

## **Functional Movement Screen Literature Review**

The Functional Movement Screen was developed in its current form approximately 15 years ago. Since then, it has gained support as a way to efficiently screen for fundamental movement ability as well as providing a systematic approach to improve limited movement patterns. As the tool has gained in popularity clinically, research has emerged that adds to the understanding of its usefulness. The purpose of this summary is to highlight the clinical application of the FMS.

### **Reliability**

The reliability of the Functional Movement Screen has been established between and within raters in multiple studies (Elias et al., 2013; Frohm et al., 2011; Gribble et al., 2013; Minick et al., 2010; Onate et al., 2012; Parenteau et al., 2013; Schultz et al., 2013; Schneiders et al., 2012; Smith et al., 2013; and Teyhen et al., 2012;). These studies have reported ICC values for inter-rater reliability generally to be high (Elias 0.90, Frohm 0.80, Onate 0.98, Parenteau 0.96, Schneiders 0.97, Smith 0.89, Teyhen 0.76). Schultz reported much lower ICC values ranging from 0.17 to 0.44 depending on the paired raters. Intra-rater ICC values range from 0.6-0.92. Substantial to excellent Kappa values have also been reported indicating high levels of agreement on the scoring of each of the individual movements of the FMS. Minick and Schneiders reported similar results with the Kappa values ranging from 0.70-1.0. One factor that affects consistency on the FMS is knowledge of the testing criteria. Frost and colleagues (2013) observed that performance on the FMS improved when the subjects were made aware of the scoring criteria and thus this component of the testing should be provided during FMS testing.

### **Normative Values**

Normative values for the FMS have been established in active adult populations (Schneiders et al., 2011, Perry and Koehle 2013). These studies have also been helpful in understanding what individual characteristics may be related to FMS composite scores in the population. The average score in 20- to 40-year-olds is approximately 15 when combining the data from the two studies. Perry and colleagues also tested older individuals and observed approximately a 1.2 composite decrease for the 50- to 59-year-old group and an additional 1.2 composite decrease for the 60+ group. Both studies did not observe any nominal difference between men and women. However, BMI was reported to be a significant factor as related to FMS composite score. Perry reported individuals with lower BMI exhibited approximately a 2-point improvement in FMS scores. This finding is supported by the work of Duncan and colleagues (2012) that reported that both BMI and physical activity were related to FMS scores in elementary-aged children; however, BMI was the more dominant of the factors.

### **Predictive Validity**

Validity of the FMS as an injury screening tool has been supported through the use of an evidenced-based cutoff score, as well as identifying the presence of an asymmetry. Five studies

have utilized screening statistics to establish the cut off score of  $\leq 14$  as being appropriate to identify individuals who have greater odds for sustaining an injury (Kiesel et al., 2007 and 2013, O'Connor et al., 2011, Lisman et al., 2012 and Butler et al. 2013). These studies utilized the FMS as a screening tool to help identify those at risk for injury by considering not the total score, but rather a "Pass/Fail" approach where the subject was or was not below the cut off.

Recognizing that a score of zero is not common, when utilizing this approach the overwhelming majority of subjects who were categorized below the cut score have at least one movement pattern that was scored a 1. Odds ratios in these studies have ranged between 2.3-8.3 in professional football players, basic training soldiers and firefighters in training. Additionally, one research study has validated that the presence of asymmetry on the FMS, regardless of total score, is associated with an elevated risk for injury in professional football players with an OR of 2.3 (Kiesel et al., 2013). Other research examining cut scores of the FMS has suggested that failure (operationally defined as  $\leq 16$ ) in firefighters was strongly associated with an injury in the previous year (Peate et al., 2007). The finding of a significant difference in FMS scores in those with a prior injury was not observed in active adults (Schneiders et al., 2011). The difference between these studies is likely associated with the difference in the common magnitude of injuries in firefighters as opposed to a general population.

These studies suggest that performance on the FMS should be considered as a risk factor for musculoskeletal injury in select populations. Therefore, it is advisable to include the FMS and other evidence-based risk factors in combination if the goal is injury prediction. This multifactorial approach has been validated by Lehr et al (2013) and Lisman et al (2013). Lehr et al. (2013) examined multiple factors which included previous injury, pain, performance on FMS and performance on the Y-Balance Test. In this study, injury risk categories were developed and the results showed that those categorized as high risk were 3.4 times more likely to suffer a time-loss non-contact injury. Lisman et al. (2013) examined the combination of FMS performance and 3 mile run time as screening factors for injury. Poor performance on this combination of variables identified Marines who were 4.2 times as likely to be injured. As a result of these initial studies, it is not advisable to only consider total FMS score as a continuous variable if injury prediction is the goal rather it should be included in a battery of other tests related to injury prediction.

### **Modifiability**

While establishing the clinical validity of the FMS is beneficial, it would have little clinical relevance if performance on the FMS were not modifiable. Four studies have reported that with corrective exercise programs, scores on the FMS can be improved with a 4-6-week training program (Bodden et al., 2013; Goss et al., 2009, Cowen et al., 2010, Kiesel et al., 2010). Improvements in the composite FMS score ranged from 2.0-3.3 on average, as well as a reduction in the number of asymmetries. Of note is the recent study by Bodden et al. that randomized subjects into either an FMS intervention group or a control group. The intervention

group demonstrated significant change in FMS composite scores and presence of asymmetries when following a corrective program as outlined in the FMS clinical training workshops. One study (Frost et al., 2011) has reported that FMS scores did not change across a 12-week program in firefighters in comparison to a group of firefighters who acted as a control. Differences in these results may be related to nuances in the interventions.

## **Summary**

In summary, the Functional Movement Screen is a reliable tool that when used as a dichotomous variable can be helpful to identify individuals who are more likely to become injured. It has also been observed that improvement in the composite FMS score and the presence of asymmetries can occur through movement-related training programs. Based on the current literature, it would be advisable to consider the FMS for athlete screening purposes particularly during pre-participation examination and as part of multi-factorial approach related to injury prediction particularly due to the low cost and time associated with the testing which allows for ease of utilization in the field.

## References

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