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Development of the University of Wisconsin Running Injury and Recovery Index

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Abstract

BACKGROUND—Runners experience a high proportion of overuse injuries, with extended recovery periods involving a gradual, progressive return to preinjury status. A running-specific patient-reported outcome (PRO) measure does not exist, and a questionnaire assessing critical elements of runners' recovery processes may have excellent psychometric properties.

OBJECTIVES—To develop a valid, reliable, and responsive evaluative PRO measure to assess longitudinal change in running ability after running-related injury (RRI) for clinical practice and research applications.

METHODS—Self-identified runners and selected experts participated in an iterative, 6-step development process of the University of Wisconsin Running Injury and Recovery Index (UWRI) in this longitudinal clinical measurement study. Content-related validity was assessed using open comments. Reproducibility was assessed using Cronbach's alpha, the intraclass correlation coefficient (ICC), and standard error of measurement (SEM). An anchor-based construct validity assessment measured the association between the change in UWRI score and global rating of change (GROC). Responsiveness assessments included floor and ceiling effects.

RESULTS—The 9-item UWRI assesses running ability following an RRI, with the maximum score of 36 indicating a return to preinjury running ability. The UWRI demonstrated acceptable internal consistency ($\alpha = .82$), test-retest reliability (ICC = 0.93), and SEM (1.47 points). Change in UWRI score was moderately correlated with the GROC ($r = 0.61$; 95% confidence interval: 0.4, 0.76). Floor and ceiling effects were absent. Completion required 3 minutes 15 seconds.

CONCLUSION—The UWRI is a reliable PRO measure and is responsive to changes in running function following an RRI, with minimal administrative burden.

LEVEL OF EVIDENCE—Therapy, level 2c.**Keywords**

patient-reported outcome measure; psychometric assessment; running injury

Running-related injuries (RRIs) include a heterogeneous collection of musculoskeletal injuries whose pain and physical limitations cause distance runners to miss competitive events, reduce training time, and receive medical care.^{22,30,48,52} To explain the RRI heterogeneity and variable precipitating factors, a conceptual framework has been proposed that incorporates tissue-specific load capacity and running-imposed load.⁴ Additionally, this conceptual framework acknowledges that stress, fatigue, or psychological factors may contribute to an individual's injury susceptibility. Athletic injuries, including RRIs, produce an emotional response, influenced by internal factors (eg, fear, confidence, motivation) or external factors (eg, coaches, teammates, parents, the competition schedule), that continues through the recovery process.^{1,15,45,57} Providers balance numerous considerations during rehabilitation, and the recovery from such injuries may not demonstrate equivalent rates of improvement for the different types of running (eg, daily runs, long runs, speed training, threshold intervals, races).^{2,42} Clinical assessments of running ability must account for an injury's disparate impact on different types of running and the dynamic nature of the multiple factors influencing the recovery process.

Patient-reported outcome (PRO) measures are the principal tool used by physical therapists to quantify limitations in functional ability and determine change in patient status due to clinical care.^{19,24} It is essential that PRO measures demonstrate efficiency and strong measurement properties, because these assessments influence subsequent clinical care decisions.⁴¹ A running-specific PRO measure does not currently exist. In the absence of a running-specific measure, PRO measures specific to a body region (eg, knee, hip) or condition (eg, Achilles tendinopathy, patellofemoral pain) are used to assess functional limitations imposed by RRIs.^{5,21,37,40,51,58} The psychometric properties of these PRO measures have not been assessed in a running population, and these measures may have limited evaluative capability, because the majority of items assess low-demand activities or fail to assess the multiple internal and external factors that influence recovery following an RRI.^{16,35,36} A running-specific PRO measure could potentially create a valid, reliable, and responsive assessment of running ability to measure RRI severity in prospective clinical studies and standardize clinical effectiveness evaluations in practice and research.^{11,29,47}

The purpose of this study was to develop a valid, reliable, and responsive evaluative PRO measure to assess longitudinal change in running ability after an RRI for clinical practice and research applications.

