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Personal factors and baseline function in patients undergoing non-operative management for chronic hip-related groin pain: a cross-sectional study

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ABSTRACT

Aim Little is known about the relationship between personal factors and perception of hip-related function among patients with chronic hip-related groin pain (HRGP) seeking non-operative management. This analysis was performed to determine if depressive symptoms, central sensitisation, movement evoked pain (MEP), pressure hypersensitivity and activity level were associated with patients' perception of hip-related function, represented by the International Hip Outcome Tool (iHOT-33).

Methods This cross-sectional study used baseline data from a pilot randomised clinical trial. Participants had anterior hip symptoms for at least 3 of the past 12 months reproduced on examination. Depressive symptoms, central sensitisation and activity level were quantified with self-report questionnaires. MEP was assessed during step down and squat. Pain pressure threshold (PPT) was used to assess pressure hypersensitivity. Statistical analysis was performed to assess bivariate association between variables and independent association of variables with iHOT-33.

Results Data from 33 participants (aged 18–40 years) with HRGP were analysed. Greater depressive symptoms (r_s=−0.48, p=0.005), higher MEP during step down (r_s=−0.36, p=0.040) and squat (r_s=−0.39, p=0.024), and greater central sensitisation (r_s=−0.33, p=0.058) were associated with lower (worse) iHOT-33 scores. Greater depressive symptoms (β=−0.47, 95% CI −0.76 to −0.17; p=0.003) and higher MEP during squat (β=−0.38, 95% CI −0.68 to −0.08; p=0.014) accounted for 37% of variability in iHOT-33. After adjusting for depressive symptoms and MEP, PPT, central sensitisation symptoms and activity level were not associated iHOT-33.

Conclusions In patients with HRGP seeking non-operative management, greater depressive symptoms and MEP are independently associated with worse self-perceived hip function.

Trial registration number NCT03959319

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The relationship between personal factors and perception of hip-related function has been studied primarily in patients with hip-related groin pain (HRGP) seeking a surgical consult, but little is known about this relationship among patients seeking non-operative management. Experts recommend utilisation of patient-reported outcome measures and psychosocial measures to monitor response to non-operative treatment despite limited evidence. Current clinical practice guidelines acknowledge that evaluation of HRGP from a pain science perspective should be considered, but no specific recommendations are made.

WHAT THIS STUDY ADDS

⇒ Increased depressive symptoms and movement evoked pain at baseline are independently associated with worse perception of baseline hip-related function in patients with HRGP seeking non-operative care.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings of this exploratory study warrant further investigation of the relationship between personal variables and perceived hip-related function. Confirmation of this relationship could strengthen expert recommendations and guide development of future clinical practice guidelines for the non-operative treatment of chronic HRGP.

INTRODUCTION

As many as 40% of young to middle-aged adults report chronic hip-related groin pain (HRGP).[1–3] HRGP can be attributed to conditions such as femoroacetabular impingement syndrome, acetabular dysplasia and acetabular labral tears,[4] and can result in significant pain and activity limitation. Structural factors[5] and patient-specific factors such as psychological impairment,[6–11] pain with movement[12 13] and somatosensory disturbances[14] contribute to the relationship of pain and the patient's perception of their mobility limitations and can confound the clinical assessment of pain. Understanding the relationship of these factors and functional limitations

is imperative for the provider to optimise recovery in patients with pain.[15]

Up to 50% of patients with HRGP present with a psychological impairment,[16 17] depression among the most common.[16] Psychosocial factors such as symptoms of depression or central sensitisation are associated with worse patient-reported function among patients with HRGP seeking a surgical consult.[6–11] A 2020 systematic review by Cheng *et al*[9] found that greater baseline psychological impairment in patients with FAI was associated with worse postoperative clinical outcomes after hip arthroscopy. Less is known about the relationship between psychosocial factors and hip-related function among patients seeking non-operative management. It is important to understand the multiple variables, including psychosocial variables, that may be associated with treatment outcomes in these patients in order to develop personalised care and maximise clinical outcomes.

