOE) had significantly lower odds of receiving IV treatment, while patients who were nHW and preferred English had higher odds of receiving IV treatment. The IV treatment group had longer LOS and ED charges. Pediatric ED patients with migraine who were Black, Asian, and Hispanic or had a LOE had a decreased likelihood of receiving IV therapies while patients who were nHW were more likely to receive IV treatments, despite similar initial pain scores.

Conclusions: These data align with previous studies on pain management disparities and highlight another area where we must improve equity for patients in the ED.

KEYWORDS

disparities in emergency care, ethnicity and language preferences (REaL), pain management, pediatric headache, race

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INTRODUCTION

Disparities in pain assessment and treatment for pediatric patients who present to the emergency department (ED) according to their race, ethnicity, and language preference are well documented. To date, there has been a focus on characterizing disparities in conditions where opioid analgesics are indicated for pain control. For example, pediatric patients presenting to the ED with acute appendicitis who are Black or African American are less likely to receive opioid analgesics or other treatment for moderate pain[1] compared to patients who are non-Hispanic White (nHW). This is also true for pediatric patients presenting to the ED with fractures; patients who are Black or Hispanic are less likely to receive opioid analgesics when compared to nHW patients.[2] It has also been shown that adult Black patients are less likely to receive opioid analgesics for migraine in the ED.[3] However, it is unclear if these disparities are related to opioid treatment or to pain assessment and treatment in general. Pediatric migraine is a painful condition where opioids are not indicated, and therefore an analysis of this population may help further inform where equity for pain treatment could be addressed and improved.

The prevalence of headaches and migraines impacting children and adolescents is high[4] (58% and 7.7%, respectively) and increasing.[5] Pediatric headache is a common complaint in the ED, accounting for up to 2.6% of visits annually.[6] There are differences in the burden of disease for headaches by race, ethnicity, and language for care (REaL) among adults; migraines are most common overall for patients who are Native American, and the prevalence of chronic migraine is highest for patients who are Hispanic and female and lowest for patients who are White and male. Ambulatory visits for migraine are lowest for Hispanic patients when compared to White or Black patients.[7] These data are not available for children. Social determinants of health and adverse childhood experiences such as food or housing insecurity, exposure to violence, separation of parents, death of a parent, cohabitation with individuals with severe mental illness, death of a parent, or unfair treatment due to race have been shown to increase risk for headache and migraine among children.[8] Migraine prevalence in pediatric patients is higher for those with lower household income, but this association is not seen when there is a family history of migraine,[9] which suggests there are separate biological and social risk factors affecting migraines in children.

There are very few studies assessing disparities among youth presenting to the ED for headache or migraine. Those available have shown that pediatric patients who are nHW are more likely to receive neuroimaging when presenting to the ED with a chief complaint of headache[10] when compared to other patient groups. There are also differences in readmission wherein pediatric patients who are nHW are more likely to be readmitted for chronic recurrent headache than Black or Hispanic patients.[11] Similar patterns have been found for adults presenting to the ED for headache or migraine. When compared to nHW adult patients, Black patients in primary care offices with headaches or migraines are less likely to receive abortive prescriptions and report lower trust and poorer physician patient communication.[12] Lower trust and level of communication have also been shown more broadly for Black patients seen by providers who are not of the same racial background.[13] Outpatient follow-up care is lacking and inaccurate diagnosis is more common for minoritized adult migraine patients.[14] However, another study found few differences in prescribing practices for abortive and preventive treatments among patients with differing racial/ethnic backgrounds.[15] Prescribing patterns for pediatric ED patients with migraine by REaL have not been reported.

There are several updated national and international evidence-based guidelines for the acute assessment and abortive care of pediatric migraine,[16] and it has been shown that the implementation of migraine guidelines in the pediatric ED can improve outcomes.[17] The best available evidence suggests that oral (PO) and/or intranasal (IN) medications may be sufficient for the initial treatment of pediatric migraine in patients who are tolerating PO intake and have not yet tried them. A combination of intravenous (IV) medications is recommended for patients who fail PO/IN treatments, for those who present with nausea or vomiting, or for those with very severe or prolonged pain.[18] This study aimed to determine whether patient race, ethnicity, language preference, and insurance status (public vs. private) predicted differences in clinical outcomes (improvements in pain intensity, duration of length of stay [LOS], and charges) and assignment between two main treatment groups (IV therapies or PO/IN therapies only) among pediatric patients seen in our ED for migraine over a 4-year period from 2016 to 2020.