METHODS

The development of this new instrument consisted of 6 steps: (1) item generation, (2) item reduction, (3) item clarification and content validation, (4) preliminary evaluation and revision, (5) reliability assessment, and (6) psychometric assessment. For each step, an RRI was defined as a musculoskeletal problem resulting from running that required the

individual to prematurely stop running while training or during a competitive event or to miss a training session or competitive event.^{31,56} Rather than employ strict criteria, research participants were allowed to self-identify as a runner in an attempt to represent the diversity within the target population. Runners who suffered at least 1 RRI were recruited from running clubs, groups, and retail stores in Wisconsin and the surrounding states (steps 1–3 and 5). We recruited physicians, physical therapists, and running research experts with at least 5 years of experience conducting patient care in a specialized running clinic or publishing articles about RRIs in peer-reviewed journals through individual solicitation (step 3). Runners experiencing a current RRI were recruited from the UW Health Sports Medicine Runners Clinic (steps 4 and 6). The UW Health Sports Medicine Runners Clinic comprises physical therapists who are running experts and who use a shared decision-making process when performing running evaluations, including video gait assessments, and implementing multimodal intervention plans using a combination of therapeutic exercise, running gait modification, training recommendations, and footwear recommendations.⁴³ Patients frequently receive concurrent physical therapy care from a separate provider in the UW Health Sports Rehabilitation Clinic.

Questionnaire Development

Semi-structured telephone interviews conducted by a single interviewer (E.A.) explored the spectrum of the RRI experience and investigated how etiological factors influence the recovery process. Questions surveyed the injury description and associated pain, activities while injured, training and racing following injury, emotional impact, and recovery and expectations, and included an open-ended request for additional information. All responses were recorded, transcribed, and coded before generating partially overlapping potential items. Using an ordinal scale, participants assessed the relevance (0 is no, 1 is yes) and importance (1 is not important, 5 is very important) of each potential item. Items were ranked by the importance product, calculated as the sum of the importance scores divided by the sum of the relevance scores across participants.²⁶ Importance product ranking and expert review reduced the item pool to develop a draft questionnaire. Written comments related to the comprehension, clarity, and ease of responding to the draft questionnaire were sought during item clarification. To assess content validity, participants were asked whether the draft questionnaire comprehensively assessed the RRI recovery process.⁵⁵

Psychometric Assessment

The response distribution for each item was analyzed. Pearson correlation coefficients were calculated to determine how each item correlated with the total score, as well as the impact of removing any single item. An exploratory factor analysis using maximum likelihood with promax rotation was performed.⁵⁵ To include systematic sources of error, the intraclass correlation coefficient (ICC) for agreement evaluated test-retest reliability between paired assessments.³² Though response memory was possible between assessments, physiologic or neuromuscular change was unlikely, and longer response periods would have increased the likelihood that a change in running ability might occur. The standard error of measurement (SEM) for agreement was calculated to evaluate score stability between administrations, including systematic error, as $SD \times \sqrt{1 - ICC}$.⁵⁵ The coefficient (Cronbach's) alpha correlation was calculated to evaluate internal consistency for the collective tool and each

identified factor.^{6,55} Anchor-based validation assessments are a common approach to evaluate patient-reported change in measures that cannot be compared to a gold standard.⁵⁵ In the absence of a universal assessment of running ability, multiple comparison measures were used throughout this project. The Lower Extremity Functional Scale (LEFS) is a 20-item PRO measure, with the 80-point maximum composite score indicating higher functional ability.⁵ The numeric pain-rating scale (NPRS) is an 11-point (0–10) ordinal response scale with end-point descriptors of “no pain at all” and “worst possible pain.”⁹ The global rating of change (GROC) is an 11-point (–5 to +5) ordinal response scale with end-point descriptors of “very much worse” and “completely recovered.”²³ The strength of the associations between outcome measures was used to evaluate construct validity using the Pearson correlation coefficient. Correlation coefficients were considered good ($r > 0.75$), moderate ($0.50 < r \leq 0.75$), fair ($0.25 < r \leq 0.50$), and no association ($r \leq 0.25$).⁴⁴ Responsiveness was assessed as the average change in PRO score reported by individuals reporting improvement (GROC score of +4 or +5) and slight improvement (GROC score of +2 or +3), and was compared using a between-subject and within-subject approach, respectively.^{9,10} Statistical significance was set at $P < .05$. All analyses were performed using the psych, irr, psychometric, and xlsx packages in R software (R Foundation for Statistical Computing, Vienna, Austria).^{13,14,17,46,49}

