Validation of a Migraine Interview for Children and Adolescents

WHAT'S KNOWN ON THIS SUBJECT: Childhood headache is a common medical condition and can negatively impact a child's social and academic life in several ways. Early and accurate diagnoses of headache syndromes, including migraine, are essential to appropriate treatment and outcome for affected youth.

WHAT THIS STUDY ADDS: The Diagnostic Interview of Headache Syndromes–Child Version is a new tool for the assessment of pediatric migraine that can enhance the standardization of collection of diagnostic criteria in both clinical and community settings, leading to better recognition and treatment of this condition.

abstract

OBJECTIVE: To date there are no structured interviews to ascertain the diagnostic criteria for headache in children. The objective of this study was to assess the validity of the Diagnostic Interview of Headache Syndromes–Child Version (DIHS-C), which was developed at the National Institute of Mental Health for a community-based family study of headache syndromes and comorbid disorders.

METHODS: The DIHS-C is a fully structured diagnostic interview composed of an open-ended clinical history, modules with key symptoms for each of the major headache subtypes, and associated impairment, duration, frequency, course, and treatment. This article presents the validation of the interview in a sample of 104 children evaluated as part of a community-based family study of migraine.

RESULTS: The sensitivity of interview diagnosis compared with an expert neurologist's diagnosis of migraine was 98%, and the specificity was 61%. Similar levels of sensitivity and specificity were found by gender and age of the children.

CONCLUSIONS: The DIHS-C provides a new tool that can enhance the reliability of pediatric diagnoses in both clinical and community settings. *Pediatrics* 2013;131:e96–e102

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KEY WORDS

headache, migraine, interview validation

ABBREVIATIONS

AUC—area under the curve

DIHS-C—Diagnostic Interview of Headache Syndromes–Child Version

ICHD—International Classification of Headache Disorders diagnostic criteria

Dr Lateef had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis, and all of the authors made substantial contributions to the conception, design, acquisition of data, analysis, and/or interpretations of the data; drafted and/or critically revised the article; and provided final approval of the version to be published.

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Headache is a common complaint in children and adolescents[1,2] and is associated with substantial impairment, particularly in the educational sphere. It is often comorbid with a range of physical and mental health problems including asthma,[3–5] allergies,[3–5] sleep disorders,[6,7] suicidal ideation,[8] emotional and behavioral problems,[9] and depression and anxiety.[10] Accurate diagnosis of headache in youth is essential to effective treatment and prevention efforts.

There has been substantial effort to develop valid diagnostic criteria for headache syndromes in children since the introduction of the International Classification of Headache Disorders diagnostic criteria (ICHD-I) in 1988.[11–18] The most recent classification of headache syndromes in children in the second edition of the International Classification of Headache disorders criteria (ICHD-II)[19] differentiates migraine in children from adults by requiring shorter duration (1–72 hours instead of 4–72 hours), less restrictive location (bifrontal/bitemporal or unilateral instead of just unilateral), and symptoms of photophobia and phonophobia that can be inferred from behavior during the headache (ie, going into a dark, quiet room) instead of just directly asking the child. Even though the ICHD-II criteria have led to enhanced sensitivity of the diagnosis of migraine with aura in children, approximately half of pediatric migraine remains undetected by the classification system.[14]

One potential explanation for the low sensitivity and/or specificity of a particular diagnostic system is the lack of standardized methods for ascertaining the criteria. For example, a major source of unreliability in the application of diagnostic criteria results from variations in clinical interviewing.[20] Although the application of symptom checklists can increase standardization of the application of diagnostic criteria, they often do not capture the dimensional nature of the symptoms, frequency, or severity of the core features of headaches. Biases can also emerge because of differential weighting of symptoms or the application of arbitrary cutoffs based on subjective thresholds.[21] Aside from 1 self-administered questionnaire that collects ICHD-II criteria for pediatric migraine in adolescents,[22] there are no structured diagnostic interviews for pediatric headache.