METHODS

This study was approved by the hospital institutional review board.

Setting

This study took place in a freestanding academic pediatric hospital ED, which receives patients from the community and surrounding region. The ED has 38 beds and receives 50,000–60,000 annual visits. Clinical pathways exist for most common diagnoses and are updated quarterly with the best available evidence and incorporated into electronic ordering to support their use. The ED migraine pathway[19] was created by a multidisciplinary team of providers from the ED and neurology, ED nurses, and pharmacists and has been in use since implementation in October 2016.

Population

All patients treated using our ED migraine pathway between October 14, 2016 (the date the pathway went live), and February 28, 2020 (just prior to COVID-19–based lockdowns) who were treated with at least one migraine-relevant medication were included. Only the first encounter was included for patients with multiple encounters. All data were acquired from the electronic medical record database.

Because this was designed as a quality improvement project with a circumscribed assessment period, no a priori sample size calculations were made. From internal monitoring we expected more than 500 patients, a number deemed sufficient to meet the project goals.

REaL characteristics

Patient race/ethnicities were self-reported by the patient or patient's family at the time of registration and were organized in the medical record into U.S. Census categories for documentation and reporting purposes. Language for care was self-reported at ED check-in, and the need for interpretation was indicated through our standard process on the ED tracking board and the door to the patient's room. Interpretation is available via in-person staff interpreters for Spanish from 2 p.m. to 12 a.m. daily and by video and phone remote options anytime. Insurance status was classified as private versus public.

Migraine pathway treatment group

Patients were treated by provider discretion utilizing the migraine pathway guidelines. For the purposes of analysis, they were grouped according to two treatment groups: PO and IN medications only or IV medications with or without PO and IN medications. Our primary outcome of interest was treatment group assignment according to REaL categories.

Clinical outcomes

Pain intensity scores were reported by patients and recorded by ED nurses using the scale most appropriate for their age, either FACES[20] or the 0–10 numeric pain scale.[21] The ED LOS was measured in the time from ED check-in until ED discharge or admission to the hospital. ED charges were calculated using billing data for the ED encounter. Improvement in pain scores, LOS, and charges were analyzed as secondary outcomes.

Data analysis

Differences in medians were obtained by 5000 bootstrap resamples with bias-corrected and accelerated confidence intervals.[22] Ordinal logistic regression was used to evaluate change in pain scores (from the first available pain score to the last available score prior to ED discharge) relative to their treatment group on the ED migraine pathway (PO only vs. IV ± PO medications). We controlled for initial pain score in this model. Binary logistic regressions evaluated the probability of getting an IV, as opposed to being in the PO only treatment group, and we adjusted for insurance type as a proxy for health care accessibility. ED LOS and ED charges were modeled with Gaussian regression; both outcomes were log-transformed to stabilize the variance and improve normality of errors in those models and were back-transformed for the figures to show the model effects on the response scale. Covariates included race/ethnicity groups, language type, and insurance type of public or private. For ED LOS, we controlled for language type, treatment group, and insurance type. For ED charges, we analyzed only the IV group and controlled for insurance type. We did not include the PO treatment group because charges were uniformly lower and without heterogeneity. Race/ethnicity and language type were not included in the same regression models as they are strongly dependent; the majority of patients with a language for care other than English (LOE) also identified as Hispanic (data not shown). For all models, sum contrasts[23] were used for comparisons across groups to avoid setting reference levels based on any particular race/ethnicity, language of care, or insurance type, because we would not necessarily expect any group to be receiving the ideal standard of care. We specifically wanted to avoid centering whiteness as the default reference category.[24,25] Sum contrasts use the grand mean to compute regression coefficients rather than having to choose a single race/ethnicity, language of care, or insurance type as a referent group. Due to small sample sizes, some race/ethnicity groups were combined into an “other” category for purposes of modeling, and those who were supported by uncompensated care or self-pay were excluded from the regression models ($n = 28$). Models were assessed for assumptions and influential data points. Type I error rate was set at 0.05 and no adjustments were made for multiple testing. Analysis was done using the MASS, dabestr,[26] tidyverse,[27] and effects packages[28,29] in R version 4.1.1.[30]

RESULTS

Patient characteristics

A total of 833 patients (median age 14.8 years, IQR 12.3–16.5 years) were included in this study, 287 of whom received PO medications only, and 546 who received IV medications, with or without PO medications. Across the full sample, patients were predominantly female (67%) and nHW (51%), had a language preference of English (87%), and had private insurance (58%); Table 1 provides a demographic overview.