Assessment of movement evoked pain (MEP) and pain pressure threshold (PPT) may provide additional information regarding the patient's pain perception. Clinical assessment of the severity of a patient's pain level can be challenging. Pain questionnaires often involve recall of pain at rest and may not accurately reflect pain related to movement.[18] Therefore, allowing a patient to report pain levels occurring with specific movements may provide a more accurate measure of movement-related pain.[19] Evaluating MEP along with performance-based measures of function and patient-reported outcomes provides a more comprehensive evaluation of the patient with chronic pain.[19] PPT, a quantitative sensory test,[20] assesses pressure hypersensitivity. Low PPT values at the painful site may indicate a heightened local nociceptive response and a low threshold for pain; however, low PPT values at a remote, non-painful site may indicate a more generalised response suggestive of nociplasty.[21] The independent relationship of MEP and PPT values to patient-reported function in people with HRGP is unknown.

The goal of the current study was to determine if depressive symptoms, central sensitisation symptoms, MEP, pressure hypersensitivity and activity level were associated with hip-specific, patient-reported function quantified by the International Hip Outcome Tool (iHOT-33).[22] Determining the relationship between personal factors and patient-reported function may influence decision-making regarding the treatments offered to those who present with HRGP. In this secondary analysis, we hypothesised that among patients with HRGP seeking non-operative management, greater depressive symptoms, greater central sensitisation, higher MEP ratings, greater local and remote pressure hypersensitivity, and lower activity level would be associated with lower perceived hip-related function.

METHODS

Study design

This was a cross-sectional study using baseline data from a pilot randomised clinical trial (RCT) (Clinical Trials NCT03959319) that recruited patients with chronic HRGP to compare the effects of joint mobilisation versus movement pattern training. The RCT was projected to span the 2-year grant cycle; however, it was prolonged by a 7-month suspension secondary to the COVID-19 pandemic. Data collection was completed at the Movement Science Research Center in Washington University's Program in Physical Therapy. Patients from a previous trial provided feedback regarding their experience that was incorporated into this trial; however, patients were not involved in the recruitment or conduct of the study.

Study population

Potential participants were recruited between 2019 and 2021 from Washington University Orthopedic and Physical Therapy clinics, the Washington University research volunteer database, focused mailings, social media and other public announcements. The RCT methods have been previously described.[23] Inclusion criteria included the following: aged 18–40 years; report of frequent hip joint or groin symptoms defined as pain, aching, or stiffness within the hip joint on most days for at least 3 months during the past 12 months[24]; report of pain severity >3/10; report of functional limitation as demonstrated by a modified Harris Hip Score<90; hip joint pain confirmed on examination; and the presence of protective sensation in the feet. We used Semmes Weinstein 5.07 monofilament to assess sensation of the feet as an initial screen for distal neuropathy which, if present, may have interfered with the PPT assessment. Exclusion criteria included previous hip surgery, fracture, infection or cancer; pain due to high impact trauma; inflammatory disease such as gout or rheumatoid arthritis; Perthes disease; slipped capital femoral epiphysis; avascular necrosis; acute pain in another joint that limits activities; hip pain referred from another source like the lumbar spine; neurological involvement affecting balance or coordination; current pregnancy or gave birth in the previous 12 weeks; Ehlers-Danlos Syndrome; or use of an assistive device other than a straight cane for more than 50% of the time when walking.

Assessment

After final eligibility was determined, participants completed self-reported questionnaires and participated in a clinical examination that included a walking warm-up, movement testing and quantitative sensory testing. The study hip was identified by the participant as the painful hip if they experienced unilateral pain, or the most bothersome hip if bilateral pain.

Outcome measure

The iHOT-33 was developed to quantify perception of activity limitations due to hip pain in young, active patients with varied hip pathology.[22] This tool consists of 33 items in 4 different domains: symptoms and functional limitations; sports and recreational activities; job related concerns; and social, emotional and lifestyle concerns.

