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ORIGINAL RESEARCH

A Swiss Cross-Sectional Study on Patients' Perspectives on Chronic Pain Management, Analgesic Treatment, and Genetic Susceptibility

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Background: Chronic pain is a prevalent and complex condition that often results in inadequate pharmacotherapy due to inter-individual variability in drug response. Pharmacogenetics (PGx) offers a promising approach to personalize pain management, particularly since many analgesic drugs are PGx actionable. However, knowledge about the clinical relevance and patient perspective on PGx in Swiss chronic pain care remains limited.

Methods: We conducted a cross-sectional online survey among chronic pain patients in the German-speaking regions of Switzerland. The questionnaire was developed to (1) assess the proportion of patients currently or previously treated with PGx actionable drugs, (2) evaluate therapy satisfaction and the perception of being taken seriously by healthcare professionals (HCPs), and (3) explore patients' awareness of PGx and their interest in genetic pain predisposition.

Results: Among the 725 participants who completed the survey, most reported current or past use of PGx actionable drugs: 85% non-steroidal anti-inflammatory drugs (NSAIDs), 54% opioids, 38% co-analgesics (antidepressants), and 73% proton-pump-inhibitors (PPIs) used as adjunctive therapy. Over one-third of participants reported no use of any analgesic drug. Therapy dissatisfaction was reported by 33%, and 28% felt not taken seriously by HCPs. Notably, 97% had never been offered PGx testing by an HCP. Despite this, 60% expressed interest in knowing their genetic pain predisposition, even if it would not affect their treatment. This interest was significantly higher among younger participants and those who were dissatisfied or felt not taken seriously by HCPs.

Conclusion: This study provides the first large-scale, representative insights into the use of PGx actionable drugs and treatment patterns in Swiss chronic pain care. In particular, the high prevalence of PGx actionable drug use and the strong patient interest in genetic information support not only the clinical, but also the biopsychosocial potential of PGx for chronic pain management.

Keywords: pharmacogenetics, PGx testing, pain sensitivity, therapy satisfaction, chronic pain care, Switzerland

Introduction

Chronic pain is a complex and multifaceted condition that persists for more than three months.[1] It affects 10–30% of the European population, with a prevalence of approximately 16% among Swiss adults.[2] Chronic pain is broadly categorized into primary and secondary forms. Primary chronic pain (eg fibromyalgia, complex regional pain syndrome (CRPS), chronic migraine) is considered an independent clinical condition and is often associated with emotional distress and functional impairment. In contrast, secondary chronic pain is a symptom of an underlying medical condition, such as cancer, diabetes, or infectious diseases. Beyond the etiological classification, it is also essential to consider the pathophysiological mechanisms of chronic pain.[1] These include nociceptive, neuropathic, nociplastic, psychogenic, or mixed pain mechanisms.[3] Therefore, treatment for chronic pain management varies and may involve non-pharmacological (eg physiotherapy, acupuncture, psychological support) as well as pharmacological interventions.[3]

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The most common framework for pharmacological pain management is the World Health Organization (WHO) analgesic ladder, which offers a structured and stepwise approach. It recommends non-steroidal anti-inflammatory drugs (NSAIDs) and other non-opioid analgesics for mild pain, and an add-on of weak opioids for moderate pain or strong opioids for severe pain.[4] While this model was originally developed for tumor-associated pain, it is often considered insufficient and inapplicable for chronic pain with a different etiology.[5] For example, for neuropathic pain, the recommended first-line pharmacological treatments include gabapentinoids, tricyclic antidepressants (TCAs), or duloxetine a serotonin-norepinephrine reuptake inhibitor (SNRI), rather than opioids.[6,7] Due to the multifactorial nature of chronic pain, the overreliance on opioids in pharmacotherapy has generally been strongly criticized.[6–8] Treatment of chronic pain should be personalized and targeted to the individual patient, taking into account the clinical classification, the pathophysiological mechanism, and psychosocial factors.[9]