The purpose of this study was to describe the background and validation of the structured Diagnostic Interview of Headache Syndromes—Child Version (DIHS-C), which can be administered by non-clinicians to detect the ICHD-II criteria for headache syndromes among children ages 7 to 18 years. (The interview is available upon request from the study investigators at http://intramural.nimh.nih.gov/research/pi/pi_merikangas.html.) The Diagnostic Interview for Headache Syndromes was developed to assess the symptom criteria for headache syndromes in both adults and children for a community-based family study of migraine and other headache syndromes. The structure is parallel to that of structured diagnostic interviews in psychiatry that have been widely used in both clinical and community settings. The interview models the clinical diagnostic interview with an open-ended series of queries regarding headaches followed by structured questions on symptoms, severity, duration, frequency, and impairment. The open-ended interview allows the interviewer to collect an overview of the history of headaches, key characteristics, changes over time, and number of different subtypes of headache. Modules for all of the major headache subtypes, including migraine, tension-type, cluster, and post-traumatic headache, are included in the interview. No hierarchic exclusions based on the number of symptoms, duration, or frequency of other headache subtypes are in the interview. Comprehensive questions regarding treatment history, prescribed and nonprescribed medication use, and laboratory and other evaluations are included. The DIHS-C was developed for administration in clinical settings by physicians, nurses, or ancillary medical staff with clinical supervision or in nonclinical settings with supervision by medical experts. The interview gathers information simultaneously from a youth and a parent or guardian, with the child as the primary informant, particularly with adolescents.

METHODS

Sampling

The study sample consisted of 104 children (53 boys, 51 girls), ages 7 through 17 years, who were interviewed about their headaches. The children were identified either through a large community family study of physical and mental health or through the headache clinic at Children's National Medical Center in Washington, DC. All of the study participants were recruited primarily from a community study of health and behavior from the greater Washington, DC, area. Because we were particularly interested in assessing migraine, we enriched the sample by recruiting both adults and children with headaches and/or migraine through distribution of brochures to local clinics. We stratified the analyses by community versus noncommunity sources to determine whether the results were similar by referral source. A subsample of 79 children (40 boys, 39 girls) also received a neurologic evaluation and ascertainment of headache status by one of the study neurologists. Among the 104 children in the study, 40 had previously been diagnosed with migraine by a clinician.

Measures

Diagnostic Interview

The DIHS-C was developed to use a parallel interview approach with the parent and the youth because of the expansive literature that notes the strength of this methodology to assess for psychiatric disorders in children and adolescents.[23–25] By using this method, the interview simultaneously ascertained information on the basis of the child's own headache experience and knowledge from the parent about the child's headaches.

The DIHS-C is a structured, multiple-informant, nonphysician interviewer–administered instrument designed to assess for lifetime experience of headache syndromes, based on ICHD-II criteria, in the general population as well as in clinical samples. The DIHS-C uses information from a youth and a parent or guardian and is administered to both simultaneously rather than separately to reduce interviewer time and expense and to maximize the accuracy of recall.[26–28] The parent is the primary informant for children younger than 12 years, and the adolescent is the primary informant when he or she is older than 12 years. Discrepancies between informants were resolved at the time of the interview to obtain a composite diagnosis.

The DIHS-C begins with an open-ended question whereby the youth/parent dyad are requested to qualitatively describe the features of the youth's headaches and if he or she experiences >1 type of headache. Afterward, the youth and parent are instructed to focus on the most severe type of headache and to ask a series of structured items designed to capture diagnostic criteria for headache syndromes. These include the following: (1) features of the headache such as pulsating, intensity, unilateral location, aggravation with physical activity, photophobia, phonophobia, nausea, and vomiting; (2) assessment of aura through questions about visual changes and complex features such as speech disturbance and unilateral weakness and/or numbness; (3) continuous item responses to capture the frequency of headaches by days per month and average duration of headaches in minutes, hours, or days; and (4) the level of distress and impairment due to headaches in school and in social and family relations by using a dimensional scale of 1 to 4. In addition, the impact of migraine over the last 3 months was assessed by the Migraine Disability Assessment Test.[29] The Migraine Disability Assessment Test is a 6-question tool that takes into account the number of days or partial number of days of activity missed across the domains of school, social/play, and household chores. Finally, inquiry about current or past medical treatment and previous headache diagnosis by a physician was noted. The interview takes ~15 to 20 minutes to administer for 1 type of headache and 30 to 40 minutes for ≥2 types of headache.

The interview does permit assessment and diagnosis of several headache subtypes so that a comprehensive summary of lifetime history of headache subtypes may be obtained. Several participants did describe features of >1 headache subtype. However, the criteria for the 3 major subtypes (migraine with aura, migraine without aura, and tension-type headache) lead to mutually exclusive classification. In addition, the clinicians tended to apply a hierarchic diagnosis for the purposes of this validation study.

