2017

Health Care Professionals Confidence and Experience With Functional Movement Screen Testing

Reynaldo Valdez

Bowling Green State University

HEALTH CARE PROFESSIONALS CONFIDENCE AND EXPERIENCE WITH FUNCTIONAL MOVEMENT SCREEN TESTING

Reynaldo Valdez, ATC

Master's Project

Submitted to the School of Human Movement, Sport, and Leisure Studies
Bowling Green State University

In partial fulfillment of the requirements for the degree of

MASTER OF EDUCATION
In
Sport Administration

April 19, 2017

<u>Project Advisor</u>

Matthew Kutz, Ph.D.

<u>Second Reader</u>

Adam Fullenkamp, Ph.D.

Abstract

Objective: Explore health care professional's level of self-confidence and experience utilizing the functional movement screen (FMS) test. **Design:** Non-experimental, exploratory and descriptive research design. **Participants:** A total of 166 participants competed the survey. Respondents were 60% male, 39% female, 1% not specified. 56% of respondents earned a master's degree, 20% doctoral, and the remaining were unspecified. The highest percentage of respondents were athletic trainers (60%) followed by physical therapists (15%) , personal trainers (10%), and certified strength and conditioning specialist (10%). 56% of respondents were FMS certified, while 43% of respondents had no FMS certification. **Intervention:** The Health Care Professional Self Confidence Scale (HCPSCS) (scale range, 1=extremely confident to 7=extremely not confident) was developed and distributed to health care professionals via Qualtrics. **Measures:** Cronbach alpha with item analysis was used to measure reliability of the survey. One-way ANOVA followed by Tukey post-hoc analysis and independent-sample *t*-tests were used to measure differences between respondents and HCPSCS items. **Results:** HCPSCS yielded satisfactory internal consistency with a Cronbach alpha of $\alpha = .85$ with an item analysis ranging from $\alpha = .77$ to .85. Males showed moderate levels of confidence administering the FMS compared to females who were only slightly confident $M=1.85\pm1.3$ vs. $M=2.62\pm1.7$; $t\ (155)=-3.13$, $p=.\ 011$. ANOVA analysis (Tukey Post Hoc) indicated that health care professionals who had ≤ 2 years of experience showed higher levels of confidence than any other experience group's when identifying muscular weaknesses, $F\ (4,162)=2.39, p=.\ 001$. When measuring overall confidence with the FMS test, and confidence in abilities to consistently and reliably score the FMS, certified FMS instructors with ≤ 2 years of experience showed higher levels of confidence in comparison to any other group, $F\ (3,90)=3.10, p=.\ 000$ and $F\ (3,87)=4.10, p=.\ 000$.

Conclusion: Health care professionals who were male, from the ages of 19-29, and certified FMS instructors all had significant findings of self-confidence. Individuals without certification still showed confidence in their abilities, thus we concluded that certification could increase levels of confidence among practitioners utilizing the FMS test, but was not predictive of confidence. The FMS should also be considered a reliable and cost effective screening assessment that can be useful with little to moderate amounts of training.

Table of Contents

Introduction

Healthcare professionals such as athletic trainers, physical therapists, massage therapists, strength and conditioning coaches, and others work towards the prevention, treatment, and rehabilitation of injuries. The ability to properly predict and prevent injuries for the physically active could prove to be beneficial in the reduction of time lost from participation, reduction of associated medical costs, and increased quality of life for all participants. Since the enactment of Title IX legislation, organized sports, recreational sports, and workplace participation numbers for both males and females have increased substantially throughout the United States. Subsequently, the number of injuries has also risen. Organized and recreational sports participation encompasses an inherent risk of injury.

