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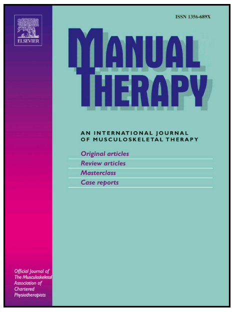

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Inexperienced examiners and the Foot Posture Index: a reliability study

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Abstract

The Foot Posture Index (FPI-6) is a reliable (experienced examiners) assessment tool used in clinical practice to classify foot posture. No work has been completed to determine the reliability of the FPI-6 between novice examiners. Therefore, the aim was to determine the inter-examiner reliability of the FPI-6 using two novice examiners (graduate level osteopathy students). The FPI-6 was used to classify the feet of 83 students recruited as part of a larger study. Data were collected simultaneously by both examiners, but there was no communication between them. The scoring system provided by the FPI-6 manual was used to assess all feet. Collated data were assessed between examiners for reliability based on raw, transformed and foot type scores. The inter-examiner reliability was high for both left ($ICC_{2,1}$=0.86) and right ($ICC_{2,1}$=0.85) feet for the novice examiners. When data were assessed based on foot type classification the examiners agreed on 76% of the left feet and 82% of the right feet with Kappa values of 0.73 and 0.72 respectively. The FPI-6 is a robust clinical tool that can be reliably utilised by inexperienced clinicians.

Keywords

FPI-6, reliability, evaluation, novice

INTRODUCTION

The Foot Posture Index (FPI-6) is a clinical assessment tool used to classify foot posture. Developed by Redmond et al. (2006), the FPI-6 is predominantly used in podiatry, but has applications across manual therapy. The tool requires the subjective assessment of six parameters of the foot/ankle complex whilst the patient stands bilaterally in a static position. Redmond et al. (2008) have reported descriptive norms pooled from various data collection centres. These normative values indicate a value of +4 (slightly pronated foot) is the most common foot type classification.

The FPI-6 has been shown to possess good inter-examiner reliability between experienced clinicians (Morrison and Ferrari, 2009; weighted kappa (Kw) = 0.86), with lower reliability between clinicians of different levels of experience (Cornwall et al., 2008; ICC = 0.52-0.62, Evans et al., 2013; ICC = 0.71-0.86). The subjectivity of the examiner influences the final score and therefore classification of foot type. When two or more examiners assess the same patient, this subjectivity has an influence on the perceived reliability of the FPI-6. Inter-examiner reliability of the FPI-6 is the focus of the current paper as previous studies have demonstrated high intra-examiner reliability (>0.90) regardless of experience level (Cornwall et al. , 2008, Evans et al. , 2012). Evans et al. (2012) demonstrated *substantial* to *almost perfect* agreement between an experienced and novice clinician for analysis of children's feet using FPI-6. As yet, no previous work has assessed inter-examiner reliability using novice clinicians only.

METHODS

Participants were recruited from the student body at Victoria University (Melbourne, Australia). A total of 83 participants (n=41 female) were involved in the study. No data that could be used to identify the participants was recorded. All 83 participants were assessed on the same day. The study was approved by the Victoria University Human Research Ethics Committee.

Participants were required to walk approximately 10 metres to the FPI-6 assessment station and stand on a 30cm high platform whilst two examiners worked through the FPI-6 checklist (Redmond et al., 2006). The examiners assessed the participant at the same time to minimise participant movement and were able to refer to the FPI-6 manual (Redmond, 2005) during the assessment. Each examiner completed a separate FPI-6 sheet per participant and passed these sheets onto a research assistant who coordinated data entry. The only other detail recorded on the sheet was the participant's number and gender. One of the authors (BV) oversaw the FPI-6 assessment process to ensure there was no communication between the examiners.

The two examiners were graduating students, 6 months from completion of their osteopathy program at Victoria University. During their studies these students had extensive training in musculoskeletal assessment but had not previously been exposed to the FPI-6. The two examiners underwent a one hour training session (Cornwall, McPoil, 2008) with an osteopath experienced in the use of the FPI-6 one week prior to data collection.

Data were analysed for each foot as raw ordinal scores, Rasch-converted total score (Keenan et al., 2007), and as categorical data according to the FPI-6 total score classification system (Redmond, Crane, 2008). In the present study an attempt was made to reduce data to analyse the left or right only (Morrison & Ferrari, 2009), but there were significant differences ($p<0.05$) between sides for both examiners.