All youth who were enrolled in the larger family study were administered a full battery of diagnostic measures including the DIHS-C when applicable. Before the beginning of the interview battery, the parent completed a medical history questionnaire that included 1 item probe about headaches (Has your child ever had headaches?). For those cases in which the parent did not endorse the presence of headache, this information was directly verified with the youth. In discrepant instances in which the youth reported headaches but the parent did not, and for those cases in which the parent endorsed headache but the youth did not, the DIHS-C was administered. The importance of inclusion of a direct interview with the child is essential to correctly identify the presence of headaches in youth as documented by Nakamura et al.[28]

For those who endorsed a second type of headache, the same items were readministered, but this time the participants were instructed to focus on features of only the second type of headache. Upon completion, each nonphysician interviewer submitted a diagnostic headache rating based on endorsement of ICHD-II criteria for migraine without aura, migraine with aura, or both. These ratings were then blindly reviewed and verified by one of the study's board-certified neurologists to ensure diagnostic accuracy by using a checklist with the ICHD-II criteria.

Validation Procedures

We first examined the concordance between the interviewer diagnosis and an independent medical history that included information on previous physician-diagnosed migraine. In the formal validation study, interviewer diagnoses of migraine were compared with independent clinician diagnoses.

Data Analysis

Concordance between clinician diagnosis and structured interview diagnosis of headache was evaluated by using descriptive measures, including sensitivity, specificity, positive predictive value, negative predictive value, and

area under the curve (AUC). Clinician diagnosis of headache was used as the gold standard when calculating sensitivity and specificity. Sensitivity measures the proportion of actual positives that are correctly identified as such, and specificity measures the proportion of negatives that are correctly identified. In our study, sensitivity measured the proportion of actual headache-positive subjects (with a clinician's diagnosis of headache) who were correctly identified by the interview, whereas specificity calculated the proportion of no-headache subjects (with a clinician's diagnosis of no headache) who were correctly classified by the interview. Positive predictive value is the proportion of the positive headache diagnoses based on the interview that is confirmed by the clinician, whereas negative predictive value states that the proportion of the nonheadache diagnoses based on the interview also has the same diagnoses from the clinician. The AUC summarizes the overall diagnostic accuracy of the headache interview. In other words, it estimates the probability that a randomly selected pair of headache and nonheadache subjects could be correctly classified on the basis of the interview.

RESULTS

A total of 104 pediatric headache diagnostic interviews were conducted as part of the study. Among these children, 40 had previously received a clinician's diagnosis of migraine. All of these 40 children were also diagnosed with migraine on the basis of the DIHS-C. Of the 79 participants who were seen by one of the study neurologists, 42% were aged 7 to 11 years and the rest were aged 12 to 17 years. The prevalence of migraine among boys and girls determined by using the DIHS-C was 67% and 77%, respectively, and by the study clinician was 50% and 59%, respectively.

Agreement between the DIHS-C and study clinician diagnosis is shown in Table 1. Of the 43 children and adolescents diagnosed with migraine by the study clinician, only 1 did not receive a diagnosis of migraine on the basis of the DIHS-C. This participant was given a diagnosis of tension-type headache by the interviewer. Fourteen participants were identified as having migraine by the DIHS-C but not subsequently diagnosed with migraine by the study clinician. Four of these participants received a diagnosis of tension-type headache by the clinician. Of note, 12 of these 14 participants denied any gastrointestinal symptoms such as nausea and/or vomiting in association with their headache. Nine of the 14 participants had never before sought medical attention for their headaches.

In Table 2 we report the diagnostic validity of the interview by migraine subtype. The prevalence of migraine (with or without aura), migraine without aura, and migraine with aura were 70.9%, 57.0%, and 34.2%, respectively, based on the interview and 54.4%, 45.6%, and 10.1%, respectively, based on the clinician's diagnoses. Migraine with aura has the highest sensitivity (100%) and specificity (69.6%). Migraine without aura has a sensitivity of 77.8% and specificity of 59.5%. For overall migraine (with or without aura), the interview was able to identify 97.7% of subjects with a migraine diagnosis from the clinician; 61.1% of the nonmigraine subjects (clinician's diagnosis) were classified in the same category by the interview. The AUC results showed that the concordance between interview and clinician diagnoses can be described as good for migraine with aura (AUC = 0.9) and as fair for migraine without aura (AUC = 0.7).