Differences in IV vs. PO therapy by REaL

There were differences in the likelihood of receiving IV versus PO/IN therapy for migraine based on race/ethnicity and insurance status (Figure 1, Table 2). Point estimates for the probability of getting IV treatment ranged from 46% for patients who were Asian with Medicaid insurance to 84% for unknown/refused race/ethnicity with commercial insurance. Notably, Asian (adjusted odds ratio [aOR] 0.50, 95% confidence interval [CI] 0.27–0.92), Black or African American (aOR 0.55, 95% CI 0.35–0.87), and Hispanic (aOR 0.57, 95% CI 0.41–0.79) patients all show significantly lower odds

TABLE 1 Patient demographics, overall and by treatment group

Characteristic	Overall	PO meds only, *n* = 287	IV meds ± PO, *n* = 546
Sex at birth			
Female	558 (67)	172 (60)	386 (71)
Male	275 (33)	115 (40)	160 (29)
Age (years)	14.8 (12.3–16.5)	13.7 (11.5–16.0)	15.1 (13.0–16.8)
Race/ethnicity			
Two or more races	38 (4.6)	11 (3.8)	27 (4.9)
Asian	35 (4.2)	18 (6.3)	17 (3.1)
Black or African American	69 (8.3)	34 (12)	35 (6.4)
Hispanic	188 (23)	91 (32)	97 (18)
nHW	423 (51)	114 (40)	309 (57)
Other[a]	47 (5.6)	13 (4.5)	34 (6.2)
Unknown/refused	33 (4.0)	6 (2.1)	27 (4.9)
Language group			
English	722 (87)	227 (79)	495 (91)
LOE	111 (13)	60 (21)	51 (9.3)
Payor group			
Commercial	480 (58)	141 (49)	339 (62)
Medicaid	325 (39)	136 (47)	189 (35)
Self-pay	28 (3.4)	10 (3.5)	18 (3.3)
Initial pain score	7 (5–8)	7 (5–8)	7 (6–9)
Unknown	167	47	120
Final pain score	3 (0–5)	4 (1–6)	3 (0–5)
Unknown	38	18	20
LOS (h)	4.6 (3.5–6.0)	3.4 (2.7–4.5)	5.2 (4.2–6.7)
Sumatriptan given in ED	387 (46)	158 (55)	229 (42)
Discharge disposition			
Discharge to home or self-care	810 (97)	285 (99)	525 (96)
Admission to inpatient	23 (3)	2 (1)	21 (4)
ED charges (US$)	2832 (1233–3418)	1173 (1083–2048)	3199 (2832–3713)

Note: Data are reported as *n* (%) or median (IQR).

Abbreviations: IQR, interquartile range; LOE, language other than English; LOS, length of stay; nHW, non-Hispanic White; PO, oral.

[a] Other includes American Indian and Alaska Native patients, Native Hawaiian and Other Pacific Islander patients, and patients who self-reported as other.

of receiving IV treatment, while nHW (aOR 1.45, 95% CI 1.08–1.93) and unknown/refused (aOR 2.40, 95% CI 1.16–5.69) patients show significantly higher odds of IV treatment, compared to the grand mean. The “two or more races” and the “other” categories were not significantly different from the grand mean. There was no appreciable difference in coefficients when adjusted for the covariate of insurance type public versus private.

There were also differences in probability of IV therapy by language group (Figure 2, Table 3), with point estimates that ranged from 46% for LOE and Medicaid patients to 71% for English and commercial insurance patients. The coefficient for the effect of LOE was significant, showing a lower likelihood of receiving an IV (aOR 0.64, 95% CI 0.52–0.79). It was moderated slightly by the inclusion of insurance type (aOR 0.71, 95% CI 0.57–0.89), with patients who have both LOE and public Medicaid insurance having the lowest probability of receiving IV treatments.

Differences in clinical outcomes by REaL

Pain intensity

Overall, change over time in pain intensity from the first available pain score to the last available pain score were similar

FIGURE 1 Effect plot for the logistic regression of the probability of getting an IV by race/ethnicity. (A) Unadjusted, (B) Adjusted by insurance type. Abbreviations: 2+: 2 or more races; B/AA: Black or African American; NHW: Non-Hispanic White.