Within the last 16 years, student athletes who participated in NCAA affiliated sports were 15-20% more likely to sustain injury (Garrison, Westrick, Johnson, & Benenson, 2015). Garrison et al. (2015) also noted that 63% of individuals who sustain an injury were at risk for further injury. Outside of athletics, injuries resulted in 1.3 million medical encounters for United States Army members, affecting over 300,000 soldiers. Marshall and Guskiewicz (2003) noted from the ages of 5 to 24, recreational sports injuries accounted for one in five injury episodes. This increased prevalence of injury has detrimental effects to the quality of life of athletes and workers, as well as increased medical costs from emergency room, physician, and rehabilitation visits. A study done by Knowles et al. (2007) emphasized the economic costs injuries have on participants. Although circumstances are different for all injuries, estimated medical costs per injury was found to be nearly $700, $2,223 per injury in human capital costs, and $10,432 per injury in comprehensive costs (Knowles et al., 2007). Increased knowledge regarding the cost, and prevalence of injuries should help shape the argument for the need of a unified injury prevention assessment tool, and implementation of such tool in large populations of athletes and workforce participants.

Sports and occupational health professionals have expanded the definition of injury to encompass injuries that occur in all fields of work, sport, and recreation. Typically, injury has been defined as bodily harm as a result of acute exposure to external forces, substances, or from the absence of heat, or oxygen (Vyrostek, Annest, & Ryan, 2010). This definition of injury misses a large variety of musculoskeletal injuries commonly categorized as non-fatal. Injuries resulting from musculoskeletal conditions are defined as small amplitude micro-traumatic forces that occur over the duration of training, overexertion, repetitive movements, prolonged static positioning, and extreme joint positions (Hauret et al., 2010). Risk factors found to contribute to injury rates are previous injury, increased body mass index, decreased muscular flexibility, and proper biomechanical alignment during sport specific movement (Shojaedin et al., 2013). If identified, intrinsic risk factors such as musculoskeletal abnormalities, neuromuscular control, contralateral muscular imbalances, and core weakness can be used to predict and prevent the occurrence of injury. Although the risk of injury can be considered multifactorial, only preliminary evidence suggests that neuromuscular, strength and conditioning programs, and injury risk assessments tools may be beneficial towards the prevention of musculoskeletal injuries.

The Functional Movement Screen (FMS) is an evaluation tool developed to help assess fundamental movement patterns. Cooks, Burton, and Hoogenboom (2006) believe the FMS could provide a means of assessing human biomechanical movements while helping to identify movement deficiencies that may lead to injury. A series of seven tests incorporating fundamental movement patterns provides a global approach to improve the efficacy of identifying risk of injury (Leeder, Horsley, & Herrington, 2013). The FMS test was designed to challenge mobility and stability of participants throughout the entire kinetic chain. FMS designers Cooks, Burton, and Hoogenboom (2006) designed the tool to utilize an ordinal scoring system, 0-3, using movement quality as the key determinant. A score of 0 is given when pain is felt at any point during testing, and a 1 is given when a loss of balance or failure to complete the movement occurs. A score of 2 indicates completion of the movement with compensation, and a score of 3 indicates a completion of movement without any compensation. The FMS test has been sought out as a clinical tool used in real time to help identify and prevent injuries among athletic populations (Stobierski et al, 2015). Teyhen et al. (2012) believes that the ease of application and low running costs of the FMS make it a very useful tool in screening active populations.

The goal of pre-participation physical exams (PPE) is to promote the health and safety of athletes (Onate et al, 2012). Primary objectives of the PPE are to screen for conditions that may be life threatening, and conditions that may predispose athletes to injury or illness. The typical PPE does not include any assessment of movement patterns, and may fall short of identifying and preventing injuries caused by improper movement patterns (Mokha, Sprague, & Gatens, 2016). The ability of the FMS to detect predisposing factors leading to injury can be useful when planning pre-rehabilitative training programs. Kiesel, Plisky, & Butler (2009) noted significant improvements of FMS re-test scores after the implementation of off-season training programs, and increased numbers of athletes who scored above previous scores. By conducting a study with a large variety of clinicians, we may be able to mimic PPE settings in which practitioners with various experiences come together.

