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Functional movement screen comparison between the preparative period and competitive period in high school baseball players

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ABSTRACT

Background: Although the functional movement screen (FMS) has been widely applied for screening athletes, no previous study has used FMS scores to examine the association between distinct training seasons in high school baseball players. The aims of this study were to ascertain the functional movement screen (FMS) scores differences between the preparative period (PPP) and the competitive period (CPP) among high school baseball players and further determine whether FMS can be used as a tool to predict injuries during two major periods.

Methods: Fifty-five male high school baseball players (age 15.3 ± 1.7 years; height 1.7 ± 0.8 m; weight 64.6 ± 11.5 kg) volunteered. Athletic injuries were reported through a self-report questionnaire. Players performed the FMS during the PPP and the CPP. A receiver operator characteristic (ROC) curve to calculate a cutoff total composite score ≤ 14 for the relationship between the FMS score and injury. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and an area under the curve (AUC) were calculated.

Results: FMS individual task score and total composite score were significantly lower in the CPP than in the PPP. However, a cutoff total composite score ≤14 for risk of injury, determined through a ROC curve, represented a low sensitivity of 58%, NPV of 66%, an AUC of 69%, specificity of 79%, and PPV of 71%.

Conclusion: Although the low sensitivity and NPV and AUC scores indicated that the FMS does not accurately predict the risk of injury, the FMS individual task and total composite scores differed significantly between the PPP and CPP. Therefore, FMS could be used as a tool to identify physical deficiencies between distinct training seasons; however, utilizing the FMS as a screening tool for injury prediction in particular during the CPP in this population would not be recommended.

Introduction

Early prevention and management of sports injuries is a strategy that plays a critical role in reducing athletic injury and enhancing exercise performance. Preventing injury is one of the main responsibilities of sports medicine staff at all levels of athletics.[1] Specifically, players' movement capability requires judicious monitoring and routine recording during distinct training periods. Poor functional movement capability resulting from strength and range-of-motion (ROM) biomechanical abnormalities might be expected following athletic injury.[2] However, in several cases, strength imbalances and muscle flexibility might not be detected if traditional assessment methods are used.[3,4] A potential tool that could facilitate overcoming this drawback is the functional movement screen (FMS). The FMS is a tool used for objective screening of athletes' body mobility, stability, and movement control. The FMS comprises seven fundamental movement tasks including deep squat (DS), hurdle step (HS), in-line lunge (ILL), shoulder mobility

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(SM), active straight leg raise (ASLR), trunk stability push-up (TSPU), and rotary stability (RS). This tool is a screening assessment that offers high intertester and intratester reliability when used by clinicians, physical therapists, and athletic trainers in the evaluation of deficits in specific functional movement patterns.[5–10]

FMS applications have been extensively investigated in collegiate students[4] and adults.[11,12] The previous study used the FMS to demonstrate changes in the functional movement patterns of volleyball and soccer players between pre-competitive and post-competitive periods; individual scores for the ASLR and RS declined among all athletes during the post-competitive season.[13] Furthermore, previous study reported that an FMS score of $\leq$14 was associated with a 4-fold increase in the likelihood of lower-extremity injury in NCAA Division II athletes in sports such as soccer, volleyball, and basketball[14] Likely, another study showed that professional football players who scored $\leq$14 on the FMS assessment carried an 11-fold increased risk of injury and presented a 51% probability of sustaining a serious injury over the course of one competitive season.[1]

