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Migraine prodromal symptoms and their clinical manifestations: an observational multicenter study

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ABSTRACT

Background: Migraine prodromal symptoms typically emerge 2-48 hours before headache onset and include cognitive, affective, and homeostatic disturbances. Although widely described in the literature, their reported prevalence varies considerably, likely due to methodological differences in symptom assessment. This multicenter observational study aimed to evaluate the prevalence, characteristics, timing, and distribution of prodromal symptoms across migraine subtypes in routine outpatient clinical practice.

Methods: Consecutive adult patients diagnosed with migraine without aura, migraine with aura, or chronic migraine according to the International Classification of Headache Disorders, 3rd edition (ICHD-3) criteria, were enrolled at multiple Italian headache centers between January and June 2025. Patients reporting prodromal symptoms constituted the study group, while those not reporting prodromal symptoms served as controls for prevalence analysis. An interviewer-administered questionnaire assessed symptom type, timing, duration, and recurrence. Descriptive statistics were performed; group differences were evaluated using *t*-tests and chi-square tests, with significance set at $p<0.05$.

Results: Among 3,711 migraine patients (mean age 41.3±13.4 years; 86.0% female), 122 (3.3%) reported prodromal symptoms. Prevalence differed significantly across migraine subtypes ($\chi^2=7.67$, $p=0.02$): 3.5% in migraine without aura, 5.3% in migraine with aura, and 2.2% in chronic migraine. The most frequent prodromal manifestations were yawning/asthenia (37.7%), difficulty concentrating (33.6%), anxiety (26.2%), hunger (21.3%), and depressive symptoms (18.9%). Mean prodromal onset occurred 9.9±11.4 hours before headache onset, with a mean duration of 6.3±8.9 hours. Female patients reported significantly longer prodromal duration than males (6.9±9.3 *vs.* 1.1 ± 1.9 hours; $p<0.001$). Prodromal symptoms recurred in approximately 30% of attacks within the same patient and remained clinically consistent over time.

Conclusions: In this large outpatient cohort, migraine prodromal symptoms were infrequently reported, particularly in chronic migraine, suggesting substantial underrecognition in routine clinical practice. Prodromal manifestations were more common in episodic migraine and were mainly characterized by non-specific cognitive, affective, and homeostatic symptoms. Their variable recurrence and duration highlight the heterogeneity of the migraine prodrome and support the need for improved recognition to facilitate earlier therapeutic intervention.

Key words: migraine, prodromal symptoms, clinical characteristics.

Introduction

Prodromal symptoms that may precede migraine-type headache typically emerge 2 to 48 hours before the onset of the pain phase. First described by Blau in 1980 under the term “complete migraine”, (1) they were later renamed “premonitory migraine” by Lance in 1982 (2) and “warning migraine” by Waelkens and colleagues in 1985 and 1986. (3,4) The previous International Classification of Headache Disorders (ICHD) (5) still adopted the terms “premonitory symptoms” and “warning migraine”; however, ICHD-3 discourages their use in favor of “prodrome phase”, as earlier terminology was inconsistently applied to denote both prodromal features and the very early symptoms of a migraine attack. (6,7)

According to Kelman, (8) prodromal symptoms can be classified into general fatigue, mood changes, gastrointestinal symptoms, and “other” manifestations. Other authors have proposed broader descriptive groupings, including cognitive, affective, autonomic, sensory, and homeostatic symptoms. In the present study, the terms cognitive, affective, and homeostatic disturbances are used as a pragmatic clinical framework rather than as a formal, validated classification system. The most frequently reported prodromal symptoms include asthenia, cognitive slowing, impaired concentration, sleepiness, irritability, neck and cranial tension, hunger with craving for specific foods, hyperosmia, yawning and transient reading, writing, or speech difficulties. (9) Unlike migraine aura, prodromal symptoms never evolve into focal neurological deficits; recent studies have shown that prodromal symptoms may be present even in patients with migraine with aura. (10-12)

Reported prevalence rates vary substantially across studies, reflecting methodological differences in symptom identification. Values range from 33% in Kelman and Santoro (8,13) to as high as 80% in studies by Quintela and Schoonman. (10,11) Many patients fail to spontaneously recognize prodromal symptoms until they are systematically prompted, suggesting that underreporting is common. Moreover, although numerous prodromal manifestations have been described in the literature, not all of them exhibit strong predictive value for an impending attack. According to Giffin, (14) yawning, increased emotionality, and difficulties with reading or speaking are among the most predictive indicators of imminent headache.

