

Functional Impairment Predicts Outcome of Youth With Headache in the Emergency Department

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Abstract

Headache is a common presenting complaint in emergency departments (EDs), with the goal of improving acute pain. However, youth with chronic headaches may demonstrate broad functional impairment in their lives due to headaches. Our objective was to determine if degree of functional impairment predicts ED course for patients with headache as part of a clinical protocol. One hundred and thirty-seven pediatric patients presenting to an ED with headache were included. Patients and parents were administered the Functional Disability Index (FDI) and ED charts were reviewed to evaluate outcomes. Higher child-reported FDI scores were associated with more medications, longer ED stay, and admission. High parent-proxy FDI score was associated with longer ED stay. Both pain score and parent-proxy FDI score were associated with imaging. The FDI was a more useful predictor of visit resources than pain score. FDI scores could be used to help anticipate patients who may require greater time and resources.

Keywords

pediatrics, headaches, functional disability, neurology, psychology

Background

Headaches are one of the most commonly reported pain types among youth.¹ Prevalence rates of headache range from 37% to 51% in school-age children, with rates increasing to 82% by age 15 years.^{2,3} Patients with headache commonly present to pediatric emergency departments (EDs)^{4,5} and headache is estimated to account for approximately 250 000 ED visits annually.⁶ Pediatric patients with chronic headache are at risk for significant functional impairment due to pain. Thus, the assessment of pain-related disability is thought to be a critical component of their evaluation and treatment.^{7,8}

ED physicians primarily rely on patient self-report for pain assessment, typically using the FACES or 0 to 10 numeric rating scale.^{9,10} The FACES scale, although well validated, has not been shown to improve management of pain in the ED, especially for youth with higher self-reported levels of pain.¹¹ Studies have found pain score assessment in the ED to be suboptimal, with less than half of ED visits having a documented pain score on arrival and even fewer having it reassessed later in the ED visit.^{5,12} Despite interventions targeted as reducing pain, ED pain scores often remain in the moderate

range.⁵ This suggests that such single time point measures of pain may be irrelevant when assessing pain of youth with chronic pain conditions and consideration of other assessment strategies may be warranted.

The Functional Disability Inventory (FDI) is one of the most widely used measures assessing impairment due to pain and has been applied to patients with abdominal pain, headache, and joint pain.^{7,8,13} However, information about headache pain-related functional impairment is limited to youth in outpatient clinics with little consideration of the measure's clinical utility in acute care settings, such as the ED.^{7,13} The parents of pediatric patients are typically strong advocates for their children, with a broad perspective on the effect chronic pain, such as headache, has on their child's life. Few studies have

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examined the impact that chronic pain, particularly headache, and pain-related functional impairment have on health care utilization.⁸ There has been limited exploration of parent-proxy report of child functional impairment in pediatric headache.¹³ Therefore, little is known of the impact of parent's perception of their child's functioning on clinical outcomes.^{7,13}

The purpose of this study is to describe parent-proxy and patient self-reported functional impairment in youth presenting to the ED with headache, enrolled in a standard of care headache protocol. We also aim to determine the relationship between functional impairment and utilization, hypothesizing that greater functional impairment would be associated with greater health care utilization in the ED setting.

Methods

Setting

Our institution is a tertiary care pediatric level 1 trauma center located in the upper Midwest, with full-time pediatric emergency physician coverage. Our pediatric ED had approximately 27 000 visits in 2016. Approximately 16% of these visits resulted in admission to the hospital. The payor mix is roughly one third Medicaid and two thirds private payor.

Our ED has a dedicated social work team consisting of approximately 45 staff members who cover the pediatric ED 24 hours per day, 7 days per week. Psychosocial services include assessment of needs and provision of resources, crisis intervention, brief counseling, and support (ie, grief support, tangible assistance as appropriate, and liaison to community agencies).

