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Original Article

Musculoskeletal Pain and Inflammatory Bowel Disease Activity Among Adults in Karachi: A Cross-Sectional Study

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ABSTRACT

Background: Musculoskeletal pain is a common extraintestinal problem among individuals with inflammatory bowel disease (IBD), but its distribution and relationship with demographic and disease-related characteristics remain incompletely characterized. Objective: To determine the burden and distribution of musculoskeletal pain among individuals with IBD in Karachi and examine its relationship with age, sex, occupation, and IBD-related activity categories. Methods: This cross-sectional study included 233 consecutively recruited participants from gastroenterology and general-practice clinics in Karachi between February and July 2025. Musculoskeletal symptoms were assessed using the Standardised Nordic Musculoskeletal Questionnaire, while IBD-related clinical activity was assessed using Harvey-Bradshaw Index (HBI)- and Simple Clinical Colitis Activity Index (SCCAI)-derived categories. Descriptive statistics and Pearson chi-square tests were applied, with statistical significance defined as $p<0.05$. Results: Of 233 participants, 178 (76.4%) were female and 147 (63.1%) were aged 21–30 years. Lower-back pain was the most frequently reported regional symptom during both the preceding 12 months (85.8%) and 7 days (80.3%). Based on the study-derived musculoskeletal pain categories, 48 participants (20.6%) had low pain, 134 (57.5%) moderate pain, and 51 (21.9%) high pain. HBI-derived categories comprised 129 participants (55.4%) in remission, 53 (22.7%) with mild activity, and 51 (21.9%) with moderate activity, whereas SCCAI-derived categories comprised 87 (37.3%) in remission, 74 (31.8%) with mild activity, 58 (24.9%) with moderate activity, and 14 (6.0%) with severe activity. Despite descriptive concentration of higher symptom categories among younger participants and women, no statistically significant associations were observed between age, occupation, or sex and musculoskeletal pain, HBI-derived activity, or SCCAI-derived activity; all corresponding chi-square tests yielded $p>0.05$. Conclusion: Musculoskeletal symptoms were common in this clinical sample of individuals with IBD, particularly involving the lower back, knees, neck, and shoulders. However, demographic characteristics were not significantly associated with musculoskeletal pain or the reported IBD-activity categories. These findings support systematic musculoskeletal assessment in IBD while emphasizing that descriptive subgroup differences should not be interpreted as independent demographic associations without appropriate statistical evidence. Keywords: Inflammatory Bowel Disease; Musculoskeletal Pain; Nordic Musculoskeletal Questionnaire; Crohn Disease; Ulcerative Colitis; Cross-Sectional Study

INTRODUCTION

Inflammatory bowel disease (IBD), principally comprising Crohn's disease and ulcerative colitis, is characterized by chronic relapsing inflammation of the gastrointestinal tract and may be accompanied

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by manifestations involving multiple extraintestinal systems. Musculoskeletal involvement represents one of the most frequently reported extraintestinal manifestations of IBD and includes inflammatory and non-inflammatory disorders affecting joints, bone, muscle, and periarticular structures (1,2). The musculoskeletal burden of IBD is multifactorial and may reflect persistent systemic inflammation, nutritional deficiencies, reduced physical activity, corticosteroid exposure, altered bone metabolism, and other disease- or treatment-related factors (2).

Pain constitutes an important component of this musculoskeletal burden. Musculoskeletal and abdominal pain are among the most frequently reported pain complaints in people with IBD, and previous work has demonstrated substantial heterogeneity in pain location, intensity, interference, and clinical presentation (3). In ulcerative colitis, chronic musculoskeletal pain has been reported more frequently than in population controls and has shown a relationship with greater intestinal disease activity, particularly for pain affecting the lower back and hip regions (4). These findings indicate that musculoskeletal symptoms in IBD cannot be interpreted solely as structural joint disease and may vary according to intestinal disease activity, comorbidity, pain processing, and other individual characteristics (3,4).

