

# Comparative Analysis of Patient-Reported Outcome Measures for Proximal Hamstring Injuries

## A Systematic Review

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**Background:** There is controversy regarding which patient-reported outcome measures (PROMs) should be used for proximal hamstring tendon injuries.

**Hypothesis:** It was hypothesized that (1) most (>50%) of the questions on the 13 most common PROMs for proximal hamstring injuries would demonstrate extensive overlap in the health domains and question categories and (2) each of the PROMs would contain a variable distribution of questions within each health domain.

**Study Design:** Systematic review.

**Methods:** We conducted a literature review through PubMed, Scopus, and CINAHL and identified the 13 most common PROMs for proximal hamstring injuries: Lower Extremity Functional Scale (LEFS), Marx activity rating scale (MARS), 12-item Short Form Survey (SF-12), Tegner activity scale (TAS), Single Assessment Numeric Evaluation (SANE), Perth Hamstring Assessment Tool (PHAT), Proximal Hamstring Injury Questionnaire (PHIQ), modified Harris Hip Score (mHHS), University of California, Los Angeles activity score (UCLA), International Hip Outcome Tool (iHOT-12), Hip Outcome Score (HOS), Sydney Hamstring Origin Rupture Evaluation (SHORE), and Non-Arthritic Hip Score (NAHS). All PROM questions were sorted into 5 health domains (pain, symptoms, activities of daily living, sports, and mindset) and further divided into question categories if they referred to similar tasks or aspects of health. Questions in the same health domain and question category were considered overlapping, and those within a health domain that did not fit into a question category were considered unique. For each PROM, we analyzed the distribution of questions within particular health domains and question categories as well as the amount of overlapping and unique questions.

**Results:** Of the 165 questions evaluated, 116 (70.3%) were overlapping, and 49 (29.7%) were unique. The SF-12 contained the most unique questions (9/12 [75.0%]). The MARS, TAS, SANE, and UCLA had 0 unique questions. The PHIQ and iHOT-12 contained questions in all 5 health domains. The PHAT, SHORE, and NAHS contained questions in every health domain except mindset. The LEFS, MARS, SF-12, TAS, mHHS, SANE, UCLA, and HOS contained questions in  $\leq 3$  health domains.

**Conclusion:** The evaluated PROMs had a high degree of overlapping questions ( $\geq 50\%$ ) and demonstrated a statistically significant variance in the distribution of questions within each health domain.

**Keywords:** proximal hamstring injury; hamstring avulsion; hamstring rupture; hamstring tear; proximal hamstring repair; patient-reported outcomes; questionnaires

Proximal hamstring tendon avulsions are uncommon injuries and make up 9% to 12% of all hamstring-related injuries.<sup>5,7</sup> The mechanism of injury typically involves rapid hip hyperflexion with simultaneous ipsilateral knee extension and forced eccentric contraction of the hamstring.<sup>12,14,20,21,35</sup> While proximal hamstring injuries can result from

traumatic events such as falling or sliding, the literature points to an increasing frequency of these injuries in middle-aged “weekend warriors” and high-performance athletes.<sup>1,12</sup>

Proximal hamstring avulsions must be evaluated carefully, as patients can experience decreased motor strength, muscle atrophy, and nerve damage.<sup>27,35</sup> The surgical indications and overall management of these injuries remain a nuanced clinical decision that is continuing to evolve. A recent study conducted by Pasic et al<sup>25</sup> surveyed 108

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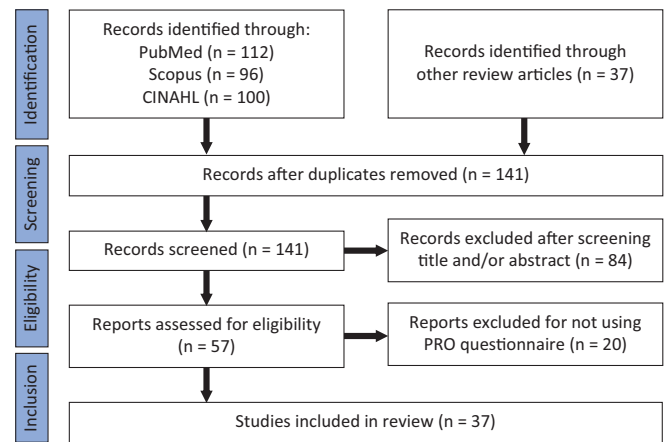
surgeon members of the American Orthopaedic Society for Sports Medicine (AOSSM) and highlighted the varied opinions regarding the standard clinical practice of proximal hamstring avulsions. In their study, the top 3 considerations for surgery were the number of tendons involved, amount of tendon retraction, and patient activity level.<sup>25</sup> While the degree of retraction and number of tendons involved remain controversial aspects in surgical decision-making, previous studies have demonstrated improved functional outcomes from surgical repair of proximal hamstring avulsions.<sup>9,10,14,36</sup>

