



Original Research

Reliability, minimal detectable change, and responsiveness of the Quick-FAAM[☆]Johanna M. Hoch^{a, *}, Cameron J. Powden^b, Matthew C. Hoch^c^a 206A Charles Wethington Building, University of Kentucky, 900 South Limestone Street, Lexington, KY 40536, United States^b Room A10, Indiana State University, 567 N 5th Street, Terre Haute, IN 47809, United States^c 206B Charles Wethington Building, University of Kentucky, 900 South Limestone Street, Lexington, KY 40536, United States

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ABSTRACT

Objective: To determine the test-retest reliability, minimal detectable change (MDC) and responsiveness of the Quick-FAAM in people with chronic ankle instability (CAI).**Design:** 10-week controlled laboratory study.**Setting:** Laboratory.**Participants:** A total of 20 adults with self-reported CAI.**Main outcome measures:** Participants completed a supervised 4-week intervention. The Quick-FAAM was assessed 4-weeks before the intervention (T1), prior to the first intervention (T2), 24-h post-intervention (T3), and 2-weeks after the intervention (T4). The Quick-FAAM is a 12-item region specific PRO scored on 5-point Likert scale, often reported as a percentage, and a lower percentage indicates decreased ankle function. Test-retest reliability was determined using Intraclass-correlation coefficients (ICC_{2,1}) and standard error of measure (SEM). The MDC was calculated using the equation: $SEM \times \sqrt{2}$. Hedges g effect sizes and associated 95% confidence intervals (95%CI) were calculated as a measure of group responsiveness.**Results:** The test-retest reliability was clinically acceptable (ICC_{2,1} = 0.82, SEM = 4.56). The MDC was 6.5% and pre-post intervention effect sizes were large between T2-T3 (ES = 1.27, 95%CI:0.59–1.95) and T2-T4 (ES = 1.49, 95%CI:0.79–2.19).**Conclusion:** The Quick-FAAM demonstrated clinically acceptable reliability and was responsive to treatment. Future research should examine these properties in patients with acute ankle and foot conditions, determine patient acceptability, and clinician feasibility.

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1. Introduction

Rehabilitation specialists are encouraged to provide patient-centered, whole person health care that integrates the patient's perceptions, needs, and values in to the rehabilitation plan (Snyder, Valovich McLeod, & Sauer, 2007; Snyder et al., 2008; Valovich McLeod et al., 2008). In addition, clinician scientists are urged to disseminate patient-oriented evidence, which provides rehabilitation specialists with evidence of treatment effectiveness from the

patient's perspective (Jette, 1995; Valovich McLeod et al., 2008). Essential to both patient-centered care and patient-oriented evidence are patient-reported outcome instruments (PROs). These instruments are self-report surveys that are completed by the patient at initial evaluation and various time points throughout rehabilitation (Michener, 2011; Valovich McLeod et al., 2008). In addition, PROs allow for a systematic and reproducible way to capture the patient's perspective of their current health condition and to determine treatment effectiveness. However, there are many barriers to the administration of PROs in clinical practice. Athletic trainers and physical therapists report length of completion time, patient difficulty, and time to analyze as barriers to PRO implementation in routine clinical practice (Jette, Halbert, Iverson, Micheli, & Shah, 2009; Snyder Valier, Jennings, Parsons, & Vela, 2014). In order to increase utilization and decrease the reported barriers, researchers have developed shortened versions of some

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commonly utilized instruments (Beaton, Wright, Katz, & Group, 2005; Hoch, Hoch, & Houston, 2016; Ware, Kosinski, & Keller, 1996) and explored other types of methodologies such as computerized adaptive technologies (Hung et al., 2012).