However, several important questions remain unexplored, the foremost being the reliability of the test when completed by a wide range of raters. Onate et al. (2012) concluded that future studies should focus on multiple raters of varying backgrounds and experiences to determine the role of FMS education and certification impacts on real time interrater reliability. It is necessary to develop a cost and time effective functional movement assessment screening process that can be incorporated into PPE's and periodic health evaluations for large-scale assessments. The motivation for this topic stems from clinical experiences with the FMS tool, and the interest in developing department wide testing for all student athletes at the division one NCAA level. As the FMS continues to gain notoriety among clinicians as an outcome assessment tool for the physically active population, little to no research has been examined on how clinical experiences and certifications play a role in the reliability of this tool.

Literature Review

Description

Cooks, Burton, and Hoogenboom (2006) noted a change in rehabilitation strategies in the past 20 years as the traditional isolated assessment and strengthening was seen as outdated and lacked integrated functional components. More recently, a move towards a functional integrated approach of rehabilitation has included proprioceptive neuromuscular facilitation (PNF), muscle synergy, and motor learning have encompassed (Cook, Burton & Hoogenboom, 2006). Unfortunately for practitioners, a functional movement evaluation test didn't exist. Cook et al. (2006) are the original developers of the Functional Movement Screen, and believed that in order to prepare individuals for a wide variety of activities, functional human movements should be assessed. Cooks, Burton & Hoogenboom (2006) believed that this tool could fill voids between the pre-participation exam and performance tests by identifying dynamic and functional capacities. The FMS is composed of seven fundamental movement patterns that place individuals in extreme positions allowing weaknesses and imbalance to become noticeable if stability and mobility are not utilized (Cook, Burton & Hoogenboom, 2006).

Among the physically activate population injuries are inevitable. A recent rise of preventative medicine has occurred, and clinicians believe a tool is needed to identify factors that may predispose athletes to injuries. Stobierski et al. (2015) has reported that a moderate amount of evidence supports the reliability of scoring in real time assessment from a variation of clinicians. Research has also shown that regardless of the level of expertise with scoring the FMS, clinicians with varying amounts of experience all demonstrate good to excellence intra-rater (ICC=.74-.92) and inter-rater (ICC=.76-.98) reliability (Stobierski et al., 2015). Since research has demonstrated strong reliability of real time assessment, the FMS tool should be used when conducting pre-participation exams.

Reliability

Much of the research done regarding the reliability of the FMS test has been with inter-rater or intra-rater reliability between raters with similar levels of experience. However, little to no research has been done looking at the differences in reliability that may exist between expert and novice raters. In a study done by Gulgin and Hoogenboom (2014), four raters (one expert, and three novices) reviewed and scored all seven FMS tests for twenty college students via film. Total scores from both novice and expert raters were compared in order to detect whether or not there were discrepancies between raters for total FMS scores. Good to excellent overall consistency was found for all raters (0.88 ICC). The study conducted by Gulgin and Hoogenboom (2014) varied from similar studies as others were done in real time analysis with multiple planes of view. The lone expert rater had a slightly lower total sum score in comparison to the novice raters, but the differences were insignificant. The researchers indicated that expert raters might be slightly more critical with more years of experience. The authors concluded that an insignificant difference of scoring was observed between experienced raters and novice raters (Gulgin & Hoogenboom, 2014).

The FMS test has been introduced into many athletics programs as a tool utilized for injury prevention but little to no research has been done to assess the test-retest reliability of the FMS. The ability to reproduce a test is important in order to establish validity to use it as an outcome measure for injury prevention. Shultz et al. (2013) FMS tested 39 NCAA varsity athletes across several different sports. Six raters with varying amounts of experience (1 undergraduate student, 1 physical therapist, 2 athletic trainers, and 2 strength and conditioning specialists) were used as raters for the study. All six raters had experience with the FMS test and all but one were FMS certified. All 39 participants attended two sessions that were conducted one week apart. Because of the FMS' standardized testing sequence, no study can randomize testing order. Test-retest reliability was considered good (ICC=. 6), but confidence intervals showed a wide variety of precision (Shultz et al., 2013). These findings indicate that the FMS test can be considered reliable, but uncertainty with the scoring criteria of complex multi joint movements can easily decrease the reliability of the FMS test. Therefore, training raters has is an important component when testing reliability.