The testing protocols were approved by the Health Sciences and the Education and Social/Behavioral Sciences Institutional Review Boards at the University of Wisconsin-Madison. Informed consent was obtained, and the rights of participants were protected in accordance with institutional policies.

RESULTS

Step 1: Item Generation

Sixteen runners who had suffered at least 1 RRI agreed to be interviewed. Five participants were elite or professional runners, and most had experience running on a team with an official coach at the high school (14/16), college (13/16), or postcollegiate (5/16) level. The authors conducted axial coding using interview question categories to identify how runners assess recovery. Data saturation occurred when interviews of recreational runners did not produce new themes. Forty-two potential items were generated.

Step 2: Item Reduction

A unique sample of 79 runners who had suffered at least 1 RRI completed paper surveys containing 42 potential items and importance product questions (ie, relevance and importance). Items were ranked by importance product, and items above the median were consistent with the primary factors identified in step 1. Items requiring skilled assessment were removed from the item pool. The RRI's impact in daily life was a critical recovery component identified in step 1; however, all items assessing specific nonrunning activities (eg, squatting, walking, etc) were below the median and consolidated into a single item. Items assessing crosstraining or physical fitness were removed because they do not directly assess running ability. The conceptual framework incorporating physical symptoms, running performance, and psychological responses was maintained when content consolidation

reduced the pool to 12 items. Individual interviews with 6 experts affirmed the relevance of 9 items, but suggested the removal of 3 items assessing interval training, event participation, and individual running goals, as these were not generally applicable or unlikely to assess the spectrum of recovery. Expert panelists provided consensus agreement that the remaining items comprehensively assessed clinically relevant components of postinjury running ability. The beta version of the 9-item University of Wisconsin Running Injury and Recovery Index (UWRI beta) included a 7-point numerical response, with unique written end-point descriptions for each item's response scale.³³ The instructions specified a 7-day recall period, and a hard-stop question restricted the completion of items 4 through 9 unless the individual ran during the preceding 7 days. A question to enforce the recall period was included because an individual may experience improvement when the medical management team advises abstinence from running.

Step 3: Item Clarification and Content Validation

A unique sample of 31 runners who had suffered at least 1 RRI provided comments regarding UWRI beta item clarity and content validity using an electronic form. Three research team members (E.N., M.R., G.T.) who were runners performed triangulation (by analyst) using open coding of all comments until data saturation. The UWRI beta was clear, easy to understand, and comprehensively assessed the recovery of running ability post injury. Participants suggested a 5-point response scale because it would be difficult to differentiate perceived changes in running status on the 7-point scale. A 5-point ordinal response system using checkboxes and written anchors at the midpoint and end points was created for each question.²⁰ Editorial changes that did not alter the item concept were made to 5 items, because greater than 10% of the sample commented on item syntax. Three participants recommended assessing concepts identified in step 1 that were below the median in step 2. Each item was scored from 0 to 4, with a maximum score of 36 indicating no deficit in running ability. If an individual had not run during the 7 days preceding completion of the UWRI beta, items 4 through 9 were scored as 0.

Step 4: Preliminary Evaluation and Revision

Individuals seeking physical therapy care at the UW Health Sports Medicine Runners Clinic for an RRI were invited to participate in a prospective, preliminary assessment of the UWRI beta. Inclusion criteria in this phase included being at least 14 years of age, able to read and write English, and of generally good health. Exclusion criteria included surgery for the injury in the past 12 months, rheumatologic disease, systemic connective tissue disorders, or clinical diagnosis of depression. A priori sample-size calculation indicated that 23 individuals would be needed to detect a correlation greater than zero, assuming $\alpha = .05$, $\beta = 20$, and $r = 0.55$.