Inter-examiner reliability was assessed using the intra-class correlation coefficient ($ICC_{2,1}$) for the Rasch-converted total FPI-6-score (Keenan et al. , 2007), weighted Kappa (Kw) for the raw scores, and generalised Kappa for the foot type classification data. Kw was also used to evaluate the examiner agreement between each of the individual criteria on the FPI-6. All coefficients were calculated using the *psych* package (Revelle, 2015) in *R* (R Core Team, 2015). The ICC and Kw were interpreted according to Landis and Koch (1977): 0 to 0.20 'slight', 0.21 to 0.4 'fair', 0.41 to 0.60 'moderate', 0.61 to 0.8 'substantial', and 0.81 or greater 'almost perfect'. Three reliability estimates were calculated to evaluate the internal structure of the FPI-6: Cronbach's alpha (α) and McDonald's omega total (ωt) and hierarchal (ωh) (Zinbarg et al. , 2005). McDonald's ωh values over 0.7 provide support for the calculation of a total score (Hecimovich et al. , 2014).

RESULTS

Descriptive data and reliability estimates for each examiner are presented in Table 1. The reliability estimates in the present study are acceptable (α & ωt >0.80) for both examiners and the calculation of a total score for the FPI-6-6 is valid (ωh >0.70). The ωh value obtained in the present study indicates over 70% of the reliable variance in the total FPI-6 score is due to the underlying latent construct (static foot posture). The inter-examiner reliability for the Rasch-converted total FPI-6 score indicates an *almost perfect* level of agreement (left $ICC_{2,1}$=0.86; 0.80-0.91; right $ICC_{2,1}$=0.85; 0.78-0.90).

Table 1: Descriptive data on raw FPI-6 scores

Total FPI-6 (n=83)	Examiner 1 Left	Examiner 2 Left	Examiner 1 Right	Examiner 2 Right
Mean ± SD	4.6±3.4	4.3±3.5	4.3±3.0	3.5±3.1
Cronbach's α	0.86 [0.82-0.91]	0.95 [0.93-0.97]	0.83 [0.77-0.89]	0.83 [0.77-0.89]
McDonald's ωt	0.87 [0.82-0.91]	0.95 [0.93-0.97]	0.84 [0.79-0.89]	0.83 [0.77-0.89]
McDonald's ωh	0.73	0.90	0.78	0.72

Foot-type classification data (Table 2a and b) indicate a percentage agreement of 75.9% (63/83) for the left foot and 82% (68/83) for the right foot with Kappa scores of 0.73 (95%CI

0.60 – 0.86) and 0.72 (95%CI 0.59 - 0.86) respectively. Most difficult for these two examiners was distinguishing the neutral and pronated foot types.

Table 2a: Classification of **left** foot type by examiner

			Examiner 2			
Examiner 1	Highly pronated	Pronated	Neutral	Supinated	Highly supinated	Total
Highly pronated	4	2				6
Pronated	1	18	9			28
Neutral		6	37	1		44
Supinated				4	1	5
Highly supinated						
Total	5	26	46	5	1	83

Table 2b: Classification of **right** foot type by examiner

			Examiner 2			
Examiner 1	Highly pronated	Pronated	Neutral	Supinated	Highly supinated	Total
Highly pronated	1	2				
Pronated		19	5			
Neutral		4	47	3		
Supinated			1	1		
Highly supinated				0		
Total	1	25	53	4		83

Agreement between classifications for each of the six FPI-6 criteria are presented in Table 3. These data highlight that the examiners had the most difficulty with the FPI-6 criterion related to curvature at the lateral malleoli. Using the left foot data only, there was little change in agreement statistics between the first and second halves of the cohort (1^{st} half; Kw=0.88[0.81-0.95]: 2^{nd} half; Kw=0.83[0.73-0.93]).

Table 3: Agreement statistics and interpretation for each of the FPI-6 criteria.