The heterogeneity of musculoskeletal pain is particularly important because different pain mechanisms may coexist in IBD. Falling et al. identified three clinically distinct musculoskeletal pain profiles characterized as mixed-mechanism, central-mechanism, and regional/remission profiles, demonstrating that conventional demographic and IBD characteristics alone did not adequately explain subgroup membership (3). Subsequent studies have provided evidence of increased central sensitization symptomatology and altered pain-processing characteristics in patients with IBD, particularly among those with persistent musculoskeletal pain (5,6). These observations support a multidimensional assessment of musculoskeletal pain rather than classification based exclusively on anatomical location or intestinal disease activity.

IBD-associated musculoskeletal manifestations may additionally include peripheral arthritis, axial symptoms, enthesitis, dactylitis, osteoporosis, and fibromyalgia-like presentations. International data demonstrate that peripheral musculoskeletal manifestations occur across the spectrum of spondyloarthritis and may involve peripheral joints, entheses, digits, hips, and shoulders (7). In patients with IBD presenting with musculoskeletal pain, fibromyalgia and spondyloarthritis may also coexist or present with overlapping clinical features, emphasizing the need to distinguish inflammatory, regional, and centrally mediated pain presentations (8). Such heterogeneity has implications for clinical assessment because management directed exclusively toward intestinal inflammation may not adequately address the complete musculoskeletal pain experience.

Potential biological connections between intestinal and musculoskeletal disease have also received increasing attention. Alterations in intestinal microbial communities and systemic immune signaling have been associated with inflammatory arthritis in IBD, including reported differences in bacterial taxa among individuals with concomitant arthritis (9). These observations provide biological plausibility for a gut–musculoskeletal relationship; however, microbiome characteristics cannot be inferred from musculoskeletal symptoms alone and require direct microbiological assessment. Accordingly, microbiome-related mechanisms provide background context rather than a measured exposure in the present investigation.

Musculoskeletal complaints also have important implications for health-related quality of life. Recent evidence from patients with Crohn's disease and ulcerative colitis indicates that joint complaints are associated with poorer quality of life, reinforcing the clinical importance of identifying patients with substantial musculoskeletal symptom burden (10). Nevertheless, locally generated evidence describing the distribution of musculoskeletal pain among individuals with IBD in Karachi remains limited. Characterizing musculoskeletal pain together with demographic characteristics and IBD-related

symptom/activity measures may therefore help define the clinical burden within this population and provide a foundation for more targeted assessment and rehabilitation.

The objective of this study was to characterize the burden and distribution of musculoskeletal pain among individuals with IBD attending clinical settings in Karachi and to examine its distribution according to age, sex, occupation, and IBD-related symptom/activity categories. The study further evaluated whether these demographic characteristics were statistically associated with musculoskeletal pain and the reported disease-activity classifications.

MATERIALS AND METHODS

This cross-sectional study was conducted among individuals with inflammatory bowel disease attending gastroenterology and general-practice clinics in Karachi, Pakistan, between February and July 2025. The investigation assessed musculoskeletal symptoms together with demographic characteristics and IBD-related clinical activity measures. Participants were recruited using non-probability consecutive sampling during the defined study period.

The required sample size was calculated using OpenEpi for estimation of a population frequency. The calculation assumed a population size of 1,000,000, an anticipated frequency of 68%, an absolute precision of 6%, a 95% confidence level, and a design effect of 1, resulting in a minimum required sample of 233 participants. The anticipated frequency was consistent with the proportion of participants reporting musculoskeletal pain in previous work examining musculoskeletal pain profiles in IBD (3). A total of 233 participants were included in the analysis.

Eligible participants were adults with a diagnosis of IBD who were willing and able to provide informed consent. The stated eligibility age range was 18–65 years. Participants were excluded if they had an autoimmune disease unrelated to the gastrointestinal condition under investigation, were pregnant or lactating, were receiving treatment for an acute infection, or had cognitive impairment that prevented completion of the study questionnaire. Consecutive eligible patients meeting the study criteria were approached during recruitment at the participating clinical settings.

