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Awareness, attitudes, and clinical practices related to medication-overuse headache among Italian pharmacists: results from a cross-sectional survey

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Abstract

Background Medication-overuse headache (MOH) is a frequent, disabling, and largely preventable secondary headache disorder, most associated with pre-existing migraine. Since many patients rely on over-the-counter medications and experience long delays before specialist referral, community pharmacists represent key frontline professionals in the identification, counseling, and prevention of medication overuse and MOH. However, data on pharmacists' knowledge and practices regarding migraine and MOH in Italy are still lacking.

Methods We conducted a nationwide, cross-sectional survey among Italian pharmacists and pharmacy students using a structured, self-administered questionnaire. The survey assessed demographic characteristics, knowledge of migraine and MOH, dispensing and counseling practices, screening for medication overuse, and referral behaviors. A composite scoring system, the Migraine and Medication Overuse Headache Knowledge and Awareness Scale (MMKAS; range 0–23), was developed by expert consensus to evaluate knowledge and professional behavior. Group comparisons were conducted using independent t-tests or Mann–Whitney U tests and categorical variables were analyzed using chi-square tests with standardized residual post-hoc analysis. For comparisons across more than two groups, one-way ANOVA or Kruskal–Wallis tests were applied, followed by adjusted post-hoc tests. A multivariable linear regression model was performed to identify independent predictors of total MMKAS scores. Internal consistency was evaluated using Cronbach's α coefficient.

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Results A total of 271 participants were included (mean age 40.8 ± 11.4 years; 15.5% men), representing all Italian regions. Overall migraine knowledge was generally preserved, whereas awareness of MOH thresholds, preventive strategies, and systematic screening was heterogeneous. Education level was significantly associated with MMKAS performance, while years of professional experience were not. In multivariable analysis, older age and practicing in southern regions were independently associated with higher MMKAS scores. Familiarity with newer preventive therapies, including anti-CGRP pathway drugs, was limited.

Conclusions Italian pharmacists show good general knowledge of migraine but relevant gaps in MOH prevention, systematic screening, and preventive management particularly related to novel anti-CGRP therapeutics. Targeted educational interventions, particularly during undergraduate and early postgraduate training, may strengthen pharmacists' contribution to migraine care and MOH prevention.

Keywords Medication-overuse headache, Migraine, Community pharmacists, Knowledge assessment, Acute treatments

Introduction

Headache disorders, mainly migraine and tension type headache (TTH) are among the most prevalent neurological disorder, and the estimated global prevalence of active headache disorder is 52% (95%CI 48.9–55.4) [1]. Their impact extends beyond the health care system, representing an enormous social and economic burden on society as a whole [2–4]. Notably, over 20% headache-related disability is attributable to medication-overuse headache (MOH) [2].

European data estimate the prevalence of MOH in the general population is around 1–2%, with a female predominance of up to 93% [5, 6]. Furthermore, MOH is also one of the most costly secondary headache disorders for both affected individuals and society [6] and epidemiological studies indicate that migraine is the underlying primary headache disorder in 80% of MOH cases [7].

Multiple risk factors for MOH have been described, including other types of comorbid pain, a more severe migraine phenotype, progressive increase in the days of use of acute medications for headache, psychiatric comorbidities, and lifestyle-related factors [2]. Since many individuals with primary headache disorders, with or without MOH, experience long delays before consulting specialists, receive a delayed diagnosis, and have limited overall interaction with the healthcare system for headache management, they predominantly rely on over-the-counter (OTC) medications [8]. Therefore, pharmacists are in a critical frontline position to identify patients affected by headache who need referral to specialist visits, counseling patients on appropriate medication use, and the potential harm of medications.

For being able to provide timely, appropriate, and high-quality counseling to patients, pharmacists need awareness, up-to-date knowledge, and understanding of the MOH. However, few studies have been performed [9, 10] and the existing evidence suggests that pharmacists' knowledge of headache management may be suboptimal. A previous survey in the US found that 85% of community pharmacists made at least one OTC headache-related suggestion every day, but pharmacists' knowledge of current migraine treatment was limited [11]. Similar results were also found in a recent study from Thailand [12]. Nevertheless, the importance of pharmacists' counseling emerged in a prospective cohort study that showed how pharmacists' advice is fundamental in the management of MOH, as demonstrated by the evidence that patients reported a significant reduction in headache frequency and analgesics use 3 months later [13].

The aim of this study was to assess knowledge about headache management and MOH among pharmacy staff in Italy, a country with a MOH prevalence of about 1.4% and no studies so far assessing pharmacists' awareness, attitudes, and clinical practices toward MOH [14]. We developed a structured questionnaire that included background questions, items assessing both self-perceived and actual knowledge of MOH, advice given on headache treatment, and the source of information about MOH.

Methods

Study design, population

We conducted an anonymized cross-sectional survey targeting Italian pharmacists and pharmacy students using a structured questionnaire. The survey consisted of a series of questions designed to explore: (i) personal and demographic information, educational and professional details, (ii) migraine, TTH, MOH awareness and knowledge of diagnostic criteria and treatment, (iii) analgesic dispensing practices and therapeutic advice for patients with headache, (iv) knowledge of referral practices and advanced therapies. The survey was administered online using a structured, self-administered questionnaire distributed nationwide between September 2025 and November 2025. Participants were recruited using convenience sampling through professional channels (namely mailing lists, regional pharmacists' boards, and

academic networks), with efforts made to ensure geographic representation across all Italian regions.

