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RESEARCH SUBMISSIONS

The teaching of headache medicine in France: A questionnaire-based study

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Abstract

Background: The treatment of patients with headache represents an important part of a neurologist's activity. It requires sufficient training for neurology residents. In France, residents in neurology can complete this training by attending specialized consultations or by participating in a postgraduate training program called "Diplôme Inter-Universitaire Migraine et Céphalées" (DIUMC).

Objective: The objective of this cross-sectional study was to investigate the French residents' knowledge in headache medicine and the impact of different types of training in headache medicine that are available in France.

Methods: An anonymous survey was carried out among 548 French residents in neurology.

Results: The questionnaires of 121 residents (22.1%) were analyzed. Among them, 54.5% (66/121) had no complementary training apart from the internship (Group 1), 21.5% (26/121) had attended only specialized consultations (Group 2), and 24% (29/121) had participated in the DIUMC (Group 3). There was no difference between all groups regarding the knowledge of the prevalence of primary or chronic headaches. There was almost no difference between the groups in the management of episodic migraine. In contrast, the management of tension-type headache and chronic headache was better known by residents of Group 3 than residents of Group 1. In these two diseases, residents of Group 3 offered prophylactic treatment more often. Almost 29% of the residents (35/121) had read the French guidelines for the diagnosis and management of migraine. In Group 3, residents had read them significantly more often (1.6% in Group 1, 38.5% in Group 2 and 62.1% in Group 3, $p < 0.001$).

Conclusion: This study shows the lack of knowledge among French neurology residents regarding headache medicine. It highlights the interest of specific training programs that could improve the practical and theoretical knowledge of future neurologists.

Abbreviations: CH, chronic headache; DIUMC, Diplôme Interuniversitaire Migraines et Céphalées; ED, emergency department; ICHD-3, *International Classification of Headache Disorders*, third edition; IQR, interquartile range; MOH, medication overuse headache; MRI, magnetic resonance imaging; TTH, tension-type headache.

KEYWORDS
neurology, postgraduate training, residents

INTRODUCTION

Headache is the fifth most common reason for visits to US emergency departments (EDs) and account for 2.8% of ED visits overall.[1] In France, it represents 4.6% of patients admitted to the ED for non-trauma-related reasons.[2] Headache is the second symptom in a neurology consult service, and migraine is the second primary diagnosis in a neurology outpatient service.[3] Owing to this frequency, most neurologists should be competent in headache management. However, the training of future neurologists offers a limited time for teaching headache medicine. This type of training is mainly given in a teaching hospital, and outpatient care is usually taught less. In France, residents can attend specialized consultations for training in headache medicine. A postgraduate training program on headaches is also offered to residents. The aim of this study was to explore whether the type of training had an influence on French residents' level of knowledge about headaches and their management.

METHODS

Overview

Entry-level medical studies last 6 years in France, with an additional 4 years for a specialization in neurology. During this internship period, residents in neurology perform eight 6-month internships in different hospital departments (six internships in neurology departments and two free internships) and regularly have courses on different areas of neurology. To improve their training in headache medicine, some residents may attend specialized headache consultations or participate in postgraduate training programs with an interuniversity diploma. This diploma, which was created in 2009, consists of 71 h of class and 35 h of internship in a headache center. It is called the "Diplôme Interuniversitaire Migraines et Céphalées" (DIUMC). It is open to all neurology residents, whatever their year of residency; to senior doctors; and to other specialties. The courses are taught at the university.

Design

This national and cross-sectional study was conducted as an anonymous questionnaire survey among French residents in neurology. In September 2020, all registered residents were sent an invitation by email to complete this online questionnaire via the Google Forms platform (Google). A reminder was sent November 2020, and all anonymous responses were collected later that month. The present study was a primary analysis of these data.

The sample size was based on available data. The residents were divided into three groups, depending on their specific training in headache medicine. Group 1 had no complementary training apart from the internship. Group 2 had attended, as a trainee, at least one specialized consultation dedicated to headache, in addition to their internship. Group 3 had attended a validated postgraduate training program (DIUMC) in addition to their internship.

Questionnaire

The questionnaire was completed on the Google Forms platform. The questionnaire was voluntary, unpaid, and anonymous. Residents completing the questionnaire were informed of the purpose of the study. They were able to review and change their answers. The questionnaire was developed by the authors (M.B., S.R., A.A., and A.D.) and was based on a previous Norwegian study, available literature, and 2013 and 2014 French guidelines for primary headaches disorders.[4–7] The 30-item questionnaire was translated for this international publication and is included as a supplement (Supporting Information S1).

Epidemiologic data on residents were collected: age, sex (given as a choice in a drop-down menu, i.e., "female" or "male"), the number of years in residency, and the validation of specific training or teaching in headache medicine. Residents also answered short, multiple-choice, or open questions about knowledge, management, experience, and use of the French national treatment guidelines and the *International Classification of Headache Disorders*, third edition (ICHD-3).[4–6,8] Questions omitted by the respondents were not included in the final analysis.