FPI-6 criteria	**Weighted K Left [95%CI]**	**Weighted K Right [95%CI]**
Talar head palpation	0.62 [0.52-0.73]	0.62 [0.46-0.77]
Curvature at the lateral malleoli	0.41 [0.21-0.62]	0.10 [-0.10-0.31]
Inversion/eversion of the calcaneus	0.73 [0.62-0.84]	0.61[0.47-0.76]
Talonavicular bulging	0.61 [0.44-0.77]	0.45 [0.29-0.60]
Congruence of the medial longitudinal arch	0.70 [0.57-0.84]	0.78 [0.69-0.88]
Abduction/adduction of the forefoot on the rearfoot	0.58 [0.43-0.73]	0.59 [0.49-0.70]

DISCUSSION

The Foot Posture Index (FPI-6) is a useful assessment tool for clinicians given that foot assessment forms part of the examination of many lower extremity conditions (Barton, Levinger, 2011, Cornwall and McPoil, 2011). Its use need not be limited to health professionals who specialise in dealing with the foot/ankle complex. Our results suggest that even novice examiners who have a background in musculoskeletal assessment are able to produce reliable inter-examiner results using the FPI-6 with minimal training. This could enhance the scope for the use of this tool in manual therapy education and practice.

Work by Morrison and Ferrari (2009) suggests that experience in use of the FPI-6 and clinical experience in assessing the foot/ankle complex may generate high inter-examiner reliability scores on the FPI-6. The results presented in the current study suggest this may not necessarily be the case. The two examiners in this study had a similar level of clinical experience (pre-registration osteopathy student with patient management experience), but had minimal experience with the FPI-6. Their knowledge of the musculoskeletal system, palpation skills and foot surface anatomy knowledge allowed them to similarly discern the FPI-6 criteria.

Learning effects have been thought to account for some of the results in previous studies (Cornwall, McPoil, 2008). Whilst it was not possible to evaluate this for each examiner, the Kw values did not change substantially between examiners for the first half of the participant group (Kw=0.88) and the second half (Kw=0.83). These results suggest there was either a limited learning effect as the agreement levels were high, or the learning effect was consistent between examiners.

Data presented here are consistent with the range of the "normal" foot classification of slightly pronated +4 (Redmond et al., 2008). Mean FPI-6 values were higher than that demonstrated by Cornwall, McPoil (2008) although differences between populations are to be expected. Agreement levels for the total FPI-6 score in the present study are consistent with Morrison and Ferrari (2009), and higher than those demonstrated by other authors (Cornwall, McPoil, 2008, Evans, Rome, 2012). These authors demonstrated *fair* inter-examiner agreement with larger confidence intervals. As with previous authors (Cornwall et al., 2008; Morrison and Ferrari, 2008) the present examiners had most difficulty distinguishing between neutral and slightly pronated feet. However the reliability data on foot type classifications suggested that this difficulty did not greatly affect the level of agreement between the examiners (Kw=0.73 and 0.72) even though these values suggest slightly less agreement than the reliability based on raw scores.

The present study is one of the few to present reliability data at individual criteria level. Moderate agreement was observed for 4 of the 6 criteria with fair agreement observed for the curvature at the lateral malleoli and abduction/adduction. In discussing the application of the FPI-6 with the examiners post data collection, the criterion they had most difficulty assessing was the curvature at the lateral malleoli. This was supported by the Kw results as this criterion demonstrated the lowest value of all 6 criteria (Left Kw=0.41; Right Kw=0.10). This FPI-6 criterion may require more training time to become familiar with the potentially subtle differences in each of the five levels on the FPI-6 classification scale.

The underlying construct being measured by the FPI-6 is static foot posture. The present study provides support for the calculation of a total score for the FPI-6, and indirect support for the classification of foot type based on the total FPI-6 score through the calculation of ωh. The ωh values for both examiners were greater than 0.70 suggesting that the calculation of a total score is valid (Hecimovich, Styles, 2014). Cronbach's alpha values are consistent with Teyhen et al. (2011) who reported α=0.88 for 'graduate [physical therapy] students' supporting the internal structure of the FPI-6.

Further research is required with patients presenting to manual therapy practices with a range of foot types and presenting complaints in order to confirm the high inter-examiner reliability results of the present study. Authors of future studies should also report reliability estimation statistics in order to build a more substantial picture about the internal structure of the FPI-6. The large sample size utilised in this study adds further weight to the findings and supports the assertion that the FPI-6 is a robust assessment tool, usable across a range of manual therapies and is not difficult to administer.

CONCLUSION

The current study suggests that the FPI-6 can be used in a reliable manner with minimal training and experience, particularly for the total FPI-6 score and the classification of foot posture based on this score. Training may need to focus on the classification of curvature at the lateral malleoli and abduction/adduction of the forefoot on the rearfoot. The reliability estimations presented here support the internal structure of the FPI-6 and the calculation of a total score.

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