Participants completed the UWRI beta, LEFS, and NPRS at the initial visit, prior to receiving physical therapy care, as is common practice in this population.^{5,8,9} To assess reliability, all participants were asked to complete the UWRI beta electronically 48 to 72 hours following the initial assessment. The UWRI beta, LEFS, NPRS, and GROC were electronically completed 8 weeks following the initial assessment, because measurable functional change is likely to occur in 8 weeks.^{7,12,39}

Thirty individuals (20 female) agreed to participate and entered the study following the informed-consent process (FIGURE). One individual withdrew for unknown reasons before completing any assessments, and 13 individuals were lost to follow-up, as they did not respond to requests to complete the short-term or 8-week assessment. Baseline characteristics were not different in those lost to follow-up. The age range of the participants was large and a variety of chronic RRIs reduced running volume (TABLE 1). The median UWRI beta score was 14 (range, 0–27) at the initial assessment and 24 (range, 6–34) at the final assessment, creating a statistically significant change in the Wilcoxon signed-rank test of paired data: 10 (range, –17 to 27) points ($P = .008$). The median LEFS score was 69 (range, 42–79) at the initial assessment and 77 (range, 46–80) at the final assessment, equating to a median change of 5.5 (range, –20 to 24) points that was not statistically significant ($P = .08$). The median NPRS score was 3 (range, 0–7) at the initial evaluation, 2 (range, 0–8) at the final assessment, and had a median change of –1 (range, –4 to 3) points that was not significant ($P = .37$). The median GROC score was 3 (range, –5 to 5). A good correlation was observed between the change in UWRI beta score over 8 weeks and the GROC ($r = 0.75$; 95% confidence interval [CI]: 39, 0.91; $P = .001$). The UWRI beta and LEFS demonstrated moderate correlation for change over the course of the study ($r = 0.55$; 95% CI: 0.05, 0.82; $P = .03$), as well as at the 8-week assessment ($r = 0.73$; 95% CI: 0.35, 0.9; $P = .002$). A correlation was not observed between the UWRI beta and LEFS at the initial assessment ($r = 0.04$; 95% CI: –0.33, 0.4; $P = .82$). A correlation between the UWRI beta and NPRS was not observed at any assessment. Individuals reporting significant clinical improvement on the GROC (+4 or +5) demonstrated a median UWRI change of 11.5 (range, 9–20) points and a median LEFS change of 5.5 (range, –2 to 15) points.²⁷ Three minutes 15 seconds were required to complete the UWRI beta.

Eighteen individuals completed the UWRI beta at the initial evaluation and at the day 2 assessment. The difference in their mean $\pm$ SD scores was 2.6 ± 5.7 and not significant ($P = .07$). The UWRI beta scores were moderately correlated between the 2 assessments (ICC = 0.56; 95% CI: 0.16, 0.81; $P = .004$). Cronbach's alpha for reproducibility showed acceptable internal consistency ($\alpha = .75$; 95% CI: .28, .93). The preliminary assessment revealed that the test-retest reliability of the UWRI beta was adversely affected, because items 4 through 9 were only presented if the person had run in the past 7 days. The UWRI beta was revised to create the UWRI, presenting all items on each administration (TABLE 2; APPENDIX, available at www.jospt.org). Written anchors accompanied each response option, and participants could select “unable to run” if the condition severity or medical recommendation prevented running.

Step 5: Reliability Assessment

Fifty-seven English-literate, self-identified adult runners in generally good health and with a single, current RRI participated in an evaluation of the UWRI test-retest reliability using a web-based survey. The sole exclusion criterion was having surgery at the injury site in the past 12 months. The web-based survey dissociated this assessment from clinical care because common RRI interventions, including gait retraining or educational interventions, may have immediate effects that influence perceived running ability.^{3,34} Fifty participants reported demographic information, injury duration and location, and current and preinjury

running volume, and completed the UWRI electronically on 2 occasions separated by 24 to 72 hours (TABLE 1). The UWRI test-retest reliability was excellent, with an ICC of 0.93 (95% CI: 0.89, 0.96; $P < .001$). Scores on the UWRI were not different between the 2 administrations ($P = .12$). The SEM was 1.47 points.