The Foot and Ankle Ability Measure (FAAM) (Martin, Irrgang, Burdett, Conti, & Van Swearingen, 2005) is a region specific PRO that has been used in the treatment and research of patients with a variety of foot, ankle, and toe conditions. The FAAM has been utilized extensively in the chronic ankle instability (CAI) literature (Houston, Hoch, & Hoch, 2015; Powden, Hoch, & Hoch, 2017), and is even recommended by the International Ankle Consortium as an outcome and classification tool for patients with CAI (Gribble et al., 2014). However, the FAAM is lengthy, with a total of 29 items across two subscales, and thus may be a burdensome for the patients and clinicians. The Quick-FAAM is a shortened version of the FAAM and includes 12-items from both of the original subscales (Hoch et al., 2016). Previous literature has described the development of the Quick-FAAM, internal consistency, convergent validity, and divergent validity (Hoch, Legner, Lorete, & Hoch, 2017; Hoch et al., 2016); however, additional psychometric properties such as responsiveness and test-retest reliability were not determined. These psychometric properties must be determined in order for clinicians and scientists to more confidently integrate this instrument in to routine examinations and investigations and determine thresholds for clinically relevant changes when applied as a rehabilitation outcome measure. Therefore, the purpose of this study was to determine the test-retest reliability, minimal detectable change (MDC) and responsiveness of the Quick-FAAM in patients with CAI.

2. Materials and methods

2.1. Design and participants

A total of 20 participants (24.35 ± 6.95 years, 169.29 ± 10 cm, 70.58 ± 12.9 kgs) participated in this controlled laboratory study and were included in this analysis. The participants were recruited by word of mouth and through both electronic and poster announcements. Participants were included if they were physically active (>24 Godin Leisure-Time Exercise Questionnaire) adults (ages 18–45) with a history of ≤ 1 ankle sprain at least 6 months prior to study initiation and ≥ 2 episodes of giving way in the past 3 months. The participants also had to answer “yes” to ≥ 5 questions on the Ankle Instability Instrument and ≤ 24 on the Cumberland Ankle Instability Tool (CAIT) (Gribble et al., 2014). Participants were excluded if they had an ankle sprain less than 6 weeks before study participation, a lower extremity injury within the last 6 months, a history of any type of lower extremity surgery, or a condition that may affect their balance. All study procedures were approved by the institution's IRB and all subjects signed an approved informed consent prior to participation.

2.2. Procedures

After informed consent and assessment of inclusion criteria, the participants completed the Quick-FAAM. The participants reported to the laboratory on four separate occasions over the course of 10 weeks. The baseline (T1) and pre-intervention data collection (T2) sessions were separated by 4-weeks of normal activity. Immediately after T2, the participants completed the 4-week intervention. Within 24–48 h of completion of the intervention, the participants completed the post-intervention data collection session (T3). Finally, the participants reported back to the laboratory 2-weeks after cessation of the intervention for a follow-up data collection session (T4). The participants completed the Quick-FAAM prior to each of the data collection sessions.

2.3. Intervention

All included participants completed a multi-modal intervention that has been previously described (C. Powden, Hoch, Jamlai, & Hoch, 2018). Briefly, the participants completed 12 supervised sessions in the laboratory which included application of talocrural joint mobilizations, balance training, and ankle strengthening administered by an athletic trainer (Powden et al., 2018). The participants also completed a daily home exercise program which consisted of gastrocnemius-soleus complex stretching and ankle strengthening (Powden et al., 2018). The participants logged their exercise compliance and were reminded to complete their home exercises during the supervised rehabilitation sessions (Powden et al., 2018).

2.4. Instrumentation

The Quick-FAAM is a 12-item, region specific PRO developed from the original FAAM (Hoch et al., 2016). The 12-items represent 7-items from the original Sport subscale, and 5-items from the original ADL (Hoch et al., 2016). In the original development work, the Quick-FAAM demonstrated excellent internal consistency ($\alpha = 0.94$), and good convergent validity with the original FAAM ($r = 0.95$, $r2 = 0.90$), and the SF-12 physical component summary ($r = 0.45$, $r2 = 0.20$) (Hoch et al., 2016). It also had a weak correlation with the SF-12 mental component summary ($r = 0.14$, $r2 = 0.02$), demonstrating good divergent validity (Hoch et al., 2016). The Quick-FAAM psychometric properties have also been examined in acute and sub-acute ankle and foot conditions (Hoch et al., 2017).