Despite the availability of various treatments, many patients experience inadequate pain relief (= therapy failure, TF) or adverse drug reactions (ADR), which contribute to overall dissatisfaction with their medical care. Studies have shown that 30–64% of chronic pain patients express dissatisfaction with their pharmacotherapy, primarily due to TF or ADRs.[10–12] One major factor contributing to those interindividual differences in drug response is genetic variability.[13] Pharmacogenetics (PGx) investigates how genetic variations influence drug metabolism, thereby affecting both drug safety and efficacy.[13] The majority of the commonly prescribed drugs for chronic pain are PGx actionable, meaning that PGx testing may serve as a basis for evidence-based recommendations to optimize pharmacotherapy.[14] Relevant drug-gene-interactions (DGIs) in therapeutic chronic pain management include NSAIDs (ie ibuprofen, celecoxib, piroxicam, tenoxicam), which are metabolized by cytochrome P450 enzyme 2C9 (*CYP2C9*);[15] opioids (ie tramadol, oxycodone, codeine), which depend on *CYP2D6* for metabolic activation;[16,17] antidepressants (ie amitriptyline, sertraline, escitalopram, citalopram, trimipramine, venlafaxine, paroxetine), whose metabolism is influenced by *CYP2C19* and/or *CYP2D6;*[18,19] and proton-pump-inhibitors (PPIs) (ie pantoprazole, lansoprazole, dexlansoprazole, omeprazole), metabolized via *CYP2C19*.[20]

Beyond influencing drug response, genetic variations are also known to affect pain perception itself.[21,22] Literature describes the role of four single nucleotide polymorphisms (SNPs) within the catechol-O-methyltransferase gene in pain intensity, which result in three haplotypes: low pain sensitivity (LPS), average pain sensitivity (APS), and high pain sensitivity (HPS).[23,24] Furthermore, variants in the μ-opioid receptor 1 (*OPRM1*), in combination with the *COMT* HPS haplotype, have been linked to insufficient analgesia and higher opioid dosages.[25] Likewise, decreased enzymatic activity of CYP2D6 has also been associated with increased pain sensitivity.[26–28] Although these genetic markers are not routinely used to predict pain outcomes in clinical practice, they may help to better understand interindividual differences in pain perception and response to analgesics, which might offer potential biopsychosocial value for affected patients.

Although research suggests that PGx panel testing improves patient outcomes,[29] real-world data on its clinical utility are lagging and its implementation remains limited.[30] This is further challenged by the low awareness and knowledge of PGx among healthcare professionals (HCPs), which has also been reported in Switzerland.[31–33] A critical, but underexplored factor is the proportion of chronic pain patients who are actually prescribed PGx actionable drugs, and thus qualify for PGx testing. International studies indicate that chronic pain patients frequently receive PGx-actionable NSAIDs, co-prescribed with PPIs, opioids and co-analgesics.[34,35] However, to date, no comparable data is available for Switzerland. This knowledge gap limits the ability to evaluate the clinical relevance of PGx testing in Swiss chronic pain care and highlights the need for national data to support implementation strategies in Switzerland.

The primary objective of this study was to assess the proportion of chronic pain patients in Switzerland who are currently or have previously been treated with PGx actionable drugs, in order to inform the clinical rationale for PGx testing in this patient population. Secondary objectives were to assess satisfaction with their current pharmacotherapy, evaluate PGx awareness and explore whether patients are interested in knowing their genetic predisposition to pain sensitivity. By gathering these data, this study will help to evaluate the practical relevance and clinical need for integrating PGx testing into multimodal chronic pain management in Swiss clinical practice, which supports the overarching goal of improving patient safety and optimizing treatment efficacy.

Materials and Methods

Study Design

We performed a descriptive, cross-sectional study in the German-speaking part of Switzerland. A questionnaire was developed consisting of 10 closed-ended questions, with an additional 3 follow-up closed-ended questions depending on prior responses, and 1 open-ended question requesting the respondent's year of birth (Supplement Material: Questionnaire). The questionnaire was piloted for clarity and comprehensibility with 5 patients of the target population and 5 scientists. The questionnaire began with an introductory text presenting the project and the research team, outlining the scientific relevance, and estimated time required to complete the questionnaire. It also included an online link to a written study information sheet to be read by the participants. The questionnaire covered the following 4 key themes:

- Key theme 1 included demographic data, such as biological sex, year of birth, highest level of education.
- Key theme 2 assessed medication use, asking about non-use, current, and/or past use of pharmacogenetic (PGx) actionable analgesic drug classes (ie Non-steroidal anti-inflammatory drugs (NSAIDs), opioids, antidepressants, and PPIs (proton-pump inhibitors)) with specific substance examples and Swiss brand names provided. Since each drug class comprised multiple substances, participants could report both current use of one substance and past use of another substance within the same drug class.
- Key theme 3 focused on therapy satisfaction and participants' perception of whether their chronic pain being taken seriously by their pharmacist, physician, or other healthcare professionals (HCPs). If participants expressed dissatisfaction with their therapy, follow-up questions were presented to identify the reason: side effects (ie adverse drug reaction (ADR)) or lack of efficacy (ie therapy failure (TF)) from the current analgesic pharmacotherapy.
- Key theme 4 addressed awareness of PGx and the participants' interest in genetic pain predisposition. Participants were asked whether PGx testing had ever been offered to them by a HCPs (eg general practitioner, medical specialist, pharmacist, physiotherapist), and whether the test had subsequently been conducted. A footnote explained what a PGx test is. Additionally, participants were asked whether they would like to know if they had a genetically increased sensitivity to pain, even if this information would not influence their pharmacotherapy.

The questionnaire concluded with a closing statement. It was developed and administered online using REDCap™, a web application for building and managing study data.

Study Population and Procedures

Individuals meeting the following criteria based on self-report were included: experience chronic pain (defined as pain lasting more than three months), being at least 16 years old, and having sufficient proficiency in German. In accordance with article 22 of the Swiss Federal Act on data protection, formal ethics approval was not required, as all data were collected anonymously and individual identities could not be traced, which was confirmed by the responsible ethics committee (BASEC-ID: Req-2024-01357). The project was reviewed by the data protection officer from the University of Basel to ensure compliance with data protection regulations. All participants were informed via the online study information sheet about eligibility criteria, data protection, withdrawal, risks and benefits, and contact persons for questions. The study adhered to the principles of the Declaration of Helsinki.

For recruitment, a flyer containing a QR code and the written study information sheet was distributed to various German-speaking medical institutions specializing in chronic pain (eg specialized hospital departments, private practice pain specialists), as well as to chronic pain-related organizations and support groups.

In total, 84 specialized medical institutions were contacted, of which 19 agreed to participate in recruitment and displayed the study materials in their waiting area. Additionally, 82 chronic pain-related organizations and support groups were contacted, of which 27 agreed to participate by either displaying the study materials at their facilities or distributing them digitally to their members or subscribers. In this way, patients became aware of the study either through flyers with QR codes or by receiving a direct link to the online questionnaire. The data collection period lasted four months, from December 9, 2024 to April 7, 2025.

Sample Size

To ensure representativeness for the German-speaking Swiss chronic pain population, a sample size calculation was performed. Assuming that approximately 1.5 million individuals in Switzerland are affected by chronic pain,[2,36] and that around 63% reside in German-speaking regions,[37] the relevant target population was estimated at 945.000 individuals. Targeting a maximum error of 5% with a 95% confidence level and using the standard formula for large populations, we aimed for a sample size of 384 fully completed questionnaires.[38]

Data Analysis

All complete questionnaires were included for analysis. Descriptive results are presented as absolute numbers (n) with corresponding percentages (%), or as median with interquartile ranges [IQR], as appropriate. Subgroup analyses were conducted using chi-square test ($p < 0.05$) to investigate associations between categorical variables (yes/no) for therapy satisfaction, perception of being taken seriously, interest in knowing one's genetic pain predisposition, and participants' demographics (sex, age, educational level). Additionally, chi-square test was used to assess associations between therapy satisfaction and the currently used drug groups in different combinations. PPIs were excluded from this analysis, as they do not provide analgesic effect. Responses coded as "don't know" (DK) were excluded from all subgroup analyses. No correction for multiple testing was applied due to the exploratory nature of the study. All analyses were conducted using Microsoft Excel (Microsoft Office Professional Plus, Version 16.0, 2016) and R (R Studio, Version 4.2.2, 2022).

Results

Demographics

A total of 863 participants took part in the study, of whom 725 completed the questionnaire (completion rate: 84% ± 2.45%). The median time required to complete the form was 2.41 minutes [IQR 2.02–3.39]. Further demographics are summarized in Table 1.

Medication Use

The distribution of medication use across the four pharmacological drug classes was categorized according to the time point of intake (current use, past use, both current and past use, or never used) and is illustrated in Figure 1.