Eligible participants were licensed pharmacists currently practicing in Italy or pharmacy students enrolled in an Italian university program. Participation was voluntary and anonymous. No financial incentives were offered for participation. Career-stage groups (early-career, mid-career, senior) were defined based on self-reported years of professional work experience. Predefined cut-offs in years were applied to categorize participants into the three groups.

Participants in the study were treated following the principles of the Helsinki Declaration of Biomedical Ethics. The study was approved by the Ethical Committee of the Università Cattolica del Sacro Cuore (protocol ID4155/2021).

Questionnaire development and validation

The MMKAS scale and its items were developed through a structured expert consensus process involving three authors with specific expertise in migraine and MOH clinical management (M.R., C.V., L.F.I.). Item selection was based on: (1) alignment with current ICHD-3 diagnostic criteria for MOH; (2) clinical relevance to pharmacist practice; and (3) iterative review and discussion among the expert panel until consensus was reached.

The first series of questions captured socio-demographic characteristics, including age, sex, and region of residence. Participants were also asked about their level of education and professional experience.

The second section collected data on knowledge of primary headache disorders, particularly migraine and TTH (considering the paucity of data, we focused this first questionnaire on migraine and TTH, the most common primary headaches related to MOH), including clinical features and treatment options. Several questions on MOH knowledge focusing on characteristics, causes, and treatment were included.

In the third section, participants were presented with a series of questions regarding analgesic dispensing practices (NSAIDs, triptans, and combination drugs with opioids), patient questions regarding headache, drug consumption, and educational advice given to patients regarding analgesic and preventive treatment.

In the final section, participants were asked about their counseling on neurological visits and novel therapies for migraine (anti-calcitonin-gene-related peptide [CGRP] pathway drugs).

Subsequently, twenty-two relevant items, covering both correct practices and common misconceptions regarding MOH management, were integrated into a final scoring system.

We named this scale Migraine and Medication Overuse Headache Knowledge and Awareness Scale (MMKAS). The scale was divided into four sections (A-D). Section A assessed migraine knowledge among pharmacists and yielded a maximum of 5 points. Section B evaluated MOH knowledge using a 6-item scoring system. Section C assessed knowledge of MOH treatment (maximum 3 points), while Section D evaluated professional behavior related to headache management (maximum 9 points). The maximum score was 23. Based on predefined cut-offs set at 11 and 17, participants were classified into three MMKAS knowledge categories: low (0–11), intermediate (12–17), and high (18–23).

The MMKAS scale and complete scoring system are reported in Supplementary Table 1.

To establish the criterion validity of our custom 23-point questionnaire score and to justify the two specific stratification thresholds utilized (11 and 17 points), Receiver Operating Characteristic (ROC) curve analysis was employed. Given the absence of a standardized external clinical gold standard for "*migraine/MOH knowledge*," the continuous score was internally validated against two distinct prognostic anchor variables that represent different dimensions of competence: (1) general self-reported familiarity with Medication Overuse Headache (MOH); and (2) self-reported practical ability to treat MOH.

The overall discriminative accuracy of the continuous score for each anchor was quantified using the Area Under the Curve (AUC) along with 95% Confidence Intervals (CI). To statistically validate our three-tier knowledge classification system (Low: ≤11, Intermediate: 12–17, High: >17), the exact coordinates corresponding to the 11-point and 17-point thresholds were mapped onto each generated ROC curve. This allowed us to extract the operational metrics of sensitivity and specificity at these specific score cutoffs, thereby determining their respective performance as exclusionary (high sensitivity) and inclusionary (high specificity) mathematical boundaries.

Content validity of the MMKAS was evaluated using the Content Validity Index (CVI) methodology. An expert panel consisting of eight specialists in headache medicine independently rated each item for relevance using a 4-point Likert scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant).

The Item Content Validity Index (I-CVI) was calculated as the proportion of experts rating each item as either 3 or 4. According to established recommendations, an I-CVI ≥ 0.78 was considered acceptable for a panel of eight experts. The Scale Content Validity Index (S-CVI/Average) was computed as the average of the I-CVI values across all items. An S-CVI/Average ≥ 0.90 was considered indicative of excellent content validity.

Statistical analysis

Considering the study's exploratory nature, no sample size was calculated a priori. A sample size of > 200 was considered adequate based on prior studies [11]. Demographic and baseline characteristics were summarized descriptively, namely mean ± standard deviation [SD] for continuous variables and number (percentage) for categorical data.

The normality assumption was assessed using the Shapiro-Wilk test. Group comparisons were performed using independent t-tests or Mann–Whitney U tests, as appropriate. Chi-square tests (χ^2) assessed associations between categorical variables. The standardized residual (Pearson's post-hoc) analysis was used for multi-group categorical comparisons. For comparisons involving more than two groups, one-way ANOVA or the Kruskal–Wallis test was used as appropriate, following evaluation of data normality and homogeneity of variances with Levene's test; Dunn's post-hoc pairwise comparisons were adjusted using the Bonferroni correction. Finally, a multivariable linear regression model was constructed to identify independent predictors of the total MMKAS, treated as a continuous numeric outcome.

An initial baseline model (M0) including age and sex was first fitted a priori in order to account for fundamental demographic confounding and to provide a reference framework for subsequent adjusted analyses. Education level, geographical location, and professional experience were then added to the model to estimate their independent effects beyond the minimal demographic adjustment. Multicollinearity was assessed, and the final model was considered stable, with variance inflation factor (VIF) values < 2 for all covariates.