Step 6: Psychometric Assessment

Participants—Retrospective chart review of 513 patients from November 2012 to October 2017 was used to conduct a psychometric assessment. The UWRI and LEFS were administered according to standard clinical procedure during the initial encounter, and data on age, sex, running experience, and current running volume were collected (TABLE 1). The UWRI and GROC were completed electronically at least 8 weeks after the initial encounter. Follow-up data are limited to 50 patients because a systematic process was not implemented until May 2017.

Item Analysis—Responses to each UWRI item were distributed across the range of potential responses, and the composite UWRI score was centered at the middle value (TABLE 3). All items were correlated with the composite UWRI score at the initial ($r = 0.51$ – 0.72) and final ($r = 0.55$ – 0.86) assessments. Each item was responsive to change, and the item-specific change was correlated with the change in composite UWRI score ($r = 0.63$ – 0.85).

Internal Consistency—The exploratory factor analysis found that 51% of the variance was explained by 2 moderately correlated factors ($r = 0.46$). Factor 1 (items 6–8) explained 26% of the variance and factor 2 explained 25% of the variance (TABLE 4). Cronbach's alpha for the UWRI composite score was .82 (TABLE 5).

Construct Validity—In addition to the initial UWRI, 50 people completed the GROC and a second evaluation of the UWRI. A statistically significant, moderate correlation was observed between the change in UWRI score and the patient-reported change on the GROC ($r = 0.61$; 95% CI: 0.4, 0.76; $P < .001$). A paired-samples t test showed a statistically significant difference between the initial and final UWRI scores ($P < .001$). The correlation of the changes in UWRI and LEFS scores was not calculated due to the limited quantity of paired data.

Responsiveness—Individuals reporting significant clinical improvement demonstrated greater change in UWRI score than those reporting slight clinical improvement ($P = .01$) (TABLE 5).²⁷ At the initial assessment, the maximum score was achieved in 1/451 (0.21%) and 44/354 (12.43%) participants completing the UWRI and LEFS, respectively, whereas the minimum UWRI or LEFS score was not achieved. At the initial evaluation, the average LEFS score was 70.75 out of 80 possible points.

DISCUSSION

The purpose of this study was to develop a valid, reliable, and responsive evaluative PRO measure to assess longitudinal change in running ability after an RRI for clinical practice and research applications. After sustaining an RRI, runners monitor symptoms and manage

the dynamic psychological response during physiologic healing and the progressive physiologic adaptation to restore preinjury performance. The 9-item UWRI accounts for how runners assess running ability through 2 components, running progression and symptom surveillance. Running progression (items 6–8) involves assessing different aspects of running through weekly volume, long-run distance, and running pace, which are unique components in the load application framework proposed by Bertelsen and colleagues.⁴ Symptom surveillance incorporates how runners monitor symptoms while running (item 4), assess training response (items 1, 3, and 5), and describe the psychological response (items 2 and 9). Though different levels of running performance and experience create disparity in what is considered normal running, runners monitor symptoms to make informed training decisions.

Elite and competitive runners make a significant investment in their running careers and described elaborate, individualized schema for symptom monitoring and profound psychological responses following injury. Nonelite and recreational runners described succinct symptom monitoring processes and greater willingness to abstain from running. Commonalities in symptom surveillance themes were illuminated during item reduction. Predictably, runners monitor symptoms while running, but runners of all performance levels frequently monitor symptoms between running sessions to determine readiness for future training. Psychological responses are inherently individualized; however, frustration is a common emotion that runners experience during recovery. The progressive increase in an athlete's confidence following injury is known to play an important role in the successful return to sport, and runners consistently reported that their running ability was fully restored when they established the confidence to train without fear of reinjury.^{25,59} The UWRI is a parsimonious, clinically relevant measure reflecting runners' self-assessment of running ability and how they subsequently make decisions during the RRI recovery process.³⁸