As the questionnaire allowed multiple responses across the different drug classes, a total of 15 possible current treatment regimens were identified in 446 participants (63%). In contrast, 279 participants (38%) reported no current drug treatment. An overview of the currently used drug class combinations is provided in Table 2.

Table 1 Participants' Demographics

Characteristic	Category	Value
Sex, n (%)	Female	594 (82%)
	Male	124 (17%)
	NA: Not answered	7 (1%)
Age, n (%)	18-39 years: Younger adults	138 (19%)
	40-64: Middle-aged adults	367 (51%)
	≥ 65 years: Older adults	220 (30%)
Education, n (%)[a]	School for less than seven years	4 (1%)
	Secondary school/A-Levels	42 (6%)
	Apprenticeship/vocational school	253 (35%)
	Advanced vocational/professional training	198 (27%)
	University/ university of applied sciences	203 (28%)
	NA: Not answered	25 (3%)

Note: [a]In case of multiple entries, only the highest educational qualification was considered.

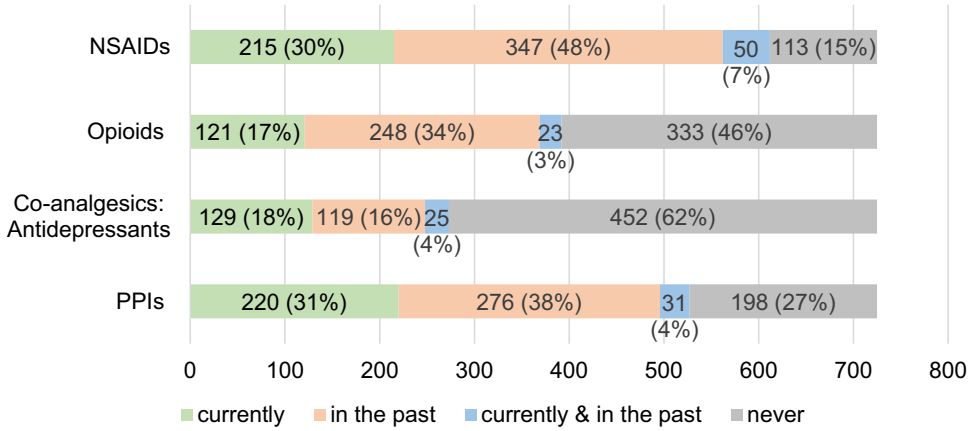

Figure 1 Distribution of medication use.

Notes: Bar charts illustrating the distribution of responses regarding the use of four drug classes, categorized according to the pharmacological subgroup (3rd level of the Anatomical Therapeutic Chemical (ATC) classification). These include: Non-steroidal anti-inflammatory drugs (NSAIDs, M01A) comprising ibuprofen, celecoxib, piroxicam, tenoxicam; Opioids (N02A) represented by oxycodone, codeine, tramadol; Co-analgesics (antidepressants, N06A) containing sertraline, paroxetine, venlafaxine, amitriptyline, trimipramine, escitalopram, citalopram; Proton-pump inhibitors (PPIs, A02B) including pantoprazole, lansoprazole, dexlansoprazole, omeprazole. The percentage and number of respondents per drug class and time point of intake are displayed within each bar. The category "currently & in the past" includes participants who reported using different substances within the same drug class at different time points.

Therapy Satisfaction and Perception of Being Taken Seriously

Among the 725 participants, 335 (46%) reported being satisfied with their therapy, 237 (33%) were dissatisfied, and 153 (21%) answered "don't know" (DK). The distribution of the reasons for dissatisfaction are illustrated in Figure 2. In

Table 2 Current Treatment Regimens Based on Combinations of Currently Used Drug Classes

TREATMENT REGIMEN	n (%)
Current use of the following drug classes:	**446 (62%)**
NSAIDs only	77 (17%)
PPIs only	68 (15%)
Co-analgesics only	42 (9%)
Opioids only	31 (7%)
NSAIDs + PPIs	65 (15%)
NSAIDs + opioids	16 (4%)
NSAIDs + co-analgesics	17 (4%)
Opioids + PPIs	16 (4%)
Opioids + co-analgesics	6 (1%)
Co-Analgesics + PPIs	14 (3%)
NSAIDs + opioids + PPIs	19 (4%)
NSAIDs + co-analgesics + PPIs	19 (4%)
NSAIDs + opioids + co-analgesics	6 (1%)

(*Continued*)

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Table 2 (Continued).