Internal consistency was evaluated using Cronbach's α coefficient. No imputation procedures were applied for missing data; all analyses were conducted using available case data. A two-tailed p-value < 0.05 was considered significant. All data were analyzed using JASP 0.95.4 and R (version 4.5.1).

Table 1 Demographics of survey participants

	Pharmacists (*n* = 271)
Age, years (mean ± SD)	40.8 ± 11.3
Male sex, n (%)	42 (15.5)
Geographical location, n (%)	
Center	107 (39.5)
Islands	22 (8.1)
North	67 (24.7)
South	75 (27.7)
Employment, n (%)	
Rural Area	53 (19.6)
Urban Area	180 (66.4)
Logistics	2 (0.7)
Industry/University/Hospital	16 (5.9)
Training	19 (7.0)
Education, n (%)	
Bachelor	174 (64.2)
Post-Bachelor	75 (27.7)
Student	22 (8.1)
Years since graduation, mean years ± SD	15.6 ± 10.3
Years of working experience, mean years ± SD	13.8 ± 9.9

Abbreviations: SD,S tandard Deviation.

Results

Demographics

A total of 271 pharmacists were included in the cohort (Table 1). The mean age was 40.8 ± 11.4 years and 15.5% of participants were men. Geographically, 39.5% of the pharmacists were from the central region, 24.7% from northern Italy, 27.7% from southern Italy, and 8.1% from the islands, representing the whole Italian national territory. 66% (66%) of pharmacists worked in urban areas, 19.6% worked in rural areas, 0.7% were personnel involved in pharmaceutical logistics, 5.9% in industry/university or hospital positions, or were engaged in training roles (7.0%). Regarding education, 64.2% held a bachelor's degree, 27.7% had also a post-graduate training, and 8.1% were current students. On average, time since graduation was 15.6 ± 10.4 years, and the mean professional work experience was 13.9 ± 9.9 years.

Content validity index, MMKAS validation and internal consistency

The MMKAS demonstrated excellent overall content validity, with an S-CVI/Average of 0.966, exceeding the recommended threshold of 0.90 (Supplementary material).

ROC curve analyses confirmed the robust validity of the continuous 23-point scoring system and the selected class boundaries. When assessed against the primary anchor variable (general knowledge of MOH), the aggregate score demonstrated an excellent discriminatory overall performance, yielding an AUC of 0.805 ($p < 0.001$) (Supplementary material).

The internal consistency of the MMKAS was acceptable, with a Cronbach's alpha coefficient of 0.718, indicating satisfactory reliability of the instrument.

Analysis by the MMKAS levels score

Based on the predefined cut-offs reported in the methods, participants were classified into three MMKAS knowledge categories: low (0–11), intermediate (12–17), and high (18–23). Education level was the only factor that differed significantly by knowledge group ($p < 0.001$). In the low-knowledge group, 22.5% of pharmacists were current students, a proportion substantially higher than in the intermediate (5.5%) or high-knowledge (6.1%)

groups. Conversely, pharmacists with postgraduate education comprised 42.9% of the high, compared to 23.5% in the intermediate and 27.5% in the low-knowledge groups, respectively (χ^2 test with post hoc standardized residual analysis). Most pharmacists with a bachelor's degree fell into the intermediate knowledge group (70.9%), compared with 23.5% of post-graduate degree holders and 5.5% of students. There were no other significant differences among the other tested variables. Table 2 reports all the comparisons of participant characteristics across knowledge levels.

Specific knowledge of primary headaches and MOH

Nearly all participants reported being familiar with migraine characteristics (95.6%) and migraine aura (94.1%). The distinction between migraine and TTH was correctly identified by 81.3% of respondents.

Regarding treatments, almost all pharmacists (96.0%) were aware that migraine management includes both acute and preventive treatments, although understanding of indications for preventive therapy was variable (Fig. 1). Preventive treatment was most commonly considered appropriate at a threshold of at least four attacks per month (41.5%), while 27.6% indicated two attacks per month, and 17.3% reported that preventive therapy should always be considered.

Awareness of MOH was less consistent. While 41.9% declared knowledge of MOH, the majority of participants (57.7%) reported no familiarity with the condition. Correct identification of populations at risk for MOH was achieved by 72.4% of participants, who selected all relevant headache categories. Diagnostic criteria were correctly recognized by 59.9%, selecting both chronic headache frequency and sustained medication overuse. Similarly, 55.1% correctly identified all major drug classes associated with MOH (Fig. 1). Knowledge of overuse thresholds was very variable, with only 29.4% correctly identifying the threshold for non-steroidal anti-inflammatory drugs and 46.0% for triptans. On the contrary, a substantial proportion selected higher or lower incorrect thresholds.

In terms of dispensing practices, ibuprofen was the most frequently dispensed analgesic for any headache (74.6%), followed by ketoprofen lysine salt (10.7%) and paracetamol (6.3%). Most pharmacists correctly identified the recommended approach to MOH management, based on the reduction of acute medication use combined with preventive therapy and counseling (89.3%). Counseling activities were commonly reported, with 61.0% asking patients about monthly analgesic intake, 91.2% recommending limitation of analgesic use, and 95.6% providing information on presumed maximum daily doses and optimal timing.

