

CHAPTER I

INTRODUCTION

Today it appears that the demand on athletic trainers, coaches, and athletes to excel in their sports is becoming greater and greater. In response to this demand, athletes are spending more time practicing, as well as expending more energy conditioning so that they are in the best shape possible for competition. Accompanying this increased demand are advances in sports research and sports medicine. In addition, individuals who participate in high-level athletics have become more specialized in their respective sports. Examples of this shift toward specialization are the middle relievers and closers in baseball and third down backs in football. By implementing the new advances in sports and specialization of athletes in today's sports environment, athletes can hopefully increase their chances of winning.

One sport in which winning is particularly important is football, specifically at the collegiate Division I-A level. At this level, the demands to win are great because football is a source of revenue for colleges' and universities' athletic programs. Much of this revenue comes from the sale of tickets for games. If a team wins, and fans want to see them play, more tickets may be sold, which may result in an increase in revenue. Also, at many institutions, the revenue generated by the football team carries a significant amount of the financial load for the entire athletic program (Brisendine, 1998). Therefore, in order to sell-out football games, programs need to be successful.

One way in which a Division I-A football program is judged to be successful is if it plays in a bowl game at the end of the season. A significant amount of money can be earned if a program has the opportunity to go to a major bowl game. For example, several teams from the Big East Conference went to bowl games after the 1999 season. As a result, Syracuse received \$1.4 million by playing in the Music City Bowl. Boston College earned \$1.6 million for playing the University of Colorado in the insight.com Bowl. Other bowl games give teams even more money. The University of Miami received \$1.8 million for playing in the Gator Bowl. Finally, Virginia Tech received \$4.0 million for playing in the Sugar Bowl, which was the National Championship game that year (Murphy, 1999).

Since the demand to win at the Division I-A football level is so high, athletes prepare for the season throughout the entire year and not just during the fall football season. When their season is completed, they participate in winter strength and conditioning programs until spring

football practice begins. When spring football is completed, the athletes are expected to participate in summer strength and conditioning activities until the season begins in August. By concentrating on strength, conditioning, and skills continuously, coaching staffs will have athletes who are strong, conditioned, and have sound skills at the beginning of the season. This results in practice time actually being spent on preparing for the upcoming game.

Along with the greater demands placed on athletes at this level, it seems that the number of individuals who participate in athletic activities in general is increasing. As people live longer, they exercise and participate in sports later in life. This is possibly due to their desire to maintain or improve their present levels of health and fitness. Also, with the changes in health care such as the rationing of care by Health Maintenance Organizations and increased health care costs, it has resulted in individuals being forced to play a more active role in maintaining their health. One way this is often accomplished is by exercising.

One problem that has resulted from the specialization of athletes, the increased emphasis on winning, and the rise in the number of sports participants is that the number of injuries afflicting athletes has remained at a fairly constant level (Athletic Testing Services, 2000). This trend has continued even with the advances in sports medicine and equipment technology because the research in these areas concentrates on decreasing the length of rehabilitation and improving overall performance, not preventing injuries. From the research performed on the prevention of injuries, little has been done to determine specifically what causes the injuries. To compound this problem, the research that has examined the prevention of injuries investigates how individual factors contribute to athletic injuries, and not how multiple risk factors affect the likelihood of athletic injuries.

Research that examines single injury causing factors may not be a reliable approach for identifying athletes who may be at a greater risk for sustaining injuries. This is because athletic injuries occur as the result of a multitude of factors. While there is a significant amount of literature addressing how deficits in isolated risk factors can increase the likelihood of an athlete getting injured; few, however, describe how multiple factors can contribute to one isolated injury. The literature examining the role of multiple factors in athletic injuries is limited (Lysens, de Weerd & Nieuwboer, 1991). An example of this can be found in evaluative measures employed in the sports medicine setting. Assessment tools such as the Functional Movement Screen™ (FMS) are used in an attempt to identify athletes who are at risk for injury by

examining isolated variables. In order to accomplish this, a single acceptable or “passing score” is designated for all individuals. While this may be a good indicator for identifying deficiencies, it appears to be unwise to claim that one “passing score” is acceptable for all athletes. Little research examines how variables, such as player position, body height, body weight, and relative body weight, affect scores on univariate assessment tools such as the FMS. If it is determined that other variables affect scores on assessment tests, the use of singular “passing scores” would not be a true indicator to recognizing at risk athletes.