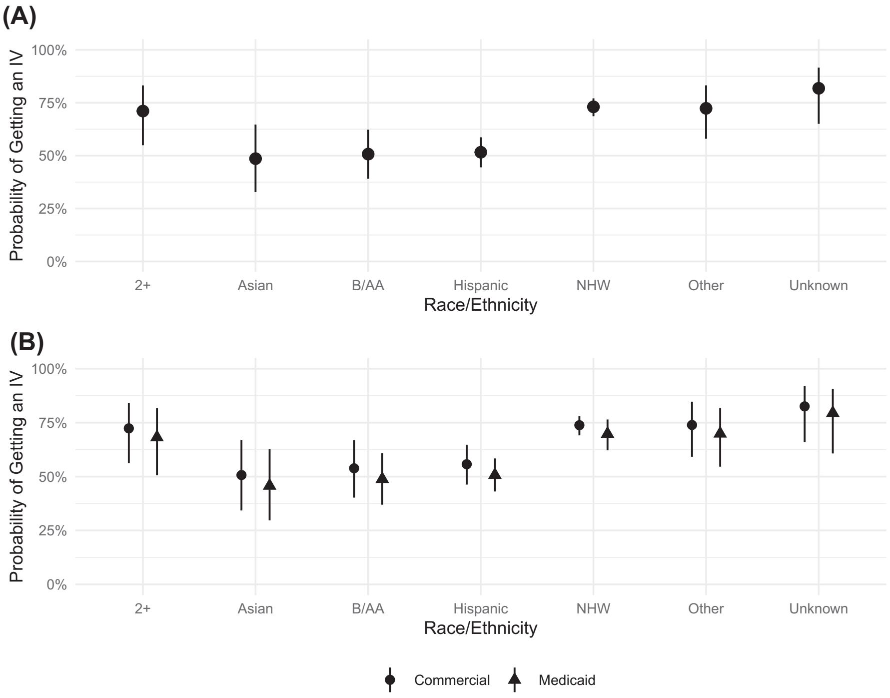


TABLE 2 Results of the logistic regression for odds of getting an IV by race/ethnicity using sum contrasts: unadjusted estimates and estimates adjusted for insurance type

	Unadjusted			Adjusted		
Characteristic	OR[a]	95% CI	p-value	OR[a]	95% CI	p-value
Race/ethnicity						
Two or more races	1.31	0.71–2.55	0.40	1.28	0.69–2.50	0.45
Asian	0.50	0.27–0.92	0.03	0.50	0.27–0.92	0.03
Black or African American	0.55	0.35–0.87	0.01	0.57	0.35–0.92	0.02
Hispanic	0.57	0.41–0.79	<0.001	0.62	0.43–0.87	0.01
nHW	1.45	1.08–1.93	0.01	1.38	1.02–1.87	0.04
Other[b]	1.40	0.79–2.57	0.26	1.39	0.78–2.56	0.28
Unknown	2.40	1.16–5.69	0.03	2.31	1.11–5.50	0.04
Insurance type						
Medicaid				0.91	0.76–1.07	0.25
Commercial				1.10	0.93–1.31	0.25

Abbreviation: nHW, non-Hispanic White.

[a] Sum contrasts are used for all variables.

[b] Other includes American Indian and Alaska Native patients, Native Hawaiian and other Pacific Islander patients, and patients who self-reported as Other.

between PO only treatment and IV treatment groups, although the IV group showed somewhat greater improvement (Figure 3, Table 1). As expected based on pathway standards, patients with lower initial pain scores were less likely to receive IV treatment, without factoring in race/ethnicity (Figure 3A, aOR 0.53, 95% CI 0.40–0.70). The sample sizes for several race/ethnicity groups were too small for statistical analysis comparing initial pain scores, but they appear similar and are presented visually in Figure 3B.

LOS

Median LOS for our population (Table 1) was 3.4 h (IQR 2.7–4.5 h) in the PO only group and 5.2 h (IQR 4.2–6.7 h) in the IV±PO group, a median difference of 1.8 h (95% CI 1.6–2.0). We did not detect any statistically significant differences in LOS by race/ethnicity or insurance type (Figure 4, Table 4). In our entire population, there were a small number of hospital admissions (3%, $n = 23$); therefore, we did not analyze for differences in disposition by REaL or insurance status.