Finally, familiarity with newer anti-CGRP therapies was limited, with only 31.6% reporting knowledge of these drugs. Despite these gaps, almost all respondents (96.7%) considered patient education on MOH in the pharmacy

Table 2 Comparisons of cohort characteristics according to Migraine and Medication Overuse Headache Knowledge and Awareness Scale (MMKAS) levels

	High knowledge (*n* = 49)	**Intermediate knowledge (*n* = 182)**	**Low knowledge (*n* = 40)**	***p*-value**
Age, years (mean ± SD)	41.7 ± 12.6	41.3 ± 10.4	37.4 ± 12.8	0.170
Male sex, n (%)	8 (16.3)	29 (15.9)	5 (12.5)	0.864
Geographical location, n (%)				0.553
Center	16 (32.7)	74 (40.7)	17 (42.5)	
Islands	4 (8.2)	16 (8.8)	2 (5.0)	
North	10 (20.9)	45 (24.7)	12 (30.0)	
South	19 (38.8)	47 (25.8)	9 (22.5)	
Employment, n (%)*				0.068
Rural Area	11 (22.4)	37 (20.3)	5 (12.5)	
Urban Area	29 (59.2)	125 (68.7)	26 (65.0)	
Industry/University/Hospital	5 (10.2)	10 (5.5)	1 (2.5)	
Training	3 (6.1)	9 (4.9)	7 (17.5)	
Education, n (%)				**< 0.001**
Bachelor	25 (51.0)	**129 (70.9)**	20 (50.0)	
Post-Bachelor	**21 (42.9)**	43 (23.5)	11 (27.5)	
Student	3 (6.1)	10 (5.5)	**9 (22.5)**	
Years since graduation, mean years ± SD	16.1 ± 12.3	15.4 ± 9.8	15.5 ± 10.2	1.00
Years of working experience, mean years ± SD	14.5 ± 11.8	13.9 ± 9.4	12.3 ± 9.6	1.00

*Two participants employed in pharmaceutical logistics were excluded to ensure statistical consistency. Post hoc Bonferroni correction was applied following the Kruskal–Wallis test, and omnibus p-value correction was applied for Pearson's chi-squared tests. Bold values are significant at standardized residual analysis. Abbreviations: SD, Standard Deviation.

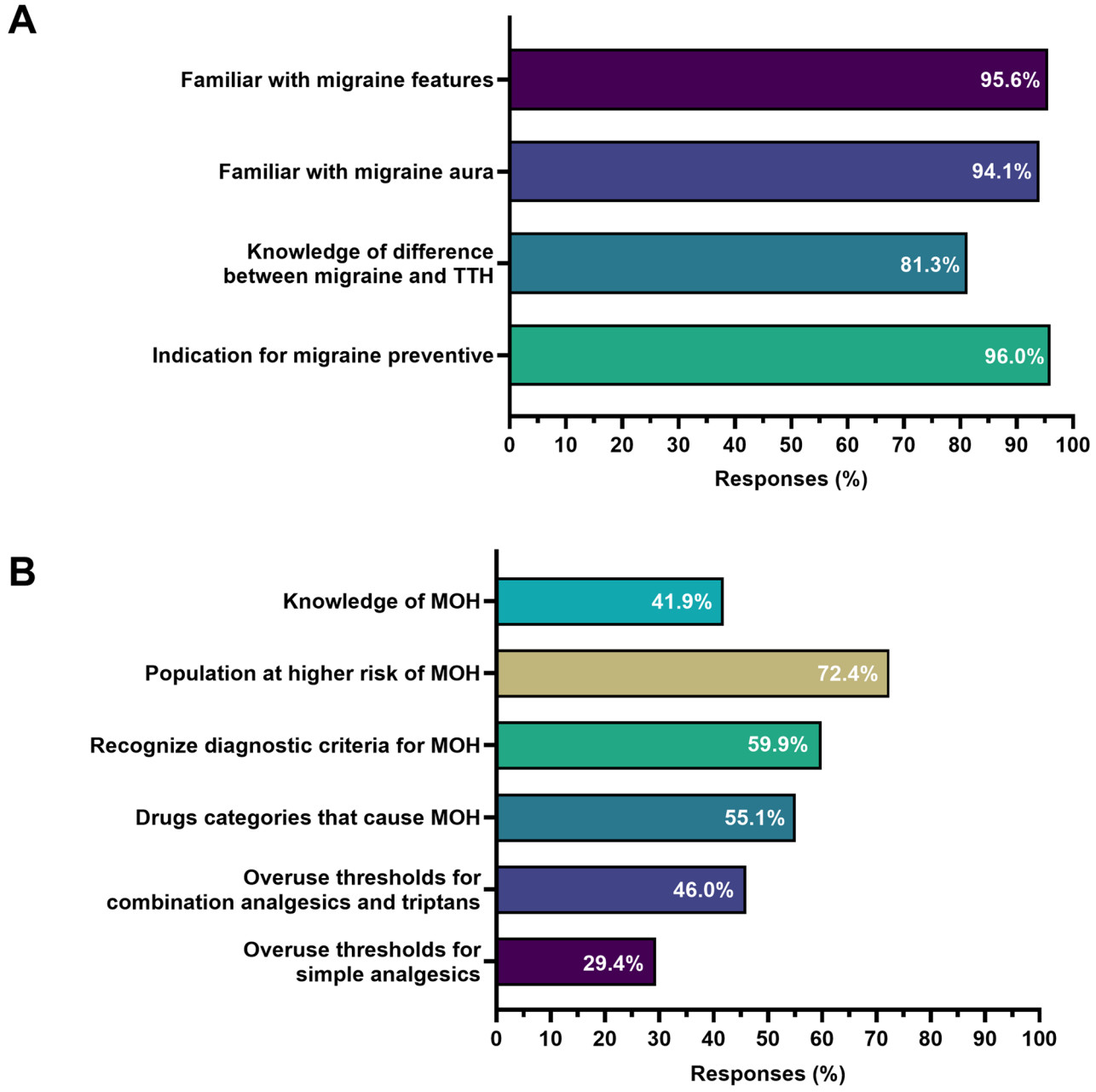

Fig. 1 Pharmacists' knowledge on migraine (**A**) and medication-overuse headache (**B**). Percentages refer to the total study population ($n = 271$). MOH, medication-overuse headache; TTH, tension-type headache