Data were obtained using a structured survey that recorded demographic characteristics and standardized symptom measures. Demographic variables included age, sex, and occupation. Age was subsequently analyzed in the categories below 20, 21–30, 31–40, 41–50, and above 50 years. Occupation was categorized as housewife, job-holder, or student. Comorbidities specified in the study framework included osteoarthritis, osteoporosis, depression, anxiety, and chronic fatigue syndrome.

Musculoskeletal symptoms were assessed using items from the Standardised Nordic Musculoskeletal Questionnaire. The Nordic questionnaire was developed for standardized assessment of musculoskeletal symptoms across defined anatomical regions and includes questions concerning symptoms during specified recall periods and their consequences for usual activities (11). The present study recorded musculoskeletal symptoms involving the neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet over the preceding 12 months and 7 days. The study dataset additionally contained a derived musculoskeletal pain classification comprising low, moderate, and high pain categories.

IBD-related clinical activity was evaluated using the Harvey-Bradshaw Index (HBI) and the Simple Clinical Colitis Activity Index (SCCAI). The HBI is an established clinical index for assessing Crohn's disease activity and includes general well-being, abdominal pain, stool frequency, abdominal mass, and complications (12). The SCCAI is a clinical symptom index developed for ulcerative colitis and incorporates daytime and nocturnal bowel frequency, urgency of defecation, blood in stool, general well-being, and extra-colonic features (13). In the analytical dataset, HBI-derived observations were classified as remission, mild, or moderate activity, whereas SCCAI-derived observations were classified as remission, mild, moderate, or severe activity.

Data were analyzed using IBM SPSS Statistics version 26.0. Categorical variables were summarized as frequencies and percentages. The prevalence of musculoskeletal symptoms was calculated separately for each anatomical region and recall period. Cross-tabulations were constructed to describe the distribution of musculoskeletal pain categories, HBI-derived activity categories, and SCCAI-derived activity categories according to age group, sex, and occupation.

Associations between demographic characteristics and the three principal categorical outcomes were evaluated using Pearson's chi-square test. For each comparison, the null hypothesis specified no association between the demographic characteristic and the respective outcome. Statistical significance was defined as a two-sided p value <0.05. Degrees of freedom were determined from the dimensions of each contingency table. Cramér's V was calculated from the reported Pearson chi-square statistics and sample size to provide a standardized measure of association strength. Internal consistency values available from the study output were summarized using Cronbach's alpha for the NMQ, HBI, and SCCAI.

RESULTS

A total of 233 participants were included in the analysis, with complete observations reported for the principal demographic and categorical outcome variables. The sample was predominantly female, with 178 women (76.4%) and 55 men (23.6%). The largest age group was 21–30 years, comprising 147 participants (63.1%), followed by 31–40 years (18.0%), 41–50 years (8.6%), above 50 years (5.6%), and below 20 years (4.7%). Students constituted 36.5% of the sample, whereas housewives and job-holders each constituted 31.8%.

Table 1. Demographic characteristics of the study population (N = 233)

Characteristic	n	%
Age group, years		
Below 20	11	4.7
21–30	147	63.1
31–40	42	18.0
41–50	20	8.6
Above 50	13	5.6
Sex		
Female	178	76.4
Male	55	23.6
Occupation		
Housewife	74	31.8
Job-holder	74	31.8
Student	85	36.5

Regional Musculoskeletal Symptoms

Musculoskeletal symptoms were common across several anatomical regions. During the preceding 12 months, lower-back pain was the most frequently reported regional symptom, affecting 200 participants (85.8%). Neck and shoulder symptoms were each reported by 164 participants (70.4%), followed by knee symptoms in 146 (62.7%), ankle symptoms in 136 (58.4%), upper-back symptoms in 106 (45.5%), hip/thigh symptoms in 96 (41.2%), wrist symptoms in 90 (38.6%), and elbow symptoms in 55 (23.6%).

