The Journal of Pain, Vol 7, No 6 (June), 2006: pp 445-451
Available online at www.sciencedirect.com

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Kinesiophobia in Migraine

Isabel Pavão Martins,* Raquel Gil Gouveia,* and Elsa Parreira†
**Centro de Estudos Egas Moniz, Instituto de Medicina Molecular, Lisbon Faculty of Medicine, Lisboa, Portugal.*
†Department of Neurology, Hospital Fernando da Fonseca, Amadora, Portugal.

Abstract: Pain aggravation by movement and avoidance of movement (kinesiophobia) is often reported by patients during migraine attacks. Yet its specific contribution to migraine diagnosis is undetermined. To characterize the frequency and severity of kinesiophobia during migraine and its role in the diagnosis of primary headaches, we questioned 150 patients (126 women and 24 men, average age 38.5 yrs) with migraine (n = 111) or tension-type headache (TTH) (n = 39) about aggravation of pain by bending forward, brisk head movements (jolt), and avoidance of movement during the attacks. The degree of pain worsening by each stimulus was measured through a visual analog scale and compared to worsening produced by other sensory stimuli such as light, sound, and smell. The discrimination power of kinesiophobia between migraine and TTH was calculated, using the International Classification of Headache Disorders criteria as gold standard. Sensitivity/specificity of studied symptoms was high in differentiating the 2 headache types: bending forward: 98%/85.7%; jolt: 96.3%/81.6%; and immobility during the attacks: 100%/70%. The degree of kinesiophobia was identical to photo- and phonophobia in migraine patients. We conclude that kinesiophobia discriminates between migraine and TTH. Bending forward and jolt may be useful additional questions to ask patients for the differentiation of headache attacks.

***Perspective:** This article evaluates the specific role of movement (movement-induced pain aggravation and avoidance of movement) in primary headaches. Kinesophobia is an easy symptom to screen, explained by migraine pathophysiology, and proved to be a sensitive and specific measure to identify migraine attacks when compared to tension-type headache.*

***Key words:** Migraine, tension-type headache, clinical diagnosis, intolerance to movement.*

Diagnosis of primary headaches depends entirely on clinical symptoms, namely, the description of pain and factors affecting it, because there are no biologic markers for such disorders. Although most patients can be classified on clinical grounds and fulfil operational diagnostic criteria, some cases are difficult to categorize, either because of atypical or incomplete presentations or because they have multiple headache types. This study concerns the specific diagnostic value of symptoms related to movement in the diagnosis of migraine that are often mentioned by patients.

Migraine attacks are associated with a marked intolerance to all sensory stimuli, including light, sound, smell,[16,20,22,25] taste,[12] touch, vibration,[5] and minor physical activity.[10,11] In addition, migraine patients often express fear of movement during the attacks, because it aggravates pain[20,22] or enhances its throbbing character. There are patients who are able to differentiate migraine from "normal headaches" at their onset by bending forward: If it aggravates pain, then it is migraine. Others mention that after headache has been controlled with medication, they know the attack is still ongoing because they can bring the pain back by brisk head movements. In a study of patients' behavior during headache attacks,[15] it was found that remaining still was a very common behavior during migraine but not in tension-type headache (TTH). Although the last version of the International Classification of Headache Disorders (ICHD-II),[11] compared with the former version,[10] incorporated this avoidance behavior in migraine diagnosis and expanded the scope of activities that aggravate headache (criteria 1.1.−C.4) "aggravation by or causing avoidance of routine physical activity (eg, walking or climbing stairs)", it did not differentiate the contribution of effort from movement, namely, head movement, in the aggravation of pain. This prompted us to investigate the diagnostic

Received September 8, 2005; Revised January 29, 2006; Accepted January 30, 2006.
Preliminary results of this study were presented at the 11th Congress of the International Headache Society (2003).
Address reprint requests to Dr. Isabel Pavão Martins, Centro de Estudos Egas Moniz, Lisbon Faculty of Medicine, Hospital de Santa Maria, 1600 Lisboa, Portugal. E-mail: labling@fm.ul.pt; ipmartins@simplesnet.com
1526-5900/$32.00

doi:10.1016/j.jpain.2006.01.449

value of symptoms of avoidance of movement, or pain aggravation with movement, that we designated by kinesiophobia (KP) in differentiating migraine from TTH.