Charges

Median charges (Table 1) were $1173 (IQR $1083–$2048) for the PO only group and significantly higher at $3199 (IQR $2832–$3713) for the IV group. The median difference for additional charges was $2026 (95% CI $1910–$2030) overall for the IV group. Charges for the PO-only group were largely made based on a set of complexity-based procedure codes that were constants, and the IV group's charges were more heterogeneous. Therefore, to assess for disparities among patient groups by REaL and insurance status, we removed the PO-only group and analyzed those receiving IV therapies. As with LOS, coefficients by REaL were all very small and nonsignificant (Table 5, Figure 5).

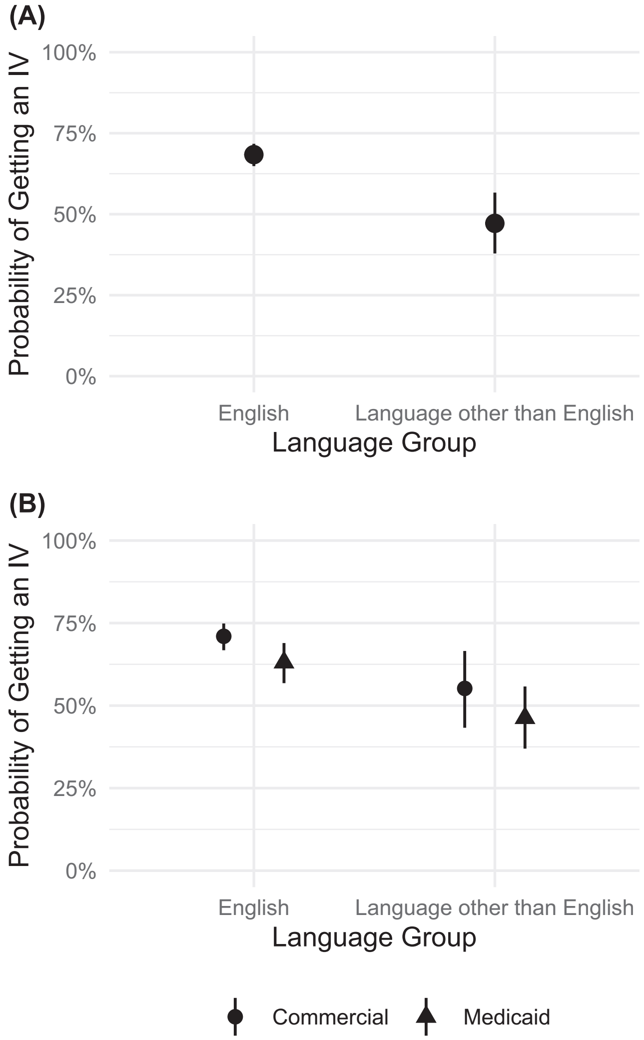


FIGURE 2 Effect plot for the logistic regression of the probability of getting an IV by language group. (A) Unadjusted, (B) Adjusted by insurance type.

DISCUSSION

In this study, we examined differences in the acute treatment of pediatric migraine in our pediatric ED by race/ethnicity, language preference, and insurance status. We found that patients who identified as Asian, Black or African American, and Hispanic were less likely to receive IV therapies and more likely to receive PO or IN medications only when compared to the overall mean, whereas patients who identified as nHW were more likely to receive IV therapies. Public versus private insurance status as a covariate increased these differences but was not significant on its own.

We found that patients with LOE had lower odds of being treated with IV therapies. We included insurance type as a covariate to account for access to medical care generally and as a proxy for socioeconomic status but did not see a significant effect of insurance status on its own. It did heighten the effect of LOE; public insurance was associated with an even lower likelihood of IV treatment.

According to the best available evidence for acute abortive migraine treatment, first-line medications for patients who are tolerating PO intake can include PO medications and/or triptans orally or intranasally.[16] For those with more severe pain or who are not tolerating PO intake, a combination of IV therapies is recommended. For those who do not improve after PO medications, IV combination therapies are also recommended. Overall, there was an improvement in pain scores across both IV or PO/IN treatment groups without a difference in final pain score for those who received IV versus PO therapies.