setting useful, and a majority frequently or often recommended neurological evaluation for headache.

Analysis by geographic location

Participant characteristics and MMKAS scores were also analyzed by geographic location. Significant regional differences emerged in age, sex, education, and employment (Table 3 and Supplementary material). In terms of knowledge performance by region, overall MMKAS knowledge scores did not differ significantly across geographical locations. There were also no significant regional differences in MMKAS sub scores for Sections A, B, or C ($p = 0.389$, 0.249, and 0.364, respectively). Section D scores showed a significant marginal variation by region (overall $p = 0.045$); however, post hoc Dunn's pairwise comparisons with Bonferroni adjustment did not reach significance for any specific regional pair (Table 3).

Analysis by education level

Age differed significantly across the education groups ($p < 0.001$) as expected (Table 4 and Supplementary material). Overall knowledge (MMKAS total score) varied by

Table 3 Comparison of cohort characteristics and Migraine and Medication Overuse Headache Knowledge and Awareness Scale (MMKAS) scores according to geographical areas of Italy

		Central (*n* = 106)	Island (*n* = 22)	North (*n* = 67)	South (*n* = 75)	*p*-value	Bonferroni *p*-value					
							C vs. I	C vs. *N*	C vs. S	I vs. *N*	I vs. S	*N* vs. S
Male sex, n (%)		11 (10.4)	5 (22.7)	7 (10.4)	**19 (25.3)**	**0.019**	-	-	-	-	-	-
Age, years (mean ± SD)		42.4 ± 11.8	44.2 ± 7.6	41.8 ± 9.7	36.5 ± 12.1	**< 0.001**	1.00	1.00	**0.002**	0.313	**0.002**	**0.004**
Education, n (%)						**< 0.001**						
	Bachelor	70 (66.0)	16 (72.7)	47 (70.1)	41 (54.7)		-	-	-	-	-	-
	Post-bachelor	30 (28.3)	6 (27.3)	20 (29.9)	19 (25.3)		-	-	-	-	-	-
	Student	7 (6.6)	0 (0)	0 (0)	**15 (20.0)**		-	-	-	-	-	-
MMKAS questionnaire, *mean ± SD*												
	Total score	14.1 ± 3.0	14.6 ± 2.7	14.1 ± 2.9	14.9 ± 3.8	0.097	-	-	-	-	-	-
	Section A	4.0 ± 0.9	4.04 ± 0.6	4.2 ± 0.6	4.13 ± 1.0	0.389	-	-	-	-	-	-
	Section B	1.9 ± 1.1	1.818 ± 1.140	1.776 ± 1.216	2.227 ± 1.300	0.249	-	-	-	-	-	-
	Section C	2.1 ± 0.7	2.0 ± 0.6	2.0 ± 0.6	2.0 ± 0.9	0.364	-	-	-	-	-	-
	Section D	5.9 ± 1.8	6.7 ± 1.2	6.1 ± 1.8	6.5 ± 2.3	**0.045**	1.00	1.00	0.058	1.00	1.00	0.22
Employment, n (%)*						**0.002**						
	Rural Area	26 (24.5)	3 (13.6)	15 (22.4)	9 (12.0)		-	-	-	-	-	-
	Urban Area	67 (63.2)	**19 (86.4)**	48 (71.6)	46 (61.3)		-	-	-	-	-	-
	Industry/University/Hospital	7 (6.6)	0 (0)	3 (4.5)	6 (8.0)		-	-	-	-	-	-
	Training	6 (5.7)	0 (0)	0 (0)	**13 (17.3)**		-	-	-	-	-	-
Time since graduation, mean years ± SD^		*17.1* ± 10.7	15.6 ± 8.6	15.7 ± 10.1	12.8 ± 10.4	0.063	-	-	-	-	-	-
Work experience, mean years ± SD^		15.2 ± 10.4	13.1 ± 7.5	14.2 ± 9.8	11.4 ± 9.7	0.104	-	-	-	-	-	-

*Two participants employed in pharmaceutical logistics were excluded to ensure statistical consistency. ^Twenty students were excluded from this analysis. The Dunn's post hoc-Bonferroni correction was applied following the Kruskal–Wallis test, and omnibus p-value correction was applied for Pearson's chi-squared tests. Bold values are significant at standardized residual analysisAbbreviations: C, Central; I, Island; N, North; S, South; SD, Standard Deviation.