Methods

Subjects

In this cross-sectional study patients were recruited by their physicians from headache and neurology outpatient clinics of 2 general hospitals. Consecutive patients, either first or follow-up visits, who fulfilled the inclusion criteria were invited to participate. The study protocol was approved by the Hospital Ethics Committee, and study subjects provided informed consent.

Inclusion criteria were the following: age over 15 years; history of chronic headache; a single primary headache type, either migraine or tension type headache; fulfilling the ICHD-I[10] diagnostic criteria; no clinical evidence of cognitive impairment (mental retardation or dementia) that could interfere with the comprehension of the study questions; and agreement to participate.

Patients with more than 1 headache type and those with medication overuse were not included. Particular care was taken to exclude the association of migraine with other headaches to avoid any confusion in the description of the attacks. Patients with daily or very frequent headaches with gastrointestinal symptoms now coded as chronic migraine (ICHD-II)[11] were excluded.

Procedure

Patients were interviewed during their clinical appointment. Biographic (age in years, gender) and clinical (diagnosis, pain chronicity, present features of the attacks) data were recorded. Diagnosis was made on clinical grounds (history, physical examination, and brain imaging or other exams, if necessary) and checked (for patients on both first and follow-up visits) according to the ICHD-I criteria. This former headache classification does not include avoidance behavior as a diagnostic criterion of migraine and only considers pain aggravation by walking stairs, or similar routine physical activity, not specifically by head movement.

Diagnosis was divided into 2 main groups: TTH (episodic and chronic) and migraine (with or without aura). Attack frequency was categorized into 3 groups: less than 1 per month, between 1 and 3 per month, and 4 or more per month. Usual duration of attacks was divided into less than 24 h, between 24 and 48 h, and more than 48 h. Average severity of pain was classified as mild, moderate, and severe, according to the degree of limitations imposed upon daily activities and work. Information concerning ongoing prophylactic medication (yes/no) and pain during the interview (yes/no) was also collected.

Patients were asked 6 closed questions concerning symptoms experienced during the attacks: pain worsening by light, sound, odors, bending forward, or jolt (brisk head movement such as head shaking), and the tendency to remain still during the attacks, whenever possible. Answers were coded Yes (always or often), No (never or rarely), and Missing (if no consistent answer could be obtained, such as "don't know," "can't decide," "have doubts about it," and "it varies"). Patients were specifically instructed to report the effect of head movement on pain, not on dizziness, nausea, or other associated symptoms. Aggravation of pain was quantified on a visual analog scale (VAS). Patients were asked to score (by self-record) the degree of aggravation (while in pain) produced by each of 6 stimuli (light, sound, odors, cough, head shaking, and bending forward) on 10-cm lines. To facilitate the interpretation of this scale, 3 face drawings illustrating the degree of pain aggravation were drawn over the 6 lines: a smiling face over the 0-cm end for no worsening, a neutral face over the middle for moderate aggravation, and a sad face over the 10-cm end for marked aggravation. As part of the development of the protocol, a pilot study was conducted in 12 consecutive headache patients (with any diagnosis of headache), and interrater reliability of answers was evaluated. Participants of the pilot study were questioned by 2 independent clinicians (only 1 was aware of the diagnosis) who completed the protocol on the same day, with an average interval of 30 minutes. Responses were consistent both regarding closed yes/no questions (Cohen K ranging from .63 to 1) and VAS scoring (r_s ranging from .68 to .96).

If the patient was in pain during the interview, he/she was specifically asked to perform the movements under study (bending forward, brisk head shaking, and cough) before rating its effect on pain.

Data Analysis and Statistics

Statistical analysis was performed using a SPSS Base system 12.0 for Windows XP and Confidence Interval Analysis software.[1]

Our primary hypothesis was that KP symptoms would differentiate migraine from TTH. The secondary objective was to compare the degree of aggravation by movement to aggravation caused by other sensory stimuli included in ICDH I diagnostic criteria of migraine.