TREATMENT REGIMEN	n (%)
Opioids + co-analgesics + PPIs	4 (1%)
NSAIDs + opioids + co-analgesics + PPIs	46 (11%)
No current use of the listed drug class	**279 (38%)**

Abbreviations: NSAIDs, non-steroidal anti-inflammatory drugs; PPIs, proton-pump inhibitors.

addition, 417 participants (57%) felt that their chronic pain was taken seriously by their HCPs, 201 (28%) reported not feeling taken seriously, and 107 (15%) indicated DK.

In subgroup analysis, no significant differences in therapy satisfaction were observed across the currently used drug classes, whether administered alone or in combination. However, certain trends emerged: The highest dissatisfaction rate was reported among participants treated with a combination of co-analgesics and opioids (71%), followed by those currently receiving co-analgesics, NSAIDs and opioids (64%) simultaneously. In contrast, the highest satisfaction rate was observed in participants treated currently with co-analgesics (59%) alone, followed by those receiving a combination of co-analgesics and NSAIDs (56%) (Supplementary Table 1).

Moreover, subgroup analyses revealed that participants who felt taken seriously by their HCPs, reported significantly greater satisfaction with their therapy compared to those who did not ($p < 0.001$). In addition, older participants (≥ 65 years) were significantly more likely to feel taken seriously by HCPs ($p = 0.004$) and also reported significantly higher therapy satisfaction ($p = 0.039$) compared to younger and middle-aged participants (18–64 years). No significant group differences in therapy satisfaction or in feeling taken seriously by HCPs were found based on sex or educational level.

Awareness of PGx and Interest in Genetic Pain Predisposition

Out of the 725 participants, 15 (2%) reported that their HCP had suggested to do a PGx test. Nine participants (1%) did not know whether a PGx test had ever been proposed to them by their HCP, while 701 (97%) indicated that no HCP had ever recommended PGx testing. Among the 15 participants who had received such recommendation, 13 (87%) reported having undergone PGx testing, whereas 2 (13%) did not.

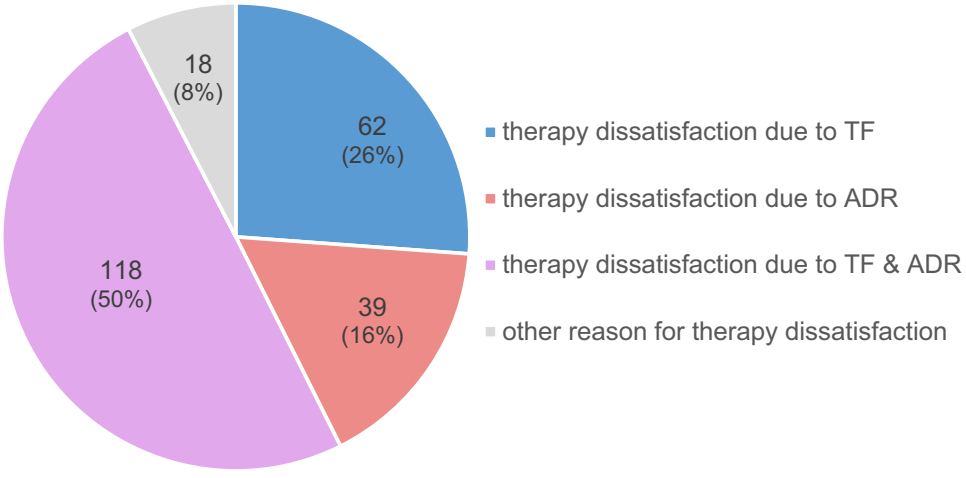

Figure 2 Reason for therapy dissatisfaction.
Notes: Pie chart illustrating the distribution of reported reasons for therapy dissatisfaction. Among the 237 participants who indicated dissatisfaction with their current analgesic therapy, 62 (26%) attributed it to therapy failure (TF), 39 (16%) to adverse drug reactions (ADR), 118 (50%) to both TF and ADR, and 18 (8%) reported other reasons.

In the final question, 437 participants (60%) indicated that they would be interested in knowing their genetic predisposition to increased pain sensitivity, even if this information would not influence their drug therapy. In contrast, 145 participants (20%) expressed no interest in knowing this information, while 143 (20%) were unsure.