Gribble et al. (2013) explored how experience using the FMS and how a varying amount of clinical experiences may affect the intra-rater reliability of FMS testing scores. The FMS has gained increasing recognition by clinicians as an outcome assessment tool for athletes. This study used three separate groups of raters who ranged in experience with FMS testing. Athletic trainers who had extensive amounts of FMS experience were considered experts, those who had limited experience were considered moderate raters, and athletic training students were considered novice raters. Raters observed three different individuals perform the FMS test by videotape, and one week later reviewed the same videos in random order. Each rater's scores were calculated in order to identify a statistical analysis. On average, moderate and expert raters exhibited moderate intra-rater reliability, with the expert group having the strongest percentage of intra-rater reliability (ICC=.76) (Gribble et al., 2013). Athletic training students who had little to no exposure with the FMS had very poor reliability (ICC=. 32). Gribble's results indicated a strong reliability of test scores provided by those clinicians who have previous experience using the FMS.

The cumulative score of an FMS test is a new concept of scoring, designed to help identify patients/athletes who are at risk of injury. According to the FMS creators, cumulative scores below 14 indicate a high risk of injury. Although previous research has examined inter-rater reliability, few studies have examined the reliability of this new screening concept (Kazman et al., 2014). The FMS scoring is designed in such way that most participants will score in the middle range even if the movement is imperfect. Findings of the study indicate that the use of a cumulative score had unclear results because each test is not interrelated (Kazman et al., 2014). The shoulder mobility and deep squat test both have different interpretations as both tests are measuring different constructs. This study can suggest that professionals who use the shoulder and deep squat test should focus on individual movement scores rather than the composite scores as developers intended it.

In a study done by Onate et al. (2012) researchers examined real time intersession and inter-rater reliability of the FMS test. Although previous studies reported moderate to excellent inter-rater reliability of the FMS test, studies had not tested reliability with real time rating and intersession reliability among the same raters. Researchers found that real time reliability of the

FMS test yielded fair to high reliability for 6 of the 7 tests conducted (Onate et al., 2012). The hurdle step test yielded poor reliability possibly due to the complexity of the movement. Positioning of the rater also played a factor in scoring results, and researchers recommend the FMS company standardize the positioning of raters for each individual test. It was recommended that future studies should focus on multiple raters of various backgrounds and experiences with FMS education and certification.

The risk of musculoskeletal conditions and injuries are multifactorial. Limited evidence has suggested that neuromuscular and strength training programs can be beneficial for preventing the occurrence of injury. A study done by Teyhen et al. (2012) looked to determine intra-raters test and retest reliability of the FMS test by utilizing a group of novice raters. If the FMS is to be utilized in the pre-participation exam, data should be collected according to the situations in which most pre-participation exams occur; in real time, with multiple different raters, and in-group settings. The FMS test showed adequate levels of reliability when assessing health service members by novice raters. Moderate to excellent component scores were observed, with 6 of the 7 tests categorized as having agreement (Teyhen et al., 2012). Intra-rater and inter-rater composite score reliability ranged from 0.74 to .076 with 95% confidence suggesting moderate to good reliability (Teyhen et al., 2012). Implications for this study indicate that error of measurement can be within one point across raters, and large groups of raters in real time scenarios mimic what a pre-participation screening environment would look like, thus enhancing the generalizability of the results.

A study done by Leeder, Horshley, & Herrington (2013) looked to analyze the inter-rater reliability of the scoring of FMS test by untrained subjects. The secondary purpose of this study was to analyze if clinical experience level had any reliability on the effect of raters. The low cost and ease of application make the FMS test a viable option for many athletic populations as a reliable screening tool (Leeder, Horshley, & Herrington, 2013). Results indicated a high level of inter-rater reliability in the single test scenario of untrained practitioners. The FMS is a clinically useful tool that can be implemented by all levels of practitioners with little to no formal training. Leeder et al. (2013) believe that a limitation of the FMS design comes from the ordinal scoring system, as it has been previously shown to have increased levels of agreement in comparison with other tests because there is a clearer distinction between the scoring levels. Further investigation should be taken in examining the implementation of a 100-point scoring scale, which in turn could help further the level of reliability of the FMS test (Leeder et al., 2013).

