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Factors Associated With Intermittent and Constant Pain Patterns in People With Gout: A Cross-Sectional Analysis

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Objective. Although gout is traditionally conceptualized as an episodic disease characterized by acute flares and symptom-free intercritical periods, some individuals report persistent joint pain that extends beyond flares. This cross-sectional analysis aimed to explore factors associated with self-reported pain patterns (constant vs intermittent) in people with gout.

Methods. This cross-sectional analysis was performed on data from 90 participants with physician-diagnosed gout who completed clinical assessments and patient-reported outcome measures. Pain patterns were classified using participant-selected validated graphical representations representing intermittent and constant pain patterns. Multivariable logistic regression was used to identify factors independently associated with constant pain. Model discrimination was assessed using the area under the receiver operating characteristic curve (ROC AUC).

Results. One-third of participants (34.4%) reported a constant pain pattern. The final regression model indicated that constant pain was independently associated with younger age of gout onset (adjusted odds ratio [aOR] 0.86, 95% confidence interval [CI] 0.79–0.93), greater activity limitation (aOR 5.75, 95% CI 1.43–23.01), and current co-existing anxiety or depression (aOR 9.21, 95% CI 1.39–60.91). The regression model demonstrated good discrimination between participants with constant and intermittent pain patterns with an ROC AUC of 0.82 (95% CI 0.73–0.91).

Conclusion. A substantial proportion of people with gout experience constant pain, which is linked to early disease onset, functional impairment, and mood disturbance. These hypothesis-generating findings suggest that the model of pain-free intercritical gout may not apply to all people with gout and may emphasize the need for tailored management strategies for people with gout.

INTRODUCTION

Gout is the most common form of inflammatory arthritis and has traditionally been conceptualized as an episodic disease, with acute flares of severe pain followed by intercritical periods with little or no symptoms, including pain.[1] However, recent research has suggested that this framework does not adequately capture the pain experiences of all people with gout.[2,3] A subset of people with gout experience persistent or even constant joint pain that extends beyond acute flares. In a study of 1,029 people with gout, 17.7% experienced ongoing joint pain four or more weeks following clinically resolved flares.[2] This persistent pain was associated with increased disease burden, including greater joint involvement, presence of tophi and bone erosions on ultrasonography, higher serum urate levels, and comorbid metabolic syndrome or hypertension.[2] Qualitative research has also shown that, in the absence of effective urate-lowering therapy (ULT), some people with long-standing gout develop constant symptoms, characterized by no relief from pain, progressive joint involvement, unpredictable and prolonged flares, and reduced efficacy of pain-relieving medications.[4]

Persistent pain in gout may arise from a combination of factors, including structural joint damage, ongoing low-grade inflammation,[5] and in some individuals, heightened pain perception.[3] In a cross-sectional study of 97 people with gout, 20.6%

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reported possible generalized pain hypersensitivity, characterized by widespread pain and allodynia.[3] Notably, these participants tended to be younger, were more likely to use colchicine or glucocorticoids rather than ULT, were more functionally impaired in social roles, and were more likely to have comorbid pain conditions (such as fibromyalgia), suggesting altered central nociceptive processing may contribute to the pain experience, rather than purely peripheral inflammatory mechanisms.[3]

Understanding factors associated with those with gout who experience constant pain is essential for optimizing care. By characterizing this subgroup, tailored therapeutic strategies can be developed that recognize that persistent pain in gout may necessitate approaches beyond conventional anti-inflammatory flares-only interventions. Therefore, this cross-sectional analysis aimed to explore factors associated with self-reported pain patterns (constant vs intermittent pain) in people with gout. Given the cross-sectional design, this analysis is intended to be hypothesis generating, with the goal of confirming that some people with gout experience constant, rather than intermittent, pain and identifying factors associated with constant pain to inform future prospective and mechanistic studies, rather than establish causal pathways.

METHODS

Study design. This study was a cross-sectional analysis of baseline data collected as part of a larger six-month prospective observational study exploring the temporal relationship between physical activity and gout flares (yet unpublished). In recognition of the high prevalence and burden of gout among Māori and Pacific Peoples in Aotearoa, New Zealand,[6] a Māori cultural adviser and academic (TK, Ngāti Porou and Ngāi Tahu) was involved to ensure cultural appropriateness of the original study design and procedures. A Māori patient research partner (KR, Ngā Puhi and Tai Poutini), with lived experience of gout, also contributed to the original study planning and data collection protocol, helping to ensure that the research was relevant and respectful and would benefit those most affected by the condition.