There were also important differences in general ED quality measures between the IV and the PO treatment groups. As expected, the ED LOS and charges were both significantly higher for

TABLE 3 Results of the logistic regression for odds of getting an IV by language group using sum contrasts: unadjusted estimates and estimates adjusted for insurance type

	Unadjusted			Adjusted		
Characteristic	OR[a]	95% CI	p-value	OR[a]	95% CI	p-value
Language group						
LOE	0.64	0.52–0.79	<0.001	0.71	0.57–0.89	0.003
English	1.56	1.27–1.92	<0.001	1.41	1.13–1.77	0.003
Insurance type						
Medicaid				0.84	0.71–0.98	0.03
Commercial				1.20	10.2–1.41	0.03

Abbreviation: LOE, language other than English.

[a] Sum contrasts are used for all variables.

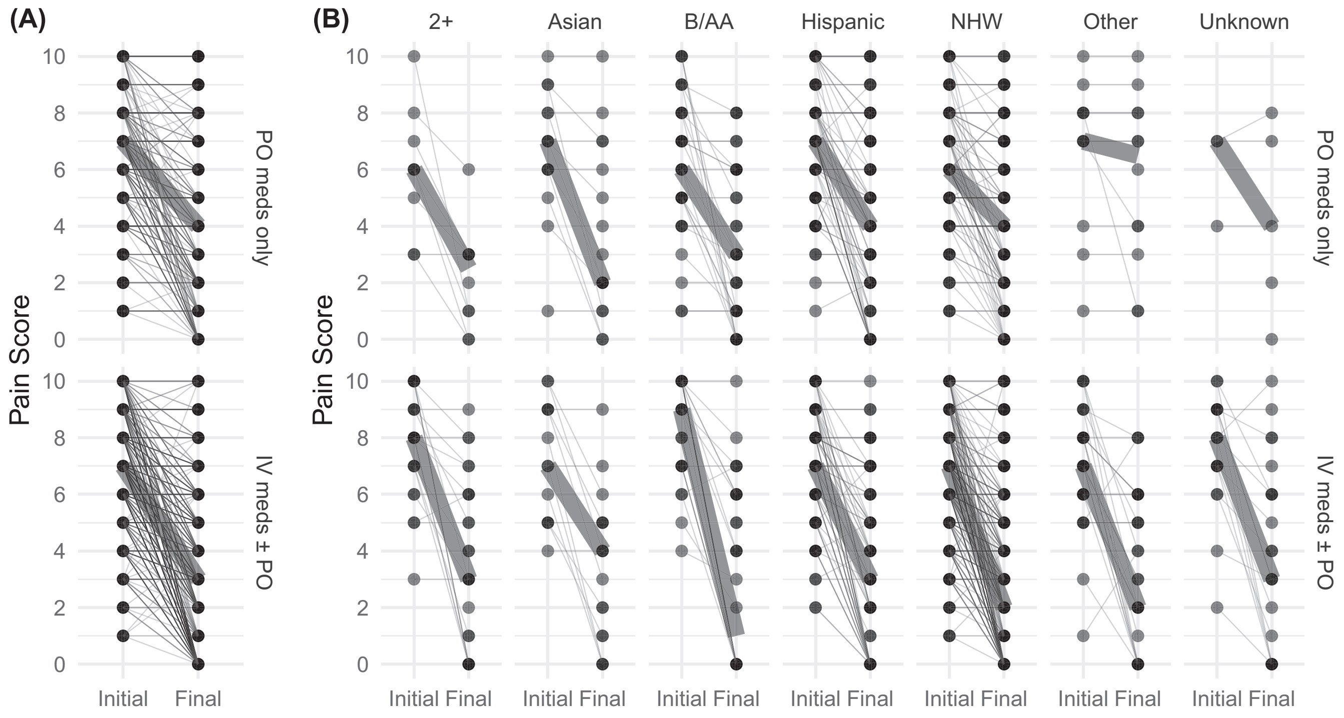
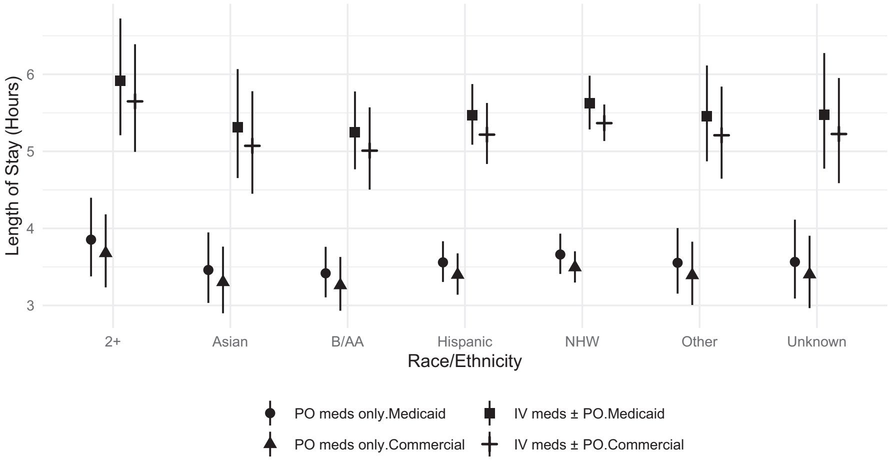