Patient-reported outcome measures (PROMs) are standardized self-reported instruments that are valuable for assessing how well patients respond to operative treatment.<sup>17</sup> Previous studies on proximal hamstring avulsions have relied on a variety of PROMs, many of which are not designed specifically for hamstring injuries.<sup>9,34</sup> Although there has been a recent impetus toward creating proximal hamstring-specific PROMs,<sup>8,16,29</sup> it is unclear how these measures compare with their nonhamstring-specific counterparts. As the number of PROMs that have been used in outcome studies on proximal hamstring injuries continues to grow, there is still a lack of consensus as to which specific PROMs are the most suitable for evaluating outcomes after these injuries.

The primary purpose of this study was to directly compare questions between the 13 most reported PROMs for proximal hamstring injuries within the literature. We hypothesized that the questions from most (>50%) of these PROMs would demonstrate a high degree of overlap. Our secondary hypothesis was that each of the 13 included PROMs would contain a variable distribution of questions within each health domain assessed in the current study. Such data can provide useful insight for choosing the best combination of PROMs for patients with proximal hamstring injuries.

## METHODS

This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>23</sup> A literature review was performed in PubMed, Scopus, and CINAHL on March 13, 2021, and rerun on June 3, 2021, to find journal articles that reported proximal hamstring tendon injuries and included outcome measures in the study. Publications were initially found by using the keywords “proximal hamstring” and “outcome” (n = 308). Studies that involved proximal hamstring tendon “avulsions,” “ruptures,” or “tears” were collected. Additional



**Figure 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart describing the search strategy and selection of studies for analysis. PRO, patient-reported outcome.

publications were identified and cross-referenced with systematic reviews on proximal hamstring avulsions by van der Made et al<sup>34</sup> (n = 13) and Bodendorfer et al<sup>9</sup> (n = 24). All publications were published between the years 1996 and 2021 and were either written in English or the abstract could sufficiently be translated into English to determine the outcome measures used.

After manually accounting for duplicates (n = 204) and removing studies that did not explicitly fit the subject matter (n = 87), a total of 54 publications remained for outcome measures to be extracted. Outcome studies that did not use a PROM were excluded (n = 20), and those that used  $\geq 1$  PROM were included (n = 34) for further analysis (Figure 1). The following PROMs were identified across all studies in order of prevalence: Lower Extremity Functional Scale (LEFS; n = 22), Marx activity rating scale (MARS; n = 10), 12-item Short Form Survey (SF-12; n = 7), Tegner activity scale (TAS; n = 6), Single Assessment Numeric Evaluation (SANE; n = 6), Perth Hamstring Assessment Tool (PHAT; n = 6), Proximal Hamstring Injury Questionnaire (PHIQ; n = 5), modified Harris Hip Score (mHHS; n = 5), University of California, Los Angeles activity score (UCLA; n = 4), International Hip Outcome Tool (iHOT-12; n = 3), Hip Outcome Score (HOS; n = 2), Sydney Hamstring Origin Rupture Evaluation (SHORE; n = 2), and Non-Arthritic Hip Score (NAHS; n = 1).

The methods used in this review were adapted from 2 previously published studies that conducted a question-

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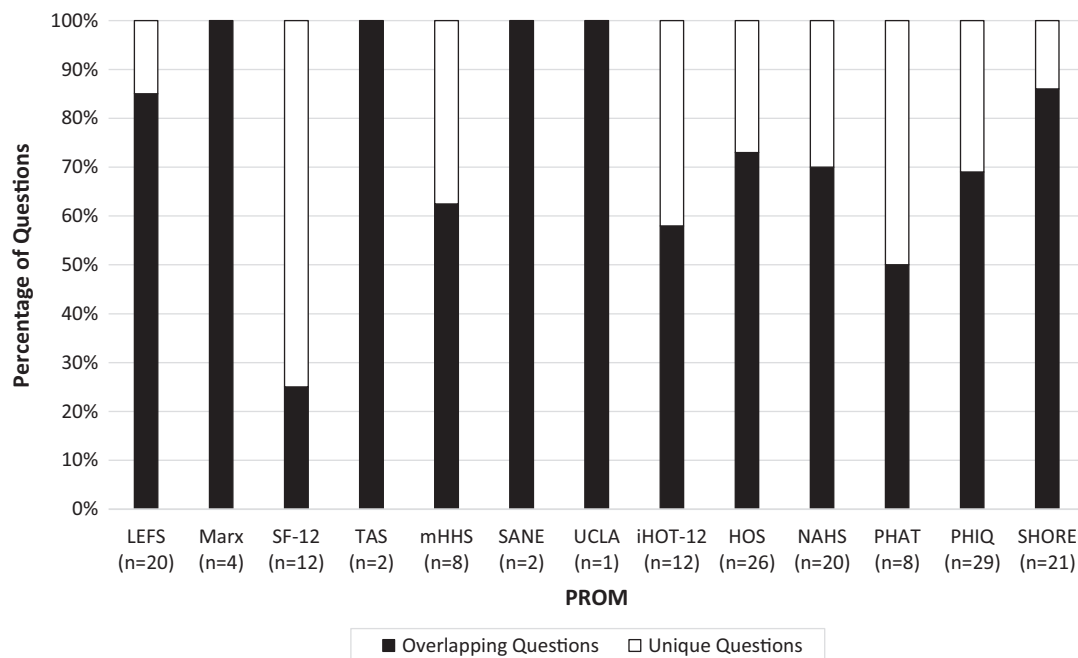
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Ethical approval from Institutional Review Board was not necessary since no patient data was used for the completion of the study.