The iterative development process incorporated the target population and produced a sample with injury and runner characteristics that are consistent with other RRI studies.^{28,54,56} Including the target population enhanced the UWRI's content validity and enabled data triangulation by source and method to ensure that the UWRI items accurately and comprehensively represent the recovery of distance-running ability following injury.⁵⁵ Participants and expert reviewers concluded that the UWRI was composed of comprehensible items that are likely to measure the construct due to their detailed, running-specific nature, while acknowledging the psychological factors associated with recovery. The 5-item response structure was chosen because it was preferred by the target population and is less burdensome to respondents than visual analog scales.²⁰ Participant responses showed that the items differentiate levels of function when used in a clinical setting and are responsive to change over time. Clinical implementation is enhanced by the low administration burden, short completion time, and simple scoring.

During preliminary testing (step 4), the UWRI beta test-retest reliability was adversely affected by a hard-stop question that blocked access to items 4 through 9 when the participant had not run during the prior 7 days. Excellent test-retest reliability was observed following modifications to present all items during each administration. The error associated with a single score was less than 2 points in the total UWRI score. It was logical to create a

single composite score because the 2 correlated subscales collectively reflect the typical process runners use to gauge their running ability during recovery, which is the primary intent of the UWRI. The internal consistency of the UWRI, and that of each component factor, was within the accepted range during all clinical evaluations, indicating that item correlation was present without item redundancy.⁶

Construct-related validity was evaluated by comparing the change observed in the UWRI score with measures commonly used to assess RRI. The UWRI demonstrated the ability to assess changes in self-reported running ability, and the change in the UWRI total score was correlated with the changes measured by the GROC. The association between the UWRI and LEFS varied throughout the steps of this study, and the LEFS may not have the capacity to respond to functional improvements, because the initial evaluation scores were skewed toward the maximum potential score. The observed moderate associations were anticipated because the UWRI was designed to be a more critical assessment of running function than other PRO measures with greater temporal stability than the GROC.^{18,53}

The UWRI was responsive to change, because individuals reporting clinically meaningful improvements on the GROC scale also reported greater change in UWRI scores than those reporting slight or no change.^{50,55} Heightened responsiveness is further supported by the absence of UWRI ceiling or floor effects. The LEFS demonstrated a ceiling effect during step 4 and approached this threshold in the large data set used in step 6.⁵⁵ Responsiveness of the LEFS is further questioned because the majority of respondents, at the initial evaluation, had a score that was too high to achieve the 9-point minimum detectable change.⁵ The iterative process used to develop the UWRI enhanced the specificity to running and produced a PRO measure capable of measuring changes in running ability regardless of body region or type of injury.

The strengths of this study include the repeated integration of the target population during item development, psychometric assessment of the UWRI using participants from the target population, and the involvement of multiple stakeholders in the development process. The sample population included a diverse representation of age, experience, running volume, speed, and injury. There are several limitations of this study, including participants lost to follow-up during prospective steps and the use of a retrospective design to conduct a psychometric assessment with clinical data. Further psychometric evaluation is warranted to evaluate the construct validity in combination with measures of running ability and other PRO measures. Clinically useful assessments of responsiveness, including minimum detectable change and minimal clinically important difference, may be determined in future studies. Future studies should also provide a better understanding of how the UWRI measures change in running ability for different performance abilities or injury types.

CONCLUSION

The UWRI is a reliable evaluative measure assessing running ability following an RRI, with minimal administrative burden. Content and construct-related validity assessments indicate that the UWRI is a more exacting evaluation of running ability than are other PRO measures currently used in this population. Continued psychometric evaluation in prospective clinical

studies is warranted, because this novel measure of running ability is responsive to patient-perceived functional change.