Statistical analysis

Descriptive statistics, including frequency and percentage for categorical variables and median and interquartile range (IQR) for non-normally distributed continuous variables after verification of normality using the Shapiro–Wilk test, were used to describe the demographics of the study participants. The characteristics of residents were compared between the three types of training groups (i.e., basic neurology training, traineeship in headache medicine, or specific training program) using the Kruskal–Wallis test for continuous variables (the Dunn–Bonferroni post hoc test was applied for $p < 0.05$) and the chi-square test or Fisher's exact test for categorical variables, when appropriate. Correct and incorrect responses to six questions about the epidemiology of headaches were compared between groups using the chi-square test or Fisher's exact test for categorical variables, when appropriate. Graphs were drawn for the

whole sample (i.e., for using tools and scales, researching comorbidity and headache impacts, using magnetic resonance imaging [MRI], and for medications that can lead to medication-overuse headache) and between groups (i.e., for the management of different primary headaches or for self-assessment of knowledge). A two-sided $p < 0.05$ was considered statistically significant. These analyses were preplanned and performed using the IBM Statistical Package for the Social Sciences, version 20.0 (IBM Corp., Armonk, NY, USA).

RESULTS

The questionnaire was sent to 548 residents in neurology. The responses were gathered from 122 residents (22.3%). One questionnaire was excluded because data were missing for the type of training completed. In total the questionnaires of 121 residents (22.1%) were analyzed. Among them, 70 were women (58.3%). The median (IQR) age was 27 (26–28) years, and the median (IQR) internship and neurology semesters were 6 (4–7) and 4 (3–6), respectively. There were three missing data: one for sex, one for internship semester, and one for neurology semester. The 121 residents were classified according to their type of training: 66 (54.5%) were placed in Group 1; 26 (21.5%) in Group 2; and 29 (24%) in Group 3. Residents in Group 1 were significantly younger than residents in Group 2 (median [IQR] age 26 [25–28] vs. 28 [27–29] years; $p < 0.001$). The number of internship semesters and neurology semesters was lower in Group 1 (median [IQR] 4 [2–6]) than in Group 2 (median [IQR] 7.5 [6–8]; $p < 0.001$) or Group 3 (median [IQR] 6 [4–8]; $p < 0.001$). Likewise, the number of neurology semesters was lower in Group 1 (median [IQR] 3 [2–5.5]) than in Group 2 (median [IQR] 6 [4.8–7]; $p < 0.001$) or Group 3 (median [IQR] 5 [4–6.5]; $p < 0.001$). Participants' characteristics are presented in Table 1.

Epidemiologic knowledge of migraine and chronic headache (CH) are summarized in Table 2.

Figure 1 summarizes the use of the ICHD-3 classification,[8] the use of a diary, the research of comorbidities, and the assessment of the impact on daily life in a migraine consultation. There was no difference between the groups. Only 21.5% (26/121) of residents always used the ICHD-3 classification to diagnose headaches. Presence or absence of medication overuse was systematically investigated in 74.4% (90/121) of cases.

Figure 2 shows the cases in which brain MRI was requested by residents.

We asked the residents whether they would prescribe acute, prophylactic, or non-pharmacological treatments in these cases. In the event of a positive response, examples were requested, and each resident could propose several treatments (Figure 3). For episodic migraine with attacks every 1–2 months, all the residents ($n = 121$; 100%) would initiate acute treatment. A total of 109 (90.1%) residents suggested non-steroidal anti-inflammatory drugs, 74 (61.2%) residents recommended triptans, and seven (5.8%) residents advised paracetamol. Hardly anyone would prescribe a prophylactic treatment. In Group 3, the residents would prescribe a non-pharmacological preventive treatment significantly less often.

For episodic migraine with 1–2 migraine attacks every week, the management did not differ among the groups. Among the 114 residents suggesting prophylactic treatment, 101 suggested beta-blockers (88.6%) before amitriptyline (26/114, 22.9%) and topiramate (16/114, 14%). Oxetorone (six of 114, 5.3%), venlafaxine (two of 114, 1.8%), angiotensin II receptor blockers (one of 114, 0.9%), gabapentin (one of 114, 0.9%), and flunarizine (one of 114, 0.9%) were mentioned more rarely.

For chronic tension-type headache (TTH; i.e., headaches that occur ≥15 days each month), prophylactic treatment was offered significantly more often by Group 3 and significantly less often by Group 1 (Group 1: 34/65 [52.3%] residents, Group 2: 20/26 [76.9%], Group 3: 27/29 [93.1%]; $p < 0.001$). The 81 residents offering prophylactic treatment cited 120 examples of drugs (several proposals could be given by each resident): amitriptyline was mentioned 72 times (60%), venlafaxine six times (5%), topiramate four times (3.3%), beta-blockers three times (2.5%), benzodiazepine twice (1.7%), oxetorone once (0.8%), and angiotensin II receptor blockers once (0.8%). In all, 25 (30.9%) residents were unable to propose medication.

For CH with three attacks a day for 2 months, prophylactic treatments were offered by Group 3 significantly more often and by Group 1 significantly less often (Group 1: 53/65 [81.5%] residents; Group 2: 24/26 [92.3%]; Group 3: 29/29 [100%]; $p = 0.020$). Among the 105 residents suggesting acute treatment, 37 (35.2%) suggested sumatriptan, 29 (27.6%) unspecified triptan, 40 (38.1%) oxygen therapy (without further details), and one (1%) suggested non-steroidal

TABLE 1 Descriptive data of the participants ($n = 121$)

	All ($n = 121$)	Group 1 ($n = 66$)	Group 2 ($n = 26$)	Group 3 ($n = 29$)	p
Sex, *n* (%)					
Female	70 (58.3)	37 (56.1)	11 (44.0)	22 (75.9)	0.052
Male	50 (41.7)	29 (43.9)	14 (56.0)	7 (24.1)	
Age, years, median (IQR)	27 (28–26)	26 (28–25)	28 (29–27)	27 (28–26)	<0.001
Internship semesters, *n*, median (IQR)	6 (7–4)	4 (6–2)	7.5 (8–6)	6 (8–4)	<0.001
Neurology, semesters, *n*, median (IQR)	4 (6–3)	3 (5.5–2)	6 (7–4.8)	5 (6.5–4)	<0.001

Note: Group 1: basic neurological formation; Group 2: traineeship in headache medicine; Group 3: specific training program.
Abbreviation: IQR, interquartile range.