**Figure 2.** Percentage of unique and overlapping questions for each patient-reported outcome measure (PROM). The number of questions within each PROM is indicated by n. HOS, Hip Outcome Score; iHOT-12, International Hip Outcome Tool; LEFS, Lower Extremity Functional Scale; Marx, Marx activity rating scale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; PHAT, Perth Hamstring Assessment Tool; PHIQ, Proximal Hamstring Injury Questionnaire; SANE, Single Assessment Numeric Evaluation; SF-12, 12-item Short Form Survey; SHORE, Sydney Hamstring Origin Rupture Evaluation; TAS, Tegner activity scale; UCLA, University of California, Los Angeles activity score.

by-question comparison of PROMs used for femoroacetabular impingement syndrome and anterior cruciate ligament injuries.<sup>18,24</sup> In the present study, individual PROMs used for proximal hamstring injuries were obtained from articles, and the questions from each PROM were compiled and collated into a single list for comparative analysis. Five health domains were established: pain, symptoms, activities of daily living (ADL), sports, and mindset. These domains were identified previously in the 2 studies on question-by-question analysis of PROMs, and many have been recognized in the orthopaedic and proximal hamstring injury literature.<sup>11,17,18,24</sup> Therefore, every question included in this study was sorted into 1 of these 5 domains. Question sorting was determined by 1 author (J.S.G.) and confirmed by 2 separate reviewers (B.Z. and M.J.M.). Within each domain, similar questions were grouped together into question categories if they asked the patient about the same activity or aspect of health, such as “sitting,” “stairs/incline,” or “running.” Questions within the same health domain and question category were defined as overlapping questions. Questions that were placed into a health domain but not placed into a question category were defined as unique questions. Each PROM was analyzed for the percentage of overlapping and unique questions, percentage of questions within each domain, and degree of overlap compared with every other individual PROM.

Chi-square tests were used to determine the statistical significance of the associations between the various

PROMs and the proportions of unique and overlapping questions as well as the distribution of questions within particular health domains and question categories. Because several PROMs have  $\leq 5$  questions, the values for each PROM were normalized to align with the PHIQ, as it contains the most questions (n = 29). A 2-proportion Z test was used to calculate the statistical significance of the proportion of PROMs that included a particular question category. All calculations were performed in Excel (Microsoft) and were considered to be statistically significant if  $P < .05$ .