Subgroup analyses showed that participants who were dissatisfied with their therapy were significantly more likely to express interest in knowing their genetic predisposition for pain sensitivity compared to those who were satisfied ($p < 0.001$). Same applies for participants who felt not taken seriously by their HCPs ($p = 0.011$). In addition, younger and middle-aged participants (18–64 years) were significantly more interested in learning about their genetic predisposition compared to older patients (≥ 65 years, $p = 0.002$). Interest in knowing one's genetic predisposition for pain did not differ significantly by sex or educational level.

Discussion

Medication Use and Treatment Pattern

With 725 completed questionnaires, this study provides valuable and representative insights into medication use and treatment patterns for the German-speaking Swiss chronic pain population. Results showed that 85% of participants reported having used NSAIDs, 54% opioids, 38% co-analgesics (antidepressants), and 73% PPIs, either currently or in the past. It is important to mention that participants were specifically asked about the use of PGx-actionable substances within these four drug classes. For those substances, PGx dosing and recommendation guidelines are available. As a result, the actual extent of overall drug use within these classes may be underestimated. At the same time, we found that more than one-third of participants reported no current use of any analgesic drug, a finding consistent with existing literature on untreated pain populations, often attributed to personal refusal to take analgesics or systemic healthcare supply deficits.[2,39,40] Conversely, 446 participants (63%) indicated current use of one or more of these drugs and were therefore exposed to at least one PGx actionable drug with strong evidence for clinically relevant DGIs.[15–18,20] Since all responses were self-reported by participants, there is a potential for inaccuracies, particularly regarding medication use. However, the questionnaire explicitly listed each PGx actionable substance along with its Swiss brand name to reduce ambiguity and minimizing the likelihood of recall bias.[41,42] The high prevalence of exposure across all four drug classes underscores that chronic pain patients represent a highly clinical relevant target population for PGx testing in Switzerland.

Around 17% of respondents reported NSAID monotherapy, making it the most commonly used single-drug regimen. This aligns with the established role of NSAIDs in managing pain conditions, where anti-inflammatory effects are central to pain relief (eg arthritis).[43] However, NSAIDs are not suitable for all types of chronic pain, particularly those without an inflammatory component, such as fibromyalgia.[44] Long-term NSAID use is also associated with moderate to severe ADRs, such as gastrointestinal bleeding, especially in older adults.[45] To prevent this, PPIs are commonly co-prescribed, which is also reflected in our data. Nevertheless, the high prevalence of PPI therapy without concurrent NSAID use might indicate potentially inappropriate long-term prescribing without clear indication,[46] which aligns with national prescribing data showing PPI as top eight of the most frequently prescribed therapeutic and pharmacological drug classes in 2023.[47] However, our data lacks information about other diagnoses or risk factors indicating PPI therapy. Our results also showed that more participants reported using PGx actionable opioids compared to PGx actionable co-analgesics. This finding contrasts with current chronic pain treatment guidelines that address neuropathic pain,[6,48] the most common pathophysiological type of chronic pain conditions.[1,49] These guidelines recommend TCAs and SNRIs as first-line therapies, while opioids are considered as second- or third-line option. This discrepancy could suggest that the chronic pain population in our cohort was more likely to be affected by nociceptive or mixed pain types, rather than neuropathic pain. Alternatively, it may reflect a broader systemic issue such as the persistence of outdated prescribing practices or a lack of adherence to current evidence-based guidelines. Indeed, existing literature has repeatedly reported persistent and obsolete prescribing behaviors in routine clinical practice, despite regular updates in best practice recommendations.[50–52]

In subgroup analyses, no statistically significant differences were found in therapy satisfaction when stratified by current drug regimen. However, certain trends were evident. Participants using co-analgesics in monotherapy reported the highest satisfaction rates (59%), closely followed by those treated with a combination of co-analgesics and NSAIDs

(56%). In addition, satisfaction decreased notably when opioids were added to a regimen. Participants currently using a combination of all three analgesic drug classes (ie opioids, NSAIDs, and co-analgesics) reported the highest dissatisfaction rate (71%). These findings may support the hypothesis that opioids were not appropriately used in our cohort and that the underlying pain mechanism may have required treatment in accordance with chronic pain guidelines addressing neuropathic pain origin. However, it is also possible that patients receiving guideline-conform monotherapy were adequately treated and satisfied, thus showing no need for opioid escalation. Conversely, opioids may have been used when non-opioid therapies were insufficient. Since we did not collect specific information on pain intensity, diagnoses, or disease duration, these interpretations remain speculative, as such confounders may have influenced both therapy choice and satisfaction. Especially, the absence of diagnostic data represents a key limitation of our study and introduces a potential case misclassification bias, limiting the ability to determine whether the observed medication pattern reflect inappropriate treatment decisions.[53,54] In addition, we did not collect information on pain intensity, which may further limit the interpretation of prescribing appropriateness.