TABLE 2 Comparison of correct and incorrect responses to six questions about the epidemiology of headaches by resident training type

Questions/responses	All ($n = 121$), *n* (%)	Group 1 ($n = 66$), *n* (%)	Group 2 ($n = 26$), *n* (%)	Group 3 ($n = 29$), *n* (%)	*p*
Migraine prevalence					0.070
Correct (c)	42 (34.7)	18 (27.3)	9 (34.6)	15 (51.7)	
Incorrect (a + b)	79 (65.3)	48 (72.7)	17 (65.4)	14 (48.3)	
a. 0%–5%	3 (2.5)	1 (1.5)	2 (7.7)	0 (0)	
b. 5%–15%	76 (62.8)	47 (71.2)	15 (57.7)	14 (48.3)	
c. 15%–25%	42 (34.7)	18 (27.3)	9 (34.6)	15 (51.7)	
Male/female ratio (migraine)					0.027
Correct (a)	70 (57.9)	34 (51.5)	13 (50.0)	23 (79.3)	
Incorrect (b + c)	51 (42.1)	32 (48.5)	13 (50.0)	6 (20.7)	
a. 1/3	70 (57.9)	34 (51.5)	13 (50.0)	23 (79.3)	
b. 1/5	44 (36.4)	27 (40.9)	11 (42.3)	6 (20.7)	
c. 1/10	7 (5.8)	5 (7.6)	2 (7.7)	0 (0)	
CDH prevalence					0.317
Correct (b)	66 (54.5)	40 (60.6)	13 (50.0)	13 (44.8)	
Incorrect (a + c + d)	55 (45.5)	26 (39.4)	13 (50.0)	16 (55.2)	
a. 0%–1%	9 (7.4)	4 (6.1)	3 (11.5)	2 (6.9)	
b. 2%–5%	66 (54.5)	40 (60.6)	13 (50.0)	13 (44.8)	
c. 5%–10%	39 (32.2)	17 (25.8)	10 (38.5)	12 (41.4)	
d. >10%	7 (5.8)	5 (7.6)	0 (0)	2 (6.9)	
MOH prevalence					0.592
Correct (a)	70 (58.3)	40 (60.6)	16 (61.5)	14 (50.0)	
Incorrect (b + c)	50 (41.7)	26 (39.4)	10 (38.5)	14 (50.0)	
a. About 1%	70 (58.3)	40 (60.6)	16 (61.5)	14 (50.0)	
b. About 5%	41 (34.2)	21 (31.8)	9 (34.6)	11 (39.3)	
c. About 10%	9 (7.5)	5 (7.6)	1 (3.8)	3 (10.7)	
CH prevalence					0.347
Correct (c)	69 (57.0)	38 (57.6)	12 (46.2)	19 (65.5)	
Incorrect (a + b + d)	52 (43.0)	28 (42.4)	14 (53.8)	10 (34.5)	
a. 1/10	1 (0.8)	0 (0)	0 (0)	1 (3.4)	
b. 1/100	5 (4.1)	3 (4.5)	1 (3.8)	1 (3.4)	
c. 1/1000	69 (57.0)	38 (57.6)	12 (46.2)	19 (65.5)	
d. 1/10 000	46 (38.0)	25 (37.9)	13 (50.0)	8 (27.6)	
Male/female ratio in CH					0.044
Correct (b)	82 (67.8)	42 (63.6)	15 (57.7)	25 (86.2)	
Incorrect (a + c)	39 (32.2)	24 (36.4)	11 (42.3)	4 (13.8)	
a. 1/1	9 (7.4)	9 (13.6)	0 (0)	0 (0)	
b. 4/1	82 (67.8)	42 (63.6)	15 (57.7)	25 (86.2)	
c. 10/1	30 (24.8)	15 (22.7)	11 (42.3)	4 (13.8)	

Note: Group 1: basic neurological formation; Group 2: traineeship in headache medicine; Group 3: specific training program.
Abbreviations: CDH, chronic daily headaches; CH, chronic headache; MOH, medication overuse headache.

anti-inflammatory drugs, opioids, or intravenous corticosteroid therapy. Among the 106 residents suggesting prophylactic treatments, 71 (67%) proposed verapamil, six (5.7%) carbamazepine, four (3.8%) beta-blockers, four (3.8%) amitriptyline, three (2.8%) lithium carbonate, two (1.9%) greater occipital nerve block, and one (0.9%) corticotherapy (without further details). In all, 15 (14.2%) residents did not know what to advise.