Sports Medicine professionals have attempted to identify which athletes are more likely to get injured as compared to others in an attempt to decrease the number of injuries. One commonly implemented method has been mass pre-participation physicals and performance testing on athletes prior to the start of their athletic seasons. These screenings are conducted “to identify disease, injury and abnormalities that would predispose someone to unnecessary injury during athletic competition. Performance tests are used to demonstrate the athlete’s ability with regards to strength, speed, power, agility and coordination” (Athletic Testing Services, 2000, p. 2). The primary drawback with “performance testing is that many of the athletes who consistently get non-contact injuries during the season are also the individuals who score well in the testing. This is because both the physicals and performance tests do not assess the functional performance of the athletes” (Athletic Testing Services, 2000, p. 3). In other words, the athletes are not assessed in a manner that resembles the movement patterns they are performing during their athletic participation.

It should be said that both pre-participation physicals and performance testing have their merits. Pre-participation physicals do help detect potential life threatening, disabling, and musculoskeletal conditions prior to the start of a season in an attempt to minimize the chances of a severe injury. If these deficiencies are detected early, an athlete can be held out of the sport or rehabilitative measures can be implemented to correct the identified problems (Linder, DuRant, Seklecki, & Strong, 1981; Michigan Governor’s Council on Physical Fitness, Health and Sports, n.d.; Tanji, 1990). It can be said that preseason physical examinations “yield a base line of the fitness for participation” (American Academy of Orthopaedic Surgeons, 1984, p. 12). However, the preseason sports’ physicals may not be an efficient way to determine who is at risk for getting injured. As discussed above, one of the main purposes of preseason physicals is to determine who is unfit to play. Fields and Delaney (1989) found in numerous studies examining

young, healthy athletes, the disqualification rate averaged only 0.3% to 1.3% of all athletes screened. If this is the case, preseason physicals may not be the most effective and efficient tool for identifying who is likely to get injured.

Performance testing also has a role in the physical assessment of athletes. Unlike the preseason physicals, performance testing is usually specific to the sport that the athletes participate in because it stresses the physical demands of the particular sport (McKeag, 1989). Examples of this would be that distance runners do not need to be tested in the forty-yard sprint, just as a three-mile run would not test the physical demands placed upon a football player during the course of a game. One thing that preseason physicals and performance testing have in common is that they attempt to locate athletes who are at risk of becoming injured during the course of the season. Besides physicals and performance testing, there other screening methods that also attempt to find at risk athletes.

One performance test, the Functional Movement Screen™ (FMS), is designed to identify athletes who are at risk of sustaining injuries, specifically from non-contact injuries during athletic participation. The FMS was developed to improve the ability of the pre-participation examination to detect functional movement patterns by assessing mobility and stability using a simple grading system. It claims that if an athlete scores low on this test, he is predisposed to suffering an injury (Athletic Testing Systems, Inc., 2000, pp. 1 & 7).

It should be stated that contact injuries such as acute traumatic fractures and concussions are unavoidable because of the collision nature of sports like football. Protective equipment, proper coaching, and rules attempt to keep these forms of injuries to a minimum. However, as long as football is a collision sport, contact injuries will continue to occur. Non-contact injuries differ from contact injuries because many non-contact injuries are preventable. Most non-contact injuries occur as the result of muscle strains or they are overuse types of injuries that are caused by “repetitive microtrauma that leads to inflammation or tissue damage in such injuries as tendonitis, ligament sprains, joint swelling, and stress fractures” (Casazza & Wilder, 1999, p. 1). Examples of predisposing factors that can lead to the development of microtrauma include faulty postures and biomechanics, poor flexibility, limited strength, inadequate cardiovascular conditioning, improper equipment, and faulty performance technique. If these predisposing factors are detected early enough and are corrected, improving strength, flexibility, and aerobic condition in those identified athletes then it may be possible to minimize non-contact types of

injuries. Chia (2000) and Watson (1999), who state that athletes who are deficient in these areas are more likely to become injured from non-contact injuries, confirm this.