Participants. Participants were recruited through a combination of community-based advertising, primary care-based recruitment, and existing research databases of people with gout who had previously agreed to be contacted about future research. Participants were eligible for inclusion if they had a physician diagnosis of gout, were aged over 20 years, and had experienced at least two gout flares in the past six months. In this study, physician diagnosis referred to a self-reported previous diagnosis of gout made by a medical doctor in routine clinical care. People with other crystal arthritis or autoimmune inflammatory arthritis (such as rheumatoid arthritis or psoriatic arthritis) were excluded, as were those who were immobile, had other musculoskeletal or neurologic conditions (unrelated to gout) affecting function, or had cognitive impairment. All participants provided written informed consent before data collection. Ethical approval for the study was obtained from the Auckland University of Technology (AUT) Ethics Committee (AUTEC ref: 24/72).

Data collection. All participants attended a baseline visit at either the AUT North Campus (Northcote, Auckland, New Zealand) or AUT South Campus (Manukau, Auckland, New Zealand) between June 2024 and April 2025. Demographic and medical characteristics were recorded for all participants including age, sex, ethnicity, weight, height, gout disease duration, flare history, tophus count, medications, and self-reported physician-diagnosed comorbidities. Comorbidities referred to conditions that the participants reported currently having at the baseline assessment visit and included cardiovascular disease, type 2 diabetes, hypertension, high cholesterol, respiratory disease, sleep apnea, and anxiety or depression. Serum urate level was obtained using a point-of-care meter.[7] Participants were also asked to complete a number of questionnaires to capture patient-reported outcomes. Quality of life was assessed using the five-item EuroQol 5-dimension 5-level questionnaire (EQ-5D-5L), which captured difficulties with mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, as well as a scale from 0 to 100 in which participants were asked to rate their current health.[8] The New Zealand value set[9] was used to assign each participant with an EQ value ranging from 1 (full health) to 0 (equivalent to death). The 10-item Health Assessment Questionnaire-II (HAQ-II) was used to capture activity limitations across 10 daily activities.[10] Individual item scores were used to calculate a total continuous HAQ-II score for each participant, which ranged from 0.00 (no disability) to 3.00 (severe disability). To capture pain at rest due to gout, pain during activity due to gout, overall pain, and global assessment of disease activity (all during the past week), four numeric rating scales were used ranging from 0 (no pain) to 10 (extreme pain). Self-reported physical activity levels were captured using the International Physical Activity Questionnaire–Short Form, which contains seven questions related to time spent in vigorous and moderate activities, as well as time spent sitting.[11] Data were used to categorize a person as having a "low," "moderate," or "high" level of physical activity. The Brief Pittsburgh Sleep Quality Index (B-PSQI) was used to capture usual sleep habits, with total scores calculated to categorize a person as having "good" or "poor" sleep quality.[12] Finally, participants were presented with four graphs depicting pain patterns (Figure 1) and were asked to select which graph best represented the pain they had experienced due to their gout over the previous six months.[13] For the purpose of the analysis, participants selecting pattern A (pain attacks with no pain in between) were categorized as having an intermittent pain pattern, whereas those selecting B (constant pain daily), C (constant background pain with pain attacks), or D (severe constant