Regarding migraine with aura, only 100/120 (83.3%) residents knew that the aura could occur during the headache phase. This response was more often correct in Group 3 and incorrect in Group

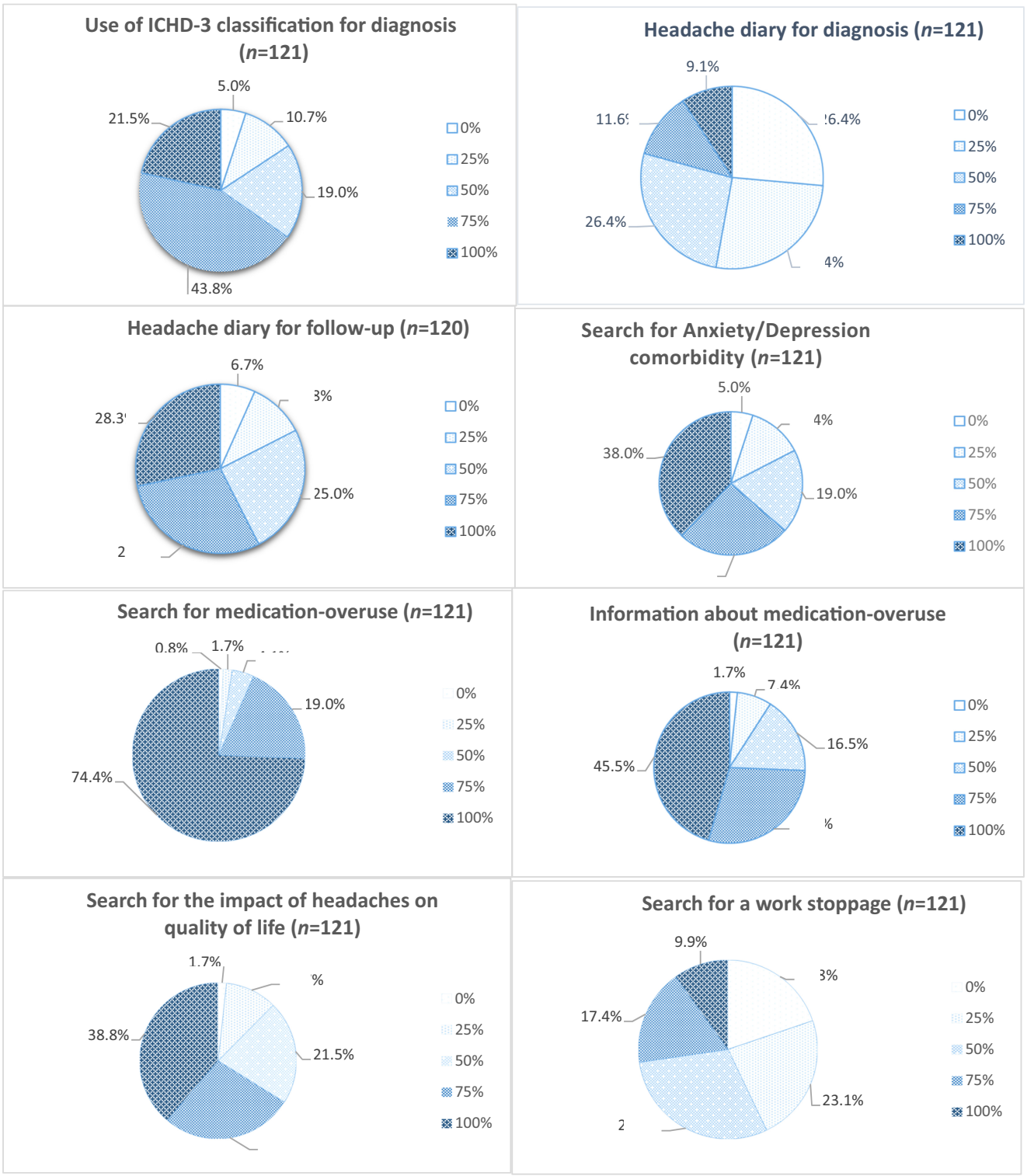

FIGURE 1 Percentage of participant who use the *International Classification of Headache Disorders*, third edition (ICHD-3) classification, migraine diary for headache diagnosis and follow-up, who search anxio-depressive comorbidity, search and give information about medication-overuse, search impact on daily life and work stoppage. [Color figure can be viewed at wileyonlinelibrary.com]

2 (54/65 [83.1%] residents answered correctly in Group 1, 18/26 [69.2%] in Group 2, and 28/29 [96.6%] in Group 3; $p = 0.023$). In all, 82 of 120 (68.3%) residents considered that performing brain MRI was not imperative in the case of a migraine with aura. A total of 111 of 120 (92.5%) residents knew that triptans are not contraindicated during the headache phase, and 113 of 120 (94.2%) knew that the basic treatments are not different from those used in migraine without aura. Only 95 of 120 (79.2%) residents knew that combined contraception is contraindicated in the case of migraine with aura.

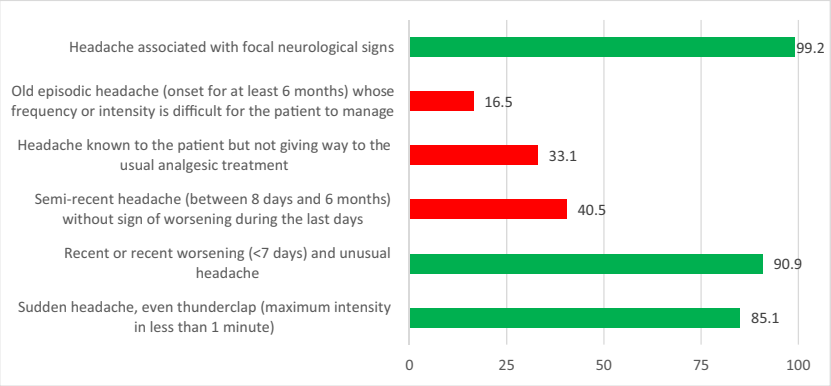

FIGURE 2 Percentage of respondents who request magnetic resonance imaging (MRI) in the different situations mentioned. Green bars correspond to situations where MRI is necessary, while the red bars correspond to situations where it is not ($n = 121$). [Color figure can be viewed at wileyonlinelibrary.com]