Table 2. Regional musculoskeletal symptoms during the preceding 12 months and 7 days

Anatomical region	12-month symptoms, n (%)	7-day symptoms, n (%)
Neck	164 (70.4)	138 (59.2)
Shoulder	164 (70.4)	139 (59.7)
Elbow	55 (23.6)	74 (31.8)
Wrist/hand	90 (38.6)	80 (34.3)
Upper back	106 (45.5)	101 (43.3)
Lower back	200 (85.8)	187 (80.3)
Hip/thigh	96 (41.2)	105 (45.1)
Knee	146 (62.7)	161 (69.1)
Ankle/foot	136 (58.4)	136 (58.4)

Musculoskeletal Pain and IBD-Related Activity Categories

A similar anatomical pattern was observed for symptoms during the preceding 7 days. Lower-back pain remained the most common complaint, affecting 187 participants (80.3%), followed by knee pain in 161 (69.1%), shoulder pain in 139 (59.7%), neck pain in 138 (59.2%), ankle pain in 136 (58.4%), hip/thigh pain in 105 (45.1%), upper-back pain in 101 (43.3%), wrist pain in 80 (34.3%), and elbow pain in 74 (31.8%). Based on the derived musculoskeletal pain classification, 48 participants (20.6%) were categorized as having low pain, 134 (57.5%) as having moderate pain, and 51 (21.9%) as having high pain. Thus, 185 of 233 participants (79.4%) were classified in the moderate- or high-pain categories.

For the HBI-derived classification, 129 participants (55.4%) were categorized as being in remission, 53 (22.7%) as having mild activity, and 51 (21.9%) as having moderate activity. For the SCCAI-derived classification, 87 participants (37.3%) were categorized as being in remission, 74 (31.8%) as having mild activity, 58 (24.9%) as having moderate activity, and 14 (6.0%) as having severe activity.

Table 3. Distribution of musculoskeletal pain and IBD-related activity categories

Outcome	Category	n	%
Musculoskeletal pain	Low	48	20.6
	Moderate	134	57.5
	High	51	21.9
HBI-derived activity	Remission	129	55.4
	Mild	53	22.7
	Moderate	51	21.9
SCCAI-derived activity	Remission	87	37.3
	Mild	74	31.8
	Moderate	58	24.9
	Severe	14	6.0

Distribution of Higher Symptom Categories

Among the 51 participants classified in the high musculoskeletal pain category, 28 (54.9%) were aged 21–30 years, 11 (21.6%) were aged 31–40 years, six (11.8%) were aged 41–50 years, four (7.8%) were above 50 years, and two (3.9%) were below 20 years. Women accounted for 38 of the 51 high-pain observations (74.5%), while men accounted for 13 (25.5%). By occupation, 20 participants with high pain were job-holders (39.2%), 16 were students (31.4%), and 15 were housewives (29.4%).

Among the 51 participants in the moderate HBI-derived category, 30 (58.8%) were aged 21–30 years. Nine (17.6%) were aged 31–40 years, five (9.8%) were aged 41–50 years, four (7.8%) were above 50 years, and three (5.9%) were below 20 years. Forty-one participants (80.4%) were female and 10 (19.6%) were male. Each occupational category contributed 17 participants (33.3%) to the moderate HBI-derived group.

Seventy-two participants were classified as having moderate or severe SCCAI-derived activity. Of these, 42 (58.3%) were aged 21–30 years, 15 (20.8%) were aged 31–40 years, eight (11.1%) were aged 41–50 years, four (5.6%) were above 50 years, and three (4.2%) were below 20 years. Women accounted for 57 of these 72 observations (79.2%) and men for 15 (20.8%). Job-holders comprised 26 participants (36.1%), housewives 25 (34.7%), and students 21 (29.2%).

These descriptive distributions were strongly influenced by the composition of the overall sample, which itself contained a predominance of participants aged 21–30 years and women. Consequently, differences in raw counts were evaluated using formal contingency-table analyses rather than interpreted independently as evidence of demographic associations.