Functional neuroimaging studies conducted over the past decade have confirmed that the prodromal phase involves early activation of subcortical regions such as the hypothalamus, the substantia nigra, and the dorsal pons, as well as various limbic cortical areas. (15) These findings support the

view of migraine as a complex brain disorder in which dysregulation begins well before the onset of pain. Additional evidence suggests alterations in homeostatic systems related to sleep-wake regulation, energy balance, and dopaminergic signaling, which may help explain early manifestations such as yawning, food cravings, mood changes, or fatigue.

Some studies, considering both the presence of prodromal symptoms and the involvement of specific brain regions, have evaluated the effectiveness of therapeutic interventions initiated at the onset of migraine prodromal phase. As early as 1982, domperidone – a dopamine antagonist – administered during the prodromal phase in a double-blind, placebo-controlled study, (16) effectively reduced both headache and aura occurrence compared with placebo (66% *vs.* 5%). Given domperidone's limited penetration of the central nervous system, it has been hypothesized that metoclopramide may produce even greater efficacy. (17) More recently, Luciani and colleagues, (18) in an open-label study, evaluated naratriptan 2.5 mg taken during the prodromal phase in patients who consistently experienced prodromal symptoms prior to pain onset. With active treatment, only 40% of patients progressed to headache, typically with lower intensity than baseline. Finally, calcitonin gene-related peptide (CGRP)-targeted acute treatment has also shown promise when administered during the prodromal phase; ubrogepant has been reported to reduce progression to moderate or severe headache and associated symptoms when taken early during premonitory symptom onset. (19)

Recent research has further suggested that recognizing and treating the prodrome phase may not only prevent headache onset but also reduce the overall burden of the attack, including associated symptoms such as photophobia, phonophobia, and functional impairment. (19,20) The growing interest in this early phase underscores the importance of systematic prodrome identification, patient education, and the development of targeted early-intervention therapeutic strategies. (20)

The present study aims to evaluate the prevalence and characteristics of prodromal symptoms in patients with migraine without aura, migraine with aura, and chronic migraine attending the outpatient clinics of several institutions. Specifically, the study seeks to characterize the type and frequency of prodromal symptoms in the study population, determine the timing of symptom onset relative to the migraine attack, assess differences in symptom presentation across migraine subtypes, evaluate potential gender-related variations, and examine the duration of prodromal symptoms.

Results

Across the participating headache centers participating in the *Italian Headache Registry* (RICe) study, a total of 3,711 migraine patients were evaluated and included in this study. The mean age was 41.3±13.4 years, and 3,191 (86.0%) were female patients. Among these patients, migraine subtypes were diagnosed as follows: 2,428 (65.4%) patients with migraine without aura, 283 (7.6%) patients with migraine with aura, and 1,000 (26.9%) patients with chronic migraine.

Within the total patient sample, 122 (3.3%) patients reported some kind of migraine prodromal symptoms, constituting the main study group (**Table 1**). The mean age of this subgroup was 39.4±12.8 years, and 108 (88.5%) were female. Among these patients, migraine subtype diagnoses were: 85 patients (69.7%) with migraine without aura, 15 patients (12.3%) with migraine with aura, and 22 patients (18%) with chronic migraine.

Considering the percentage of patients manifesting migraine prodromal symptoms, these were present in 3.5% of patients suffering from migraine without aura, 5.3% of patients with migraine with aura, 2.2% of patients with chronic migraine. Prodromal symptoms were not equally distributed among migraine groups, with a statistically significant difference detected by the chi-square test (χ^2=7.67, df=2, p=0.02). Patients with migraine without aura and migraine with aura showed significantly more prodromal symptoms than expected for an equal distribution, whereas those with chronic migraine showed fewer than expected for an equal distribution.

Considering the specific types of prodromal symptoms, their distribution was as follows (**Figure 1**): yawning and asthenia were present in 46 patients (37.7%); difficulty in concentration in 41 patients (33.6%); anxiety in 32 patients (26.2%); hunger in 26 patients (21.3%); depression in 23 patients (18.9%); vertigo in 20 patients (16.4%); thirst in 13 patients (10.7%); speech impairment in 12 patients (9.8%); difficulty in reading/writing in 6 patients (4.9%); and dysgeusia in 3 patients (3.5%).