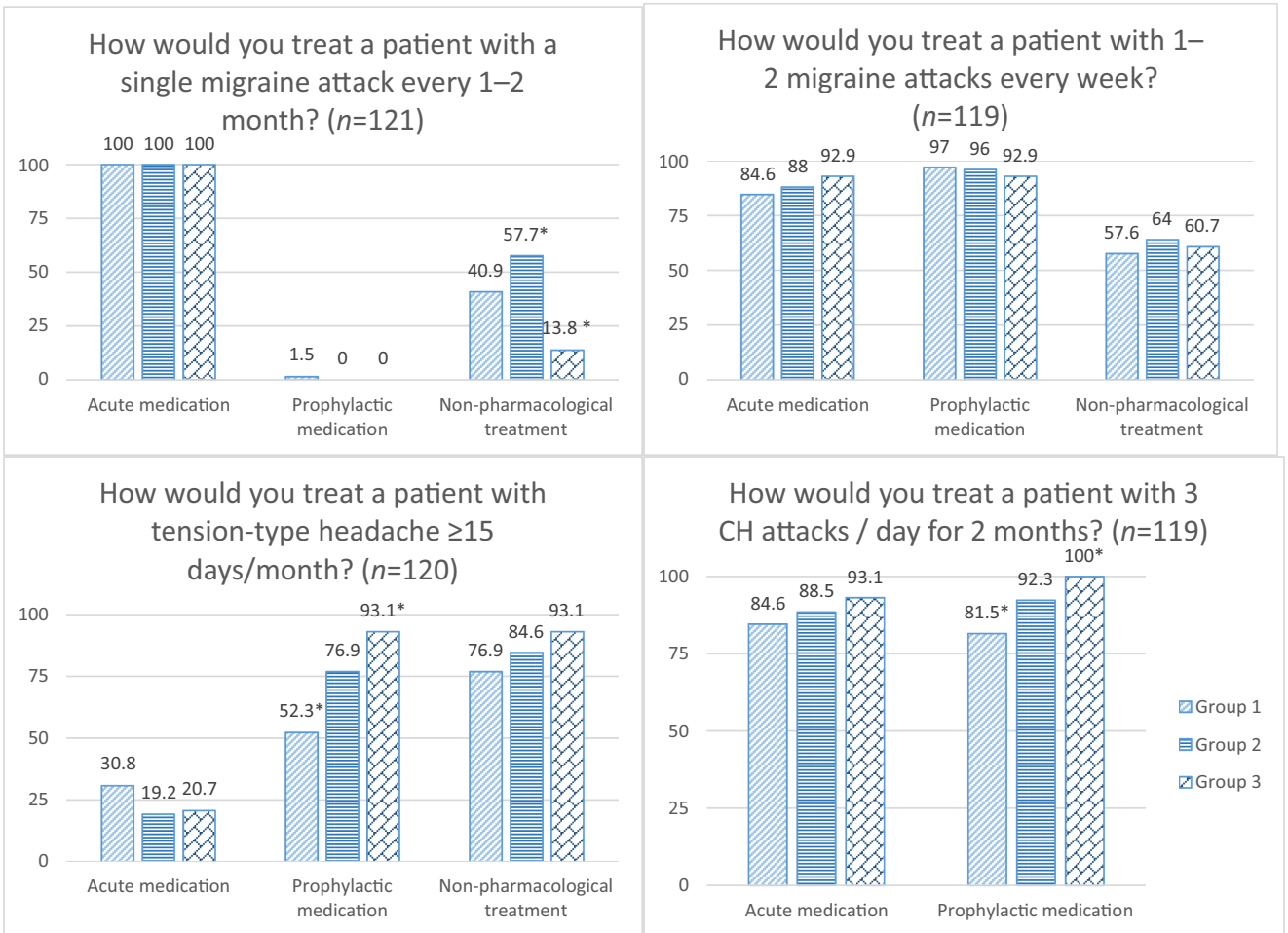

FIGURE 3 Percentage of residents who would use different types of treatments for patients with episodic migraine with attack every 1–2 month or 1–2 attacks every week, chronic tension-type headache and episodic cluster headache. *Statistically significant values. Group 1, basic neurological formation; Group 2, traineeship in headache medicine; Group 3, specific training program. [Color figure can be viewed at wileyonlinelibrary.com]

We asked residents which treatment would lead or not lead to medication overuse headache (MOH) (Figure 4). Group 3 reported significantly more often than other groups that triptans could lead to MOH (47/66 [71.2%] residents in Group 1, 16/26 [61.5%] in Group 2, and 27/29 [93.1%] in Group 3; $p = 0.019$). Residents in Group 3 reported statistically less often that antiseizure drugs could lead to MOH (11/66 [16.7%] residents in Group 1, six of 26 [23.1%] in Group 2, and none of 29 [0%] in Group 3, $p = 0.015$). In the case of MOH, all