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APPENDIX

UNIVERSITY OF WISCONSIN RUNNING INJURY AND RECOVERY INDEX					
Instructions: Consider your current running injury over the past 7 days when answering each question; check (☐) the appropriate box.					
1. How does your running injury impact your ability to perform daily activities?	☐ No impact	☐ Slightly impact	☐ Moderately impact	☐ Significantly impact	☐ Unable to perform
2. How frustrated are you by your running injury?	☐ Not frustrated	☐ Mildly frustrated	☐ Moderately frustrated	☐ Significantly frustrated	☐ Extremely frustrated
3. How much recovery have you made from your running injury?	☐ Complete recovery	☐ Significant recovery	☐ Moderate recovery	☐ Minimal recovery	☐ No recovery
4. How much pain do you experience while running?	☐ No pain	☐ Minimal pain	☐ Moderate pain	☐ Significant pain	☐ Unable to run
5. How much pain do you experience during the 24 hours following a run?	☐ No pain	☐ Minimal pain	☐ Moderate pain	☐ Significant pain	☐ Unable to run
6. How has your weekly mileage or weekly running time changed as a result of your injury?	☐ Same or greater than before my injury	☐ Minimally reduced	☐ Moderately reduced	☐ Significantly reduced	☐ Unable to run
7. How has the distance of your longest weekly run changed as a result of your injury?	☐ Same or longer than before my injury	☐ Minimally reduced	☐ Moderately reduced	☐ Significantly reduced	☐ Unable to run
8. How has your running pace or speed changed as a result of your injury?	☐ Same or faster than before my injury	☐ Minimally reduced	☐ Moderately reduced	☐ Significantly reduced	☐ Unable to run
9. How does your injury affect your confidence to increase the duration or intensity of your running?	☐ Confident to increase my running	☐ If I increase, I might be fine	☐ Neutral	☐ If I increase, I might get worse	☐ I cannot increase my running

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KEY POINTS**FINDINGS**

The University of Wisconsin Running Injury and Recovery Index (UWRI) is a novel, running-specific patient-reported outcome measure reflecting how runners assess their own running ability while recovering from a running-related injury. The UWRI is a reliable assessment that can measure the change in running ability during an episode of care.

IMPLICATIONS

The UWRI systematically assesses postinjury distance-running ability with very little burden on providers or patients.

CAUTION

Construct-related validity and responsiveness require additional prospective, psychometric assessment conducted in combination with clinical care.

FIGURE.

Participant flow diagram. Abbreviations: GROC, global rating of change; LEFS, Lower Extremity Functional Scale; PRO, patient-reported outcome; UWRI, University of Wisconsin Running Injury and Recovery Index.

TABLE 1

Participant Demographics*

	Step 4: Preliminary Evaluation	Step 5: Reliability Assessment	Step 6: Psychometric Assessment
n	30	50	513
Age, y	36.9 ± 11.0 (15–57)	33.4 ± 8.4 (20–54)	35.4 ± 12.9 (12–74)
Sex, n (%)			
Female	20 (66.7)	32 (64)	296 (57.7)
Male	10 (33.3)	18 (36)	217 (42.3)
Running experience, y	2.4 ± 1.2	9.9 ± 7.2	11.5 ± 10.7
Symptom duration, mo	8.8 ± 9.9	2.8 ± 1.7	NA
Current running volume, km/wk	21.9 ± 26.1	31.7 ± 26.3	276 ± 21.1
Preinjury running volume, km/wk	372 ± 24.6	577 ± 35.4	NA
Injury location, n (%)	40 (100)	50 (100)	NA
Lumbopelvic	4 (10)	4 (8)	
Hip or thigh	6 (15)	10 (20)	
Knee	14 (35)	8 (16)	
Leg or calf	6 (15)	4 (8)	
Ankle	2 (5)	7 (14)	
Foot	8 (20)	13 (26)	
Other	0 (0)	4 (8)	

Abbreviation: NA, not available.

* Values are mean ± SD or mean ± SD (range) unless otherwise indicated.