These items are rated on a 0–100 visual analog scale with a higher score indicating less difficulty with performance; the overall score is calculated as the mean of all answered items and the minimal clinically important difference is 6 points.[22] The iHOT-33 has been shown to be reliable, valid and responsive to clinical change for use in this population.[25]

Explanatory measures

Depressive symptoms

We administered the Patient-Reported Outcomes Measurement Information System Adult Depression v1.0[26] (PROMIS Depression) measure to quantify depressive symptoms. PROMIS is a reliable and valid tool which is an easily administered measure of patient-reported symptoms and functioning.[27] PROMIS Depression asks respondents to rate items like negative mood and negative cognition on a scale from 1 (never) to 5 (always).[27] A T-score is used for analysis in which a score of 50 (SD of 10) is average for the US general population. For PROMIS Depression, a score of 40 is 1 SD better than the general US population, and a score of 60 is 1 SD worse.[26] The measure has high internal consistency and strong correlations with legacy measures among people with various musculoskeletal disorders.[28]

Central sensitisation

The Central Sensitization Inventory (CSI) is a highly reliable and valid self-report tool, and it is used to identify the presence of centrally mediated symptoms like fatigue and cognitive difficulties often linked to nociplasty.[29] To quantify symptoms related to central sensitisation, we used part A of the CSI. Total scores range from 0 to 100, with 100 indicating more frequent symptoms of central sensitisation.[29] Neblett *et al*[29] reported that a clinically meaningful cut-off score of 40 or higher yielded good sensitivity and specificity for identifying patients presenting with symptoms of central sensitisation.

Movement evoked pain

Prior to performing each movement task, the participant was asked to rate their hip joint pain using a numeric pain rating scale ranging from 0 to 100 (0=no pain and 100=worst pain imaginable). The patient then performed 20 repetitions of a step-down tap while keeping the limb of their study hip on the step and tapping the floor with the contralateral limb. The step height used was based on each patient's height: 15.2 cm for heights<163 cm, 20.3 cm for heights 163–180 cm, and 25.4 cm for heights >180 cm. After completion of 20 repetitions, the patient rated their hip joint pain again. This procedure was then repeated using a bilateral, deep squat. For this task, the patients stood just in front of the step used for the step-down tap task. They were instructed to squat and tap their buttocks on the step. If they were unable to reach the step, they were encouraged to squat 'as low as you can go.' For both tasks, each patient was allowed to self-select the position of their feet.

Quantitative sensory testing

To assess mechanical PPT, values were obtained using the Wagner Instruments FPN 100 analog algometer with a 1 cm^2 tip. Digital pressure algometry has been shown to have high intra-rater reliability[30] and to be associated with pain severity.[31] The purpose of this test was to determine the point at which the patient began to feel pain when stimulated by the algometer. The patient was instructed to say 'Stop,' when they first detected that the pressure sensation experienced at the beginning of the test turned into a painful sensation. The examiner applied the algometer tip to the test location and applied increasing force at a rate of 0.5 $kg/cm^2/s$. A practice trial was performed on the non-dominant volar forearm to familiarise the patient with the test. To quantify generalised nociceptive response (generalised pressure hypersensitivity), PPT was assessed at the dominant thenar eminence.[32] To quantify local nociceptive response (local pressure hypersensitivity), PPT was assessed in the anterior groin region, at the location indicated by the patient as the location of their hip joint pain. Primary location of pain for all participants was the anterior groin. For each test location, three trials were performed in a slightly overlapping method. A 20 s rest was provided between trials. Lower PPT values indicate greater pressure sensitivity, and lower PPT values at both the hip and the thenar eminence may indicate central sensitisation.[33]

Self- reported activity demands

Participants' activity demands over the previous 6 months were quantified using the University of California at Los Angeles (UCLA) activity score. The UCLA rates physical activity level from 1 to 10 (low to high) and may be useful for assessing change in self-reported physical activity across a group.[34]