Headache Protocol

Our ED Headache Protocol was developed with 2 goals in mind: (1) to standardize medical treatment of youth presenting to the ED with headache and (2) to integrate a psychosocial component to the care of youth with headache in the ED. The protocol was developed in collaboration among professionals from pediatric emergency medicine, pediatric neurology, pediatric psychology, and social work. It is a stepwise, standardized framework for intravenous and intranasal medication administration after failure of oral analgesics to alleviate headache. The protocol is a 5-step progression based on self-reported symptoms (see Figure 1). Social workers are notified at protocol initiation and conduct a psychosocial evaluation, assess the functional impact of the headache, and provide evidence-based pain management recommendations.¹⁴

Participants

We enrolled a convenience sample cohort of parent-child dyads presenting to the children's ED between December 2012 and June 2016 for treatment of headache via retrospective chart review. Inclusion criteria were the following: (1) enrollment in the ED Headache Protocol after failure of oral analgesics and (2) parent and patient ability to read and comprehend questionnaires in English. Exclusion criteria were the following: (1) headache related to trauma, shunt malfunction, or meningitis; (2) presentation with headache as a secondary complaint; and/or (3) significant developmental delay in the patient or parent that would affect the ability to complete the questionnaire. Patients with multiple ED visits for headache were only enrolled in the study the first time they were placed on the Headache Protocol during the enrollment period; they were not necessarily naïve to the protocol. The study was reviewed by the university's institutional review board.

Measures

Demographic Information. Information extracted from the electronic medical record (EMR) included date of birth, date of visit, gender, and primary ICD-9 or ICD-10 diagnosis (International Classification of Diseases, 9th and 10th revisions).

Visit Characteristic Outcome Measures. Information extracted from the EMR included length of stay in the ED, disposition, return to the ED within 72 hours of discharge, neuroimaging, neurology consults, number of protocol steps used, and pain scores at admission and discharge.

Functional Disability Inventory. The FDI¹⁵ is a 15-item self-report and parent-proxy inventory assessing difficulty with the performance of daily activities in home, school, recreational, and social domains (see Appendix A, available online). These include activities such as "walking up the stairs," "reading or doing homework," or "doing something with friends." Participants rate how much difficulty they had completing various tasks, "in the past few days . . ." on a 5-point Likert-type scale, ranging from 0 to 4 (*no trouble to impossible*). Individual scores are totaled to a maximum of 60 with higher scores indicating greater pain-related disability. Levels of pain-related functional impairment can be calculated into no/mild (0-12), moderate (13-29), and severe (≥ 30).¹³ The FDI has been used with a wide range of pain conditions and is reported to have moderate to high test-retest reliability, moderate cross-informant (parent-child) reliability, high internal consistency, and good predictive validity.^{13,15}