2.5. Statistical analysis

Means and standard deviations (\pm SD) were calculated for each of the time points (T1-T4). Two subjects did not complete the Quick-FAAM at T1, therefore only 18 subjects were included in the 4-week test-retest reliability analysis. Intraclass correlation coefficients ($ICC_{2,1}$) and standard error of measure (SEM) were used to examine the test-retest reliability between T1 and T2. The minimal detectable change (MDC) was calculated using the equation $MDC = SEM * \sqrt{2}$ (Beaton, Bombardier, Katz, & Wright, 2001; Wyrwich, Tierney, & Wolinsky, 1999). We examined responsiveness on an individual level by determining the number of participants (percentage) that exceed the calculated MDC at T3 and T4 when compared to T2. Finally, group responsiveness was examined using Hedges g effect sizes and 95% confidence intervals (CI) between time points T2, T3, and T4 for all 20 participants. All statistics were performed in SPSS version 21 or Microsoft excel. Where applicable, alpha was set a priori $p < 0.05$.

3. Results

The means (\pm SD) for each time point are in Table 1. The test-retest reliability was clinically acceptable, with an $ICC_{2,1} = 0.82$ and a SEM of 4.56%. The calculated MDC was 6.5%. When examining

Table 1
Quick-FAAM means and standard deviations (\pm SD) for each of the four time points (T1-T4).

Time Point	Mean (\pm SD)
T1	75.12 \pm 11.64
T2	79.38 \pm 11.33
T3	91.88 \pm 7.64
T4	93.3 \pm 6.32

responsiveness at the individual level, a total of 15 participants (75%) exceed the MDC at T3, and a total of 17 participants (85%) exceed the MDC at T4. In regards to group responsiveness, the effect sizes for both T2-T3 (1.27, 95%CI = 0.59–1.96) and T2-T4 (1.49, 95% CI = 0.79–2.19) were large. Finally, mean group differences between T2 and T3 (12.5%), and T2-and T4 (13%) exceeded the calculated MDC.

4. Discussion

The purpose of this investigation was to examine the test-retest reliability and responsiveness of the Quick-FAAM for application in future clinical practice. Additionally, we aimed to calculate the MDC value to further interpret treatment effectiveness when providing care to patients with CAI. Our results indicate the Quick-FAAM has clinically acceptable test-retest reliability and is responsive over the course of a 4-week rehabilitation program for patients with CAI. Furthermore, a change in $\pm 6.5\%$ indicates true change has occurred, beyond measurement error.

The examination of test-retest reliability is important for PRO implementation, as the results should be reproducible when no change is expected to have occurred. The Quick-FAAM has acceptable test-retest reliability, in addition to previously determined good internal consistency (Hoch et al., 2016). This instrument is suitable for implementation in clinical practice when treating patients with CAI as the results were reproducible when we did not expect the included participants condition to change (T1-T2). Given the nature of the study design, we calculated a 4-week test re-test reliability. This length of time between the two reliability time points may be more applicable to clinical practice. This length of time is similar to that in the original FAAM development studies, where the FAAM-Activities of Daily Living (ICC = 0.89) and FAAM-Sport (ICC = 0.87) subscales had higher test-retest reliability (Martin, Irrgang, Burdett, Conti, & Swearingen, 2005). While the FAAM is the most common region-specific instrument utilized in CAI rehabilitation to date (Houston et al., 2015; Powden et al., 2017), we recommend clinicians and scientists explore the use of the Quick-FAAM in future research and clinical practice.