Statistical analysis

Due to the exploratory nature of this analysis, statistical testing was performed at the 0.10 alpha level of significance to reduce the chance of type II error (ie, failing to detect a significant effect when it exists). Scatterplots of the relationship among each pair of variables indicated that relationships were not linear. As such, Spearman correlations (r_s) were used to reflect the strength and direction of the monotonic relationship among each pair of variables. All variables were candidates for inclusion in a stepwise, multivariable regression model of variables associated with the iHOT-33 average score. The stepwise regression method selects variables for inclusion or exclusion from the model in a sequential fashion based on the significance level of 0.10 for entry and 0.10 for removal. Variables that do not satisfy the 0.10 threshold for entry in the model are not included in the final multivariable model and thus have no associated p value. The model selects variables that contribute information that is statistically independent of the other variables in the model. Because of the high intercorrelation among the two MEP pain variables coupled with collinearity diagnostics, only

one of these variables could be included in the multivariable model. Either of these correlated measures would perform nearly equivalent in the multivariable model. Even though different domains of movement are assessed by squat (mobility) compared with step down (strength and motor control), these correlated measures would be expected to perform nearly equivalent in the multivariable model. A decision was made to include MEP pain during bilateral squat in the primary multivariable model because there was no missing data for this variable. Parameter estimates and corresponding 95% CIs are reported for variables in the multivariable model, adjusted for all variables in the model. R^2 values are reported and measure the proportion of variation in iHOT explained by the variables that are included in the model at each step. All data were ranked transformed for the multivariable analyses.

A sensitivity stepwise multivariable regression model was performed for 32 observations with the inclusion of MEP pain during step down rather than MEP pain during bilateral squat. The primary model was robust, meaning that the same conclusions were achieved in the primary model as achieved in the sensitivity model with 32 observations and where MEP pain during step down was included rather than MEP pain during bilateral squat. The data were analysed using SAS software, V.9.4 of the SAS System for Windows.

RESULTS

Thirty-three patients were enrolled. Demographic data are provided in table 1 and a summary of statistics for variables at baseline is found in table 2. In the bivariate models (table 3), MEP during step down, MEP during bilateral squat, CSI and PROMIS-Depression were significantly associated with iHOT-33 ($p<0.1$).

In the primary stepwise multivariable regression model, PROMIS Depression explained 23% of the variability in iHOT (table 4). After adjusting for depression, MEP during bilateral deep squat was found to explain an additional 15% of the variability in iHOT. After adjusting for MEP and PROMIS Depression, PPT of the study hip, PPT of the thenar eminence, CSI and UCLA active score were not independently associated with iHOT and were not entered in the model. In summary, higher values of PROMIS Depression and higher values of MEP during the bilateral deep squat were independently associated with lower iHOT values, where these two variables account for 37% of the variability in iHOT. Similar results were found in the sensitivity model that included MEP during the step-down tap in place of the MEP bilateral, deep squat(table 4).

This is a secondary analysis of an existing dataset and a post-hoc power computation was performed to determine the minimum r^2 increment required for a third variable to be entered into the primary regression model at 0.10 alpha with 80% statistical power. With the fixed sample size of 33, a minimum r^2 increment of 0.17 would be needed, that is, the third variable would need to explain 17% more of the variance in iHOT that is not already explained by depression and MEP. This corresponds to a medium-large effect size of 0.20.[35]

Table 1 Demographics for all randomised patients who provided baseline data, overall sample (n=33)

Variable	Overall sample n=33
Age* (year), mean±SD	29±5.8 (age range 19–39)
Gender, n (%)	
Male	7 (21%)
Female	26 (79%)
Race, n (%)	
White	31 (94%)
African American	1 (3%)
Biracial (Asian and White)	1 (3%)
Ethnicity, n (%)	
Hispanic or Latino	2 (6%)
Not Hispanic or Latino	31 (94%)
Education level, n (%)	
12th grade or GED	1 (3%)
College	20 (61%)
Non-doctoral graduate Degree	11 (33%)
Doctoral degree	1 (3%)
Hand dominance, n (%)	
Right-handed	29 (88%)
Left-handed	4 (12%)
Measured BMI (kg/m^2), mean±SD	25±5.5 (range 18.1–41.5)
Study limb, n (%)	
Left	17 (52%)
Right	16 (48%)
Pain involved limb, n (%)	
Unilateral left	11 (33%)
Unilateral right	8 (24%)
Bilateral	14 (42%)
Pain duration (categorical), n (%)	
3 to <6 months ago	6 (18%)
6 to <12 months ago	6 (18%)
1–2 years ago	9 (27%)
3 to <5 years ago	3 (9%)
5–10 years ago	8 (24%)
>10 years ago	1 (3%)
CSI severity, n (%)	
Subclinical	25 (76%)
Mild	5 (15%)
Moderate	2 (6%)
Extreme	1 (3%)
UCLA†, range	4 to 10