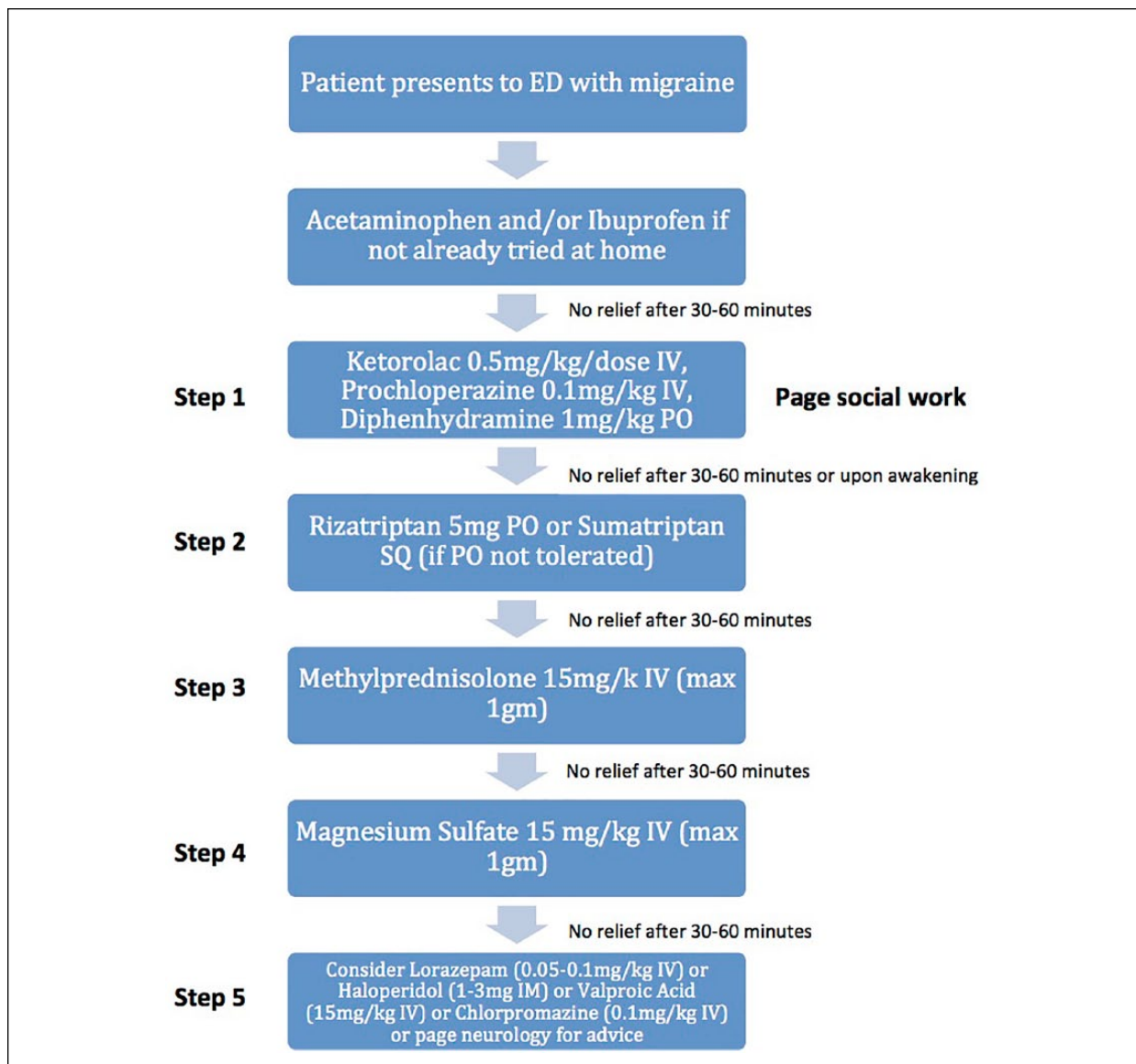


Figure 1. Headache protocol steps.

Study Procedure

Families were notified by the medical team that their child was being placed on the Headache Protocol. The social worker completed a standard of care psychosocial assessment and administered the FDI. Every patient had a parent complete the FDI parent-proxy version, and patients who were at least 8 years old completed the FDI self-report measure. For patients less than 8 years old, or otherwise unable to read, the FDI was read to them. When completed, the social worker scored the FDI(s) to guide their clinical intervention. The social worker then provided a Comprehensive Headache Management booklet

to the family, which provided psychosocial resources for outpatient headache management. If appropriate, the social worker introduced the patient and family to relaxation resources on the hospital's interactive patient care system and/or offered books on pain coping for the family to look at while in the ED. The FDI scores were then entered into the EMR social work note while the paper FDI(s) were saved in a secure file. Social workers used this information to guide their conversations with families but physicians were not typically aware of the FDI scores and it was not included in their treatment algorithm.

