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Literature review

The interrater and intrarater reliability of the functional movement screen: A systematic review with meta-analysis

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ABSTRACT

Objective: To synthesize the literature and perform a meta-analysis for both the interrater and intrarater reliability of the FMS™.
Methods: Academic Search Complete, CINAHL, Medline and SportsDiscus databases were systematically searched from inception to March 2015. Studies were included if the primary purpose was to determine the interrater or intrarater reliability of the FMS™, assessed and scored all 7-items using the standard scoring criteria, provided a composite score and employed intraclass correlation coefficients (ICCs). Studies were excluded if reliability was not the primary aim, participants were injured at data collection, or a modified FMS™ or scoring system was utilized.
Results: Seven papers were included; 6 assessing interrater and 6 assessing intrarater reliability. There was moderate evidence in good interrater reliability with a summary ICC of 0.843 (95% CI = 0.640, 0.936; $Q_7 = 84.915$, $p < 0.0001$). There was moderate evidence in good intrarater reliability with a summary ICC of 0.869 (95% CI = 0.785, 0.921; $Q_{12} = 60.763$, $p < 0.0001$).
Conclusion: There was moderate evidence for both forms of reliability. The sensitivity assessments revealed this interpretation is stable and not influenced by any one study. Overall, the FMS™ is a reliable tool for clinical practice.

1. Introduction

The Functional Movement Screen (FMS™) was developed to improve screening for individuals who participate in physical activities by identifying limitations and restrictions in completing 7 movement tasks: deep squat, hurdle step, in-line lunch, shoulder mobility, active straight leg raise, trunk stability push-up, and rotatory stability (Cook, Burton, & Hoogenboom, 2006a, 2006b). It has been theorized that individuals who compensate or have pain when completing the FMS™ tasks may exhibit poor movement patterns during physical activity or sport, thus predisposing them to injury (Cook et al., 2006a, 2006b). The FMS™ is comprised of 7 movement tasks that are both functional and dynamic and incorporate the entire kinetic chain (Cook et al., 2006a).

The 7 movement tasks are scored on a 0–3 ordinal scale (Cook et al., 2006a, 2006b; Cook, Burton, Hoogenboom, & Voight, 2014). A score of 3 indicates the individual is able to perform the movement without compensation, a score of 2 indicates the movement is performed but with other compensatory movements, a score of 1 is rendered if the movement is unable to be performed and a score of 0 is given when pain is elicited when performing the task (Cook et al., 2006a, 2006b, 2014). In addition, most of the functional movement tasks are assessed bilaterally to identify asymmetrical patterns (Cook et al., 2006a, 2006b, 2014). The total score is summed, using the patient or client's lowest score if the task was assessed bilaterally (Cook et al., 2006a, 2006b, 2014). The total score an individual can receive is 21, and the lower the score, the greater the client or patient's risk for injury. Previous research has demonstrated a score of ≤14 on the FMS was predictive of injury for professional football players (Kiesel, Pilsky, Voight, & Kaminski, 2007), female collegiate athletes (Chorba, Chorba, Bouillon, Overmyer, & Landis, 2000) and officer candidates (O'Connor, Deuster, Davis, Pappas, & Knapik, 2011).

Due to the relative minimal amount of time it takes to perform the FMS™ and the relatively quick and easy scoring mechanism, the FMS™ can easily be implemented as a screening assessment for