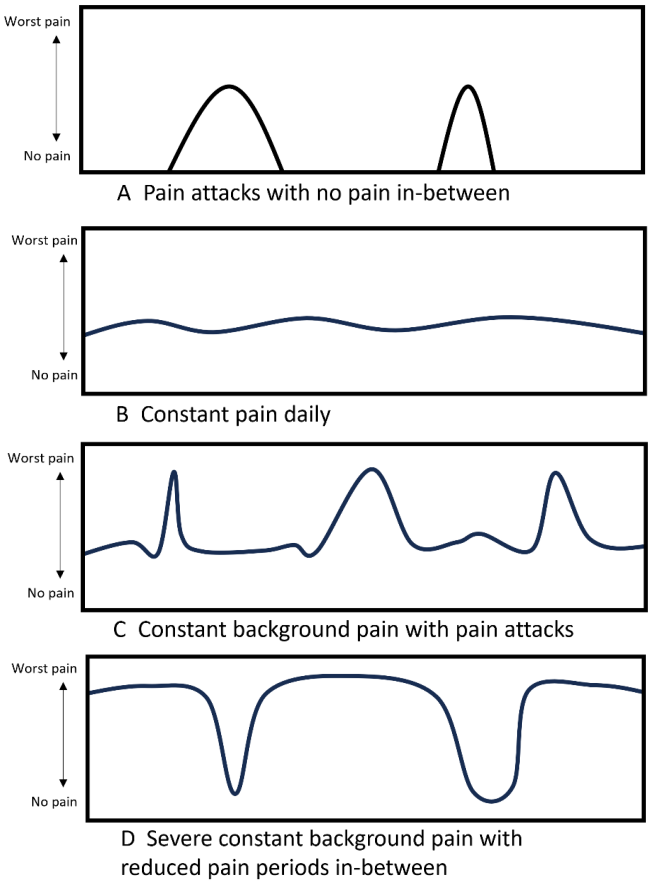

Figure 1. Pain patterns. Participants reporting pattern A were classified as having an intermittent pain pattern, whereas participants reporting patterns B, C, or D were classified as having a constant pain pattern.

background pain with reduced pain periods in between) were categorized as having a constant pain pattern. This dichotomous classification was adopted from previous work in chronic pancreatitis in which, relative to intermittent pain (pattern A), participants selecting constant pain (patterns B, C, or D) had greater pain spread, higher sensitivity to pain triggers, greater pain catastrophizing, and poorer quality of life.[13] In the current study, this symptom-based classification was used to capture the temporal pattern of gout pain rather than to infer a specific underlying pain mechanism. All 90 participants provided complete baseline data; therefore, no imputation or other missing-data procedures were required.

Statistical analysis. A multivariable binary logistic regression analysis was conducted using the *glm2* package[14] in RStudio (version 2025.05.0) to examine the association between participant characteristics (demographic, medical, and patient-reported outcomes) and pain pattern. Pain pattern, the dependent variable, was dichotomized as 0 = intermittent and 1 = constant. Before model construction, univariable screening analyses (eg, chi-square tests for categorical variables and independent samples *t*-tests [or nonparametric Mann-Whitney U tests] for continuous variables) were performed to compare participant characteristics between the intermittent and constant pain groups and to identify candidate predictors for multivariable modeling. For continuous variables, distributional assumptions were assessed using multiple approaches: skewness, excess kurtosis, Shapiro-Wilk test, histograms, and normal Q–Q plots. These checks informed whether parametric or nonparametric methods were to be applied in the univariable analyses. The results from the univariable analyses were used to identify candidate predictors of pain pattern at a significance level of $P < 0.25$. This threshold was selected to reduce the risk of excluding potentially important predictors too early and to allow for residual confounding in multivariable analysis.[15] Variables meeting this criterion, along with those deemed clinically or theoretically relevant, were considered for inclusion in the multivariable model. Multicollinearity among predictors during variable screening was assessed by examining pairwise correlation coefficients. Variables with correlations >0.80 were considered highly collinear, and in such cases, one of the correlated variables was excluded from the multivariable model based on theoretical relevance or clinical interpretability. No adjustment for multiple comparisons was applied in the univariable screening analyses, as statistical inference was based on the final multivariable model only. Final multivariable model selection was performed using a bidirectional approach via the R *step()* function, starting from a full model that included all candidate predictors. This procedure iteratively added and removed variables based on the Akaike information criterion, aiming to identify the most parsimonious model with optimal fit. This method was preferred because stepwise methods relying on *P* values are known to increase the risk of biased estimates, overfitting, and unstable variable inclusion due to their reliance on arbitrary statistical thresholds rather than theoretical or clinical relevance.[16] The absence of multicollinearity among predictors in the final model was confirmed using variance inflation factor and tolerance statistics via the *performance* package in R.[17] Model performance and stability were also evaluated using changes in −2 Log Likelihood, the Hosmer-Lemeshow goodness-of-fit test, and Nagelkerke R^2.

To reduce overfitting and ensure model stability, the final multivariable model was limited to approximately three predictors (events per predictor variable ≈ 10),[18,19] with the final number retained based on model performance.[20] The univariable analyses were used as screening procedures to examine associations between each independent variable and pain pattern and to identify candidate predictors for multivariable modeling. Descriptive statistics and *P* values are reported for these analyses. Adjusted odds ratios (aORs) along with their 95% confidence intervals (CIs) were reported for each predictor retained in the final multivariable logistic regression model. Model discrimination was assessed using the area under the receiver operating characteristic curve (ROC AUC) with 95% CIs (DeLong's method) via the

pROC package in R.[21] Statistical significance was set at $P < 0.05$ for all analyses. *P* values from univariable analyses were not adjusted for multiple comparisons, as these analyses were intended for variable screening rather than formal hypothesis testing.