The FMS attempts to find athletes who have a greater chance of becoming injured by assessing the stability and mobility of individual athletes at specific joints and muscle groups through seven tests. These tests are the Deep Squat[®], Hurdle Step[®], In-line Lunge[®], Shoulder Mobility[®], Active Straight Leg Raise[®], Trunk Stability Push-up[®], and Rotational Stability[®]. If deficits in mobility and stability are discovered, interventions can be implemented prior to the start of an athlete's season so that the chances of injury can be decreased. However, while the FMS may be an effective tool to identify deficits in stability and mobility, it does not address any of the other internal and external risk factors that are associated with athletic injuries.

This problem was demonstrated in a pilot study conducted with the football team at Virginia Polytechnic Institute and State University using the injury data from the 1999-2000 season. The results of this study contradicted the literature and the premise of the FMS. It was shown that the athletes who were deficient in stability and mobility were less likely to sustain a non-contact injury during the season. In contrast, the athletes who demonstrated greater stability and mobility suffered more injuries, particularly non-contact injuries. It was from the findings of the pilot study that the question is raised whether other variables may also affect scores achieved by athletes on the FMS score.

For the FMS to truly be an effective screening tool for identifying at risk athletes, it must address other risk factors, not just mobility and stability. The literature supports the premise that for an assessment tool to potentially aid in the prevention of injuries, it must examine multiple predisposing risk factors (Meeuwisse, 1991).

Statement of the Problem

The purpose of this study was to determine whether the scores on the Functional Movement Screen[™] (FMS) are affected by variables other than mobility and stability. The other variables addressed were position played, body height, body weight, and relative body weight (Bird, 1992; Boughton, 2001; Daplan, Digel, Scavo, & Arellana, 1995; Meisenheimer, 1997; Pfeiffer & Mangus, 1998; Watson, 1999; Zemper, 1989). This study focused on the following questions:

- 1) Is there a significant difference in FMS scores between different position groups of Division I-A football players?

- 2) Is there a significant relationship between FMS scores and the body weight of Division I-A football players?
- 3) Is there a significant relationship between FMS scores and the height of Division I-A football players?
- 4) Is there a significant relationship between FMS scores and the relative body weight of Division I-A football players?

Research Hypotheses

- 1) No significant difference exists between FMS scores of different football position groups in Division I-A football programs that conduct the FMS.
- 2) No relationship exists between the body height of a Division I-A football player and the score that athletes achieve on the FMS.
- 3) No relationship exists between the body weight of a Division I-A football player and the score that athletes achieve on the FMS.
- 4) No relationship exists between the relative body weight of a Division I-A football player and the score that athletes achieve on the FMS.

Significance to the Field

In sports there is a demonstrated need to decrease the number of injuries suffered by athletes. The best approach to accomplish this goal while being efficient and cost-effective is to identify at risk individuals prior to the start of the athletes' season. The athletic training literature also indicates a need to locate athletes at risk prior to the start of their athletic seasons so that deficiencies can be corrected. However, to date, there has not been an effective tool that allows the coach or athletic trainer to consistently locate the injury prone athletes prior to the start of the sports season. This is because most assessment tools and current research only examine how one or a few risk factors relate to athletic injuries, just like the FMS.

As of now, it is not known how effective the FMS is at locating the athletes who are at a greater risk of suffering injuries. Presently, there is no literature supporting evidence to show that the FMS is effective. The only information from the developers of this particular screening tool is anecdotal. Since the FMS assesses an individual's stability and mobility, the effectiveness of the FMS to preventing non-contact athletic injuries may need to be questioned because of the multifactoral nature of sports injuries.

Also, to date, minimal research examines how additional risk factors affect scores on assessment tools like the FMS. Again, it is not possible to determine one exact factor that causes athletic injuries, because multiple factors contribute to how someone gets injured. Some of the risk factors include previous injuries, poor playing surface, improper equipment, insufficient flexibility, skeletal malalignments, muscular weakness, poor performance technique, and training errors as well as position played, body height, body weight, and relative body weight (Casazza & Wilder, 1999; Chia, 2000; Orchard, Seward, McGivern, & Hood, 1999; Watson, 1993). Therefore, the examination of other factors, such as position played, height, weight, and relative body weight as they relate to FMS scores, can determine whether or not one score can be utilized for all athletes. If these other factors are found to have an affect on the FMS score, then at its present design, the FMS may not be an effective way to identify players who are at a greater risk of sustaining athletic injuries.