Frequency distributions and descriptive statistics (means, medians, and standard deviations) were calculated for all patients and each diagnostic group. Comparisons between patients with migraine and TTH were made by chi-square (χ^2) test to analyse differences in frequency distribution, *t* test to compare patients' age and chronicity of headache in years, and Mann and Whitney *U* test to compare median values between the 2 groups in degree of pain aggravation by each sensory stimulus. Because 5 different stimuli were being compared, significant values were adjusted to $P < .01$.

To analyze the discriminative value of the measures studied for the diagnosis of migraine, analysis of sensitivity (the proportion of patients with migraine that are correctly identified by each specific study symptom), specificity (the proportion of patients without migraine that are correctly identified by the absence of that symptom), positive predictive value (PPV) (the likelihood that the pattern of response to a given stimulus (aggravation of pain or not) gives the correct diagnosis of migraine in this sample of headache patients), negative predictive value (NPV) (the probability that an individual without each KP symptom has, of suffering from another diagnosis, ie, TTH, not migraine), and likelihood ratios (the likelihood that a given test result (presence of KP symptoms during headache) would be expected in a patient with the target disorder (migraine) compared to the likelihood that the same result would be expected in a patient without that disorder, ie, with TTH), with 95% confidence intervals (CI), were calculated. In this analysis negative answers and missing values were collapsed into one category and compared to positive answers. For the continuous variables a receiver operating characteristic (ROC) analysis was performed. Sensitivity and specificity of each KF symptom were plotted on a graph and compared with those of typical migraine symptoms (included in the ICHD-I criteria). The area under the curve (AUC) was calculated.

The consistency of results between interview answers and VAS was studied. For each VAS item, mean scores were compared between patients who responded yes (aggravation of pain) and those who responded no (no modification of pain) to the corresponding closed question. This comparison was performed independently of diagnosis, ie, including all patients, to analyze the agreement between interview answers and self-rating reports.

Table 1. Population (n = 150)

	Diagnosis			
	Migraine	TTH	Statistics	*P (df)*
n	111	39		
Females:males	95:16	31:8	$\chi^2 = .80$	NS(*1*)
Age average (yrs)	37.5	41.2	$t = -1.24$	NS
Standard deviation	11.3	17.2		
Headache history (yrs)	14.7	9.8	$t = 2.03$	
Standard deviation	11.5	11.7		NS
Attack frequency				
>4/month	22	34	$\chi^2 = 57.84$	<.000 (*2*)
1-3/month	74	4		
<1/month	15	1		
Attack duration				
>48 hours	32	26	$\chi^2 = 22.40$	<.000 (*2*)
24-48 hours	39	1		
<24 hours	40	12		
Attack severity				
Mild	4	30	$\chi^2 = 98.91$	<.000 (*2*)
Moderate	21	9		
Severe	86	0		

Abbreviations: χ^2, chi-square test; *t,* Student *t* test; *P*, significance level; NS, nonsignificant at $P < .01$; DF, degrees of freedom; TTH, tension type headache.

Results

Clinical and Biographic Data

There were 150 patients: 126 women and 24 men, with an average age of 38.5 yrs (±13.1 yrs), ranging from 16 to 73 yrs. Patients suffered from headaches on average for 13.5 yrs (±11.7 yrs). At the time of the inquiry only 26.7% of the patients were taking prophylactic medication. The majority (81.3%) were observed outside the headache attack. According to the ICHD-I criteria,[10] 111 patients had migraine (80 cases without aura, 31 with aura) and 39 TTH (30 chronic and 9 episodic). Clinical and biographic data according to the diagnosis are shown in Table 1. Individuals with migraine, compared with those with TTH, had less frequent, shorter, and more intense headache attacks, because the majority of TTH patients had the chronic subtype. There was no difference in the proportion of patients taking prophylactic medication in the 2 groups. The majority of patients observed during pain had TTH ($\chi^2 = 34.5^1$; $P < .0001$).