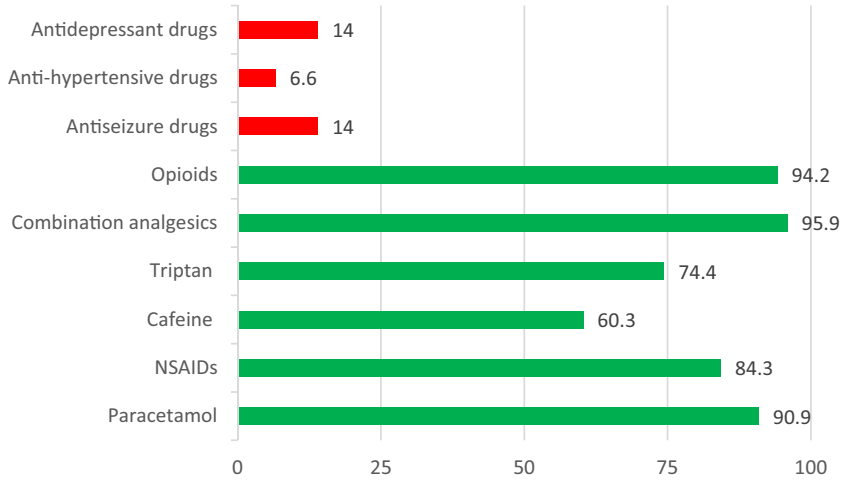

FIGURE 4 Percentage of the participants who stated that each of the given medications can lead to medication-overuse headache. Green bars represent those medications that are known to cause medication-overuse headache, while red bars represent those that do not ($n = 121$). NSAIDs, non-steroidal anti-inflammatory drugs. [Color figure can be viewed at wileyonlinelibrary.com]

residents suggested a drug withdrawal; 117 of 121 residents (96.7%) associated the withdrawal with a prophylactic treatment, with no difference between the groups.

In all, 35 of the 121 (28.9%) residents read the French guidelines for the diagnosis and management of migraine.[4] Group 3 read them significantly more often, and Group 1 read them significantly less (seven of 66 [1.6%] in Group 1, 10/26 [38.5%] in Group 2, and 18/29 [62.1%] in Group 3; $p < 0.001$). Among them, five of 35 (14.3%) used them in 25% of cases, 19 of 35 (54.3%) in 50% of cases, nine of 35 (25.7%) in 75% of cases, and two of 35 (5.7%) in 100% of cases.

Figure 5 summarizes the self-assessment of residents' knowledge concerning main headaches. Group 3 significantly considered that they had better knowledge of the four types of headaches compared with the other groups. On the contrary, Group 1 significantly considered they had significantly poorer knowledge concerning the four types of headaches compared with the other groups ($p < 0.001$ for all four types of headaches).

As far as the residents were concerned, the main barrier to improving the treatment of patients with headache was lack of training about treating patients with headache in consultation. Residents provided comments, such as that there was "lack of teaching at the university," "lack of supervision from senior neurologists," "insufficient follow-up consultations in outpatient clinics," "patients with headache are difficult and demanding," and "no effective treatment option for many patients."

Residents considered headache medicine to be less prestigious than other subspecialties in neurology (Table 3). The mean (SD) score and median score were respectively 3.9 (1.5) and 4, ranked on a 1–6 scale, where 1 indicated the highest prestige.

DISCUSSION

This study showed some gaps in the knowledge and management of primary headaches by French neurology residents. Kristoffersen et al.[7] also conducted a questionnaire-based study, highlighting the poor knowledge of headache medicine in neurology residents in Norway. In our study, we found that postgraduate training programs on headaches provide better knowledge on headache medicine. In general, residents with a diploma in headache medicine knew the epidemiologic data of headache better, were better able to manage TTH and CH, and had a higher level of knowledge of MOH and migraine with aura. The residents of the present study were unfamiliar with the epidemiology of headaches (TTH, CH, and MOH). In the Norwegian study, this lack of knowledge was also found for migraine, CH, and their comorbidities.[7]

The ICHD-3 classification is largely used by headache specialists for the diagnosis of patients with headache.[8] Its introduction section specifies that this classification is not intended to be memorized; this document "should be consulted time and time again." This classification and its French translation are available free of charge (https://ichd-3.org/). In our study, neurology residents insufficiently used this classification. It is probable that a lot of them have never downloaded it. In the Norwegian study, only half of the residents used it regularly.[7]

At the time of the study, the revised guidelines for the diagnosis and management of migraine had not been yet published.[9] The available guidelines in French were published in 2013.[4] Despite the availability of the French version, only 28.9% of residents read these guidelines. Bösner et al.[10] reported that general practitioners use different strategies to diagnose headache, including "knowing the patient and their background," "first impression during consultation," "intuition and personal experience," and "application of the test of time." According to them, established guidelines do not play a role in the diagnostic evaluation. It would be interesting to know the strategies neurology residents use to diagnose headaches without using the ICHD-3 classification.

In the French guidelines, it is recommended to use a headache diary for the diagnosis and follow-up of headache and to screen for medication overuse in CH.[5,9] In our study, headache diaries