The purpose of examining position played, body height, body weight, and relative body weight rather than other variables mentioned above is because they are objective. There is minute discrepancy in the results of these measurements because little or no subjectivity is required in order to attain the information. This makes the control over attaining this information greater than assessing other variables, such as flexibility, skeletal malalignments, and muscular weakness because more skill and knowledge is required by the examiners to assess the factors, as compared to position played, height, weight, and relative body weight. This subjectivity can cause the data to vary, making the findings inconsistent.

If it is found that other variables affect scores on the FMS, then there is a need to determine how the additional risk factors can be included into the assessment tool. By incorporating those additional factors with mobility and stability, individualized scores can be developed for test subjects to possibly better locate the athletes at risk of injury. If this is done, then the FMS can then possibly identify an athlete who has a greater chance of sustaining a non-contact injury. If this is accomplished, then the sports medicine community can become closer to decreasing the incidence of non-contact athletic injuries.

Basic Assumptions

While conducting this study, the following assumptions were made.

1. It was assumed that all examiners for the FMS were trained in the proper screening procedure for the FMS so that clear and objective criteria are maintained. However, individual variability in scoring was most likely inevitable.
2. It was assumed that multiple examiners were used. Therefore, inter-rater reliability may have an effect on the test results. The developers of the FMS have examined inter-rater reliability for this particular screening tool and found it to be ninety-two percent, while intra-rater reliability was ninety-four percent (Gray Cook, *The Art and Science of Sports Medicine* 2001, June 7, 2001).

Variables

The dependent variables were the scores of the FMS. The independent variables were the position groups of the athletes, and the players' height, body weight, and relative body weight.

Limitations

The following possible limitations have been identified:

1. The subjects consisted of male Division I-A football players from the three colleges that utilized the FMS. Also, at the time of this study, only Division I-A schools had been tested.
2. One college did not record the height and weight of its athletes during testing. Therefore, not all of the subjects were involved in each statistical analysis, affecting the number of subjects in the study.
3. Testing for each team was conducted on different dates. If teams tested their players during the season, or just at its conclusion, athletes may have scored lower due to soreness and minor, nagging injuries sustained during the course of the season.
4. Not all athletes on each team were tested. Therefore, if all players on the teams were tested, the results of the study may have differed.
5. Since pre-existing data were being used, there was no control over how the data were collected. Also, since multiple examiners were utilized at each of the three testing sites, there was no control over whether each examiner followed the specific scoring criteria.

Operational Definitions

1. Athlete Exposure—One athlete participating in one practice or contest where he or she is exposed to the possibility of athletics injury (NCAA, 2001, p. 80).

2. Body Mass Index (BMI)—A formula to assess a person’s body weight relative to his height (American Heart Association, 2001, p. 1).
3. Clearing test—A specific test performed by the athlete after completing the Shoulder Mobility©, Trunk Stability Push-up©, and Rotational Stability© tests. If an athlete experiences pain or discomfort in these tests, he automatically receives a score of zero (0) on that specific FMS test, but further evaluation should be performed by a medical professional (Athletic Testing Services, 2000, p. 20).
4. Combo group/player—A football group or player whose position is linebacker, tight end, quarterback, tailback, fullback, or specialist.
5. Contact injury—An injury that occurs as the result of direct contact with another player or object.
6. Core musculature of the body—The abdominal and lumbropelvic musculature of the body.
7. Extrinsic/external risk factors—Risk factors that are environmental-related (Orchard, Seward, McGivern & Hood, 2001, p. 1). Examples of extrinsic/external risk factors are the sport played, the position of the athlete, and the weather conditions during competition.
8. Injury rate—A ratio of the number of injuries to the number of athlete exposures (NCAA, 2001, p. 80).
9. Intrinsic/internal risk factors—Risk factors that are player-related (Orchard et al., 2001, p. 1). Examples of intrinsic/internal risk factors are the height, weight, and strength of the athlete.
10. Line of scrimmage group/player—A football group/player whose position is offensive or defensive lineman.
11. Non-contact injury—An injury that occurs in which there is not direct contact with another athlete or object.
12. Relative body weight—Body Mass Index (BMI).
13. Reportable injury—An injury that “occurs as a result of participation in an organized intercollegiate practice or contest; requires medical attention by a team athletic trainer or physician; and results in restriction of the student-athlete’s participation in one or more days beyond the day of injury” (NCAA Football Injury Surveillance System, 2001, p. 2).

14. Skill group/player—A football group or player whose position is a receiver, cornerback, rover, or safety.