Pain Aggravation by Sensory Stimuli and Avoidance Behaviour During Headache Attacks

The proportion of patients reporting aggravation by each sensory stimulus, including movement, was significantly higher among those with migraine. Answers coded as missing were not included in this analysis (Table 2). Missing answers to each question were, by decreasing order of frequency: aggravation by smell (14 subjects), bending forward,[8] sound,[4] jolt,[3] light,[2] and immobility during attacks.[2]

Quantification of Pain Aggravation by Each Stimulus

Patients with migraine reported significantly ($P < .0001$) higher rates of headache aggravation in response to all sensory stimuli, especially light and movement, than patients with TTH. The latter reported more worsening of pain by sound than by other stimuli. The difference between median scores reported by migraine and by TTH cases was higher for the 2 measures of KP (aggravation by bending forward and jolt) and aggravation by light than for aggravation by smell, sound, or cough (Fig 1).

Response Consistency Between VAS and Headache Questionnaire

The clinician performing the interview was aware of the diagnosis, which could introduce some bias into patients' answers. In order to control response bias, we studied the consistency of the answers between closed questions and self-rating records. Consistency of responses between yes/no questions and visual analog ratings (self-rated, without interference from the observer) were compared, for each stimulus, in all patients independently of diagnosis (n = 150). Mean score of pain worsening by each stimulus was consistently higher ($P < .0001$) in the group of patients who reported aggravation by that stimulus than in patients who did not. Mean values in cm (for Yes vs No responses) were: aggravation by sound: 8.55 vs 2.50; by light: 7.99 vs .99; by jolt: 8.73 vs 1.62; by bending forward: 8.67 vs 1.44; and by smell: 7.36 vs 0.63.

Validity of Kinesiophobia as Independent Diagnostic Criteria for Migraine

Two analyses were performed.

1) Response to each question regarding aggravation by movement (jolt and bending) and immobility during the attacks (Yes vs No or Missing) were compared to the diagnostic gold standard, ie, ICHD-I

Table 2. Aggravation of Headache by Different Types of Stimuli and Behaviour During the Attacks

Aggravation by	Diagnosis		Statistic Test	P (df)
	Migraine (n = 111)	TTH (n = 39)		
Light				
Yes	107 (97.3%)	7 (18.4%)	$\chi^2 = 94.8$	<.000 (1)
No	3	31		
Sound				
Yes	104 (95.4%)	21 (56.8%)	$\chi^2 = 33.5$	<.000 (1)
No	5	16		
Smell				
Yes	74 (74.7%)	6(16.2%)	$\chi^2 = 38.1$	<.000 (1)
No	25	31		
Jolt				
Yes	105 (96.3%)	7 (18.4%)	$\chi^2 = 94.3$	<.000 (1)
No	4	31		
Bending forward				
Yes	105 (98.1%)	5 (14.3%)	$\chi^2 = 106.2$	<.000 (1)
No	2	30		
Standing still during the attacks				
Yes	110 (100%)	11 (29.7%)	$\chi^2 = 89.1$	<.000 (1)
No	0	26		

Abbreviations: χ^2, chi-square test; DF, degrees of freedom.

criteria. In addition, compound measures were computed associating those values (Yes to both vs No to both or Yes to one and No or Missing to the other): aggravation by bending forward and jolt (BJ), by bending over and standing still (BS), by jolt and standing still (JS), and by all 3 (BJS). Results were compared to diagnostic migraine symptoms such as photo- and phonophobia, nausea, and vomiting (Table 3).

Aggravation of pain by bending forward or by jolt or their association with attempted immobility (BS and JS) had a sensitivity similar to photophobia and phonophobia for the diagnosis of migraine but a higher specificity. Immobility during the attack was a very sensitive but not a specific migraine symptom. Association between aggravation by bending forward and standing still (BS) was a good measure to discriminate between the 2 diagnoses, with a high