Table 4 Comparison of cohort characteristics and Migraine and Medication Overuse Headache Knowledge and Awareness Scale (MMKAS) scores according to educational status (bachelor's degree, post-bachelor's degree, and student)

	Bachelor ($n=174$)	Post-Bachelor ($n=75$)	Student ($n=21$)	*p*-value	Bonferroni *p*-value		
					B vs. PB	B vs. S	PB vs. S
Male sex, **n (%)**	26 (14.9)	15 (20.0)	1 (4.8)	0.200	-	-	-
Age, *years*, *mean ± SD*	43.0 ± 10.6	40.7 ± 10.2	23.6 ± 2.9	**< 0.001**	0.175	**< 0.001**	**< 0.001**
MMKAS questionnaire, *mean ± SD*							
Total score	14.4 ± 2.6	13.8 ± 3.6	12.5 ± 5.0	**0.012**	0.864	**0.033**	**0.009**
Section A	4.1 ± 0.7	4.1 ± 0.9	3.6 ± 1.4	0.543	-	-	-
Section B	1.8 ± 1.1	2.1 ± 1.3	2.0 ± 1.1	0.219	-	-	-
Section C	2.1 ± 0.6	2.1 ± 0.8	1.7 ± 1.1	0.353	-	-	-
Section D	6.2 ± 1.7	6.4 ± 1.9	5.0 ± 3.0	0.192	-	-	-
Employment, n (%)*				**< 0.001**			
Rural Area	36 (20.7)	17 (22.7)	0 (0.0)	-	-	-	-
Urban Area	**133 (76.4)**	46 (61.3)	1 (4.8)	-	-	-	-
Industry/University/Hospital	3 (1.7)	**12 (16.0)**	1 (4.8)	-	-	-	-
Training	0 (0)	0 (0)	**19 (90.5)**	-	-	-	-
Time since graduation, *mean years ± SD*	16.0 ± 10.5	14.7 ± 10.0	-	0.413	-	-	-
Work experience, *mean years ± SD*	14.5 ± 9.9	12.8 ± 9.6	2.6 ± 3.5	**0.016**	0.674	0.052	0.131

Bold values are significant at standardized residual analysis. Abbreviations: B, Bachelor; PB, Post-Bachelor; S, Student; SD, Standard Deviation.

education level ($p=0.012$). Pharmacists in the student group had the lowest mean total score (12.56 ± 5.08) compared to those with a bachelor's degree (14.42 ± 2.65) or post-bachelor's degree (13.89 ± 3.68). In post hoc testing, the score was significantly lower for students compared to bachelor's ($p=0.033$) and post-bachelor ($p=0.009$) groups, whereas total scores for bachelor's vs. post-bachelor groups did not differ ($p=0.864$). Knowledge subscores (Sections A–D) did not show significant differences between education groups.

Analysis by work experience

The analysis of work experience (career stage) was conducted using three different groups: early career ($n=82$), mid-career ($n=86$), and senior pharmacists ($n=103$), with statistically significant differences for age, educational background, geographic distribution, and work location ($p<0.01$) (Table 5 and Supplementary material).

In contrast to these demographic and practice-setting differences, knowledge levels evaluated with MMKAS score did not differ across work experience groups.

Predictors of MMKA score

A multivariable linear regression was conducted to identify independent predictors of MMKAS. Geographical location and age resulted as significant predictors. The latter was independently associated with higher MMKAS total scores ($p=0.034$). Additionally, pharmacists practicing in the southern regions showed higher MMKAS scores compared to those practicing in other regions ($p=0.008$). Being a current student was associated with significantly lower scores than non-students, though the difference was not statistically significant ($p=0.050$). No significant difference was observed between pharmacists with a postgraduate degree and those with other educational levels ($p=0.285$). Details are reported in Table 6.

Discussion

In this survey of Italian pharmacists, we provide a comprehensive overview of current knowledge, attitudes, and professional behaviors related to migraine and MOH.

In this study, pharmacists demonstrated a generally high level of awareness of core migraine features and management principles, contrasted by relevant gaps in knowledge and practice related to MOH. Fewer than half of participants reported knowledge of the condition and substantial uncertainty regarding diagnostic criteria and overuse thresholds. Although most pharmacists correctly identified the appropriate therapeutic approach to MOH and frequently reported counseling behaviors such as limiting analgesic intake and providing dosage information, systematic screening for medication overuse and consistent application of preventive strategies were not homogeneously implemented.

Interestingly, pharmacists recognize more precisely the threshold for medication overuse of combination analgesics and triptans compared to simple analgesics, a finding that may be related to a greater perceived harmfulness of these drugs. Moreover, familiarity with innovative acute and preventive options, including anti-CGRP therapies, remained low.

Education, rather than professional experience, is the primary determinant of correct knowledge and appropriate clinical behaviors in the management of migraine and MOH.

Table 5 Comparison of cohort characteristics and Migraine and Medication Overuse Headache Knowledge and Awareness Scale (MMKAS) scores stratified by work experience