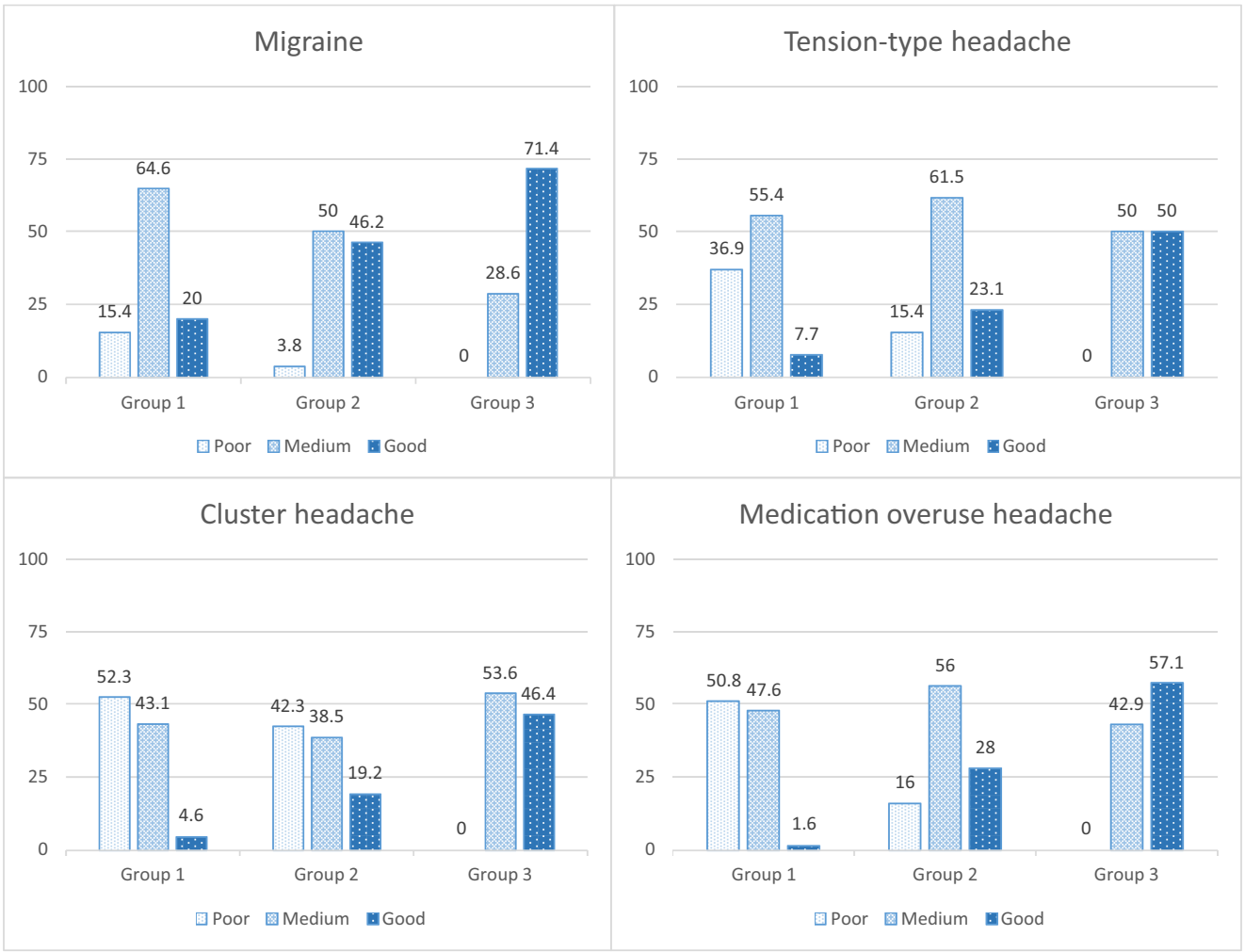

FIGURE 5 Percentage of the residents responding good (green), medium (yellow), or poor (red) to the question "How do you rate your own knowledge of migraine, tension-type headache, cluster headache, and medication-overuse headache?" ($n = 119$). Group 1, basic neurological formation; Group 2, traineeship in headache medicine; Group 3, specific training program. [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Prestige scores of different neurological subspecialties on a 1–6 point scale, where 1 indicates the highest prestige ($n = 111$)

	Mean (SD)	Median
Multiple sclerosis	2.5 (1.5)	2
Movement disorder	2.5 (1.5)	2
Epilepsy	2.9 (1.4)	3
Cerebrovascular diseases	2.9 (1.7)	3
Headache	3.9 (1.5)	4
Dementia	3.9 (1.6)	4

were generally not used for diagnosis but more often for follow-up. Furthermore, residents looked for medication overuse, but they less often explained its risks. Keeping a headache diary and knowing risks of medication overuse are part of preventing it. Overall, residents were aware of the treatments leading to MOH. However, certain prophylactic treatments were wrongly implicated (antidepressant, antihypertensive, and antiseizure drugs). This misunderstanding probably explains the low use of prophylactic treatment in some patients with headache. Group 3 had a better knowledge of medication overuse than the other groups, possibly suggesting better prevention of it.

The treatment of a patient with migraine with a low or high frequency of attacks was well adopted and did not differ between the groups. Although all residents initiated acute treatment of infrequent migraine, acute treatment was discontinued in 12.7% once prophylactic treatment was initiated. There were fewer treatments of TTH than migraine, and the proportion of residents unable to provide a treatment was high. Group 3 offered prophylactic treatments significantly more often than Group 1. This suggests that additional training concretely improves the treatment of patients with TTH. The treatment of patients experiencing CH seems less well known. This may reflect an ignorance of the disease and the severity of the attacks. This study shows that additional training concretely improves the treatment of patients with CH. The second-most-cited molecule is carbamazepine, a sign of confusion between CH and trigeminal neuralgia.

Surprisingly, 14.9% of residents did not request MRI for thunderclap headaches. On the contrary, many residents requested MRI in situations where it is not necessary. The overuse of MRI can be explained by a lack of knowledge of headaches and a need for reassurance. The use of national recommendations[4] would lead to less frequent use of MRI. This would reduce the time to have a MRI examination and reduce the cost of healthcare. In 2015, Callaghan et al.[11] reported frequent use of imaging in situations where guidelines specifically recommended against their use.