RESULTS

Participant characteristics. Participant characteristics are summarized in Table 1. Participants ranged in age from 25 to 75 years, and all but one were male. The sample included individuals from diverse ethnic backgrounds, including 36% Asian, 37% European, 12% Māori, and 24% Pacific peoples. Mean (SD) gout disease duration was 10.8 (9.6) years, with participants reporting a mean (SD) number of gout flares in the past six months of 3.8 (3.4). Some participants also presented with current comorbid conditions, including obesity, hypertension, high cholesterol, and respiratory disease.

Pain patterns. An intermittent pain pattern (pattern A) was reported by 59 participants (65.6%). The remaining 31 participants (34.4%) reported constant pain patterns, with 6 (6.7%) experiencing constant pain daily (pattern B), 16 (17.8%) experiencing constant background pain with pain attacks (pattern C), and 9 (10.0%) experiencing severe constant background pain with reduced pain periods in between (pattern D).

Univariable analyses. In the univariable analyses, a longer gout disease duration, younger age at onset, greater serum urate level, current sleep apnea, current comorbid anxiety/depression, lower quality of life (EQ-5D-5L total index score), greater activity limitation (HAQ-II score), greater overall pain, greater patient global score, and worse quality of sleep (B-PSQI total score) were significantly associated with the constant pain pattern (Table 2). Other variables were not significantly associated with the pain pattern (all $P > 0.05$). Multicollinearity assessment identified a pairwise correlation between age and gout disease duration ($r = 0.87$); to reduce collinearity while retaining the clinical information from both variables, these predictors were replaced with age at onset (age minus gout disease duration) for consideration in the multivariable analysis.

Multivariable analysis. In the final multivariable model, younger age of gout onset (aOR 0.86, 95% CI 0.79–0.93, $P < 0.001$), greater activity limitation (aOR 5.75, 95% CI 1.43–23.01, $P = 0.013$), and current comorbid anxiety/depression (aOR 9.21, 95% CI 1.39–60.91, $P = 0.021$) remained independently associated with constant pain (Table 3). The final model with these three predictors demonstrated good fit (Hosmer-Lemeshow test, $P = 0.77$), explained 40.2% of the variance in pain patterns (Nagelkerke $R^2 = 0.402$), and had an ROC AUC of 0.817 (95% CI 0.728–0.905), indicating good discrimination

Table 1. Participant characteristics*

Characteristics	Values
N	90
Age, mean (SD), y	45.0 (11.3)
Sex, n (%)	
Female	1 (1.1)
Male	89 (98.9)
Ethnicity, n (%)	
Asian	32 (35.6)
European	33 (36.7)
Māori	11 (12.2)
Pacific peoples	22 (24.4)
Other	3 (3.3)
Body mass index, mean (SD), kg/m^2	33.0 (7.8)
Employed, n (%)	64 (71.1)
Full-time employment, n (%)	58 (64.4)
Physical/laborious work, n (%)	17 (18.9)
Gout disease duration, mean (SD), y	10.8 (9.6)
Age at onset, mean (SD), y	34.2 (11.0)
Number of gout flares in preceding 6 mo, mean (SD)	3.8 (3.4)
Subcutaneous tophi, n (%)	9 (10.0)
Serum urate, mean (SD), mmol/L	0.41 (0.12)
Urate-lowering therapy use, n (%)	56 (62.2)
Other medications, n (%)	
Colchicine	28 (31.1)
NSAIDs	32 (35.6)
Analgesics	7 (7.8)
Glucocorticoids	13 (14.4)
Antihypertensives	18 (20.0)
Lipid-lowering agents	13 (14.4)
Antidiabetics	8 (8.9)
Antiplatelets/anticoagulants	7 (7.8)
Diuretics	1 (1.1)
Current comorbidities, n (%)	
Cardiovascular disease	4 (4.4)
Type 2 diabetes	8 (8.9)
Hypertension	20 (22.2)
High cholesterol	16 (17.8)
Respiratory disease	11 (12.2)
Sleep apnea	3 (3.3)
Anxiety or depression	9 (10.0)
Obesity	53 (58.9)
EQ-5D-5L EQ value, mean (SD)	0.88 (0.15)
EQ-5D-5L VAS, mean (SD)	70.9 (19.8)
HAQ-II, mean (SD), range	0.30 (0.42), 0–3.00
Pain at rest (0–10), mean (SD)	1.39 (2.19)
Pain during activity (0–10), mean (SD)	1.72 (2.35)
Overall pain (0–10), mean (SD)	1.84 (2.07)
Patient global score (0–10), mean (SD)	1.94 (2.61)
IPAQ-SF, mean (SD), MET-min/wk	
Vigorous	1,592.4 (1,936.2)
Moderate	1,163.9 (1,188.6)
Walk	1,393.6 (1,385.3)
Total	4,149.9 (3,618.4)
IPAQ-SF, physical activity category, n (%)	
Low	13 (14.4)
Moderate	23 (25.6)
High	54 (60.0)
B-PSQI total (0–15), mean (SD)	6.4 (2.8)
B-PSQI category, n (%)	
Good quality sleep	37 (41.1)
Poor quality sleep	53 (58.9)