*Age self-reported by patients in screening interview.
†Patients asked to rate their activity level over the previous 6 months. 10=regularly participate in impact sports; 1=wholly inactive, dependent on others.
BMI, body mass index; CSI, Central Sensitization Inventory; GED, General Education Diploma; SD, standard deviation; UCLA, University of Los Angeles Activity Score.

Table 2 Summary statistics for variables at baseline (n=33)

Variable	Median (IQR)*	Minimum to maximum
Mean PPT‡ (kg/cm^2) study hip	2.60 (1.47)	0 to 5.53
Mean PPT§ (kg/cm^2) thenar eminence (dominant)	3.73 (1.07)	2.20 to 6.67
MEP: (0–100 NRS) study hip step down†¶	20 (34)	0 to 65
MEP: (0–100 NRS) study hip bilateral squat¶	25 (20)	0 to 70
Total score of CSI (required at least 20 non-missing questions) **	25 (9)	5 to 65
PROMIS-Depression T-score††	48.1 (6.4)	34.2 to 77.5
Average score of iHOT-33‡‡	60.7 (21.2)	27.8 to 89.8
UCLA§§	9 (4)	4 to 10

*IQR defined as the 75th minus the 25th percentile.
†There is one observation with missing data, n=32. Subject did not complete task secondary to pain.
‡Low PPT values at the painful site may indicate a heightened local nociceptive response and a low threshold for pain.
§Low PPT values at a remote, non-painful site may indicate a more generalised response suggestive of nociplasty.
¶Movement evoked pain was quantified by the numerical pain rating provided by the patient after completion of 20 repetitions of the task.
**CSI scores range from 0 to 100, with 100 indicating more frequent symptoms of central sensitisation.
††A higher PROMIS-Depression T-score represents more of the construct being measured where a score of 50 (SD of 10) is average for the US general population.
‡‡iHOT-33 scores range from 0 to 100, with a higher score indicating less difficulty with the performance of each item.
§§UCLA scores range from 1 to 10, with lower scores indicating lower physical activity levels.
CSI, Central Sensitization Inventory; MEP, movement evoked pain; NRS, numeric rating scale; PPT, pain pressure threshold; UCLA, University of California Los Angeles Activity Score.

DISCUSSION

This study examined the relationships between patients' perception of hip-related function and personal factors including depressive symptoms, central sensitisation symptoms, movement evoked pain, pressure hypersensitivity and activity level in patients seeking non-operative care for HRGP. Our hypotheses were partially supported. Among the variables assessed, we found that greater depressive symptoms and higher MEP values, assessed during bilateral squat or unilateral step-down-tap, were independently associated with lower hip-related function. Central sensitisation symptoms, pressure hypersensitivity and self-reported activity level were not independently associated with

Table 3 Spearman correlations reflecting the strength and direction of the monotonic relationship between each pair of variables (n=33)

Spearman correlation (r_s), p value for the correlation (p)							
Variable	**Mean PPT (kg/cm^2) thenar eminence (dominant)**	**MEP Study hip step down***	**MEP Study hip bilateral squat**	**Total score of CSI**	**PROMIS-Depression T-score**	**UCLA**	**Average score of IHOT-33**
Mean PPT (kg/cm^2) Study hip	r_s=0.55, **p=0.001**	r_s=–0.40, **p=0.025**	r_s=–0.30, **p=0.092**	r_s=–0.28, p=0.11	r_s=–0.13, p=0.48	r_s=0.17, p=0.35	r_s=0.25, p=0.16
Mean PPT (kg/cm^2) thenar eminence (dominant)		r_s=0.09, p=0.61	r_s=–0.06, p=0.74	r_s=–0.33, **p=0.061**	r_s=–0.21, p=0.23	r_s=0.31, **p=0.084**	r_s=0.13, p=0.47
MEP Study hip step down*			r_s=0.69, **p<0.0001**	r_s=–0.06, p=0.74	r_s=0.04, p=0.82	r_s=0.07, p=0.69	r_s=–0.36, **p=0.040**
MEP Study hip bilateral squat				r_s=–0.12, p=0.50	r_s=0.03, p=0.86	r_s=0.19, p=0.29	r_s=–0.39, **p=0.024**
Total score of CSI					r_s=0.66, **p<0.0001**	r_s=0.33, **p=0.061**	r_s=–0.33, **p=0.058**
PROMIS-Depression T-score						r_s=0.37, **p=0.032**	r_s=–0.48, **p=0.005**
UCLA							r_s=0.19, p=0.28

