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| **Title page**Can we predict injury in male football players based on the Functional Movement Screen and other tests of injury risk?  |

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**What did I do?**

I investigated the validity of the Functional Movement Screen (FMS) 1 for measuring movements and predicting injury. I also validated models that predict injury occurrence in football players.

**Why did I do it?**

To reduce injury for individual players, and mitigate the impact of injury rates on team performance, clinicians regularly advise players whether they are safe to train/play during the preseason and in season. The FMS is the most commonly used movement screening test used in football to inform decision-making. Evidence that the test is valid is lacking 2 3. A second approach to assess readiness to play is to use statistical models, informed by guidelines of football governing bodies which include a variety of potential risk factors 4 5 . Existing models lack precision or clinical usefulness in predicting events such as injury. The inability to prospectively model injury may stem from inappropriate predictors and modelling methods.

**How did I do it?**

In study 1, I investigated the validity of the FMS i.e. the measurement capabilities, using 3D movement analysis. As a part of this study, a retroreflective marker set to measure whole body movements had to be developed and tested for reliability. I then assigned measurable pass/fail thresholds to each of the FMS assessment criteria. In study 2, a cross section study of 24 participants from one English team during one season (September 2015 to May 2016) was carried out. The FMS was conducted during preseason with scores recorded by an experienced assessor and derived, retrospectively, from the 3D movement data that was simultaneously captured. Subsequent injury surveillance was conducted by the team physiotherapist and injuries recorded in the team database (in accordance with the consensus statement for data collection and injury reporting 4). In study 3, I developed an injury model based on a variety of risk factors identified in the literature and recommended by football governing bodies (including previous injury, acute to chronic workload ratio, fitness measures and other factors related to participation in football).

**What did I find?**

Results from study 1 identified that the FMS scale and scoring criteria, in its current form, did not demonstrate the basic properties needed to provide an accurate measure of movement, injury risk or any of the other reported capabilities of the FMS 6. Similar results were observed in study 2, as the FMS thresholds used to predict injury, whether scores were determined by a real-time assessment or an objective assessment of 3D movements, did not predict injury. Furthermore, assigning measurable pass/fail thresholds to the FMS scoring process demonstrated the complexity of the FMS assessment process. In study 3, the models developed in accordance with existing recommendations were unable to prospectively model injuries accurately (R = 0.23), and the primary problem was a large number of false positives i.e. those predicted as likely to suffer injury but who did not sustain one.

**What is the most important clinical impact?**

* The FMS does not demonstrate the properties needed from a measurement scale and has neither the validity for clinical application in ranking movement patterns nor predictive validity for injury.
* The terminology and framework associated with injury recording and predictive injury modelling may not capture relevant details that are important in the modelling of injury.
* Further work is needed to identify appropriate predictor variables and modelling methods that can be used to model injury risk and help inform clinical decision making.
* This thesis provides data that argues against the use of FMS to measure movement or predict injury.

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