Data Analysis

We described our sample with descriptive statistics and used bivariate correlations between parent- and child-reported FDI responses and ED visit variables to explore relationships, as well as 1-sample *t* tests to compare our sample performance relative with a reference group.¹³ Multiple linear and logistic regression analyses were conducted to test the extent to which the FDI predicted clinical outcome variables when controlling for admission pain score. All data were analyzed in SPSS v. 23. Missing data were excluded from analyses.

Results

Descriptive Analyses

Demographic and Medical Information. We collected FDIs on 148 parent-child dyads. Eleven children did not meet inclusion criteria, leaving 137 parent-child dyads for analysis. Fourteen children were unable to complete the FDI due to their medical status. Seven parents did not complete the parent-proxy FDI for unknown reasons. The participants were between 7 and 18 years old (mean [*M*] = 13.9, standard deviation [*SD*] = 2.76) and 79.6% of the child sample was female (Table 1). The majority of our sample identified as Caucasian (75.2%) and non-Hispanic (95.6%). Over half of the sample had a previous diagnosis of migraine (54.7%).

FDI. Parent total FDI scores (*M* = 27.57, *SD* = 15.1) and child total scores (*M* = 25.4, *SD* = 14.1) fell in the moderate range of impairment, with moderate child-parent agreement ($r = 0.62$, $P < .001$; see Figure 2). The average discrepancy in parent and child FDI scores was 2.1 with significant variability (*SD* = 12.7; range = -32 to 45). Although parent scores were generally higher than child scores, and this was not statistically significant ($P = .072$). Compared with an outpatient clinic sample (*M* = 17.4, *SD* = 11.2),¹³ the current study's sample of youth presenting to the ED with headache had a significantly higher child-reported FDI mean ($t[122] = 6.26$, $P < .001$).

Visit Characteristic Outcome Measures. The modal number of protocol steps completed was one (*M* = 1.75, *SD* = 1.2, median = 1, range = 1-5) with 65.7% of the sample completing protocol step one. Neurology was consulted in 8.8% of cases and 19.7% received cross-sectional imaging (ie, magnetic resonance imaging, computed tomography). The majority of our sample was discharged from the ED, with only 7.3% admitted to the hospital for further headache management. After discharge from the ED, 8% returned within 72 hours. Mean

Table 1. Patient Demographic and Medical Information.

	Frequency (n = 137)	Percent
Gender		
Male	28	20.4%
Female	109	79.6%
Age		
7-10 years	24	17.5%
11-14 years	40	29.2%
15-18 years	73	53.3%
Ethnicity		
Hispanic	6	4.4%
Non-Hispanic	131	95.6%
Race		
African American	22	16.1%
Asian	1	0.7%
Caucasian	103	75.2%
Mixed race	2	1.5%
Other	7	5.1%
Unknown	2	1.5%
Initial pain score		
0-2	1	0.7%
3-5	15	10.9%
6-8	64	46.7%
9-10	51	37.2%
No initial pain score	6	4.3%
Previous diagnosis of migraine		
Yes	75	54.7%
No	62	45.3%

pain score on admission was 7.8 (range = 2-10, *SD* = 2.9) and 2.6 at discharge (range = 0-10, *SD* = 2.9). Time in the ED (from first medication administration to discharge order placement) ranged from 38 to 1422 minutes (*M* = 389.7, *SD* = 330.5) and all were discharged or admitted within 24 hours (Tables 2 and 3).

Bivariate Correlations. Higher parent-proxy FDI scores showed weak correlation with higher pain scores on admission ($r = .18$, $P < .05$), higher pain scores on discharge ($r = .20$, $P < .05$), and longer time in the ED ($r = .20$, $P < .05$). Higher child-report FDI scores were moderately correlated with a higher pain score at discharge ($r = .40$, $P < .001$) and weakly correlated with a greater number of protocol steps ($r = .19$, $P < .05$) and a longer time in ED ($r = .20$, $P < .05$). Number of protocol steps was strongly correlated with pain score at discharge ($r = .59$, $P < .000$) and time in ED ($r = .73$, $P < .000$).