Table 3 displays the concordance between the DIHS-C and the clinician's diagnosis for migraine (with or without aura) by gender and age of the participants. All of the girls with migraine were identified by the interview compared with 95% of the boys with migraine. The specificity for boys and girls was 65.0% and 56.3%, respectively. The AUC results showed good concordance for both boys (0.8) and girls (0.8). The interview was able

TABLE 1 Agreement Between Diagnostic Interview and Clinician's Diagnosis

	Diagnostic Interview				Total, *n* (%)
	Migraine With and Without Aura	Migraine With Aura	Migraine Without Aura	No Migraine Headache	
Clinician's diagnosis, *n*					
Migraine with and without aura	0	1	0	0	1 (1)
Migraine with aura	4	3	0	0	7 (9)
Migraine without aura	11	6	17	1	35 (44)
No headache	3	1	10	22	36 (46)
Total, *n* (%)	18 (23)	11 (14)	27 (34)	23 (29)	79 (100)

TABLE 2 Agreement Between Diagnostic Interview and Clinician's Diagnosis by Headache Subtypes

	Migraine With or Without Aura	Migraine Without Aura	Migraine With Aura
Sensitivity, % (*n*)	97.7 (42/43)	77.8 (28/36)	100 (8/8)
Specificity, % (*n*)	61.1 (22/36)	60.5 (26/43)	70.4 (50/71)
PPV, % (*n*)	75.0 (42/56)	62.2 (28/45)	27.6 (8/29)
NPV, % (*n*)	95.7 (22/23)	76.5 (26/34)	100 (50/50)
AUC	0.8	0.7	0.9

NPV, negative predictive value; PPV, positive predictive value.

TABLE 3 Agreement Between Diagnostic Interview and Clinician Diagnosis by Headache Subtypes According to Gender and Age Group

	MIG		Age <12 Years			Age ≥12 Years		
	Girls	Boys	MIG	MIG 0	MIG A	MIG	MIG 0	MIG A
Sensitivity, % (*n*)	100 (23/23)	95.0 (19/20)	94.1 (16/17)	75.0 (12/16)	100 (1/1)	100 (26/26)	80.0 (16/20)	100 (7/7)
Specificity, % (*n*)	56.3 (9/16)	65.0 (13/20)	81.3 (13/16)	76.5 (13/17)	71.9 (23/32)	45.0 (9/20)	50.0 (13/26)	69.2 (27/39)
PPV, % (*n*)	76.7 (23/30)	73.1 (19/26)	84.2 (16/19)	75.0 (12/16)	10.0 (1/10)	70.3 (26/37)	55.2 (16/29)	36.8 (7/19)
NPV, % (*n*)	100 (9/9)	92.9 (13/14)	92.9 (13/14)	76.5 (13/17)	100 (23/23)	100 (9/9)	76.5 (13/17)	100 (27/27)
AUC	0.8	0.8	0.88	0.76	0.86	0.73	0.65	0.85

MIG, migraine without aura and migraine with aura; MIG 0, migraine without aura; MIG A, migraine with aura; NPV, negative predictive value; PPV, positive predictive value.

to correctly identify all of the true headache subjects for migraine with aura for both age groups and for any migraine (with or without aura) for the group aged ≥12 years. The specificity is lower for the older age group (≥12 years) compared with the younger group (<12 years). The AUCs showed good concordance for any migraine and migraine with aura for the younger group and fair concordance for migraine without aura in the younger group. For ages ≥12 years, the AUCs were poor for overall migraine and migraine without aura but reached a good level of concordance for migraine with aura. κ Statistics ranged from 0.32 (migraine with aura) to 0.60 (any migraine) and varied dramatically by age group, most likely due to the small sample size affecting the κ statistic. Therefore, in this sample, AUC provided a more accurate determination of concordance.

DISCUSSION

These findings show that the DIHS-C is a reliable and valid method for ascertaining migraine in both clinical and community settings. The overall sensitivity and specificity for migraine was 98% and 61%, respectively. That is, nonphysicians who administered the DIHS-C identified 14 participants (ie, false-positives) as suffering from migraine that the clinician did not diagnose. Conversely, there was only 1 clinician-diagnosed case of migraine not detected by the DIHS-C (ie, only 1 false-negative).

Although the sensitivity for any headache subtype was high for both girls (100%) and boys (95%), the specificity differed moderately between boys (65.0%) and girls (56.3%). The DIHS-C rating revealed a higher prevalence of migraine with (21.5%) and without aura (31.7%) in girls, whereas boys were found to have higher rates of aura only (3.8%) and tension-type headache (7.6%). In comparison, clinician ratings yielded equal rates of migraine without aura for boys and girls (22.8%).