In contrast to test-retest reliability, an instrument suitable for clinical use should detect change over time; improving when the patient's health condition improves and vice versa. The Quick-FAAM exhibited a small effect size during the non-treatment phase of the study (T1-T2) and large effect sizes after treatment (T2-T3) which continued at the follow-up measurement (T2-T4). Of further importance are the individual and group responder analyses. A total of 75% or more of the participants had increased Quick-FAAM scores at T3 or T4 when compared to T2. The group mean improvements in Quick-FAAM also exceeded the calculated MDC of 6.5%. This response is similar to the response of the FAAM, which was included in the seminal work of this study and previously reported (Powden et al., 2018). Powden et al. reported the FAAM-Sport and ADL had large effect sizes, which also exceed the calculated MDC for both T2-T3 and T2-T4 time points (Powden et al., 2018). Furthermore, in the original development work of the FAAM, Martin et al. (Martin et al., 2005) determined that the instrument was responsive to change in patients with a variety of foot and ankle conditions. We recommend future research and clinical practice include the Quick-FAAM as the region specific PRO to examine treatment effectiveness. The length of the instrument, coupled with the development for use specifically for CAI patients may address some of the reported barriers for utilization of PROs in clinical practice.

This research is not without limitations. First, the clinician who treated the CAI patients included in this study was not blinded to the patient outcomes. Also, we anticipated that all participants

included in this study would demonstrate Quick-FAAM improvements following the intervention. Future research should consider blinding the treating clinician to outcome scores to limit bias and examining responsiveness in instances when improvement is not anticipated. In addition, this report did not examine all of the psychometric properties that must be taken in to consideration when selecting an instrument for practice. While the convergent and divergent validity, test-retest reliability, responsiveness and interpretability have been determined for the Quick-FAAM, additional psychometric testing is warranted. Specifically, researchers need to determine whether or not this instrument is acceptable to patients and clinicians, and feasible to implement in clinical practice.

5. Conclusion

The Quick-FAAM has acceptable test-retest reliability over a 4-week period, and is responsive to change throughout a 4-week evidence based treatment plan. This was determined based on both an individual and group analysis. While the original FAAM has been utilized extensively in the CAI literature (Houston et al., 2015; Powden et al., 2017), and is recommended as an inclusionary criterion for classifying CAI patients; we recommend the use of the Quick-FAAM in future research and clinical practice. This shorter, responsive instrument may address some of the barriers identified for physical therapists and athletic trainers that treat patients with this condition. The implementation of this instrument in practice will assist clinicians in providing whole-person, patient centered care and allow for the examination of treatment effectiveness from the patient's perspective. Future research should explore additional psychometric properties of this instrument, and further examine these psychometric properties in patients seeking treatment for acute or sub-acute foot and ankle health conditions.

Ethical approval

The work presented was approved by the institutions IRB. All participants provided their signed informed consent prior to their participation.

Conflicts of interest

None declared.

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References

- Beaton, D. E., Bombardier, C., Katz, J. N., & Wright, J. G. (2001). A taxonomy for responsiveness. *Journal of Clinical Epidemiology*, 54(12), 1204–1217.
- Beaton, D., Wright, J., Katz, J., & Group, U. E. C. (2005). Development of the Quick-DASH: Comparison of three item-reduction approaches. *Journal of Bone and Joint Surgery American*, 87(5), 1038–1046.
- Gribble, P. A., Delahunt, E., Bleakley, C., Caulfield, B., Docherty, C. L., Fourchet, F., ... McKeon, P. O. (2014). Selection criteria for patients with chronic ankle instability in controlled research: A position statement of the International Ankle Consortium. *British Journal of Sports Medicine*, 48(13), 1014–1018.
- Hoch, M. C., Hoch, J. M., & Houston, M. N. (2016). Development of the quick-FAAM: A preliminary shortened version of the foot and ankle ability measure for chronic ankle instability. *International Journal of Athletic Therapy & Training*, 21(4), 45–50. <https://doi.org/10.1123/ijatt.2016-0002>.