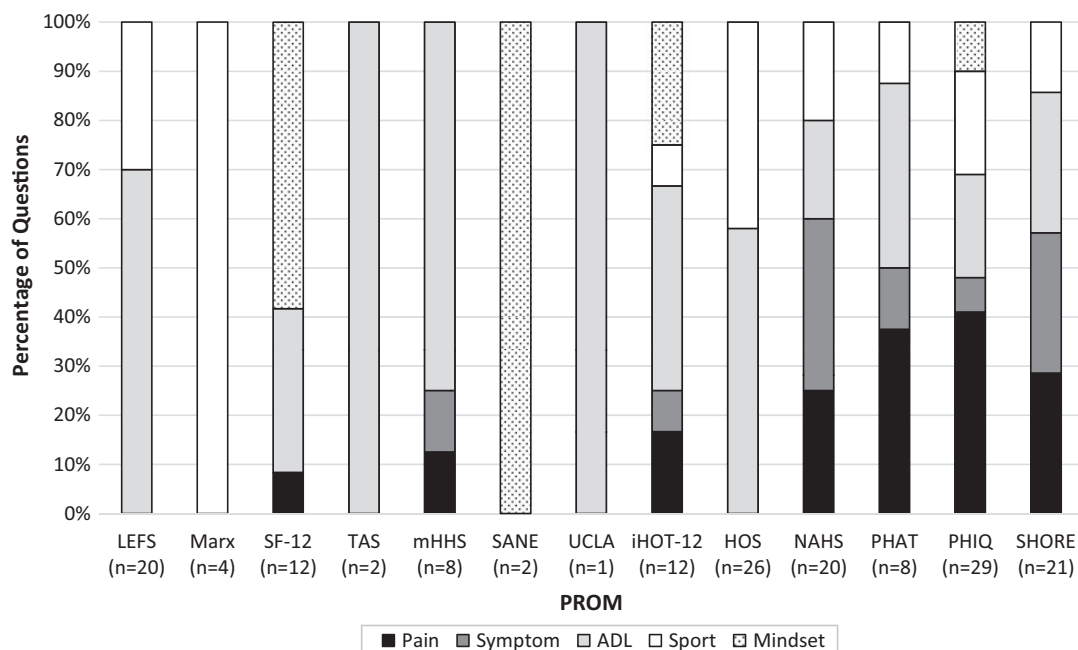
## RESULTS

Across all 13 PROMs included in this study, a total of 165 questions were pooled and characterized as either overlapping or unique questions. Overall, 116 questions (70.3%) overlapped with a question from  $\geq 1$  PROM, and 49 questions (29.7%) were considered unique. Overlapping questions are listed in Appendix Tables A1 and A2 and are organized by the corresponding health domain and question category. The most prevalent overlapping question category was stairs/incline within the ADL domain (14/165 questions; 7/13 PROMs), which was determined to be statistically significant compared with all question categories included in  $\leq 2$  PROMs (79/165 questions) ( $P < .05$ ).

Every unique question is listed in Appendix Table A3 and is sorted under the specific PROM that they originate from.

	LEFS	Marx	SF-12	TAS	mHHS	SANE	UCLA	iHOT-12	HOS	NAHS	PHAT	PHIQ	SHORE
LEFS (n=20)	—	15.0%	15.0%	0.0%	30.0%	0.0%	0.0%	25.0%	70.0%	25.0%	15.0%	30.0%	15.0%
Marx (n=4)	50.0%	—	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	100.0%	25.0%	25.0%	25.0%	25.0%
SF-12 (n=12)	25.0%	0.0%	—	0.0%	8.3%	0.0%	0.0%	0.0%	16.7%	16.7%	0.0%	16.7%	8.3%
TAS (n=2)	0.0%	0.0%	0.0%	—	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
mHHS (n=8)	50.0%	0.0%	12.5%	0.0%	—	0.0%	0.0%	25.0%	25.0%	25.0%	12.5%	37.5%	25.0%
SANE (n=2)	0.0%	0.0%	0.0%	0.0%	0.0%	—	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
UCLA (n=1)	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	—	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
iHOT-12 (n=12)	25.0%	8.3%	0.0%	0.0%	16.7%	0.0%	0.0%	—	25.0%	25.0%	0.0%	8.3%	8.3%
HOS (n=26)	61.5%	15.4%	19.2%	0.0%	26.9%	0.0%	0.0%	23.1%	—	30.7%	3.8%	23.1%	19.2%
NAHS (n=20)	30.0%	5.0%	15.0%	0.0%	15.0%	0.0%	0.0%	15.0%	35.0%	—	5.0%	35.0%	20.0%
PHAT (n=8)	25.0%	12.5%	0.0%	12.5%	12.5%	0.0%	12.5%	0.0%	12.5%	12.5%	—	37.5%	37.5%
PHIQ (n=29)	27.6%	10.3%	10.3%	0.0%	13.8%	6.9%	0.0%	3.4%	20.7%	27.6%	17.2%	—	27.6%
SHORE (n=21)	28.6%	14.3%	14.3%	14.3%	28.6%	0.0%	14.3%	14.3%	28.6%	42.9%	42.9%	71.4%	—

**Figure 3.** Comparison of overlapping questions between any given 2 patient-reported outcome measures (PROMs). The red color indicates a higher percentage of overlap, and the blue color indicates a lower percentage of overlap. The number of questions within each PROM is indicated by n and determines the denominator to calculate the percentage of overlap for each row. HOS, Hip Outcome Score; iHOT-12, International Hip Outcome Tool; LEFS, Lower Extremity Functional Scale; Marx, Marx activity rating scale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; PHAT, Perth Hamstring Assessment Tool; PHIQ, Proximal Hamstring Injury Questionnaire; SANE, Single Assessment Numeric Evaluation; SF-12, 12-item Short Form Survey; SHORE, Sydney Hamstring Origin Rupture Evaluation; TAS, Tegner activity scale; UCLA, University of California, Los Angeles activity score.



**Figure 4.** Percentage of questions within each health domain for each patient-reported outcome measure (PROM). The number of questions within each PROM is indicated by n. HOS, Hip Outcome Score; iHOT-12, International Hip Outcome Tool; LEFS, Lower Extremity Functional Scale; Marx, Marx activity rating scale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; PHAT, Perth Hamstring Assessment Tool; PHIQ, Proximal Hamstring Injury Questionnaire; SANE, Single Assessment Numeric Evaluation; SF-12, 12-item Short Form Survey; SHORE, Sydney Hamstring Origin Rupture Evaluation; TAS, Tegner activity scale; UCLA, University of California, Los Angeles activity score.