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individuals who participate in physical activity (Jade, 2013). However, the clinometric properties of the FMS™ must be explored to ensure it is reliable within and between clinicians to enable consistent identification of limitations, restrictions and asymmetrical movement patterns (Gulgin & Hoogenboom, 2014; Minick, Kiesel, Burton, Taylor, Plisky, & Butler, 2010; Smith, Chimera, Wright, & Warren, 2013). If the screening tool is reliable within and between clinicians, identifying the effectiveness of treatment strategies to improve compromised or painful tasks will be clearer as changes in the overall score for the tasks in which patients and athletes had difficulty or pain when completing would be more likely due to the intervention rather than the lack of reliability between clinicians or assessments (Minick et al., 2010; Smith et al., 2013). Interestingly, the reliability of the FMS™ has been reported in several recent studies (Gribble, Brigle, Pietrosimone, Pfile, & Webster, 2013; Gulgin & Hoogenboom, 2014; Onate et al., 2012; Parenteau-G et al., 2014; Shultz, Anderson, Matheson, Marcello, & Besier, 2013; Smith et al., 2013; Teyhen et al., 2012). These studies have utilized differing methods of evaluating such as real-time and video-taped scoring, utilized raters with varying levels of clinical and FMS™ experience, and assessed both interrater and intrarater reliability. In addition, these studies have utilized various physically active populations such as active-duty service members (Teyhen et al., 2012), physically active adults (Minick et al., 2010; Onate et al., 2012; Smith et al., 2013), athletes (Loudon, Parkerson-Mitchell, Hildebrand, & Teague, 2014; Shultz et al., 2013), and adolescent athletes or physically active children (Butler, 2012; Parenteau-G et al., 2014). However, to date there has been no synthesis with meta-analysis of the evidence regarding the reliability of the FMS™ to make a definitive statement regarding the clinical applicability of the use of this screening tool in practice. If this screening tool is reliable within and between raters, clinicians can be confident in their assessments and begin to utilize interventions to improve difficult or painful tasks for their athletes and patients. Furthermore, clinicians can assess the effectiveness of their interventions through re-evaluation of the patient's ability to complete the tasks, looking for improved scores from the initial assessment. Therefore, the purpose of this systematic review with meta-analysis was to synthesize and critically appraise the published evidence describing the interrater and intrarater reliability of the FMS™ and to calculate a pooled reliability coefficient using meta-analysis for both interrater and intrarater reliability.

2. Methods

2.1. Search strategy

A computerized search of Academic Search Complete, CINHAL Plus with full text, Medline and SportsDiscus with full text databases from their inception to March 17, 2015 was performed (Table 1). Two authors (JWC and JMH) independently reviewed the titles and abstracts of all articles obtained after the search and screened the articles for inclusion based on the criteria listed below. The full text of the manuscript was screened if additional information for study selection was needed. A hand search of the reference lists of the articles screened for inclusion was also performed to identify articles that were not located during the electronic search.

Table 1
Search summary: keywords and search terms used.

Step	Search terms	Boolean Operator	EBSCO Host
1	Functional movement screen Functional movement screening	OR	370
2	Reliability	OR	749,105
3	Adolescent High school Interscholastic Adult College Intercollegiate Military Physically active Athletes	OR	10,680,416
4	1, 2, 3	AND	105[a]

[a] Total from search was 140, 30 duplicates were removed by EBSCO Host. Additional 5 removed due to duplication following hand review of retrieved studies.

2.2. Criteria for selecting studies

2.2.1. Inclusion criteria

The following criteria were used to select studies for inclusion in this systematic review:

- Studies with a primary purpose of determining the interrater or intrarater reliability of the FMS™ when assessed using physically active participants (including high school/interscholastic/adolescent athletes, adult/collegiate/intercollegiate athletes, individuals described as being in the military).
- Studies that assessed all 7 movements of the FMS™ test as described by Cook et al. (Cook et al., 2006a, 2014) with or without the 3 clearing tasks.
- Studies that utilized the scoring system as described by Cook et al. (Cook et al., 2006a, 2014) and provided reliability assessment for the composite score utilizing intraclass correlation coefficients (ICCs).
- Studies that were published in the English language.
- Studies that were published in peer-reviewed journals.

2.2.2. Exclusion criteria

The following exclusion criteria were used to screen studies for this systematic review:

- Editorials, commentaries, case studies, guidelines, conference proceedings, or review articles.
- Studies that included participants who reported an injury at time of data collection.
- Studies that assessed the inter- or intrarater reliability as a sub-analysis to a larger study (Loudon et al., 2014; Schneiders, Davidson, Horman, & Sullivan, 2011) or did not employ ICCs to determine reliability (Minick et al., 2010).
- Studies that did not assess all 7 tasks of the FMS™ screen or included other screening tests in the study design (Frohm, Heijne, Kowalski, Svensson, & Myklebust, 2012; Jade, 2013).

2.3. Data extraction

A total of 14 studies were reviewed in their entirety for inclusion (Figure). Two reviewers (JMH and JWC) independently applied the selection criteria to the 14 studies to determine if they met the inclusion criteria. Following independent review of the 14 studies, the reviewers met and discussed the further exclusion of 7 studies as these studies did not meet the inclusion criteria. Once the final 7 studies were determined, the two reviewers (JMH and JWC) independently reviewed the studies and extracted the following data: study purpose, study design type, rater details, participant details, FMS™ assessment technique, FMS™ scoring technique, statistical analysis, and conclusions. A third reviewer (MCH) was consulted if there was a discrepancy in data extraction between the two