- Hoch, J. M., Legner, J. L., Lorete, C. J., & Hoch, M. C. (2017). The validity of the Quick-FAAM in patients seeking treatment for an acute or subacute foot or ankle condition. *Journal of Sport Rehabilitation*. <https://doi.org/10.1123/jsr.2016-0089>.
- Houston, M., Hoch, J., & Hoch, M. (2015). Patient-reported outcome measures in individuals with chronic ankle instability: A systematic review. *Journal of Athletic Training*, 50(10), 1019–1033.
- Hung, M., Nickisch, F., Beals, T. C., Greene, T., Clegg, D. O., & Saltzamn, C. L. (2012). New paradigm for patient-reported outcomes assessment in foot & ankle research: Computerized adaptive testing. *Foot & Ankle International*, 33(8), 621–626.
- Jette, A. M. (1995). Outcomes research: Shifting the dominant research paradigm in physical therapy. *Physical Therapy*, 75(11), 965–970.
- Jette, D. U., Halbert, J., Iverson, C., Micheli, E., & Shah, P. (2009). Use of standardized outcome measures in physical therapist practice: Perceptions and applications. *Physical Therapy*, 89(2), 125–135.
- Martin, R. L., Irrgang, J. J., Burdett, R. G., Conti, S. F., & Van Swearingen, J. M. (2005). Evidence of validity for the foot and ankle ability measure (FAAM). *Foot & Ankle International*, 26(11), 968–983. doi:905748 [pii].
- Michener, L. A. (2011). Patient- and clinician-rated outcome measures for clinical decision making in rehabilitation. *Journal of Sport Rehabilitation*, 20, 37–45.
- Powden, C. J., Hoch, J. M., & Hoch, M. C. (2017). Rehabilitation and improvement of health-related quality of life detriments in individuals with chronic ankle instability: A meta-analysis. *Journal of Athletic Training*, 52(8), 753–765.
- Powden, C., Hoch, J., Jamlai, B., & Hoch, M. (2018). Effects of a 4-week multimodal intervention on disease-oriented and patient-oriented outcomes in individuals with chronic ankle instability. *Journal of Athletic Training*. accepted, February 2018.
- Snyder Valier, A. R., Jennings, A. L., Parsons, J. T., & Vela, L. I. (2014). Benefits of and barriers to using patient-rated outcome measures in athletic training. *Journal of Athletic Training*, 49(5), 674–683.
- Snyder, A. R., Valovich McLeod, T. C., & Sauers, E. L. (2007). Defining, valuing, and teaching clinical outcomes assessment in professional and post-professional athletic training education programs. *Athletic Training Education Journal*, 2(2), 31–41.
- Snyder, A. R., Parsons, J. T., Valovich McLeod, T. C., Curtis Bay, R., Michener, L. A., ... Sauers, E. L. (2008). Using disablement models and clinical outcomes assessment to enable evidence-based athletic training practice, part I: Disablement models. *Journal of Athletic Training*, 43(4), 428–436. <https://doi.org/10.4085/1062-6050-43.4.428>.
- Valovich McLeod, T. C., Snyder, A. R., Parsons, J. T., Bay, R. C., Michener, L. A., & Sauers, E. L. (2008). Using disablement models and clinical outcomes assessment to enable evidence-based athletic training practice, Part II: Clinical outcomes assessment. *Journal of Athletic Training*, 43(4), 437–445.
- Ware, J. E., Kosinski, M., & Keller, S. D. (1996). A 12-item short-form health survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care*, 34(3), 220–233.
- Wyrwich, K. W., Tierney, W. M., & Wolinsky, F. D. (1999). Further evidence supporting an SEM-based criterion for identifying meaningful intra-individual changes in health-related quality of life. *Journal of Clinical Epidemiology*, 52(9), 861–873.