FIGURE 3 Changes in pain level between initial and final pain score. Thin lines are individual patients; thicker lines are medians for that group. Abbreviations: 2+: 2 or more races; B/AA: Black or African American; NHW: Non-Hispanic White.

FIGURE 4 Effect plot for the regression for ED length of stay for the treatment groups by race/ethnicity and insurance type. 2+, two or more races; B/AA, Black or African American; NHW, non-Hispanic White; PO, oral.



patients who got an IV compared to those who received only PO or IN treatments. The sample sizes were smaller when comparing all of the individual REaL groupings, and we did not see significant differences by REaL for ED charges or LOS.

There is a theme in the literature of increased testing and treatment for patients who identify as nHW compared to those from other race/ethnicity groups from several recent studies on pediatric ED disparities. These include more antibiotics for viral illnesses,[31] head imaging for minor head trauma,[32] and chest radiography for bronchiolitis[33] when they are not recommended. For pediatric migraine patients, there are also higher rates of inappropriate opioid prescriptions for patients who are nHW as a first-line treatment.[34] Our results suggest a similar pattern for patients who are nHW being more likely to receive IV treatments for acute migraine, and patients who are Black, Hispanic, and Asian being less likely to receive them. However, all patients started with similar pain scores, had improvement between initial and final pain scores, and had similar final pain scores and overall admission rates for treatment failure were extremely low (2.8%, *n* = 23).

Although we do not know the exact causes of these treatment group differences, they may be due to structural racism or bias within the individual patient and provider interactions. Implicit bias is an unconscious association that can affect perspectives and decision making. There are many examples of implicit bias among health care providers, including in the pediatric ED.[35,36] It has been shown to alter provider prescribing behaviors, particularly for pain control.[37]

TABLE 4 Results of the regression for log LOS by treatment group, race/ethnicity, language group, and insurance type using sum contrasts

Characteristic	Beta[a]	95% CI	p-value
Intercept	1.45	1.40 to 1.50	<0.001
Race/ethnicity			
Two or more races	0.07	−0.03 to 0.18	0.18
Asian	−0.03	−0.15 to 0.08	0.56
Black or African American	−0.05	−0.13 to 0.04	0.30
Hispanic	−0.01	−0.07 to 0.06	0.87
nHW	0.02	−0.03 to 0.07	0.39
Other[b]	−0.01	−0.11 to 0.09	0.89
Unknown	0.00	−0.12 to 0.11	>0.90
Language group			
English	0.02	−0.03 to 0.07	0.42
LOE	−0.02	−0.07 to 0.03	0.42
Treatment group			
PO meds only	−0.21	−0.24 to −0.19	<0.001
IV meds ± PO	0.21	0.19 to 0.24	<0.001
Insurance type			
Commercial	−0.02	−0.05 to 0.01	0.14
Medicaid	0.02	−0.01 to 0.05	0.14

Abbreviations: LOE, language other than English; nHW, non-Hispanic White; PO, oral.

[a] Sum contrasts are used for all variables.

[b] Other includes American Indian and Alaska Native patients, Native Hawaiian and other Pacific Islander patients, and patients who self-reported as Other.