The SF-12 and PHIQ each contained the highest number of unique questions (n = 9 each). The SF-12 was the only PROM that contained a statistically significant proportion

of unique questions (P < .001). The LEFS, mHHS, iHOT-12, HOS, NAHS, PHAT, and SHORE contained a range from 3 to 7 unique questions each. The MARS, TAS, SANE,

and UCLA did not contain any unique questions. Figure 2 illustrates the percentage of overlapping and unique questions within each PROM.

Every PROM had  $\geq 50\%$  overlapping questions when compared across all the other PROMs, with the exception of the SF-12 in which 75.0% of its questions were considered unique. The SHORE and LEFS had the highest percentage of overlapping questions at 85.7% and 85.0%, respectively. Figure 3 shows the percentage of overlapping questions between any given 2 PROMs, with 100% of the questions from the TAS ( $n = 2$ ) and UCLA ( $n = 1$ ) overlapping with each other and with the PHAT and SHORE. The HOS contained 100% of the questions from the MARS ( $n = 4$ ), and the PHIQ contained 100% of the questions from the SANE ( $n = 2$ ). Additionally, 70.0% of the questions from the LEFS ( $n = 20$ ) overlapped with the HOS, while 61.5% of the questions from the HOS ( $n = 26$ ) overlapped with the LEFS. Further, 71.4% of the questions from the SHORE ( $n = 21$ ) overlapped with the PHIQ. The overlap between the remaining pairs of PROMs was  $\leq 50\%$ . A chi-square test for independence determined the relationship between a PROM and the distribution of unique and overlapping questions to be statistically significant ( $P < .0001$ ).

Figure 4 compares each PROM in relation to the percentage of questions in each health domain (ie, pain, symptoms, ADL, sports, and mindset). The most common domain was ADL (69/165 questions; 11/13 PROMs), and the least common was mindset (15/165 questions; 4/13 PROMs). The iHOT-12 and PHIQ are the only 2 PROMs that incorporated questions in all 5 domains. Additionally, the PHIQ included the most questions concerned with pain ( $n = 12$ ). The SHORE, PHAT, and NAHS included at least 1 question in every domain except mindset. The SF-12 included questions in the pain and ADL domains and had the highest number of questions in the mindset domain ( $n = 7$ ), while the mHHS had questions in the domains of pain, symptoms, and ADL. The LEFS and HOS contained questions that pertained to only ADL and sports, while the HOS had the most questions in either respective domain (ADL:  $n = 15$ ; sports:  $n = 11$ ). Additionally, 4 of 13 PROMs comprised only a single domain: MARS (sports), TAS (ADL), SANE (mindset), and UCLA (ADL). A chi-square test for independence determined the relationship between a PROM and the distribution of questions within each domain to be statistically significant ( $P < .0001$ ).

## DISCUSSION

The main finding in this study was that 70.3% of the questions from the 13 most common PROMs for proximal hamstring injuries were overlapping. These findings supported our primary hypothesis that many of the questions from these PROMs overlap in health domains and question categories. Additionally, these PROMs demonstrated a statistically significant variance in the distribution of questions within each health domain. Therefore, our secondary hypothesis of predicting a unique composition of representative health domains was also confirmed. Based on comparative analysis of questions in this study, the PHAT,

LEFS, and SF-12 may be the preferred combination for collecting extensive functional and psychological outcome data for any patient with proximal hamstring injuries. Future clinical studies are needed to further support this recommendation.

In the present study, the SF-12 was the most unique PROM (9/12 questions), which is most likely because of the inclusion of questions that assess the psychological aspects of recovery. In conjunction with our findings, Jansson et al<sup>18</sup> and Oji et al<sup>24</sup> demonstrated that quality of life or mental health is the least commonly included domain among PROMs used for other orthopaedic injuries. However, psychological components have been shown to correlate with recovery progression and have demonstrated value in predicting future injuries.<sup>13,28</sup> A study conducted by Skaara et al<sup>30</sup> found an association between return to sports and questions regarding trust in the injured leg and fear of maximum performance in patients with proximal hamstring injuries. The inclusion of mindset questions in the SF-12 such as “Did you have a lot of energy?” or “[Did you feel that you] Accomplished less than you would like” may provide imperative clinical insight into the recovery of proximal hamstring injuries.<sup>14,31</sup> Compared with all other PROMs analyzed in this study, the SF-12 adds a mental component score for recovery assessment and may increase the diversity of outcome measurements when used in combination with other PROMs.