*EQ-5D-5L, EuroQol 5-dimension 5-level questionnaire; B-PSQI, Brief Pittsburgh Sleep Quality Instrument; EQ, EuroQol; HAQ-II, Health Assessment Questionnaire-II; IPAQ-SF, International Physical Activity Questionnaire–Short Form; MET, metabolic equivalent of task; NSAID, nonsteroidal anti-inflammatory drug; VAS, visual analog scale.

Table 2. Univariable associations between participant characteristics and pain pattern*

	Intermittent pain (n = 59)	Constant pain (n = 31)	*P* value[a]
Age mean (SD), y	46.3 (12.0)	42.5 (9.7)	0.133
Sex, n (%)			0.466
Female	1 (1.7)	0 (0.0)	
Male	58 (98.3)	31 (100.0)	
Ethnicity, n (%)			0.331
Asian	11 (18.6)	10 (32.3)	
European	26 (44.1)	7 (22.6)	
Māori	7 (11.9)	4 (12.9)	
Pacific peoples	13 (22.0)	9 (29.0)	
Other	2 (3.4)	1 (3.2)	
Body mass index, median (IQR), kg/m^2	31.0 (28.4–35.4)	37.8 (26.6–39.7)	0.715
Employed, n (%)	45 (76.3)	19 (61.3)	0.136
Full-time employment, n (%)	41 (69.5)	17 (89.5)	0.840
Physical/laborious work, n (%)	9 (20.0)	8 (42.1)	0.067
Gout disease duration, median (IQR), y	6.0 (2.25–11.5)	12.0 (8.0–19.5)	**0.001**
Age at onset, mean (SD), y	37.49 (11.22)	27.94 (7.47)	**<0.001**
6-mo flare history, mean (SD)	3.31 (1.44)	4.84 (5.31)	0.124
Serum urate, mean (SD), mmol/L	0.39 (0.12)	0.45 (0.13)	**0.050**
Subcutaneous tophi, n (%)	7 (11.9)	2 (6.5)	0.416
Urate-lowering therapy use, n (%)	34 (57.6)	22 (71.0)	0.215
Other medications, n (%)			
Colchicine	19 (32.2)	9 (29.0)	0.757
NSAIDs	17 (28.8)	15 (48.4)	0.065
Analgesics	3 (5.1)	4 (12.9)	0.188
Glucocorticoids	8 (13.6)	5 (16.1)	0.742
Antihypertensives	14 (23.7)	4 (12.9)	0.222
Lipid-lowering agents	10 (16.9)	3 (9.7)	0.351
Antidiabetics	5 (8.5)	3 (9.7)	0.849
Antiplatelets/anticoagulants	4 (6.8)	3 (9.7)	0.626
Diuretics	0 (0.0)	1 (3.2)	0.165
Current comorbidities, n (%)			
Cardiovascular disease	2 (3.4)	2 (6.5)	0.503
Type 2 diabetes	5 (8.5)	3 (9.7)	0.849
Hypertension	15 (25.4)	5 (16.1)	0.314
High cholesterol	11 (18.6)	5 (16.1)	0.767
Respiratory disease	7 (11.9)	4 (12.9)	0.886
Sleep apnea	0 (0.0)	3 (9.7)	**0.015**
Anxiety or depression	3 (5.1)	6 (19.4)	**0.032**
Obesity	36 (61.0)	17 (54.8)	0.571
EQ-5D-5L index, median (IQR)	0.95 (0.88–1.00)	0.84 (0.77–0.95)	**0.010**
EQ-5D-5L VAS, mean (SD)	72.98 (19.41)	66.90 (20.08)	0.169
HAQ-II, median (IQR)	0.00 (0–0.3)	0.20 (0–0.75)	**0.041**
Pain at rest (0–10), median (IQR)	0 (0–1.5)	1.0 (0–3)	0.107
Pain during activity (0–10), median (IQR)	0 (0–2.5)	1.0 (0–4)	0.156
Overall pain (0–10), median (IQR)	1 (0–2)	2.0 (1–4.5)	**0.003**
Patient global score (0–10), median (IQR)	0 (0–1.5)	2 (0–5)	**0.049**
IPAQ-SF, median (IQR), MET-min/wk			
Vigorous	1,080 (484–2,064)	792 (0–1,680)	0.182
Moderate	960 (120–1,572)	720 (60–2,160)	0.908
Moderate-vigorous	1,980 (1,140–3,824)	1,752 (720–3,720)	0.416
Walk	693 (363–1,881)	924 (495–2,376)	0.352
Total	3,132 (1,995–5,726)	3,534 (1,718–5,124)	1.000
IPAQ-SF, physical activity category, n (%)			0.769
Low	8 (13.6)	5 (16.1)	
Moderate	14 (23.7)	9 (29.0)	
High	37 (62.7)	17 (54.8)	
B-PSQI total (0–15), mean (SD)	6.02 (2.71)	7.26 (2.90)	**0.047**
Sleep efficiency, mean (SD), %	86.91 (10.54)	88.37 (15.11)	0.600
B-PSQI category, n (%)			0.216
Good quality sleep	27 (45.8)	10 (32.3)	
Poor quality sleep	32 (54.2)	21 (67.7)	