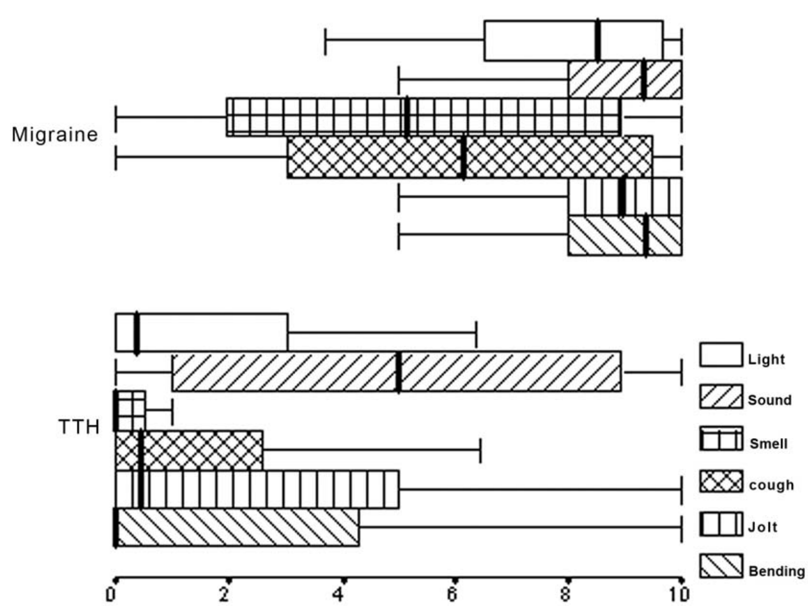

Figure 1. *Horizontal axis* represents the visual analog scale; *lines* represent range of values marked, boxes represent interquartile ranges, and *heavy vertical lines* represent medians for each stimulus. Differences were significant (Mann-Whitney test; $P < .0001$) between migraine and tension-type headache patients in all stimuli.

Table 3. Diagnostic Value of Different Symptoms During Migraine Attacks

	Aggravation by (%)						Aggravation and Avoidance Behavior (%)			
	Bending Forward	Jolt	Light	Sound	Smell	Remaining Still	Jolt + Bending	Bending + Remain Still	Jolt + Remaining Still	Bend + Jolt + Remaining Still
Sensitivity	95	95	96	94	76	99	89	94	94	88
(CI 95%)	(89-99)	(89-98)	(91-98)	(88-97)	(58-75)	(95-99)	(82-94)	(88-97)	(88-97)	(81-93)
Specificity	87	82	82	46	85	72	95	95	89	95
(CI 95%)	(73-94)	(67-91)	(67-91)	(32-61)	(70-93)	(56-84)	(83-98)	(83-99)	(76-96)	(83-99)
Positive predictive value	96	94	93	83	93	91	98	98	96	98
(CI 95%)	(89-98)	(88-97)	(88-97)	(76-89)	(85-97)	(85-95)	(93-99)	(93-99)	(91-99)	(93-99)
Negative predictive value	85	84	89	72	47	97	75	84	83	74
(CI 95%)	(71-93)	(70-93)	(75-96)	(52-86)	(36-59)	(83-99)	(61-85)	(71-92)	(69-92)	(60-84)
Likelihood ratio for migraine										
Positive test	7.38	5.27	5.37	1.75	4.33	6.54	16.9	18.27	9.14	17.2
(CI 95%)	(3.3-16.7)	(2.7-10.3)	(2.7-10.5)	(1.3-1.3)	(2.1-9.2)	(2.9-14.7)	(4.4-65)	(4.7-70.5)	(3.6-23.1)	(4.5-66.5)
Negative test	0.06	0.07	0.04	0.14	0.39	0.01	0.11	0.06	0.07	0.12
(CI 95%)	(.03-.14)	(.03-.15)	(.02-.12)	(.06-.3)	(.29-.53)	(.0-.08)	(.07-.19)	(.03-.16)	(.03-.15)	(.07-.20)

specificity and sensitivity. Its likelihood ratio for migraine diagnosis was 18.3.

2) Concerning the response of patients in the visual analog scale, we compared the ROC curves of response to different stimuli between the 2 diagnostic entities. The AUC values and significant values at 95% CI are depicted in Fig 2.

Once again, the degree of headache aggravation by bending forward and jolt yield a diagnostic validity for migraine similar to photophobia and superior to phonophobia and osmophobia.

Discussion

Aggravation of pain by movement and avoidance of movement are sensitive and specific manifestations of migraine that can contribute to its differentiation from TTH in outpatient clinics.