Considering the mean onset of migraine prodromal symptoms prior to migraine, symptoms began 9.9±11.4 hours before headache onset. The mean duration of prodromal symptoms was 6.3±8.9 hours overall. When analyzing by sex, the mean prodromal symptom duration was 1.1±1.9 hours in male patients compared to 6.9±9.3 hours in female patients, representing a statistically significant difference (p<0.001).

Finally, the recurrence of prodromal symptoms within individual patients was reported at 30% of migraine attacks; furthermore, among all patients who experienced prodromal symptoms, these symptoms remained persistent over time in relation to their critical subtype.

Table 1. Demographic and clinical features of patients reporting any migraine prodromal symptoms (main study group).

	Main study group reporting prodromal symptoms (n=122)		p-value
Age (years), mean ± SD	39.4±12.8		
Gender (female), n (%)	108 (88.5)		
Diagnosis, n (%)	Migraine without aura Migraine with aura Chronic migraine	85 (69.7) 15 (12.3) 22 (18)	
Prodromal symptoms onset prior to headache (hours), mean ± SD	9.9±11.4		
Prodromal symptoms duration (hours), mean ± SD	All patients Male patients Female patients	6.3±8.9 1.1±1.9 6.9±9.3	p<0.001
Prodromal symptoms incidence	Migraine without aura Migraine with aura Chronic migraine	3.5% of patients 5.3% of patients 2.2% of patients	p=0.02
Prodromal symptoms recurrence in the single patient	30% of migraine attacks		

SD, standard deviation.

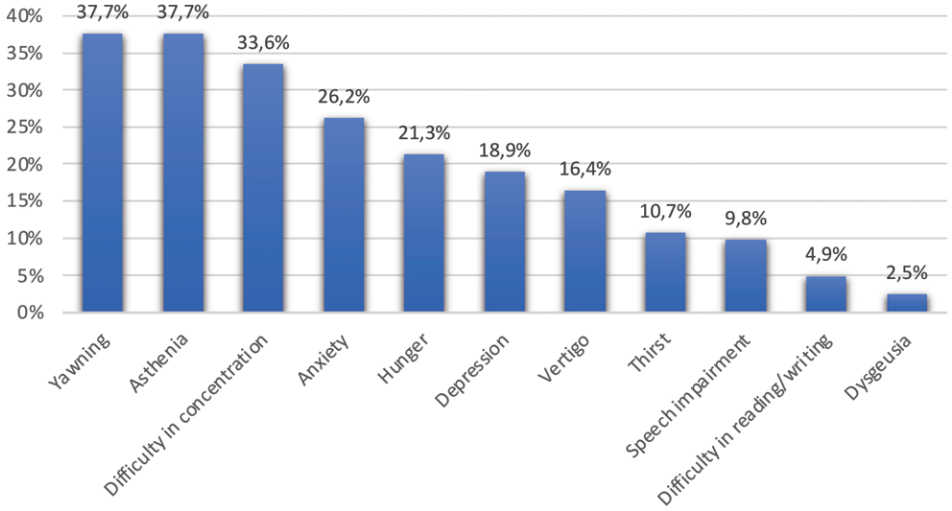

Figure 1. Frequency of migraine prodromal symptoms.

Discussion

The present multicenter observational study provides a systematic evaluation of migraine prodromal symptoms in a large outpatient population, offering insights into their prevalence, clinical characteristics, temporal profile, and distribution across migraine subtypes. Notably, while much of the existing literature reports prodromal symptoms in one-third to over two-thirds of migraine patients, our study found a markedly lower prevalence, with only 3.3% of the overall population reporting prodromal manifestations.

This finding differs substantially from previous literature, such as the studies by Kelman (8) and Santoro *et al.*, (13) who reported prodromal symptoms in approximately one-third of migraine patients, and from studies by Quintela *et al.*, (10) and Schoonman *et al.*, (11) where prevalence rates reached 70-80%. These discrepancies are likely attributable to methodological differences. While those studies relied on structured interviews, targeted questionnaires, or prospective symptom recording, the current investigation reflects routine outpatient clinical practice, where prodromal symptoms are often not spontaneously recognized or reported unless patients are specifically prompted. Our data therefore suggest that, in real-world settings, migraine prodromal symptoms remain largely underdiagnosed, despite their potential clinical relevance. Furthermore, the exclusion of symptoms such as photophobia, phonophobia, and neck stiffness from the prodromal phase, given their frequent overlap with early headache-phase symptoms, may have contributed to the observed lower frequency observed in our cohort.