*EQ-5D-5L, EuroQol 5-dimension 5-level questionnaire; B-PSQI, Brief Pittsburgh Sleep Quality Instrument; HAQ-II, Health Assessment Questionnaire-II; IPAQ-SF, International Physical Activity Questionnaire–Short Form; IQR, interquartile range; MET, metabolic equivalent of task; NSAID, nonsteroidal anti-inflammatory drug; VAS, visual analog scale.
[a]Chi-square tests for categorical variables and independent samples *t*-tests (or Mann-Whitney U tests) for continuous variables. Bolded *P* values indicate statistical significance at $P < 0.05$.

Table 3. Multivariable logistic regression*

Variable	aOR	95% CI	*P* value
Age at onset (years)	0.86	0.79–0.93	**<0.001**
Activity limitation (HAQ-II)	5.75	1.43–23.01	**0.013**
Current comorbid anxiety/ depression	9.21	1.39–60.91	**0.021**

*Model fit: Hosmer-Lemeshow test, $P = 0.77$; Nagelkerke $R^2 = 0.402$; ROC AUC = 0.817 (95% CI 0.728–0.905). Bolded *P* values indicate statistical significance at $P < 0.05$. aOR, adjusted odds ratio; CI, confidence interval; HAQ-II, Health Assessment Questionnaire-II; ROC AUC, area under the receiver operating characteristic curve.

between participants with constant and intermittent pain. Due to the small number of participants with current comorbid anxiety/depression (n = 3 with intermittent pain vs 6 with constant pain), a sensitivity analysis was run without this variable included in the final model. This resulted in an R^2 of 0.337 and an AUC of 0.782 (95% CI 0.684–0.881), with estimates from the remaining predictors similar in magnitude (age at onset aOR 0.88; activity limitation aOR 4.19), suggesting the primary conclusions are robust to inclusion of this sparsely observed predictor.

DISCUSSION

In this cross-sectional study, one-third of people with gout reported a constant pain pattern, as opposed to the intermittent pain pattern that is typical of the episodic flaring nature of gout. Those who reported constant pain were more likely to have a younger age at onset, greater activity limitation, and current coexisting anxiety/depression.

People with younger onset gout experience more severe disease, including more severe hyperuricemia, higher flare frequency, polyarticular involvement, and earlier progression to chronic disease markers due to their longer lifetime exposure to recurrent flares and inflammation.[22] In addition, the ongoing monosodium urate (MSU) crystal deposition and low-grade intercritical inflammation that occurs in the absence of flares[5] may sustain nociceptive input. This prolonged inflammatory burden not only accelerates structural disease progression but may create conditions that favor persistent pain. Over time, repeated flares may induce recurrent peripheral sensitization[23] and potentially hyperalgesic priming[24] of joint nociceptors, with sustained nociceptive drive increasing the likelihood of ongoing central sensitization of nociceptive pathways[23] and the transition to a constant pain state.[25] Supporting this, persistent postflare pain has been linked to longer disease duration,[2] and generalized pain hypersensitivity has been observed more often in younger people with gout.[3] Compared with these previous gout cohorts, our sample was younger than the crystal-proven rheumatology outpatient sample (mean age 45.0 vs 68.9 years)[3] and was selected for recurrent recent flares, whereas the hospital-based study defined persistent pain as a visual analog scale ≥4 for more than four weeks after a flare and reported this in 17.7% of participants.[2] These differences in sample characteristics and pain definition may help explain why a relatively high proportion of participants in our study reported a constant pain pattern. Age-related sensory changes may further contribute: pain thresholds rise with age, whereas younger individuals have greater pain acuity and are more likely to perceive ongoing pain in the presence of low-grade inflammation.[26]