Residents assessed themselves quite correctly. They considered themselves better trained regarding migraine than for TTH, MOH, and CH. These responses are consistent with the results of the questionnaire. Group 3 assessed themselves better, and Group 1 self-assessed themselves as lesser, which was not always the case in the results. However, when there was a significant difference, it was always in the direction of Group 3 residents, suggesting that additional training generally improves residents' knowledge.

According to the Global Burden of Neurological Disease Study 2016, migraine is the second leading cause of disability, varying in disability-adjusted life years between first and fourth in regions around the world.[12] The number of neurologists will have to increase to provide specialist neurological care for the most common disabling neurological disorders. Our study highlights the need to increase the number of neurologists trained in headache.

Among the obstacles to the training in headache medicine, the first-mentioned concern was the lack of training and lack of university education. The small proportion of time devoted to headache medicine in medical schools was underlined in many countries in several studies.[13,14] A recent American study[15] concluded that headache medicine appears to be underrepresented in neurology departments' grand rounds. This study also suggested that nearly 60% of program directors who participated felt that headache medicine was sufficiently represented in grand rounds.

Headache as a subspecialty was felt to be less prestigious among residents in neurology. This feeling of prestige was the same as for dementia. Kristoffersen et al.[16] found similar results concerning neurology residents in Norway. This perception of prestige can potentially affect how residents are involved in headache medicine and why some residents receive optional training in headache medicine. As suggested by Kristoffersen et al.,[16] the improvement of the theorical and practical training in headache medicine is probably a way to increase the interest and prestige of this subspecialty.

We did not find significant differences in headache knowledge between residents who participated in headache consultations and those who had not. This suggests that a theorical training about headache is crucial for residents who will have to care for patients with headache. The importance of a headache diploma has been highlighted in the revised French guidelines on migraine.[9] It is now recommended to refer patients with severe migraine (French criteria) to a neurologist or a physician certified by the DIUMC. In cases of resistant or refractory migraine (European Headache Federation criteria), patients should be referred to a neurologist certified by the DIUMC.

Residents reported the lack of access to outpatient training as an obstacle to the training of headache medicine. In the study of Mahajan et al.,[17] 46% of neurology residents felt they did not have enough outpatient exposure. In January 2021, among the 2,895 neurologists in France, 35% worked in private practice or had a mixed practice (https://drees.shinyapps.io/). Patients with headache represented an important part of the practice of an outpatient neurologist.[3] The outpatient training may be a way for neurologists to treat patients with headache.

Regarding the limits of our study, only 22.1% of neurology residents responded to the questionnaire. These results may not be representative of all neurology residents. In the literature, the rate of participation to a questionnaire-based study addressed to neurology residents is highly variable, from 12% in a Spanish study[18] to 86% in a Norwegian study.[7]

Another limit is from the anonymity of the responses and the absence of prevention of multiple entries from the same individual. This is unlikely but the answers could have been duplicated by a resident who answered several times.

Interns without additional training were younger and had completed fewer internship semesters. It is more likely that residents that had done the additional training DIUMC or attended specialized consultations had progressed further in their curriculum. Group 2 is probably heterogeneous. The number of specialized consultations and the experience of the internship supervisor in headache medicine were not defined. Indeed, the acquired knowledge is probably dependent on the number of consultations the resident attended.

In conclusion, this study showed the lack of knowledge among French neurology residents concerning headache medicine as it has been observed in other countries. We also highlighted that a specific training program in headache medicine is essential because it could improve the practical and theoretical knowledge of future neurologists. Neurology residents seem to be better trained in migraine than in other headaches, but this training needs to be extended to more residents. In addition, training should be emphasized for other primary headaches and for secondary headaches. Other studies are necessary to affirm the improvement of knowledge and management of headaches after specific training, but these results must be taken into consideration to develop and optimize this education.

AUTHOR CONTRIBUTIONS

Study concept and design: Marion Beltramone, Sylvain Redon, Anne Ducros, Anne Donnet. *Acquisition of data*: Marion Beltramone. *Analysis and interpretation of data*: Marion Beltramone, Sara Fernandes. *Drafting of the manuscript*: Marion Beltramone, Alexandre Avouac, Sylvain Redon. *Revising it for intellectual content*: Marion Beltramone, Sara Fernandes, Anne Ducros, Anne Donnet. *Final approval of the completed manuscript*: Marion Beltramone, Sara Fernandes, Sylvain Redon, Alexandre Avouac, Anne Ducros, Anne Donnet.

CONFLICT OF INTEREST

Dr. Beltramone reports no disclosure. Dr. Redon reports no disclosure. Dr. Avouac reports no disclosure. Dr. Ducros received personal

fees from AbbVie/Allergan, Eli Lilly, Lundbeck, Novartis, Teva. Dr. Donnet reports disclosure with Allergan, Almirall SAS, Astellas, AstraZeneca Pharmaceuticals, Grunenthal, Lilly, MSD, Orkyn, Pfizer, Saint-Jude, Sanofi-Aventis, Teva, Zambon.

ETHICS STATEMENT

In accordance with French law, this study did not require the authorization of an ethics committee and was deemed exempt by the local research ethics committee. The aim, the procedure of the study, and the strict anonymity of their answers were explained to each resident before their participation. In this context, participation in the study corresponds to the individual's non-opposition.

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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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