*There is one observation with missing data, n=32. Subject did not complete the task secondary to pain. Significant correlations (p <0.10) are in **bold.**
CSI, Central Sensitization Inventory; PPT, pain pressure threshold; UCLA, University of California at Los Angeles Activity Score.

Table 4 Summary of stepwise multivariable regression model of baseline variables association with the iHOT-33 average score

Variable	Model r^2 (selection order) *	Final model	
		Adjusted parameter estimate (95% CI) †	P value
Primary model including MEP bilateral squat (n=33)			
Mean PPT (kg/cm^2) study hip	NS		
Mean PPT (kg/cm^2) thenar eminence (dominant)	NS		
MEP trial 1: (0–100 NRS) study hip bilateral squat	0.37 (2)	–0.38 (–0.68, –0.08)	**0.014**
Total score of CSI (required at least 20 non-missing questions)	NS		
PROMIS depression T-score	0.23 (1)	–0.47 (–0.76, –0.17)	**0.003**
UCLA	NS		
Sensitivity model including MEP step down (n=32) ‡			
Mean PPT (kg/cm^2) study hip	NS		
Mean PPT (kg/cm^2) thenar eminence (dominant)	NS		
MEP Trial 1: (0–100 NRS) study hip step down	0.32 (2)	–0.36 (–0.68, –0.03)	**0.031**
Total score of CSI (required at least 20 non-missing questions)	NS		
PROMIS depression T-score	0.19 (1)	–0.43 (–0.74, –0.11)	**0.010**
UCLA	NS		

*R^2 measures the proportion of variation in iHOT explained by the variables included in the model at each step.
†Parameter estimates are adjusted for all variables in the final model and are based on rank-transformed data. For example, -0.38 is the average decrease in iHOT-33 rank for every 0.38 increase in MEP pain rank, after adjusting for PROMIS depression rank.
‡There is one observation with missing data, n=32. Subject did not complete the task secondary to pain. Significant (p <0.10) variables are in **bold.**
CI, confidence interval for parameter estimate; CSI, Central Sensitization Inventory; MEP, movement evoked pain; NS, not significant for entry into the model (ie, p>0.10); PPT, pain pressure threshold; UCLA, University of California Los Angeles Activity Score.

iHOT-33 scores after adjusting for MEP and depressive symptoms. The findings of this secondary analysis suggest that both psychological impairments, such as depressive symptoms, and movement-related factors, such as MEP, may be associated with patient reported function in patients with HRGP seeking non-operative treatment. Further investigation and confirmation of this relationship could strengthen expert recommendations and guide development of future clinical practice guidelines for the non-operative treatment of chronic HRGP.

Despite the high prevalence of psychological impairment among those with HRGP,[16] current rehabilitation guidelines lack recommendations for screening for these impairments. We found an inverse relationship between baseline depressive symptoms and perceived hip-related function in patients with HRGP seeking non-operative care. Our findings were like those reported by Hampton *et al*[6] and Jacobs *et al*,[7] who found that lower mental health scores correlated with worse baseline function in patients with hip pathology seeking operative care. Given the cross-sectional nature of our study, we do not know if lower iHOT-33 scores preceded depressive symptoms or are possibly a result of depressive symptoms. Prospective studies are needed to better understand the temporal relationship between depressive symptoms and perceived limitations in patients seeking non-operative management for HRGP. Previous reports suggest that the presence of depression is associated with risk of worse outcomes after orthopaedic surgical procedures,[36] but we do not know if this relationship exists between depressive symptoms and non-operative management.