Association Analyses

Pearson chi-square analyses provided no evidence of statistically significant associations between age, occupation, or sex and any of the three categorical outcomes at the prespecified $\alpha = 0.05$ threshold. Age

was not associated with HBI-derived activity, $\chi^2(8) = 8.952$, $p = 0.346$, Cramér's V = 0.139; SCCAI-derived activity, $\chi^2(12) = 8.191$, $p = 0.770$, Cramér's V = 0.108; or musculoskeletal pain category, $\chi^2(8) = 7.645$, $p = 0.469$, Cramér's V = 0.128.

Occupation was likewise not associated with HBI-derived activity, $\chi^2(4) = 4.188$, $p = 0.381$, Cramér's V = 0.095; SCCAI-derived activity, $\chi^2(6) = 5.936$, $p = 0.430$, Cramér's V = 0.092; or musculoskeletal pain category, $\chi^2(4) = 2.687$, $p = 0.612$, Cramér's V = 0.076. No statistically significant associations were found for sex with HBI-derived activity, $\chi^2(2) = 0.697$, $p = 0.706$, Cramér's V = 0.055; SCCAI-derived activity, $\chi^2(3) = 0.910$, $p = 0.823$, Cramér's V = 0.062; or musculoskeletal pain category, $\chi^2(2) = 0.130$, $p = 0.937$, Cramér's V = 0.024. The corresponding effect-size estimates were small throughout.

Table 4. Associations of demographic characteristics with musculoskeletal pain and IBD-related activity categories

Predictor	Outcome	Pearson χ^2	df	p value	Cramér's V
Age group	HBI-derived activity	8.952	8	0.346	0.139
Age group	SCCAI-derived activity	8.191	12	0.770	0.108
Age group	Musculoskeletal pain	7.645	8	0.469	0.128
Occupation	HBI-derived activity	4.188	4	0.381	0.095
Occupation	SCCAI-derived activity	5.936	6	0.430	0.092
Occupation	Musculoskeletal pain	2.687	4	0.612	0.076
Sex	HBI-derived activity	0.697	2	0.706	0.055
Sex	SCCAI-derived activity	0.910	3	0.823	0.062
Sex	Musculoskeletal pain	0.130	2	0.937	0.024

All tests were two-sided. Statistical significance was defined as $p < 0.05$. Cramér's V values were derived from the reported Pearson chi-square statistics and N = 233.

Internal Consistency

The available reliability analysis included all 233 participants. Cronbach's alpha was 0.86 for the 27 NMQ items, 0.76 for the five HBI components, and 0.89 for the six SCCAI components. These estimates indicated acceptable-to-high internal consistency within the reported item sets. The originally calculated combined coefficient across all 38 items was not used as an overall measure of a single construct because the three instruments assess conceptually different domains.

DISCUSSION

The present study demonstrates a substantial burden of musculoskeletal symptoms among individuals with IBD attending clinical settings in Karachi. Lower-back pain was the most frequently reported regional symptom over both the 12-month and 7-day recall periods, while symptoms affecting the neck, shoulders, knees, ankles, hips, and upper back were also common. In the study-derived overall pain categorization, 79.4% of participants were classified as having moderate or high musculoskeletal pain. These findings are consistent with the broader recognition that musculoskeletal manifestations constitute an important component of the extraintestinal burden of IBD and may encompass inflammatory articular disease as well as non-inflammatory pain, reduced bone health, and muscle-related morbidity (1,2). Population-based and clinical investigations have similarly demonstrated substantial musculoskeletal involvement among patients with IBD, although prevalence estimates vary according to case definitions, disease characteristics, and the musculoskeletal outcomes assessed (1,14).

The high frequency of lower-back pain in the present sample is clinically relevant because axial symptoms represent an established component of the musculoskeletal spectrum associated with IBD. Musculoskeletal involvement may range from nonspecific regional pain to inflammatory back pain, sacroiliitis, spondyloarthritis, peripheral arthritis, enthesitis, and other rheumatological manifestations (1,7,15). Nevertheless, symptom questionnaires alone cannot establish whether reported regional pain represents inflammatory spondyloarthritis, mechanical pain, central pain amplification, or another musculoskeletal disorder. The present results therefore describe symptom burden rather than provide rheumatological diagnoses. This distinction is particularly important because previous studies have

shown that patients with IBD may demonstrate overlapping inflammatory and non-inflammatory musculoskeletal presentations (7,8,15).