Treatment Satisfaction and Feeling Taken Seriously

In the study we observed a treatment dissatisfaction rate of 33% and a rate of 28% of participants who felt not taken seriously by their HCPs. Reported treatment dissatisfaction rates among chronic pain patients in Europe range from 30–64%, placing our findings at the lower end of this range.[2,11,55] However, it is important to note that previous comparative studies were not conducted exclusively in Switzerland. The Swiss healthcare system is regarded as one of the most advanced in Europe in terms of access, continuity of care, and infrastructure.[56–58] Moreover, recent developments in Swiss pain centers include the integration of multimodal and interdisciplinary approaches (eg psychological support, physiotherapy, lifestyle counseling), which may have contributed to the relatively low patient dissatisfaction observed in our cohort.[9] It is also possible that our recruitment strategy involving pain-related organizations, support groups and specialized centers, attracted a particularly engaged population with high health literacy, who are proactive in managing their healthcare and may already benefit from individualized approaches to chronic pain management as mentioned above. By design, we included the DK response category, which was selected by 21% of participants and may have also influenced the overall satisfaction /dissatisfaction rate. On the one hand, the DK option allows respondents to express uncertainty or lack of opinion, thereby reducing the risk of forced or socially desirable responses.[59,60] On the other hand, studies have argued that such options may be overused by disengaged respondents, potentially lowering data quality.[61,62] However, we assume that participants who voluntarily engaged with the study (eg by scanning the QR code) demonstrate a certain level of interest and motivation. Therefore, we consider the inclusion of a DK category appropriate in our context. Furthermore, it should be noted that certain terms, such as "feeling taken seriously" were not explicitly defined, which may have introduced variability in how respondents interpreted and answered these questions.

Subgroup analysis revealed that older participants (≥ 65 years) were significantly more likely to report both therapy satisfaction and feeling taken seriously by their HCPs. This finding aligns with previous literature showing that older adults show greater psychological resilience, lower levels of pain catastrophizing, and higher acceptance of chronic pain as part of the aging process.[63,64] Despite the high proportion of female participants (82%), no significant associations were observed between sex and either therapy satisfaction or feeling taken seriously. This finding contrast with previous literature reporting sex-based differences in therapy satisfaction and care-seeking behavior.[65,66] We also did not find any significant differences based on education level. This indicates that neither sex nor education-related disparities may play a major role in chronic pain management within the Swiss healthcare context. However, the results of the subgroup analyses need to be interpreted with caution. This exploratory study was not designed for causal interpretations, and subgroup analyses may be underpowered.

Awareness and Biopsychosocial Implications of PGx Testing

Among the 724 participants, only 15 (2%) reported that a PGx test had ever been suggested to them, and 13 (1.8%) individuals reported having undergone such testing. This result aligns with expectations, as PGx testing has not yet been integrated into routine clinical practice in Switzerland. One possible reason for the low testing rate may be the limited accessibility and infrastructure for PGx testing. In addition, many HCPs lack training, experience, or confidence to

interpret and apply PGx results. Further implementation of PGx testing may also be hindered by limited reimbursement and the lack of integration into existing care models.[31,32]

In a previous national study, Wittwer et al used claims data from a large Swiss health insurance provider and showed that out of 894.748 individuals, only 817 (0.09%) received an ambulatory PGx test.[67] The slightly higher proportion observed in our study may be explained by the fact that we did not restrict our question to ambulatory testing, thus PGx tests performed in in-patient settings are also included. Additionally, some of the specialized hospital departments and medical pain specialists involved in the participants' recruitment already referred patients to another observational study from our research center ("Pharmacogenetic Testing of Patients with unwanted Adverse Drug Reactions or Therapy Failure"), in which PGx testing was conducted. Thus, we cannot exclude the possibility that some participants who had undergone PGx testing in that study also responded to the questionnaire in this study, even overestimating the number of PGx testing in the population.