In our sample, a higher MEP value reported with a physical task was associated with a lower iHOT-33 score. We were unable to find any studies reporting the association between MEP and patients' perception of hip-specific function among patients with chronic HRGP; however, our findings are like those reported in studies involving other musculoskeletal pain populations. In their study involving older adults with chronic low back pain, Knox *et al*[12] found that higher MEP reported after the performance of physical assessments for endurance and mobility was associated with greater self-reported functional limitations. Similarly, in a study of patients with whiplash injury, Mankovsy-Arnold *et al*[13] found that MEP reported with a single-point lift task and a repetitive lifting task was a stronger predictor of disability than pain reported in a sedentary position. MEP is more sensitive to change than pain at rest,[37] and therefore may a be useful outcome measure for physical therapists to monitor changes in pain with symptomatic tasks over time. MEP may also reflect personal factors

involved in the patient's perception of pain more accurately than pain at rest or recall of worst pain.[19] Finally, MEP assessment is feasible in the clinical setting and has the potential to improve our understanding of movement-related pain by assessing effect of movement modification on pain reports.[38]

Symptoms associated with central sensitisation, pressure hypersensitivity and self-reported activity level were not independently associated with iHOT-33 after adjusting for MEP and depressive symptoms. The lack of an independent association with central sensitisation may be due to the high correlation between the CSI and PROMIS Depression, small sample and relatively low prevalence (24%) reporting subclinical CSI scores. We were surprised that pressure hypersensitivity was not associated with iHOT-33 scores. Our findings may be due to variability in people's approach to coping with their pain. Some patients with chronic HRGP may continue to participate in activities even though they are painful, while others may be more likely to restrict painful activities. We also hypothesised that those reporting a higher activity level, represented by a higher UCLA score, would report fewer functional limitations. This was not the case. With review of the questions included on each score, it is clear these instruments provide different information about the patient's status. The iHOT-33 includes questions for different domains including symptoms and functional limitations, sports and recreational activities, job-related concerns, social concerns, emotional concerns and lifestyle concerns,[22] and the UCLA activity score is one question summarising frequency and impact of their physical activity.[34] The patients enrolled in our study varied in both the frequency and impact level of their physical activity, which may be related to personal preference and not necessarily hip pain.

Our study should be considered exploratory and hypothesis generating. Limitations of the study include a small sample size (n=33) of primarily white (94%), female (79%), highly educated (97% college degree or higher) subjects. These limitations indicate that our results may not be generalisable to a more diverse patient demographic. The COVID-19 pandemic significantly limited our recruitment. Future efforts to recruit a more diverse patient population will be implemented. Additionally, we may have identified a correlation that existed in our small sample that is not generalisable to a larger group. Our study was cross-sectional, so we are unable to determine a temporal relationship between factors like baseline function and depressive symptoms. We assessed only one quantitative sensory test, thus limiting our findings. A complete profile using the standardised protocol recommended by the German Research Network on Neuropathic Pain may be more informative.[20] Another limitation of our study is that the order of movement testing was not randomised. We recognise that the performance of step down prior to squat may potentially affect performance and MEP associated with the squat, but because the order of task completion was consistent throughout the study, we do not feel that the lack of randomisation of movement test items confounds the results.

CONCLUSIONS

Among patients with HRGP seeking non-operative care, increased depressive symptoms and movement evoked pain at baseline are independently associated with perception of worse baseline hip-related function as measured with the iHOT-33. The findings of this exploratory study warrant further investigation of the relationship among psychological impairments, movement evoked pain and perceived hip-related function.

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Contributors All authors conceived the project and contributed to the study design. MH-H was the guarantor. KS-M performed the statistical analysis. RDD, MH-H and KS-M interpreted the data and results and drafted the original manuscript. All authors contributed to the revision, completion and review of the final manuscript.

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Competing interests None declared.

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Patient consent for publication Not applicable.

Ethics approval This study was approved by the Human Research Protection Office of Washington University School of Medicine, the reference number is 201901005. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data and accompanying code are available from the corresponding author upon reasonable request.

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