Condition-specific PROMs may be more sensitive than generic PROMs for detecting small changes in health and functional outcomes.<sup>6</sup> The PHAT, SHORE, and PHIQ were designed specifically to assess patients who sustained proximal hamstring injuries.<sup>8,16,29</sup> Of these, the PHAT and SHORE are the only validated proximal hamstring-specific PROMs.<sup>8,16</sup> However, the SHORE was validated by correlating its functional outcome scoring to that of the PHAT.<sup>16</sup> Additionally, the PHAT is the most frequently used of these proximal hamstring-specific PROMs in the literature (6/34 included studies) and has been gaining recognition as the preferred PROM for proximal hamstring injury studies.<sup>2,3,7,8,26,27,33</sup> In conjunction with these findings, the PHAT had the greatest proportion of unique questions compared with the other proximal hamstring-specific PROMs in this study. These unique questions incorporate a visual analog scale to evaluate pain “at rest” and “with stride-out stretch” as well as categorical scores for activity levels, such as the maximum time for “driving a car.”<sup>8</sup> Moreover, the PHAT contextualizes common symptoms and characterizes the potential sequelae of proximal hamstring injuries, such as gluteal pain and sitting intolerance, more comprehensively than the questions in the SHORE. As such, the PHAT may be a more inclusive PROM for assessing important recovery milestones compared with the SHORE when evaluating outcomes in patients with proximal hamstring injuries.

Because acute proximal hamstring injuries are prominent in athletes,<sup>19</sup> PROMs that use questions pertaining to strenuous activities and sports, such as the LEFS and MARS, may be beneficial to include for a more physically active population. The LEFS is a nonspecific PROM that was originally designed to gauge patients' functional ability

in daily activities and athletics for all lower extremity impairments.<sup>4</sup> Compared with all 13 PROMs included in this study, the LEFS is the most common nonspecific validated PROM used in the literature for proximal hamstring injuries (22/34 included studies) and primarily contained overlapping questions (17/20 questions) in our analysis.<sup>27</sup> Similarly, the MARS was created to be a specialized sports-focused prognostic tool for the knee and can be completed in 1 minute with the use of other PROMs.<sup>22</sup> Overall, the MARS is the second most common nonspecific validated PROM included in this study and often has been used to assess functional outcomes of athletes with proximal hamstring injuries.<sup>1,10,15,31</sup> However, several studies have provided findings suggesting that the MARS may have an apparent ceiling effect, as a significant proportion of patients achieve the maximum possible score.<sup>2,10,15</sup> Consequently, the MARS may not be able to accurately discriminate various outcomes in patients with proximal hamstring injuries who achieve maximum scores. Therefore, the LEFS may be more reliable than the MARS for evaluating differences in activity- and sports-related outcomes in patients with proximal hamstring injuries.

Ultimately, our findings highlight the compositional heterogeneity of PROMs commonly used for proximal hamstring injuries. In return, using 1 specific PROM makes it challenging to accurately evaluate outcomes for these injuries. It is commonplace in orthopaedics to use a combination of PROMs to provide adequate coverage in data collection across important health domains, and our findings suggest that it may be the preferred option for assessing proximal hamstring injuries.<sup>32</sup> The PHAT is a well-balanced and validated PROM that contains unique questions across most of the health domains defined in this study and may represent more inclusive outcome measurements for proximal hamstring injuries. In more athletic patients, the LEFS can be included to gauge functional improvements in ADL and sports-related activities. Lastly, the SF-12 can provide unique insight into the mental components of recovery from proximal hamstring injuries. Given the aforementioned findings in this comparative analysis, the PHAT, LEFS, and SF-12 may be the most suitable combination of PROMs that can be used to evaluate a wide spectrum of outcomes in patients who experience proximal hamstring injuries.

### Limitations

Although we conducted a comprehensive question-by-question assessment of the PROMs, there are some limitations inherent to this study. The present study only analyzed the similarities and differences between how each PROM specifically phrased each respective question to the patient. In doing so, some of the data on question overlap do not necessarily depict an accurate representation of the associations between the overlapping questions in the PROMs. For example, through the scope of our question-by-question analysis, the TAS and UCLA resulted in 100% question overlap with the PHAT and SHORE. However, this analysis overlooks other important differences, such as the increased depth of answer choice options and differences in scoring systems. Additionally, this study did not

directly analyze aspects such as validity, reliability, response rate, and other psychometric measures that are also vital to the credibility of these PROMs.

### CONCLUSION

The 13 PROMs for proximal hamstring injuries had a high degree of overlapping questions ( $\geq 50\%$ ) and demonstrated a statistically significant variance in the distribution of questions within each health domain. The PHAT, LEFS, and SF-12 may be the most suitable combination of PROMs that can be used to evaluate a wide spectrum of outcomes in patients who experience proximal hamstring injuries.