	Early Career (*n* = 82)	Mid-Career (*n* = 86)	Senior (*n* = 103)	*p*-value	Bonferroni *p*-value		
					EC vs. MD	EC vs. S	MD vs. S
Sex (M), n (%)	12 (14.6)	14 (16.3)	16 (15.5)	0.957	-	-	-
Age (mean ± SD)	28.7 ± 5.5	39.8 ± 6.1	51.2 ± 7.6	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**
Geographical location, n (%)				**0.010**			
Center	30 (36.6)	29 (33.7)	48 (46.6)	-	-	-	-
Islands	3 (3.7)	**12 (14.0)**	7 (6.8)	-	-	-	-
North	16 (19.5)	23 (26.7)	28 (27.2)	-	-	-	-
South	**33 (40.2)**	22 (25.6)	20 (19.4)	-	-	-	-
MMKAS questionnaire, mean ± SD)							
Total score	13.9 ± 3.6	14.8 ± 2.9	14.4 ± 3.1	0.290	-	-	-
Section A	4.0 ± 1.0	4.1 ± 0.8	4.0 ± 0.7	0.619	-	-	-
Section B	1.9 ± 1.2	2.0 ± 1.2	1.9 ± 1.1	0.914	-	-	-
Section C	2.08 ± 0.9	2.1 ± 0.7	2.1 ± 0.7	0.961	-	-	-
Section D	5.7 ± 2.2	6.5 ± 1.6	6.29 ± 1.8	0.126	-	-	-
Education				**< 0.001**			
Bachelor	42 (51.2)	53 (61.6)	**79 (76.7)**	-	-	-	-
Post-bachelor	20 (24.4)	**32 (37.2)**	23 (22.3)	-	-	-	-
Student	**20 (24.4)**	1 (1.2)	1 (1.0)	-	-	-	-
Employment, n (%) *				**< 0.001**			
Rural Area	14 (17.1)	12 (14.0)	**27 (26.2)**	-	-	-	-
Urban Area	42 (51.2)	**68 (79.1)**	70 (68.0)	-	-	-	-
Industry/University/Hospital	7 (8.5)	5 (5.8)	4 (3.9)	-	-	-	-
Training	**17 (20.7)**	1 (1.2)	1 (1.0)	-	-	-	-
Time since graduation (mean years ± SD) ^	4.3 ± 5.2	12.2 ± 4.9	25.4 ± 6.5	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**

*Two participants employed in pharmaceutical logistics were excluded to ensure statistical consistency. ^Twenty students were excluded from this analysis. Post hoc Bonferroni correction was applied following the Kruskal–Wallis test, and omnibus p-value post-hoc Pearsons's analysis was applied for chi-squared tests. Bold values are significant at standardized residual analysis.Abbreviations: EC, Early Career; MD, Mid-Career; S, Senior; SD, Standard Deviation.

Table 6 Multivariable linear regression analysis of predictors of the Migraine and Medication Overuse Headache Knowledge and Awareness Scale (MMKAS) score

Predictor	β (SE)	95% CI	*p*-value
Age	0.067 (0.031)	0.005–0.129	**0.034**
Education (post-Bachelor vs. Others)	0.475 (0.444)	-0.399–1.350	0.285
Education (Student vs. Others)	-1.663 (0.846)	-3.330–0.003	0.050
Experience (Mid-career vs. Others)	-0.083 (0.598)	-1.258–1.099	0.894
Experience (Senior vs. Others)	-1.083 (0.817)	-2.692–0.526	0.186
Geographical Location (Islands Vs Others)	0.295 (0.756)	− 1.193–1.784	0.696
Geographical Location (North Vs Others)	-0.073 (0.499)	-1.055–0.908	0.883
Geographical Location (South Vs Others)	1.352 (0.503)	0.361–2.343	**0.008**
Sex (Male vs. Female)	-0.414 (0.031)	-1.500–0.673	0.454

Values in bold are statistically significant. Abbreviations: CI, Confidence Interval.

However, important gaps emerged in the understanding and application of therapeutic principles. Although most pharmacists were aware of both acute and preventive treatment options for migraine, the indications for initiating preventive therapy were not consistently recognized. Migraine was often considered a disease to be managed only with acute treatment, as a transitory pain condition. This acute-centered view is relevant, as it may lead to repeated use of symptomatic medications rather than prophylactic treatment and favor the development of MOH [15, 16]. This is particularly relevant in southern regions where migraine treatment has been reported to be delayed and MOH and non-response also to the newest therapeutics are common among older patients [15, 16].

Accordingly, while awareness of MOH as a distinct entity was present, knowledge regarding overuse thresholds, risk populations, and optimal management strategies was heterogeneous. Of note, professional years of experience did not translate into higher MOH knowledge scores, indicating that daily exposure to patients with headache and prescription of medications does not automatically increase competence in recognizing

or preventing MOH. This condition appears to require structured and targeted educational interventions rather than relying solely on clinical experience. It is therefore possible that the root of the problem lies in undergraduate-level formal education, where this entity is likely insufficiently addressed. Without adequate training and awareness, pharmacists may fail to recognize the issue and therefore may not identify patients at risk [11]. This concept, in fact, is in line with a previous work from the US, where pharmacists frequently recommend OTC headache products while showing limited knowledge of migraine as a neurobiological disease and of evidence-based guidelines of treatment [11]. Comparable results have been documented in Sweden, where pharmacy staff often overestimated their own knowledge of MOH while demonstrating poor objective understanding of causative medications and appropriate management strategies [10].

Pharmacists occupy a relevant and underestimated position in the headache care pathways, acting as gatekeepers to acute headache medications and health care system. Despite their strategic role in preventing MOH, our data suggest that pharmacists remain underutilized in this context. Counseling practice, such as assessing monthly headache frequency and medication intake, was inconsistently applied. The discrepancy between practice and theoretical knowledge underscores the need for practice-oriented training that translates knowledge into pragmatic instructions for daily routine.

In a previous Italian survey conducted in community pharmacies, Brusa et al. [17] reported that a large proportion of patients seeking pharmacy care fulfilled criteria for definite or probable migraine; nearly one-third did not undergo an evaluation by a headache specialist. This finding confirms the underutilized role of pharmacists in the line of care [17]. Our survey depicted a similar figure, particularly in the systematic use of OTC medications without clear referral indications.