Prodromal symptoms were not uniformly distributed across migraine subtypes. Patients with migraine without aura and migraine with aura showed a higher-than-expected (for an equal distribution) prevalence of prodromal symptoms, whereas patients with chronic migraine exhibited a significantly lower prevalence. This observation is consistent with previous reports suggesting that prodromal symptoms may be less easily identifiable in chronic migraine, where the high frequency of attacks and the presence of persistent interictal symptoms blur the temporal distinction between migraine phases. (10,12) Central sensitization and continuous symptomatology may mask discrete prodromal features, reducing patients' ability to recognize them as specific warning signs.

The symptom profile observed in our cohort is largely consistent with that described in the literature. Yawning and asthenia were the most frequent prodromal manifestations, followed by difficulty in concentration, anxiety, hunger, and depressive symptoms. Similar symptom patterns were reported by Kelman, (8) who identified fatigue, mood changes, and cognitive slowing among the most common prodromal features, and by Giffin *et al.*, (14) who highlighted yawning and cognitive disturbances as particularly predictive of impending headache. The predominance of these non-specific cognitive, affective, and homeostatic symptoms supports the concept that the prodromal phase reflects early dysfunction in subcortical and limbic networks rather than focal cortical processes.

The mean onset of prodromal symptoms approximately 10 hours before headache onset aligns with the temporal window reported in previous studies, which typically describe prodromal manifestations emerging several hours up to 2 days before pain onset. (9,14) However, the wide interindividual variability observed in our cohort underscores the heterogeneous nature of the migraine prodrome and suggests that rigid temporal definitions may inadequately capture the individual experience of this phase.

A notable finding of the present study is the significant gender difference in prodromal symptom duration, with female patients reporting substantially longer prodromal phases than male patients. This result should be interpreted cautiously, given the limited number of male patients reporting prodromal symptoms and the consequent risk of unstable estimates. Although data on sex-related differences in prodromal characteristics are scarce, this observation may reflect known sex-related differences in migraine pathophysiology, hormonal modulation, or symptom perception. Sex-related differences in migraine biology, particularly the modulatory role of estrogen on hypothalamic function, dopaminergic pathways, pain processing, and cortical excitability, may influence the timing and expression of premonitory symptoms. (21,22) In addition, differences in interoceptive awareness, symptom perception, and reporting behavior between women and men may have contributed to the observed finding. Given these considerations and the relatively small male subgroup, the present result should be regarded as exploratory and requires confirmation in larger, prospectively characterized, and more gender-balanced cohorts.

Prodromal symptoms recurred in approximately 30% of migraine attacks within the same patient, indicating moderate

intraindividual consistency. This recurrence rate is lower than that reported in studies using prospective designs, (10,11) again suggesting that recall-based assessments may underestimate both frequency and consistency of prodromal manifestations. Nevertheless, the presence of recurring prodromal patterns in a subset of patients supports their potential utility as individualized warning signs for early therapeutic intervention.

Overall, the findings of this study emphasize the clinical relevance of the migraine prodrome while simultaneously highlighting its underrecognition in routine clinical practice. Systematic education of both patients and clinicians may improve awareness and identification of prodromal symptoms, potentially facilitating timely interventions aimed at preventing or attenuating the subsequent headache phase.

As a last addition, in our clinical practice, we have also observed that nutraceutical compounds containing *Tanacetum parthenium*, 5-hydroxytryptophan, and magnesium appear to be effective in reducing duration and disability of the aura symptoms in migraine with aura in acute treatment, confirming previous observations on its beneficial role on aura-related mechanisms. (23-25) However, the same treatment did not show a relevant effect on migraine prodromal symptoms. This dissociation further supports the hypothesis that migraine aura and prodromal manifestations rely on at least partially distinct pathophysiological mechanisms, although these observations should be considered exploratory and would require further studies to support them. Moreover, according to our clinical experience, a reduction in overall migraine attack frequency was frequently associated with a marked improvement or even disappearance of prodromal symptoms. This observation suggests that prodromal manifestations may be strongly dependent on the global disease burden and central sensitization processes, rather than representing an entirely independent phenomenon.

Finally, recent therapeutic studies, including trials of ubrogepant administered during the prodromal phase, (19) further support the clinical importance of recognizing early migraine symptoms and targeting treatment before pain onset.