Validity

In recent years, a great deal of factorial validity of the FMS measurement model has existed, but almost no confirmatory factor analysis have been conducted to measure invariance across different demographics of student athletes. Gnacinski et al. (2016) proposed in the current study to identify and confirm the factorial structure of the FMS measurement model, while examining FMS measurement of invariance across sex with the use of previously identified measurement model. Results indicated that the use of the 1-factor model (FMS sum score) emerged as the most accurate measurement model when compared with the 2-factor model (Basic Movement and Complex movement sum scores) (Gnacinski et al., 2016). The secondary purpose of their study was to examine FMS measurement invariance across sex using the sum score (1-factor model). Research indicted that FMS measurement invariance failed to hold across sex, indicating that the sum scores used for FMS testing does not hold equivalent meaning for male and female participants (Gnacinski et al., 2016). Researchers believe that the results of this study indicate that a lack of invariance across sex could have contributed to the inconsistent factor structure across multiple studies done before.

Predictive Value

The ability to properly predict and prevent injuries for physically active, civilian, and military populations would prove to be beneficial in reducing time lost due to injury, and in rising medical costs associated with musculoskeletal injuries. In 2012, the United States Army had accumulated over 1.3 million medical visits for over 300,000 soldiers. Bushman et al. (2015) wanted to determine if there were any predictive values that could be found when performing the screening tool, while associating the FMS in a population of young active soldiers. Findings identified low sensitivity and positive predictive value when using the FMS as an injury-screening tool. A significant finding from the study was that a FMS composite score lower than 14 had higher correlation to overuse injuries, and not traumatic injuries (Bushman et al., 2015). In this study, the FMS tests performed actually missed the majority of actual injuries experienced during data collection. In the FMS scoring, pain indicates an automatic zero in score but the study done by Bushman et al. (2015) indicates that pain was a greater predictor for future injury than actual composite scores.

In a study done by Mokha, Sprague, and Gatens, (2016) preseason scores and subsequent injuries throughout the season were used to assess the predictive value of the FMS after identifying asymmetrical movement disorders, and low individual test scores. Researchers hypothesized that asymmetry, or a score of 1, would indicate a stronger predictive value in regards to musculoskeletal injuries in comparison to composite FMS scores. Study results showed that athletes with composite scores 14 or below were no more likely to sustain an injury than participants who scored above 14 (Mokha et al., 2016). Asymmetry or limited movement patterns had a sensitivity level of 81% (54% for composite scores) when conducted independently of composite FMS scores (Mokha et al., 2016).

Meeuwissee & Fowler, (1988) analyzed the frequency of injury in 712 intercollegiate athletes from the years of 1984 to 1985. A secondary purpose of this study was to compare past history and pre-participation findings to assess the predictability of injury. For males and females, researchers observed injury rates of 38% and 32% respectively, during the one-year study. Interestingly, these numbers were much higher than previously reported by Jackson et al., (1980) who reported injury rates of 8.9% for males and 9.6% for females. The differences between the two studies were speculatively attributed to the fact that football was not played at the intercollegiate level in the prior study. Meeuwissee & Fowler, (1988) also noted an importance of differentiating injury by sex, as both genders follow different injury patterns. The second section of this study showed no correlation between pre-participation exams and injuries that occurred in the post-exam period. No consistent patterns between corresponding findings and most common injuries were observed (Meeuwissee & Fowler, 1998).