Although numerous studies have investigated FMS among collegiate students and adults, relatively few studies have been published on the use of FMS among adolescents, particularly in high school baseball players. Only one FMS study specifically investigated high school baseball players. This study used the fundamental movements of the FMS as a 16-week FMS training program; the results demonstrated that the hand-grip strength and bench-press strength of the athletes had increased by 12% and 9%, respectively, at the end of the training course.[15] However, no previous study has used FMS scores to examine the association between distinct training seasons in high school baseball players. Among baseball players in the National League and American League, the majority of injuries were to the upper extremities (51%). Lower extremity, spine and core, and other injuries accounted for 31%, 12%, and 6% of the total injuries, respectively, during the various seasons in a baseball player's year.[16] Given the importance of functional movement patterns for team sport athletes, there is value for strength and conditioning professionals to understand whether FMS is used as a tool to examine preseason training and in-season competition for baseball players, and promptly identify physical deficiencies. The preparative period (PPP) consists of the general strength and conditioning training, specific skill and tactical training, the purpose of this phase was to develop the factors needed for a peak performance. During competition period (CPP), when players during base running or chasing fly balls are more likely to play more competitively and harder for the win. Consequently, players may increase incidence of injuries during games is owing to the effect of higher intensity in corresponding to 2-fold shoulder injuries and 3-fold elbow injuries.[17] Therefore, the aims of this study were to 1) use the FMS to investigate the differences between the PPP and the CPP among high school baseball players, and 2) further determine whether FMS can be used as a screening tool to predict musculoskeletal injuries, in particular during the CPP.

Methods

Participants

The participants were fifty-five male high school baseball players (age = 15.3 ± 1.7 years; height = 1.7 ± 0.8 m; body mass = 64.6 ± 11.5 kg; body mass index = 22.5 ± 3.4 kg/m^2) from Taiwan. Before data collection, we excluded participants who had 1) previously sustained severe neuromuscular injuries, such as fractures, second- and third-degree ligament sprains and muscle strains, and joint subluxation or dislocation; 2) undergone surgical procedures; or 3) experienced head or spinal injury or visual, vestibular, or balance disorders during the preceding 3 months. Participants with previous FMS experience were also excluded to avoid the possibility of bias caused by familiarization.[18] The investigation was approved by Institutional Review Board. All participants and guardians were informed of the benefits and risks of the study. Written informed consent was obtained from the participants and their guardians before data collection.

Procedures

Data were collected at an outdoor training site on a high school campus. The athletes wore athletic clothing and running shoes during the study. An FMS instructor with the certified athletic trainer measured the FMS scores for all participants during the PPP (1st FMS) and CPP (2nd FMS). First FMS testing during PPP occurred in Feb just start the in-season; 2nd FMS testing during the CPP occurred in May at the end of the in-season (Fig. 1). In addition, injuries were reported to the athletic trainer through a self-report questionnaire. All tasks were performed according to the standardized procedures and the verbal instructions developed by Cook.[19] For this investigation, the athletic injury was defined as any musculoskeletal pain complaint, on or off the field, between the PPP and CPP, and it included the following criteria: injury assessed by an orthopedic doctor, certified athletic trainer, or licensed physical therapist.

Functional movement screen testing

The FMS comprises seven fundamental movement tasks and three clearance tests. Each FMS is scored using an ordinal scale (0–3) to obtain a composite score (0–21); the scoring criteria are shown in Table 1. With respect to the seven movement tasks, the participants were assessed by their DS, HS, ILL, SM, ASLR, TSPU, and RS performance. Only verbal instructions without any coaching were allowed during the screening process. In the three clearance tests, the participants were assessed for any pain during shoulder flexion corresponding to horizontal adduction and internal rotation (shoulder impingement test), end-range spinal flexion (spinal flexion test), and end-range spinal extension (spinal extension test). When a participant experienced pain during any portion of a movement, the corresponding FMS component movement was assigned a score of 0. The FMS has been shown to exhibit high intertester (0.843) and intratester reliability (0.869), which were established by calculating the intraclass correlation coefficient.[20] Furthermore, the reliability scores obtained from novice and expert raters showed close agreement.[6] In this study, the intrarater reliability was 0.851, which suggested high reliability.

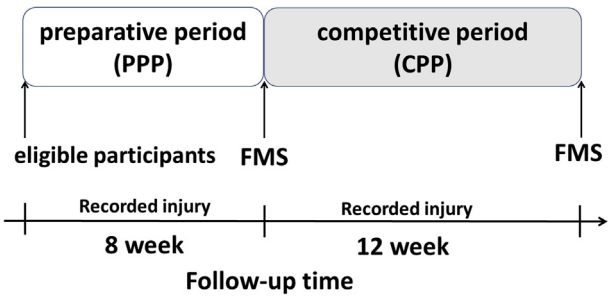

Fig. 1. The time frame of the experimental design.