Aggravation of pain by bending forward and/or jolt (vertical and horizontal head movements) and avoidance of movement during headache attacks was almost invariably reported by migraine patients but rarely described by those with TTH, and they were as discriminat-

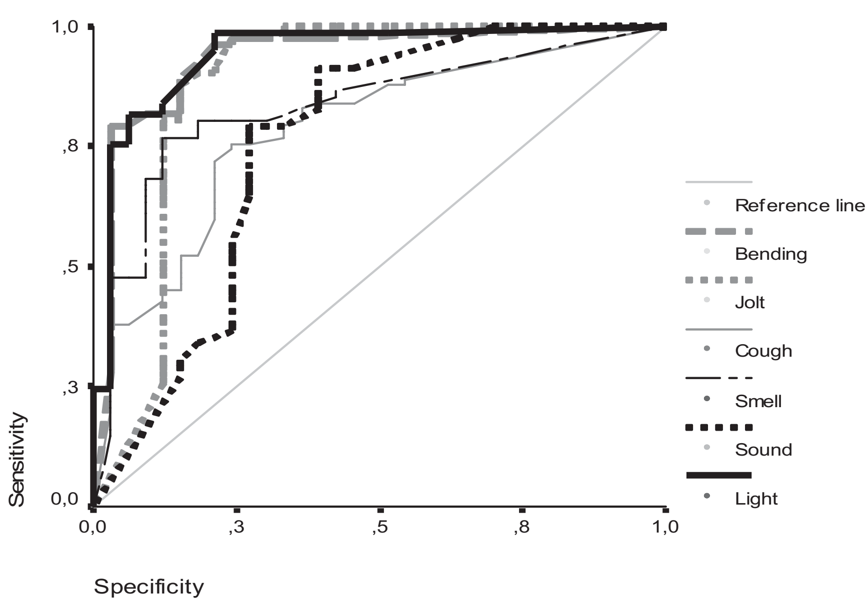

Figure 2. Area under the curve for photophobia was .943 (standard error .027, 95% CI .891-.995), for phonophobia .757 (standard error .059, 95% CI .641-.837), for osmophobia .834 (standard error .041, 95% CI .752-.915), for aggravation with cough .785 (standard error .047, 95% CI .694-.877), for jolt .878 (standard error .050, 95% CI .781-.976), and for bending .934 (standard error .030, 95% CI .876-.992). All were significant; $P < .0001$.

ing as photophobia (and more than phonophobia) between the 2 headache disorders. The latter 2 symptoms, though not compulsory for migraine diagnosis, were part of the diagnostic criteria used (and hence biased in this sample), whereas avoidance of movement and pain aggravation by head movement alone (not exertion) were not required according to the ICHD-1 diagnostic criteria. From the present study it is quite clear that head movement alone (jolt and bending forward) does aggravate migraine pain, and, therefore, part of the avoidance behavior observed during migraine attacks can result from avoidance of head movements. These results reinforce the advantage of introducing avoidance behavior in the ICHD-2.[11]

Osmophobia was found to be a specific but not sensitive measure to discriminate migraine from TTH, a result that corroborates previous research.[7,16] The most discriminating composite criterion was the association between aggravation by bending forward and staying still during the attacks.

Patients with migraine also reported higher rates of pain aggravation by all sensory stimuli than patients with TTH, corroborating previous studies.[25] The degree of pain aggravation produced by movement (bending forward and jolt) was similar to that caused by light and sound. Although this intolerance has been consistently found in studies about patients' behavior during the attacks or studies of aggravating factors in migraine,[4,12,15,16,20,22,25] it has not been analyzed as a concurrent validity criterion for diagnosis.

With few exceptions,[9,12,27] the majority of studies on aggravating factors in migraine, were performed by direct questioning of patients (ie, producing yes/no answers). In the present study, symptoms were also quantified in a linear scale, avoiding the imposition of a predefined cut-off point of severity above which a symptom is clinically significant. Besides, it allows a direct comparison of severity between different symptoms.

Head movements were rated by migraine patients as factors that markedly aggravated headache (8.5, on average, on a 10-point scale). Thus, KP adds to the burden of migraine caused by pain, nausea, and cognitive disturbances, because it may restrain the patient from moving around normally. In a study on interictal daily functioning of migraine patients,[23] it was also found that migraine sufferers have lower body mobility than healthy controls. Interestingly, cough had a lower score as an aggravating factor than head movement. However, 21.4% of patients were unable to rate the effect of cough on headache in the scale, possibly because cough is unlikely to occur during the majority of headache attacks.