Studies using simulated patient methodologies further support these observations. Such studies have consistently shown insufficient counseling quality in community pharmacies, particularly regarding dose and duration in drug use, and identification of red flags requiring further evaluation by headache specialists [18, 19]. Our findings support this evidence, suggesting that self-reported practices may not mirror real-world counseling quality [18, 19].

Another important concern is the current knowledge of new preventive therapies for migraine, especially dealing with the anti-CGRP pathway drugs. Familiarity with these treatments was limited and unevenly distributed, being higher among pharmacists with post-Bachelor's education and lower among students. Notably, knowledge of these therapies was not associated with years of professional experience. This suggests that advances in migraine treatment are not adequately incorporated into routine pharmacy practice, and an insufficient familiarity with new treatments may have important clinical consequences. A limited understanding may reinforce the perception that migraine is primarily and exclusively managed with acute medications, perpetuating overuse of analgesics. Our finding is in line with international surveys reporting poor diffusion of knowledge of advances in headache treatment outside specialist settings [18].

Finally, recent surveys from the Middle East similarly showed notable gaps in guideline awareness and in the adoption of newer therapies among pharmacists, including anti-CGRP therapies [20, 21].

From a public health perspective, the survey addresses highly relevant points. MOH is common, disabling, and largely preventable. Even modest improvement in pharmacists' knowledge and counseling behaviors could translate into earlier identification of at-risk patients, more appropriate use of acute medications, and timely referral for preventive care. Given the accessibility of pharmacists, targeted educational strategies represent an opportunity to improve headache care. In previous works, public health policies appeared useful: the Danish national awareness campaign [22] demonstrated that targeted education involving pharmacists can significantly improve population-level awareness of MOH, supporting the notion that structured educational strategies could directly address the gap identified in our survey [22]. Consistently, studies focusing on MOH costs and outcomes have highlighted that early educational intervention could substantially reduce long-term burden, a role that remains largely untapped according to current evidence [23].

The present study has several strengths. First, it provides a comprehensive overview of pharmacists' knowledge, attitudes, and professional behaviors related to MOH, drawing on a relatively large sample that includes participants from all Italian geographic regions. This broad coverage enhances internal generalizability within the national context. Second, the study employed a structured and purpose-built assessment tool, the MMKAS, developed through expert consensus among clinicians with specific expertise in MOH. The scale allowed a multidimensional evaluation rather than relying on isolated or purely self-perceived measures. Third, we have also performed analyses by education, geographic area, and work experience, and conducted a multivariable regression modeling to account for potential confounding factors.

At the same time, some limitations should be acknowledged. The cross-sectional design inherently limits causal interpretation, as associations between demographic or educational variables and knowledge scores cannot establish directionality or causation. Data was collected

through a self-administered questionnaire, which introduces the possibility of recall bias and social desirability bias, potentially leading participants to overreport guideline-consistent knowledge and counseling behaviors. The online and voluntary nature of participation may also have resulted in selection bias, favoring pharmacists with greater interest in headache disorders or continuing education. Compared with national workforce data from the Italian National Federation of Pharmacists' Orders (FOFI), indicating that women represent approximately 65–70% of practicing pharmacists in Italy, female participants were somewhat overrepresented in our sample (84.5%), which may reflect a self-selection effect typical of voluntary online surveys [24]. Furthermore, due to overlapping recruitment channels, the exact response rate to the questionnaire could not be determined.

Although the MMKAS demonstrated good internal consistency and strong content validity, as well as satisfactory criterion-related validity based on ROC curve analysis, it has not yet undergone external validation or test–retest reliability assessment, which constrains its immediate applicability beyond this study setting. Furthermore, due to overlapping recruitment channels, the exact response rate to the questionnaire could not be determined.

Conclusions

Our study showed that pharmacists' knowledge of migraine and MOH is uneven and strongly dependent on formal education, with persistent gaps in preventive strategies and awareness of newer therapies. Educational interventions, particularly at the undergraduate and early postgraduate levels, may foster pharmacists' contributions to migraine management and the prevention of MOH. Pharmacists occupy a strategic and underestimated role in migraine management, above all in the prevention of MOH, as frontline healthcare professionals. Yet their potential remains limited by insufficient specific training on disease knowledge, preventive therapies, and new emerging treatments.

Abbreviations

MOH	Medication-overuse headache
MMKAS	Migraine and medication overuse headache knowledge and awareness scale
NSAIDs	Non-steroidal anti-inflammatory drugs
CGRP	Calcitonin gene-related peptide
TTH	Tension-type headache
OTC	Over-the-counter
SD	Standard deviation
CI	Confidence interval
VIF	Variance inflation factor
ANOVA	Analysis of variance
IHS	International headache society

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Author contributions

MR designed the study and conducted the main survey. MR,MP and SDT performed the analysis. MR, FT, LFI and SDT wrote the first draft of the manuscript. All Authors critically reviewed the manuscript, agreed to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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Data availability

Data supporting the findings in the present study are reported in the article and in the supplementary materials. The data collected and analyzed for the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Participants in the study were treated following the principles of the Helsinki Declaration of Biomedical Ethics. The study was approved by the Ethical Committee of the Università Cattolica del Sacro Cuore (protocol ID4155/2021).

Competing interests

The authors declare no competing interests.

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