Previous research also supports the observed association between constant pain and greater activity limitation. Pain severity has been reported as the strongest independent predictor of baseline HAQ scores and future functional decline, even in those initially without limitation.[27] People with gout commonly report difficulty with mobility-related tasks such as walking, stair climbing, and outdoor work,[28,29] which aligns with measurable gait changes that are consistent with antalgic, pain-avoidance strategies.[30–32] These gait abnormalities persist even in the absence of flares and are strongly correlated with ongoing intercritical foot pain.[31] Persistent pain may reinforce these avoidance behaviors, leading to long-term activity limitation. Chronic pain processes are also known to sustain functional impairment and inactivity. Although the cross-sectional design used in our analysis prevents causal inference, constant pain likely drives functional impairment; however, a bidirectional relationship remains possible. For example, physical inactivity can heighten pain sensitivity, contribute to physical deconditioning, and impair pain coping mechanisms, further intensifying activity limitation and perpetuating a cycle of increased pain and functional impairment.[33]

Participants with a constant pain pattern had a significantly higher prevalence of current comorbid anxiety and depression. Depression and anxiety are common in people with gout and are associated with greater disease burden, lower health-related quality of life, and higher functional impairment.[34] When pain is constant, active coping strategies such as exercise become difficult, whereas passive coping (such as withdrawal or dependence) becomes more likely.[35] These strategies have been linked to worse psychological outcomes in people with rheumatoid arthritis.[35] In addition, comorbid anxiety/depression may intensify the pain experience and increase the likelihood of constant pain.[36,37] Similar bidirectional relationships between pain and mood have also been reported in other types of arthritis, in which depression and anxiety can further reduce treatment adherence and heighten pain perception.[37–40] Unlike intermittent pain, constant pain may be associated with functional and structural brain changes that amplify pain and disrupt mood regulation.[41] For example, in osteoarthritis, active brain regions associated with constant pain are largely distinct from those activated by evoked pain, with greater involvement of limbic regions.[41]

Taken together, these findings also show some interesting parallels with previous work on generalized pain hypersensitivity in gout.[3] In that study, 20.6% of crystal-proven rheumatology outpatients screened positive for possible generalized pain

hypersensitivity, with younger age and greater functional difficulties independently associated with this phenotype.[3] Similarly, in our study, younger age of gout onset and greater activity limitation were independently associated with a constant pain pattern. Although these outcomes reflect different constructs, the overlap suggests that a constant pain pattern may, in some patients, identify a subgroup in whom altered pain processing contributes to the pain experience.

However, this interpretation should remain cautious, because the pain-pattern graphs classify the temporal experience of pain, rather than directly identifying the underlying pain mechanism. A constant pain pattern in gout could plausibly reflect several processes, alone or in combination, including ongoing peripheral nociceptive input from structural joint damage or low-grade intercritical inflammation or nociplastic mechanisms. However, evidence from other conditions suggests that this temporal distinction is clinically meaningful. In chronic pancreatitis, the same graph-based dichotomization used in the present study differentiated patients with constant versus intermittent pain, with the constant pain group showing greater pain spread, higher sensitivity to pain triggers, greater catastrophizing, and poorer quality of life.[13] Similar concepts have also been described in osteoarthritis, in which patients distinguish intermittent from constant pain as qualitatively different pain experiences[42] and in which temporal pain patterns and the unpredictability of pain have been associated with quantitative sensory testing measures of pain facilitation (pressure pain thresholds, temporal summation) and inhibition (conditioned pain modulation).[25] Taken together, this cross condition evidence supports the interpretation of constant pain in gout as a clinically meaningful, higher-burden pain phenotype, whereas the heterogeneity of mechanisms implicated across conditions cautions against treating it as a direct indicator of any single pain process.

Although median self-reported pain intensity was low in this study, this likely reflects the fluctuating nature of gout pain and the fact that pain intensity was captured at a single baseline time point, whereas the pain-pattern graphs reflected the broader temporal experience of pain over the preceding six months. Also, pain intensity alone may not fully capture the impact of pain on daily life, particularly when pain is constant or unpredictable. Constant background pain and unpredictability of painful gout flares may be more distressing and activity-limiting than episodic pain alone, even when average intensity is modest.