Kinesiophobia may be explained by different pathophysiologic phenomena, involving the meninges, the intracranial veins, or the vestibular apparatus. Perivascular meningeal neurogenic inflammation is known to be part of the migraine attack,[18,21] and meningeal irritation from other causes (such as meningitis) typically produces intolerance to movement, especially jolt, possibly by increased susceptibility of pain-sensitive structures.[2,24] Intracranial venous congestion has been shown to aggravate migraine headaches in experimental circumstances, particularly when the patient is in the supine position,[4,7,8] and therefore it could explain pain aggravation by bending forward. The lack of consistent aggravation of pain by cough in the present series is not against this hypothesis, because sensitivity to increased intracranial venous pressure is lower in the upright position and few patients could recall how they responded to cough. Vestibular dysfunction (including motion sickness) is frequent in migraine sufferers,[14,17] and passive head movement (eg, during driving) was shown to precipitate and aggravate migraine attacks.[22] However, if a vestibular disorder was the cause of KP, vertigo and loss of balance should be expected during the attacks, and this is not usually reported. A fourth explanation for KP is to attribute it to physical effort, a well known aggravating factor of migraine. Yet, jolt and bending forward differ from the effort of walking and climbing stairs (used as criteria by the ICHD) by lacking continuity, muscle contraction against gravity, hemodynamic changes, and vibration (passive vibration is transmitted to cephalic structures by pacing the floor), sharing only movement with them. Therefore, we believe that KP is best explained by the meningeal or meningovascular hypothesis.

An aspect that was not explored in this study was the timing of occurrence of KP during the attack, which is known to have a typical neurophysiologic[6,18] and clinical[3] sequence of events. Kinesiophobia may be the intracranial equivalent of allodynia,[6] an extreme form of cutaneous sensitivity in the V-nerve territory, described in the late phase of the attack, when pharmacologic agents (including triptans) have little effect on pain. These aspects may be clarified in future studies.

Certain chronic pain syndromes have been explained by the fear-avoidance model,[13,26] whereby patients fear and avoid factors that provoke or aggravate pain which, in turn, maintains chronic pain. There is evidence that fear of movement or injury/reinjury contributes to chronic musculoskeletal pain, chronic low back pain, and fibromyalgia, and scales for KP have been developed[19] to evaluate it. It is not known if KP contributes to aggravation of migraine (in frequency, duration, or chronicity), but it has been shown that the interictal behavior of migraine patients includes low mobility,[23] which may constitute a sign of avoidance behavior. This is an area that needs further research.

There are some pitfalls to the present study that limit generalization of the results. First, the "gold standard" diagnostic criteria with which KP was compared were those of the former ICHD-I classification.[10] This former version of the ICHD did not incorporate avoidance behavior and just mentioned physical activity as an aggravating factor of migraine pain. Therefore the use of these former criteria avoided the bias of selecting patients through the same criteria that were being evaluated. The present results support the changes that were incorporated into the ICHD-II.

A second limitation concerns the study population. It is a clinical sample with an overrepresentation of episodic migraine and chronic TTH. This limits generalization of these results to community/epidemiologic populations. Third, the fact that the study questions were asked by a clinician who was aware of the diagnosis could have introduced a bias in the answers. However, the high consistency between self-rating and direct questioning on every item contradicts that possibility.

Kinesiophobia is a simple, sensitive, and specific measure to differentiate migraine from TTH in clinical populations. Its sensitivity suggests that it will detect the majority of migraine patients, and its specificity indicates that it will not misidentify those with tension headache. Direct questioning about bending forward and/or jolt are thus further aspects that one may ask to elicit symptoms of kinesiophobia. This information may be useful for patients to identify migraine attacks and to choose the appropriate therapy, particularly in those with more than one headache type. This suggestion, given by migraine sufferers, inspired this research.

Acknowledgments

The authors thank Dr Susana Borges who participated in the organization of the database and an anonymous reviewer for suggestions that were incorporated in the text. This work received the second "Tecnifar Award" in 2003 granted by Tecnifar and the Portuguese Headache Society.

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