TABLE 5 Results of the regression for log charges for patients treated with IV by race/ethnicity and insurance type using sum contrasts

Characteristic	Beta[a]	95% CI	p-value
Intercept	8.09	8.06, 8.12	<0.001
Race/ethnicity			
Two or more races	0.03	−0.06, 0.11	0.53
Asian	−0.08	−0.19, 0.03	0.14
Black or African American	0.03	−0.05, 0.11	0.47
Hispanic	−0.04	−0.10, 0.01	0.12
nHW	0.04	0.00, 0.08	0.07
Other[b]	0.01	−0.07, 0.09	0.79
Unknown	0.02	−0.07, 0.10	0.69
Insurance type			
Commercial	−0.01	−0.03, 0.02	0.46
Medicaid	0.01	−0.02, 0.03	0.46

Abbreviation: nHW, non-Hispanic White.

[a] Sum contrasts are used for all variables.

[b] Other includes American Indian and Alaska Native patients, Native Hawaiian and other Pacific Islander patients, and patients who self-reported as Other.

There is also evidence that differences exist in how providers assess pain and distress according to patient race which relates to their opioid recommendations.[38] Raising awareness about the potential influence of implicit bias on medical decision making among ED staff is a crucial first step toward improving equity for pediatric patients with migraine and other health conditions.

LIMITATIONS

There are several limitations to our study. All data were retrospective and therefore rely on accurate and complete documentation of clinical events. We report differences in migraine treatment by REaL, but it is difficult to know other clinical factors that may have affected provider decision making such as medications taken prior to arrival or presence of nausea or vomiting. We also do not have data to report if patients were referred to the ED by their primary care doctor (PCP) or a specialty clinic or self-referred. The patients in our ED typically have a PCP, but we cannot ascertain how differences in access to care might have affected the presentation to the ED, especially for a first-time headache. Pain scores were not always available before and after each migraine treatment, so it is possible that a patient could have received treatment after the final pain score or that pain could have changed between the final score and discharge from the ED.

CONCLUSIONS

In this retrospective analysis of pediatric migraine patients in the ED, we found that race/ethnicity and language for care were significantly associated with odds of receiving intravenous therapies compared to oral or intranasal treatments. Patients who were Black or African American, Asian, and Hispanic all had lower odds of intravenous therapy compared to the overall mean, as did patients with a language for care other than English. Results did not differ significantly when adding insurance type as a covariate. Patients who were non-Hispanic Whites had higher odds of receiving intravenous therapy. Those who did receive intravenous treatment had longer ED length of stay and higher ED charges. These data suggest that race/ethnicity and language for care are associated with treatment choices for pediatric migraine in the ED despite an established evidence-based guideline and represent an opportunity to improve equity for our patients.

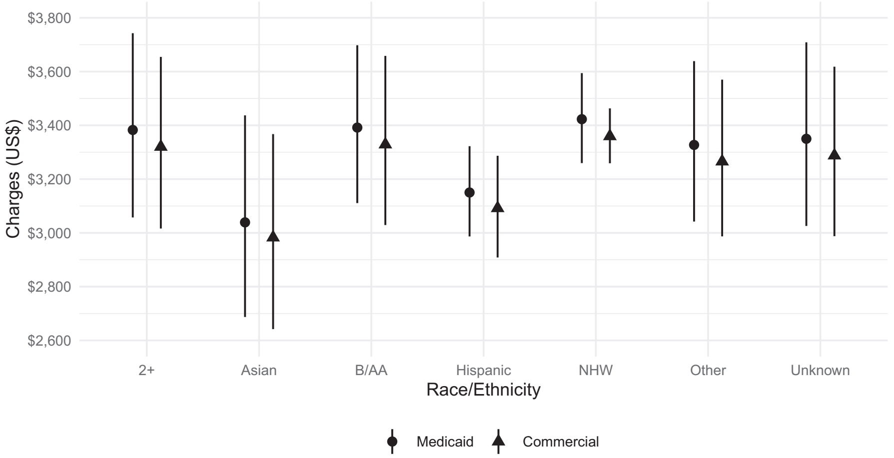


FIGURE 5 Effect plot for the regression for ED charges by race/ethnicity and insurance type, for the IV ± PO treatment group only. 2+, two or more races; B/AA, Black or African American; NHW, non-Hispanic White.

AUTHOR CONTRIBUTIONS

Emily A. Hartford, Heidi Blume, Jessica Hauser Chatterjee, and Emily Law contributed to study question, design and analysis plan. Dwight Barry performed all statistical analysis of the data. Emily A. Hartford, Dwight Barry, and Emily Law drafted the manuscript. Heidi Blume and Jessica Hauser Chatterjee revised and edited the manuscript.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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