The current findings also reinforce the heterogeneous nature of musculoskeletal pain in IBD. Falling et al. demonstrated through latent class analysis that musculoskeletal pain in IBD could be separated into mixed-mechanism, central-mechanism, and regional/remission profiles and reported that comorbidity burden was more informative for subgroup membership than conventional demographic or IBD characteristics (3). Additional work has shown that patients with IBD and persistent musculoskeletal pain may exhibit greater symptoms associated with central sensitization and altered pain processing compared with IBD patients without musculoskeletal pain and healthy controls (5,6). The present investigation did not perform the latent-class analysis required to reproduce those mechanism-based profiles; accordingly, the low, moderate, and high pain categories observed here should be interpreted as study-derived symptom-severity categories rather than equivalent to the three mechanistic profiles described by Falling et al. (3).

Although higher absolute numbers of participants with severe symptom categories were observed among women and individuals aged 21–30 years, these distributions reflected, in part, the demographic composition of the overall sample. Formal analyses found no significant association between age and musculoskeletal pain ($p=0.469$), occupation and musculoskeletal pain ($p=0.612$), or sex and musculoskeletal pain ($p=0.937$). Similar null associations were observed for demographic variables in relation to HBI- and SCCAI-derived activity classifications. These findings correct the initial interpretation based solely on subgroup counts and indicate that the study provides no statistical evidence that age, sex, or occupation independently differentiated the categorical outcomes examined. The results are broadly compatible with previous evidence showing that demographic features alone may be insufficient to explain heterogeneous musculoskeletal pain experiences in IBD (3). Occupational exposures can contribute to musculoskeletal symptoms in other populations, but such relationships are context dependent and cannot be inferred from descriptive occupational differences alone (16).

The disease-activity findings require equally cautious interpretation. More than half of the HBI-derived observations were classified as remission, while SCCAI-derived classifications showed a wider distribution from remission to severe activity. Previous research in ulcerative colitis has shown that greater disease activity may accompany a greater burden of chronic musculoskeletal pain (4), while other studies demonstrate that musculoskeletal manifestations may either parallel intestinal activity or follow a clinical course that is partly independent of bowel inflammation (1,15). The absence of significant demographic associations with HBI- or SCCAI-derived activity in the present study therefore does not imply that intestinal disease activity is unrelated to pain; rather, the analyses performed here do not establish demographic determinants of either outcome.

Interpretation of the HBI and SCCAI findings must also respect their disease-specific purposes. HBI is used to assess Crohn's disease activity, whereas SCCAI was developed for ulcerative colitis (12,13). Consequently, disease-activity estimates are most clinically informative when aligned with the corresponding IBD subtype. Lack of subtype-stratified presentation limits the extent to which the current HBI- and SCCAI-derived distributions can characterize disease activity within Crohn's disease and ulcerative colitis separately. This issue is particularly important because both diseases fall under the IBD spectrum but differ in anatomical involvement, clinical course, and activity assessment.

The relationship between intestinal disease and musculoskeletal symptoms is biologically plausible but multifactorial. Chronic inflammatory signaling, immune dysregulation, nutritional deficits, corticosteroid exposure, reduced physical activity, and disturbances in bone and muscle regulatory pathways may contribute to musculoskeletal morbidity in IBD (2). Interest has also grown in the gut–musculoskeletal axis, with studies reporting associations between intestinal microbial characteristics and arthritis and broader reviews proposing potential microbiome-mediated effects on musculoskeletal health (9,17,18). However, the present study did not assess gut microbiota, microbial metabolites,

inflammatory biomarkers, or related molecular pathways. Its results therefore cannot establish microbial dysbiosis as a mechanism for the observed musculoskeletal symptoms, and such pathways should be regarded as hypotheses for future mechanistic investigation rather than conclusions of the current study.