This study underscores the potential multifactorial nature of constant pain in people with gout and highlights key considerations for management. Treating to serum urate target as recommended in the American College of Rheumatology and EULAR gout management guidelines remains foundational to reduce MSU crystal load and gout flare frequency,[43] which may also lessen ongoing nociceptive drive. Individuals with early onset gout and constant pain may benefit from earlier, more intensive ULT and closer monitoring to prevent structural damage and the progression of pain.[44] These findings are particularly relevant for Māori and Pacific peoples who not only experience high prevalence of gout[6] but also early onset of gout with frequent flares and major physical impairment.[45–47] This underscores the importance of culturally safe and equitable management, including codesigned interventions with Māori and Pacific communities.[48,49] A broader multimodal treatment approach for those whose pain persists despite adequate inflammatory control may also be appropriate. In such cases, conventional flare-focused strategies may be insufficient.

Several additional variables, including gout disease duration, serum urate, and sleep apnea, also showed associations with the constant pain pattern in the univariable screening analyses. Although these findings should be interpreted cautiously because they were not retained in the final multivariable model, they may still represent clinically meaningful predictors for investigation in larger prospective studies. Future research may also explore stratified care approaches that combine treat-to-target urate strategies with individualized, multimodal interventions including lifestyle modification, advice around physical activity maintenance, cognitive behavioral therapies, and, where appropriate, centrally acting analgesics to evaluate the effectiveness of these approaches compared to conventional flare-focused management.[33,50] Intercritical markers of inflammation (such as C-reactive protein), imaging to quantify osseous or tophaceous damage, and quantitative sensory testing were not measured in this study. Prospective longitudinal studies incorporating these measures are therefore warranted to clarify the relative contributions of low-grade inflammation, MSU deposition, structural joint damage, and central sensitization to persistent pain in gout. By distinguishing subgroups with predominantly inflammatory/structural pain from those with more prominent pain-sensitization features, future work could inform stratified care models in which patients with ongoing inflammatory or structural drivers are prioritized for tighter urate-lowering and anti-inflammatory strategies, whereas those with prominent pain-sensitization features may benefit from additional multimodal pain management approaches.

This study has some methodologic limitations. The cross-sectional design precludes causal inference, limiting the ability to determine the directionality of observed associations between pain patterns and other factors. The relatively small sample size of the constant pain subgroup may reduce statistical power and precision of effect estimates, reflected by the wide CIs for some associations. Eligibility was based on a self-reported prior physician diagnosis of gout made in routine clinical care, and crystal identification or formal classification criteria were not independently verified by the study team. Although this approach reflects real-world clinical practice, it may have introduced some diagnostic uncertainty. Furthermore, our inclusion criteria requiring two or more flares in past six months likely enriched for active disease and may not represent people with well-controlled gout. This may overestimate the prevalence of constant pain compared to

community-based samples of people living with gout. Reliance on self-reported measures, including pain-pattern classification via graphical selection, may introduce potential for recall and misclassification bias. Although the dichotomous pain-pattern classification adopted has face validity and has been used to meaningfully discriminate different pain phenotypes in other chronic pain conditions,[13] it is not a direct measure of pain mechanism, and it has not been formally validated in gout against criterion standards such as daily pain diaries or other temporal measures of pain such as the Measure of Intermittent and Constant Osteoarthritis Pain.[42] The small sample size and data availability in the current study also limited investigation of whether the three constant pain patterns (B, C, D) reflect distinct clinical states in gout, but future research in larger samples may wish to explore this further. Finally, the sample was also overwhelmingly male, limiting generalizability to women, including potential sex-specific differences in pain perception.

In conclusion, this analysis highlights that over one third of people with gout experience constant pain, which is associated with younger age at onset, greater activity limitation, and current co-existing anxiety or depression, suggesting a higher disease burden. Although most participants reported an intermittent pattern consistent with pain-free intercritical gout, these findings indicate that this model may not fully capture the pain experience of all people with gout and supports the need for tailored, multimodal management approaches for those with more persistent pain.

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AUTHOR CONTRIBUTIONS

All authors contributed to at least one of the following manuscript preparation roles: conceptualization AND/OR methodology, software, investigation, formal analysis, data curation, visualization, and validation AND drafting or reviewing/editing the final draft. As corresponding author, Dr Stewart confirms that all authors have provided the final approval of the version to be published and takes responsibility for the affirmations regarding article submission (eg, not under consideration by another journal), the integrity of the data presented, and the statements regarding compliance with institutional review board/Declaration of Helsinki requirements.

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