TABLE 2

Items Included in the University of Wisconsin Running Injury and Recovery Index

Item	Included in Beta Version	Included in Final Version
How does your running injury impact your ability to perform daily activities?	Yes	Yes
How frustrated are you by your running injury?	Yes	Yes
How much recovery have you made from your running injury?	Yes	Yes
Have you run in the past 7 days?	Yes	No
How much pain do you experience while running?	Yes	Yes
How much pain do you experience during the 24 hours following a run?	Yes	Yes
How has your weekly mileage or weekly running time changed as a result of your injury?	Yes	Yes
How has the distance of your longest weekly run changed as a result of your injury?	Yes	Yes
How has your running pace or speed changed as a result of your injury?	Yes	Yes
How does your injury affect your confidence to increase the duration or intensity of your running?	Yes	Yes

Item Analysis of the University of Wisconsin Running Injury and Recovery Index From Step 6: Psychometric Assessment*

TABLE 3

Item	Initial	Final	Change
1	3.12 ± 0.89	3.80 ± 0.63	0.16 ± 1.78
2	1.51 ± 1.10	2.50 ± 1.18	0.76 ± 1.23
3	1.85 ± 1.04	2.70 ± 0.82	1.04 ± 1.14
4	2.39 ± 1.00	3.33 ± 0.50	0.60 ± 0.91
5	2.53 ± 0.95	3.00 ± 0.67	0.52 ± 1.05
6	1.44 ± 1.13	2.30 ± 1.16	0.92 ± 1.12
7	1.50 ± 1.21	2.20 ± 1.23	1.16 ± 1.21
8	1.97 ± 1.26	3.10 ± 0.74	0.60 ± 1.22
9	1.23 ± 1.07	2.60 ± 1.26	1.44 ± 1.63
Score	17.71 ± 6.14	2707 ± 6.63	7.37 ± 784

* Values are mean ± SD.

Factor Loading of University of Wisconsin Running Injury and Recovery Index Items From Step 6: Psychometric Assessment Initial Evaluations

TABLE 4

Item	Factor 1	Factor 2
1	-0.04	0.53
2	0.25	0.51
3	-0.21	0.71
4	0.03	0.66
5	-0.08	0.69
6	0.95	-0.05
7	0.95	-0.06
8	0.68	0.10
9	0.09	0.55

TABLE 5
Psychometric Properties of the University of Wisconsin Running Injury and Recovery Index*

	Step 4: Preliminary Evaluation	Step 5: Reliability Assessment	Step 6: Psychometric Assessment
Item analysis [‡]	$r = 0.36-0.81$	$r = 0.47-0.82$	$r = 0.43-0.71$
Internal consistency			
Factor 1	$\alpha = .75 (.28, .93)$	$\alpha = .83 (.76, .89)$	$\alpha = .82 (.80, .84)$
Factor 2	$\alpha = .81 (.71, .93)$	$\alpha = .88 (.81, .94)$	$\alpha = .89 (.87, .91)$
Factor 2	$\alpha = .72 (.56, .88)$	$\alpha = .74 (.62, .85)$	$\alpha = .78 (.74, .80)$
Reproducibility			
ICC (agreement)	0.56 (0.16, 0.81)	0.93 (0.89, 0.96)	NA
SEM (agreement)	4.46	1.47	NA
Construct validity			
UWRI change – GROC	$r = 0.75 (0.39, 0.91)$	NA	$r = 0.61 (0.4, 0.76)$
Responsiveness			
UWRI: significant improvement [‡]	13.33 ± 4.93	NA	9.38 ± 5.78
UWRI: slight improvement [‡]	10.42 ± 10.31	NA	4.5 ± 7.55
Ceiling effect [§]	UWRI, 0%; LEFS, 25%	UWRI, 0%	UWRI, 0.22%; LEFS, 12.43%
Floor effect [§]	UWRI, 3.45%; LEFS, 0%	UWRI, 0%	UWRI, 0%; LEFS, 0%

Abbreviations: GROC, global rating of change; ICC, intraclass correlation coefficient; LEFS, Lower Extremity Functional Scale; NA, not available; SEM, standard error of measurement; UWRI, University of Wisconsin Running Injury and Recovery Index.

*Values in parentheses are 95% confidence interval.

[‡]Range of item response (total score).

[‡]Values are mean $\pm$ SD. Significant improvement, GROC of +4 or +5; slight improvement, GROC of +2 or +3.

[§]Ceiling and floor effects are calculated as the percent of respondents achieving the maximum and minimum composite scores, respectively.