Multiple Regression

Multiple linear regression and multiple logistic regression were used to determine the utility of parent-proxy

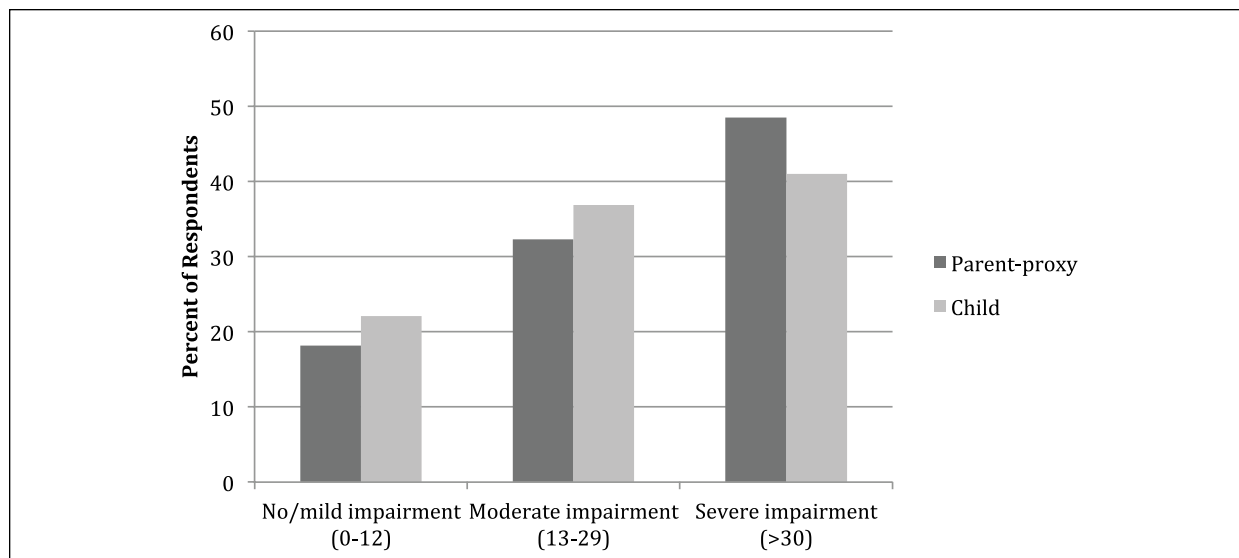


Figure 2. Level of Functional Disability Index (FDI) impairment by informant.

Table 2. Outcomes by Patient FDI Level of Impairment.

	No/Minimal (FDI 0-12), n = 27	Moderate (FDI 13-29), n = 55	Severe (FDI ≥ 30), n = 41
Female, n (%)	22 (17.9%)	33 (26.8%)	42 (34.1%)
Male, n (%)	5 (4.1%)	12 (9.8%)	9 (7.3%)
Average baseline pain score	7.5	7.8	8.1
Average protocol steps	1.4	1.6	2
ED average length of stay (hours)	4.9	5.4	8.4
Admission rate, n (%)	0 (0%)	3 (2.4%)	6 (4.9%)
Neurology consult, n (%)	0 (0%)	3 (2.4%)	7 (5.7%)
Cross-sectional imaging, n (%)	7 (5.7%)	11 (8.9%)	8 (6.5%)
Return ED visit < 72 hours, n (%)	4 (3.3%)	3 (2.4%)	4 (3.3%)

Abbreviations: FDI, Functional Disability Index; ED, emergency department.

Table 3. Outcomes by Parent-Proxy FDI Level of Impairment.