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## APPENDIX

TABLE A1

Pooled Questions From All PROMs Categorized by Health Domain: Pain and Activities of Daily Living<sup>a</sup>

Question Category	Question	LEFS (n=20)	Marx (n=4)	SF-12 (n=12)	TAS (n=2)	mHHS (n=8)	SANE (n=2)	UCLA (n=1)	iHOT-12 (n=12)	HOS (n=26)	NAHS (n=20)	PHAT (n=8)	PHIQ (n=29)	SHORE (n=21)
<b>Pain</b>														
General	Pain (0-44 points)					✓								
	Current pain													✓
	Pain (after injury)													✓
	Pain (preinjury)													✓
	How much pain, on average, have you experienced in your injured/surgical leg in the past week?												✓	
	Overall, how much pain do you have in your hip/groin?								✓					
Sitting	Sitting												✓	
	When sitting (0-10)											✓		
	Sitting or lying?									✓				
	Sitting/driving (after injury)													✓
	Sitting/driving (pre-injury)													✓
	Current sitting/driving ability													✓
Stairs/incline	Climbing stairs												✓	
	Going up or down stairs?									✓				
	Walking uphill												✓	
Walking on flat surface	Walking on a flat surface?									✓				
	Walking: flat surfaces												✓	
Lying on affected side	Sleeping												✓	
	At night while in bed?									✓				
Running/sprinting	Running long distance (>3 miles)												✓	
	Running short distance (1-3 miles)												✓	
	Sprinting												✓	
<b>Activities of Daily Living</b>														
Stairs/incline	Current stairs/incline													✓
	Stair/inclines (after injury)													✓
	Stair/inclines (pre-injury)													✓
	Stairs (0-4 points)					✓								
	Going up or down 10 stairs (about 1 flight)	✓												
	Climbing several flights of stairs			✓										
	Climbing stairs													✓
	Ascending stairs										✓			
	Going up 1 flight of stairs								✓					
	Walking uphill												✓	
	Walking up steep hills								✓					
	Going down 1 flight of stairs								✓					
	Descending stairs										✓			
	Walking down steep hills								✓					
Walking	Distance walked (0-11 points)					✓								
	Walking initially									✓				
	Walking between rooms	✓												
	Walking 2 blocks	✓												
	Walking a mile	✓												
	Walking approximately 10 min									✓				
	Walking 15 min or greater									✓				
How difficult is it for you to walk long distances?								✓						





**TABLE A2**  
Pooled Questions From All PROMs Categorized by Health Domain: Symptoms, Sports, and Mindset<sup>a</sup>

Question Category	Question	LEFS (n=20)	Marx (n=4)	SF-12 (n=12)	TAS (n=2)	mHHS (n=8)	SANE (n=2)	UCLA (n=1)	iHOT-12 (n=12)	HOS (n=26)	NAHS (n=20)	PHAT (n=8)	PHIQ (n=29)	SHORE (n=21)
<b>Symptoms</b>														
Stiffness/tightness	Stiffness in your hip?										✓			
	Does your affected leg feel stiff?												✓	
	Current tightness													✓
	Tightness (after injury)													✓
	Tightness (pre-injury)													✓
Hip sensations	How much trouble do you have with grinding, catching, or clicking in your hip?								✓					
	Catching or locking of your hip?										✓			
<b>Sports</b>														
Running/sprinting	Running (max time)											✓		
	Current running/walking ability													✓
	Running/walking (after injury)													✓
	Running/walking (pre-injury)													✓
	Running short distance (1-3 miles)												✓	
	Running: running while playing a sport or jogging		✓											
	Running 1 mile									✓				
	Running on even ground	✓												
	Running on uneven ground	✓												
	Running long distance (>3 miles)													✓
Cutting/lateral movement	Sprinting												✓	
	Cutting: changing directions while running		✓											
	High demand sports involving sprinting or cutting (pain)										✓			
	Making sharp turns while running fast	✓												
	How concerned are you about cutting/changing directions during your sport or recreational activities?								✓					
Pivoting	Cutting/lateral movements									✓				
	Pivoting: Turning your body with your foot planted while playing a sport		✓											
Accelerate/decelerate	Twisting/pivoting on involved leg									✓				
	Decelerate: coming to a quick stop while running		✓											
Jogging/fast walking	Starting and stopping quickly									✓				
	Jogging for exercise										✓			
	Low impact activities like fast walking									✓				
Squatting	Walking for exercise										✓			
	Squatting	✓												
Mindset	Deep squatting									✓				
	<b>Mindset</b>													
Awareness of problem	How much of a distraction is your hip problem?								✓					
	How much of the time are you aware of the disability in your hip?								✓					
Self-evaluating progress	Estimate the strength of your affected leg (percentage)												✓	
	Estimate your recovery from injury (percentage)												✓	
	How would you rate your affected joint/region of interest today as a percentage of normal?						✓							
	How would you rate your opposite side today as a percentage of normal?						✓							