For children aged <12 years, the sensitivity and specificity of migraine were 94.1% and 81.3%, respectively. However, for those children aged >12 years, sensitivity was 100% whereas specificity decreased to 45.0%, thereby indicating greater misclassification because headaches become more common with age. The rate of migraine without aura with the DIHS-C and the clinician were the same for children aged <12 years (20.3%), whereas rates were higher with the DIHS-C than with the clinician in adolescents (ie, 36.7% vs 25.3%, respectively). Moreover, there were no cases of tension-type headache identified by the clinician in children aged <12 years, whereas 3.8% were identified by the DIHS-C. Although clinician ratings were higher for tension headache (10.1% vs 8.9%) for those aged >12 years, the DIHS-C showed higher rates of overall migraine types, suggesting that it is possible that some of these cases may have been misclassified. Because all of the DIHS-C ratings were reviewed and approved by a board-certified neurologist, the discrepancies between ratings are better explained by missed cases on the part of the clinician rather than by the DIHS-C interviewer. That is, low specificity was a partial result of the clinician-applied gold standard.

For example, the interview actually detected more cases than those identified by the clinician's unstructured assessment. This finding is attributable to the comprehensive structured nature of the DIHS-C, which assesses the full range of subtypes without prioritizing migraine which tends to be the focus of clinical experts. In addition, the lifetime scope of the history collected in the DIHS-C also yielded more information on the history of milder headaches as well as those that were not current. Moreover, further evaluation of false-positive interview cases revealed that nausea/vomiting was not associated with headache in the majority of cases that were diagnosed by the interview but not by the clinician. This finding suggests that even though nausea/vomiting is not an essential criterion for the diagnosis of migraine, the physician may place greater weight on gastrointestinal symptoms in the diagnosis of migraine. Underreporting of these symptoms to the clinician is another possible explanation. Therefore, the sensitivity of the DIHS-C demonstrates the difference in its ability to ascertain the International Headache Society diagnostic criteria for pediatric migraine compared with a checklist or unstructured clinical methods.[11,12,14–16,18]

As such, the DIHS-C may be most valuable in clinical settings as an initial history-gathering method, administered by a nonphysician, which can then be used by the treating clinician.

In research settings and particularly in epidemiologic studies, standardized means of ascertaining criteria are also essential. The bulk of national health surveys that do not focus on headache solely only assess physician-diagnosed migraine. Consequently, these studies are biased toward treated cases or contain only a few questions regarding current headaches or migraine, which limits our ability to estimate morbidity, course, and treatment outcomes in representative surveys of the general population. Therefore, a structured, more comprehensive interview such as the DIHS-C may allow for more accurate headache diagnosis and classification.

The strengths of this study include the following: the community-based sample, which was enriched by children with headaches from the Children's National Medical Center; systematic and independent evaluation of the interview compared with neurologists with expertise in headache; and the comprehensive information that was obtained on headache that was not restricted solely to ICHD-II criteria. In addition, the DIHS-C was designed to interview both the parent and child together, with the child as the primary informant to avoid possible underreporting of headaches and headache symptoms. Previous studies have shown high levels of underreporting of child headaches by parents[27,28,30,31]; for example, in our earlier work we found that only 42% of parents were aware of their children's headaches, and only 59% for parents of children with migraine.[28] In clinical settings, youth are generally far more accurate in the reporting of symptoms of headache pain, whereas the parent is far more precise in the recounting of the level of impairment experienced by the youth during headache attacks and in the reporting of treatment history. Similarly, frequency of headache attacks is better identified by the parent in younger children ($<$12 years) and by youth $\geq$12 years. Thus, the concurrent interviewing of both youth and parent served to enhance the overall exactness of headache diagnosis.

Limitations include the restriction of the clinical validity study to migraine rather than the full spectrum of headache subtypes included in the DIHS-C. Although the interview was designed to ascertain criteria for the full range of headache subtypes, we did not have a sufficient number of cases with physician diagnoses to validate the other subtypes. Other limitations include the relatively small sample size and the length of the interview, which exceeds that of the standard headache questionnaire. For maximum efficiency, the DIHS-C in clinical settings could be administered by trained nonphysician medical personnel before the physician evaluation.

CONCLUSIONS

The DIHS-C is a new tool for the assessment of pediatric migraine that can enhance the standardization of the collection of diagnostic criteria in both clinical and community settings. It can provide more comprehensive information on headaches in clinical settings to improve efficiency and comprehensiveness of information and to provide more accurate estimates of migraine and its burden in the general community.

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