	No/Minimal (FDI 0-12), n = 25	Moderate (FDI 13-29), n = 42	Severe (FDI ≥ 30), n = 63
Female (patient), n (%)	21 (16.2%)	33 (25.4%)	52 (40%)
Male (patient), n (%)	5 (3.8%)	9 (6.9%)	13 (10%)
Average baseline pain score	7.2	7.6	8.0
Average protocol steps	1.5	1.8	1.9
ED average length of stay (hours)	4.7	5.8	9.4
Admission rate, n (%)	1 (0.8%)	2 (1.5%)	7 (5.4%)
Neurology consult, n (%)	2 (1.5%)	1 (0.8%)	8 (6.1%)
Cross-sectional imaging, n (%)	7 (5.4%)	9 (6.9%)	10 (7.7%)
Return ED visit < 72 hours, n (%)	1 (0.8%)	7 (5.4%)	3 (2.3%)

Abbreviations: FDI, Functional Disability Index; ED, emergency department.

Table 4. Regression of FDI Scores on Outcomes When Controlling for Admission Pain Scores.

	B	SE B	β	P
# Headache Protocol steps				
Child FDI	.018	.008	.195	.034*
Parent FDI	.011	.007	.128	.159
Time in ED				
Child FDI	5.342	2.247	.216	.019*
Parent FDI	4.765	2.037	.210	.021*
Admission				
Child FDI	.074	.032	1.077	.022*
Parent FDI	.026	.024	1.026	.278
Imaging				
Child FDI	-.023	.018	.977	.188
Parent FDI	-.035	.017	.966	.044*
ED revisit <72 hours				
Child FDI	-.052	.029	.949	.069
Parent FDI	-.034	.024	.967	.160

Abbreviations: FDI, Functional Disability Index; SE, standard error; ED, emergency department.

*Significant $P < .05$.

and child-report FDI scores on predicting clinical outcomes after controlling for the children's admission headache pain scores (Table 4). When controlling for admission pain score, child FDI (but not parent) predicted the number of headache protocol steps. Higher FDI scores by parent and child report were more significant predictors of time in the ED than admission pain scores. Children (but not parents) reporting higher levels of impairment were more likely to be admitted to the hospital when controlling for their admission pain scores. Finally, child pain level (but not impairment) on ED admission was a significant predictor of the child receiving imaging while for parent report both child's pain on admission and parent FDI score predicted likelihood of imaging. No variables predicted neurology consultation or ED revisit within 72 hours.

Discussion

Headaches are a common presenting complaint in the pediatric ED.^{4,5} Youth with chronic headache are at risk for significant functional impairment, and therefore the assessment of pain-related disability is thought to be a critical component of their evaluation and treatment.^{7,8} However, assessment in the ED typically consists of pain assessment at a single time point, which may not fully capture the broader pain experience or be predictive of health outcomes. The present study sought to examine whether parent- and child-reported functional impairment as measured by the FDI in a pediatric ED

predicts resource utilization. The measurement of functional impairment is a standard practice among psychologists when treating chronic pain conditions. However, this would be the first time, to our knowledge, it would be utilized in the ED setting for pediatric patients with headaches.

When controlling for initial pain scores, youth with higher FDI scores required more medication interventions and were more likely to be admitted. Higher parent-reported child impairment was predictive of cross-sectional imaging. Both parent and child reports of higher impairment were predictive of longer length of stay in the ED. Neither score predicted neurology consult nor return to the ED within 72 hours. These results show that we should consider assessing both parent- and child-FDI scores in patients presenting to the ED with headache, as they predict different utilization outcomes. In most other studies of functional impairment and pain, child-self report is favored, while parent-proxy report is understudied.¹³ Clinicians should consider accessing parent report as a predictor of future health care utilization or if the child's pain severity may affect their ability to respond accurately.