<sup>a</sup>HOS, Hip Outcome Score; iHOT-12, International Hip Outcome Tool; LEFS, Lower Extremity Functional Scale; Marx, Marx activity rating scale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; PHAT, Perth Hamstring Assessment Tool; PHIQ, Proximal Hamstring Injury Questionnaire; PROMs, patient-reported outcomes; SANE, Single Assessment Numeric Evaluation; SF-12, 12-item Short Form Survey; SHORE, Sydney Hamstring Origin Rupture Evaluation; TAS, Tegner activity scale; UCLA, University of California, Los Angeles activity score.

**TABLE A3**  
Unique Questions Identified From Included PROMs Categorized by Health Domain<sup>a</sup>

PROM <sup>b</sup>	Domain				
	Pain	Symptoms	Activities of Daily Living	Sports	Mindset
LEFS (n=3/20)			Lifting an object, like a bag of groceries, from the floor	<ul style="list-style-type: none"> <li>Hopping</li> <li>Your usual hobbies, recreational or sporting activities</li> </ul>	
SF-12 (n=9/12)	How much did pain interfere with your normal work? (Including work outside the home and housework)?		How much of the time has your physical health or emotional problems interfered with your social activities?		<ul style="list-style-type: none"> <li>Did you have a lot of energy?</li> <li>Have you felt down-hearted and blue?</li> <li>Have you felt calm and peaceful?</li> <li>In general, would you say your health is...</li> <li>Accomplished less than would like (as result of physical health)</li> <li>Accomplished less than would like (as result of emotional problems)</li> <li>Did work or activities less carefully than usual</li> </ul>
mHHS (n=3/8)		Limp (0-11 points)	<ul style="list-style-type: none"> <li>Public transport (0-1 point)</li> <li>Support: crutch, cane, etc. (0-11 points)</li> </ul>		
iHOT-12 (n=5/12)	How much pain do you experience in your hip after activity?		<ul style="list-style-type: none"> <li>How concerned are you about picking up or carrying children because of your hip?</li> <li>How difficult is it for you to get up and down off the floor/ground?</li> <li>How much trouble do you have with sexual activity because of your hip?</li> </ul>		How concerned are you about your ability to maintain your desired fitness level?
HOS (n=7/26)			<ul style="list-style-type: none"> <li>Recreational activities</li> <li>Stepping up and down curbs</li> </ul>	<ul style="list-style-type: none"> <li>Jumping</li> <li>Landing</li> <li>Ability to perform activity with your normal technique</li> <li>Ability to participate in your desired sport as long as you would like</li> <li>Swinging objects like a golf club</li> </ul>	
NAHS (n=6/20)	Standing upright?	<ul style="list-style-type: none"> <li>Decreased movement in your hip?</li> <li>Your hip giving way on you?</li> </ul>	<ul style="list-style-type: none"> <li>Rising from bed</li> <li>Rising from sitting</li> </ul>	Low demand sports (ex. golf/ bowling)	
PHAT (n=4/8)	<ul style="list-style-type: none"> <li>With stride-out stretch (0-10)</li> <li>At rest (0-10)</li> </ul>	Do you have local tenderness over your hamstring/ buttock?	Driving a car (max time)		
PHIQ (n=9/29)	<ul style="list-style-type: none"> <li>How often do you take medicine for your affected leg?</li> <li>Daily household activities (ex. cleaning, cooking, laundry, dressing)</li> <li>Strenuous sport/work activities</li> </ul>	Do you experience numbness and/or tingling below your knee in your affected leg?	Walking: flat surfaces	<ul style="list-style-type: none"> <li>Total number of hours/week you participate in athletic activities</li> <li>Strenuous sport/work activities</li> <li>Check the sports that you currently play</li> </ul>	Are you satisfied with the result of your surgery?
SHORE (n=3/21)		<ul style="list-style-type: none"> <li>Aches (after injury)</li> <li>Aches (preinjury)</li> <li>Current aches</li> </ul>			

<sup>a</sup>The MARS, TAS, SANE, and UCLA did not have at least 1 unique question. HOS, Hip Outcome Score; iHOT-12, International Hip Outcome Tool; LEFS, Lower Extremity Functional Scale; MARS, Marx activity rating scale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; PHAT, Perth Hamstring Assessment Tool; PHIQ, Proximal Hamstring Injury Questionnaire; PROMs, patient-reported outcomes; SANE, Single Assessment Numeric Evaluation; SF-12, 12-item Short Form Survey; SHORE, Sydney Hamstring Origin Rupture Evaluation; TAS, Tegner activity scale; UCLA, University of California, Los Angeles activity score.

<sup>b</sup>n = unique questions/total questions.