Beyond actual testing behavior, 60% of respondents expressed interest in learning about their genetics, even if such information would not affect their analgesic therapy. This finding aligns with previous literature highlighting the psychological relevance of PGx. Studies have shown that understanding one's genetic profile can support patient empowerment, legitimize symptoms, and improve patient outcomes.[68–71] Unlike many other chronic diseases, chronic pain lacks clear biomedical markers and is therefore frequently perceived as imagined and illegitimate.[72] Notably, participants who expressed dissatisfaction with their therapy or felt not taken seriously by their HCPs also showed greater interest in learning their genetic pain predisposition. While our study did not assess reasons for dissatisfaction or feeling not being taken seriously, other studies showed that chronic pain patients reported that their symptoms were underestimated or doubted.[72–74] In this context, genetic information can serve as an important psychosocial function by offering patients a biologically grounded explanation for their pain perception and potentially inadequate analgesic treatment effects. Similar findings in psychiatric settings show that patients derive emotional benefit from understanding the biological basis of their symptoms, even when no therapy change results.[75,76] Although pain-specific biomarkers are not yet available in routine clinical practice, growing evidence suggests that genetic variants in *COMT, OPRM1*, and *CYP2D6* are associated with increased pain sensitivity and may be predictive for overall pain perception.[21,24–26] Such information may help reduce stigma among HCPs and provide emotional reassurance to patients.[77]

In subgroup analyses, sex and education level did not significantly influence patients' interest in genetic pain predisposition, while age did. Younger and middle-aged participants (18–64 years) were significantly more likely to express interest in learning about their genetic pain profile compared to older patients (≥ 65 years). This finding may reflect broader generational shifts toward patient-centered, digitally supported, and personalized approaches to healthcare.[78–80] Previous studies have shown that younger individuals are more likely to seek explanations for their health conditions and engage with tools such as genomics testing, decision aids, and personalized health applications.[81–84] These age-related differences highlight the need for targeted communication and structured information on genetic testing.[85,86] Tailored strategies may be required to ensure that both younger and older patients can engage with the concept of PGx, whether for therapy guidance or emotional reassurance. To conclude, we hypothesize that PGx has the potential to be not only a tool for pharmacological decision-making, improving patient safety and drug efficacy but also a source of psychological validation for patients and their HCPs.

Conclusion and Outlook

Our findings provide new insights into the medication patterns and perspectives of chronic pain patients within one of Europe's most advanced healthcare systems. To our knowledge, this is the first large-scale cross-sectional study in Switzerland that explored the intersection of chronic pain management, analgesic treatment and genetic susceptibility. In particular, the epidemiological overview of PGx-relevant pharmacotherapy in Swiss chronic pain patients adds valuable information to question current prescribing patterns and guideline adherence among Swiss HCPs. The high prevalence of PGx-actionable drug use, combined with a strong interest in genetic insights, especially among younger individuals who are dissatisfied with their therapy, highlights the multifaceted value of PGx in this target population. Beyond its role in optimizing drug safety and efficacy, PGx may also serve as a tool for validating patients' pain experiences, providing emotional reassurance and patient empowerment.

However, it is important to note that our findings are limited by the lack of diagnostic information such as pain type or underlying conditions, which restricts the clinical interpretation of medication use. Furthermore, while the interest in PGx testing was high, real-world access to such testing remains in general limited in Switzerland, and systemic barriers may still prevent its routine implementation in the future.

Further research should focus on prospective trials that assess the clinical utility of PGx-guided chronic pain management, as measured by patient-reported outcomes. Special attention should be directed to biopsychosocial dimensions, as the communicative and psychosocial impact of PGx may be comparably important as its pharmacological contribution.

Data Sharing Statement

The anonymized data set generated and analyzed during this study is not publicly available due to ethical considerations. Analysis codes and data can be made available by the corresponding author (a.bollinger@unibas.ch) upon reasonable request.

Ethics Statement

In accordance with article 22 of the Swiss Federal Act on data protection, formal ethics approval was not required, as all data were collected anonymously.

Informed Consent Statement

As the data were anonymized, no informed consent from participants was required, and the study was exempt from ethics committee approval. However, all participants received written information about the study at the beginning of the survey, including details about the use of their data for research purposes, as well as for publishing.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal Clinical Epidemiology; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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