Pediatric patients presenting with headache rarely have an underlying life-threatening illness. However, they utilize significant hospital resources, including inpatient beds and social work consultations. While our ED had the resources to place patients on extended observation protocols (up to 24 hours) and have social work see all patients placed on the headache protocol that capability is not universal. For example, in one study at another Midwestern academic institution, 22% of ED patients presenting with migraines were admitted to the hospital.¹⁶ Based on our study results, utilization of FDI scores may help ED physicians predict which patients may require increased time and resources. Social workers have a unique role to play in the pediatric ED, with some studies reporting their interventions associated with decreased health care utilization.¹⁷ In EDs without the benefit of a robust social work group, patients with higher FDI scores can have social work consults prioritized to discuss symptom management and alternative treatment options. Additionally, EDs that are unable to accommodate extended lengths of stay may benefit from early identification of those patients likely to require admission.

Children with headache pain presenting to the ED report higher levels of impairment as compared with an outpatient clinic setting, where less than 20% of subjects reported severe impairment.¹³ The fact that youth presenting to ED have higher levels of impairment is not entirely surprising, particularly since most youth in the ED with headache have usually been experiencing

several days of pain. In addition, their pain has to be seen as severe or impairing enough to be determined significant by their families, causing them to seek ED-level care. Clinicians working with pediatric headache patients who have a history of ED utilization may consider that these youth are more affected by their pain than those whose headache have been primarily managed on an outpatient basis.

Currently, pain scores are mandated by The Joint Commission and typically assessed early in the visit.¹⁸ However, in our study pain scores were not predictive of resource utilization other than cross-sectional imaging. Assessment of functional impairment may be more useful for predicting resource utilization.⁹ At our institution, a patient's FDI score was ascertained after the headache protocol order was placed. Physicians were unaware of FDI scores, as the social work note was usually not written until after the patients' disposition had been determined. However, social workers were able to utilize these scores to guide both interventions in the ED and future outpatient management, such as relaxation techniques or referrals to psychology. Given this fact, FDI scores were not incorporated into physician decision-making. With the ease of administration and scoring, it would be feasible to have any patient presenting with a headache fill out the FDI questionnaire along with their parent early in the visit, possibly during triage. By incorporating the FDI into initial assessments, health care professionals could utilize the information in conjunction with pain scores to optimize treatment of patients.

While the present findings highlight the importance of assessing psychosocial variables associated with headache pain in an acute care setting, there were limitations. This was a convenience sample done at a single Midwestern institution. As a relatively well-resourced pediatric facility with 24-hour dedicated social work, our results may not be generalizable. However, despite the fact that social work administered the FDI in our study, it does not take significant time or a dedicated skill set. Additionally, it is important to consider that the FDI assesses functional disability over the last 2 weeks, which may not fully capture functional limitations of children presenting in an acute pain crisis to the ED. The number of return ED visits and hospitalizations for headache is a very limited means of assessing health outcome that may not capture some of the other nuances of the pediatric headache experience. The majority of the sample consisted of white females in their early teens and therefore results may not be representative of other demographics. We did not quantify the chronicity of the child's pain, which may have added to our ability to differentiate between children with more chronic disability due to their pain. Finally, our ability to confidently predict future health

care utilization is limited, as we were only able to track utilization in our hospital system given the scope of our EMR. As a result, we were unable to report utilization for headache by primary care physicians, urgent care centers, other institutions, or subspecialist visits for headache, thereby possibly underestimating health care utilization in our sample.

Conclusion

This is the first study to explore the relationship between functional impairment and health care utilization in youth presenting to the ED with headache. Our findings highlight the potential clinical utility of the FDI as a screening measure for pain-related impairment in an acute care setting and underscore the importance of evaluating commonly used measures of pediatric chronic pain in different clinical settings. Our findings also underscore the importance that parent perception of child impairment may play in predicting health care utilization for headache.

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Author Contributions

JLH conceptualized the study, provided data acquisition, reviewed statistical analyses, and drafted the final manuscript. SLL, LEH, and LED contributed to data acquisition, contributed to the first draft of the manuscript and edited the final manuscript for intellectual content. ESP, AJR, and KAK conceptualized the study, reviewed statistical analyses, and edited the manuscript for intellectual content.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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