Conclusions

In this large multicenter outpatient cohort, migraine prodromal symptoms were infrequently reported, particularly in chronic migraine, confirming a substantial underrecognition of this phase in routine clinical practice. Prodromal manifestations were more common in episodic migraine and were mainly characterized by non-specific cognitive, affective, and homeostatic symptoms, most frequently yawning and asthenia.

Prodromal symptoms typically preceded headache onset by several hours and showed wide variability in duration, with a longer prodromal phase reported by female patients. Their inconsistent recurrence across attacks suggests limited predictive value at the individual level.

Clinical observations indicate that prodromal symptoms may be pathophysiologically distinct from migraine aura and closely related to overall disease burden, as suggested by their poor response to aura-targeted nutraceuticals and their improvement with reduced attack frequency. Improved recognition of the migraine prodrome may support earlier interventions and better clinical management.

Materials and Methods

The present observational multicenter study included patients with a diagnosis of migraine without aura, migraine with aura, or chronic migraine, evaluated at the participating outpatient centers (Istituto Clinico Città di Brescia, Humanitas Gavazzeni [Bergamo], Voghera Hospital [Pavia], Fondazione Camplani [Brescia], and IRCCS C. Mondino Foundation [Pavia], Italy). We acknowledge that chronic migraine may coexist with aura history; however, chronic migraine was analyzed as a separate frequency-based category. Patients manifesting some type of migraine prodromal symptom were included in the study group (for symptom evaluation and characterization); patients not reporting prodromal symptoms were included in the control group (in order to have, collectively, a sample of migraine outpatients for prevalence analysis).

Written informed consent was obtained for every patient included in the study. The study is a part of the RICe, approved by the local ethics committee of Careggi University Hospital, Florence, Italy (CEAVC Studio RICe, 14591_oss and subsequent amendments 2022-609).

Patient enrollment started on January 1, 2025, and ended on June 30, 2025.

Inclusion criteria for patients to be enrolled in the migraine prodromal symptoms study group were: i) ability to understand the study procedures and provide written informed consent; ii) age ≥18 years; iii) documented history of migraine without aura, migraine with aura, or chronic migraine according to the diagnostic criteria of the ICHD-3; (7) and iv) reported clinical manifestation of some migraine prodromal symptoms.

Exclusion criteria for the migraine prodromal symptoms study group comprised: i) inability or refusal to provide informed consent; ii) diagnosis of a headache disorder other than migraine without aura, migraine with aura, or chronic migraine according to ICHD-3 diagnostic criteria; (7) iii) major neurological, psychiatric, or systemic disorders potentially interfering with reliable symptom reporting; and iv) cognitive impairment or language barriers preventing adequate interview completion.

Patients meeting inclusion criteria i, ii, and iii but not iv (not reporting migraine prodromal symptoms) were included in the control group in order to have a sample to evaluate the prevalence of migraine prodromal symptoms in migraine patients. All participants underwent an interviewer-administered questionnaire listing migraine prodromal symptoms (including yawning, asthenia, difficulty in concentration, anxiety, depression, hunger, thirst, vertigo, speech impairment, difficulty in reading/writing, and dysgeusia), for which they were asked to indicate presence or absence, duration, onset in relation to migraine attack, and symptom recurrence over time. Photophobia, phonophobia, and neck stiffness were not included among core prodromal variables because of their frequent overlap with early headache-phase symptoms in routine retrospective interviews. Other collected data included patients' age, gender, and migraine diagnosis (with aura, without aura, or chronic).

Symptom recurrence was assessed retrospectively during the clinical interview. Patients reporting prodromal manifestations were specifically asked whether the same symptoms tended to recur across subsequent migraine attacks and, when possible, to estimate the approximate proportion of attacks in which such symptoms were present.

Descriptive statistical analysis was performed. Continuous variables were assessed for normality using visual inspection of histograms and quantile-quantile (Q-Q) plots, together with the Shapiro-Wilk test. Demographic and clinical characteristics with normal distribution were expressed as mean ± standard deviation. Median and range were reported for non-normally distributed variables. Categorical variables were expressed as numbers and percentages. Differences between groups in continuous variables were evaluated using Student's *t*-test or Welch's *t*-test, as appropriate, to assess statistical significance. A chi-square test was performed to determine the presence of significant differences in categorical variables between groups. Statistical significance was set at $p<0.05$.

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