Non-inflammatory and centrally mediated pain conditions should also remain part of the clinical differential when evaluating musculoskeletal complaints in IBD. Fibromyalgia and chronic widespread pain have been investigated in IBD populations, and clinical studies demonstrate that fibromyalgia may coexist with spondyloarthritis or mimic inflammatory musculoskeletal symptom patterns (8,19). Central sensitization-related symptom burden may further distinguish patients with persistent musculoskeletal pain from those without such pain (5). These observations support comprehensive assessment incorporating pain distribution, inflammatory features, function, psychological factors, comorbidities, and intestinal disease status rather than assuming that every musculoskeletal symptom directly reflects active gastrointestinal inflammation.

The findings have implications for rehabilitation and interdisciplinary management. High regional symptom frequencies, particularly involving the lower back and weight-bearing joints, support routine screening for musculoskeletal complaints in patients with IBD. Patients with persistent or function-limiting symptoms may benefit from coordinated evaluation involving gastroenterology, rehabilitation, and rheumatology where clinically indicated. Management should also account for the gastrointestinal safety profile of analgesic strategies because nonsteroidal anti-inflammatory drugs may pose gastrointestinal risks in susceptible patients, while non-pharmacological approaches such as individualized exercise, physical rehabilitation, pain education, and optimization of general health may provide useful components of multimodal care (20). Nutritional status and broader lifestyle factors may also warrant consideration because they can influence both chronic musculoskeletal health and the systemic consequences of IBD (2,21).

Several methodological limitations should be considered when interpreting these findings. The cross-sectional design prevents determination of temporal or causal relationships between IBD activity and musculoskeletal symptoms. Consecutive non-probability sampling from selected clinical settings may introduce selection bias and limits generalizability to the wider IBD population of Karachi or Pakistan. The sample was predominantly female and heavily concentrated in the 21–30-year age group, which influenced raw subgroup counts and reduced comparability across demographic strata. Musculoskeletal symptoms and clinical activity were largely questionnaire based and were therefore susceptible to recall and reporting bias. Potential confounders including medication exposure, physical activity, nutritional status, body composition, psychological status, socioeconomic conditions, and duration or subtype of IBD were not incorporated into adjusted multivariable analyses despite evidence that several of these factors may affect musculoskeletal health or pain experience (2,3,5,21,22). Finally, disease-specific interpretation was constrained by the absence of separate Crohn's disease and ulcerative colitis denominators for HBI- and SCCAI-based analyses.

Notwithstanding these limitations, the study provides locally relevant descriptive evidence on musculoskeletal symptom burden in an IBD clinical population in Karachi and demonstrates the importance of distinguishing descriptive subgroup concentration from statistically supported association. The use of standardized musculoskeletal symptom assessment and the inclusion of multiple body regions provide a broad representation of symptom distribution. Future studies should employ clearly defined IBD subtype groups, validated pain-severity or mechanism-based classification procedures, probability-based or multicenter recruitment, and multivariable analysis incorporating disease duration, medication exposure, physical activity, psychological factors, nutritional status, and comorbidities. Longitudinal designs incorporating rheumatological examination, objective inflammatory markers, imaging where clinically appropriate, and direct microbiome or metabolomic

measures would be required to investigate temporal and mechanistic pathways linking intestinal and musculoskeletal disease (3,9,17).

CONCLUSION

Musculoskeletal symptoms were common among individuals with IBD in this Karachi clinical sample, with lower-back pain representing the most frequently reported regional complaint and the majority of participants falling within the study-derived moderate or high pain categories. Although younger adults and women accounted for many participants with higher symptom categories, age, sex, and occupation were not significantly associated with musculoskeletal pain or HBI- and SCCAI-derived activity classifications. The findings therefore support routine assessment of musculoskeletal symptoms as part of IBD care but do not establish demographic predictors, distinct mechanism-based pain profiles, or microbiome-mediated causation. Future subtype-specific, longitudinal, and analytically adjusted studies are required to clarify the clinical and mechanistic determinants of musculoskeletal pain in IBD.

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