The aim of the study done by Shojaedin et al. (2014) was to determine the relationship between FMS scores and history of injury in identifying the predictive value of the FMS test. Faulty movement patterns place abnormal stress on joints and muscles causing possible injury. The FMS can help identify an athlete’s risk level for injury. 27% of the participants studied scored below the FMS composite score of 14 indicating a potential for injury. The cut off of 14 was determined in a study of 46 professional football players. The small sample size and the general athletic population lead the authors to believe that this cut off score value should be used with caution with varying groups studied (Shojaedin et al., 2014). Researchers believed that the use of a cut off score of 17 could predict athlete's injuries at 4.7 times greater likelihood compared to the current standard score of 14 (Shojaedin et al., 2014).

Movement Dysfunction

Since the enactment of Title IX of the Educational Assistance Act, women's participation in high school sports have increased by roughly 2.8 million. It is estimated that 38,000 ACL injuries occur to female athletes annually. No successful screening/identifying methods for predicting ACL injuries were available at the time of the Hewett et al. (2005) study. Researchers believed that biomechanical measures could accurately predict the risk of ACL injuries (Hewett et al., 2005). Athletes who sustained ACL injuries experienced 2.5 times greater knee abduction motion, and 20% higher ground reaction forces. Abduction at the knee joint predicted ligament injury with 73% specificity and 78% sensitivity suggesting that athletes should avoid excessive valgus alignment when landing, cutting, or decelerating (Hewett et al., 2005) The FMS tool has commonly been described as a injury prevention tool, and should be used to help identify muscular instabilities that are likely to cause ACL injuries as seen in this study.

Core stabilization can be contributed to increased stabilization of the torso while allowing a transferring and control of force within the kinetic chain. Functional movement was defined as the ability to produce and maintain balance through the use of mobility and stability of the kinetic chain while performing basic functional patterns of movement (Okada, Huxel, Nesser, 2011). This study looked at whether a relationship existed between core stability and performance, and how core stability affected power, strength, and balance. Okada et al. (2011) hypothesized that a significant relationship between core stability and functional movement would exist. To assess core stability, the McGill's trunk muscle endurance test was used to test four positions of strength. Functional movement was assessed with the use of the FMS test.

Although the FMS requires a series of stabilization and core control, a lack of significant correlation was apparent (Okada et al., 2011). This suggested a new theory that if a subject has poor mobility and coordination, FMS success would not be attainable despite strong core musculature. These findings also suggest that only a minimum amount of core strength is necessary to complete the FMS successfully (Okada et al., 2011).

Female athletes are at a greater risk for anterior cruciate ligament (ACL) injuries (Zazulak, Hewett, Reeves, Goldberg, & Cholewicki, 2007). Dynamic stability of the knee depends strongly on the appropriate motor response of surrounding muscles as the truck position changes during functional movements such as cutting, stopping, and landing. Researchers believed that an inadequate amount of neuromuscular control of the body’s trunk and core would attribute to knee injuries by compromising dynamic stability of the lower extremity, creating an increase in abduction torque (Zazulak et al., 2007). The purpose of the study was to identify neuromuscular factors related to core stability that have the potential to predispose athletes to knee injuries. Zazulak et al. (2007) tested trunk response and core control by unloading a sudden force in three directions at random, creating a need for isometric core contraction. Results indicated that trunk displacement created a potential neuromuscular impairment of the trunk, decreasing neuromuscular control, and increasing knee injury risk at high speeds (Zazulak et al., 2007). Lateral angular displacement of the trunk was found to be the best indicator for the prediction of knee ligament injury. Zazulak et al. (2007) suggested that the use of a core stability muscular training program could help decrease knee injuries by 72% for female athletes. The FMS is commonly used to help predict and prevent ACL injuries, but no comparison studies have been done at this point.

Injury Prevention

In a review of literature done by Hafeez (2015) the use of knee and ankle braces were examined as a tool for injury prevention. Ankle braces are widely popular in sports today and help provide support to the ankle joint in hopes to provide protection from medial or lateral ankle sprains. The use of braces is most common at the ankle and knee joint. In a group of 1,396 intramural tackle football players, the rate of injury for the unbraced group was double of the braced group (Sitler et al., 1990). A majority of studies have shown the effectiveness of the knee brace in preventing injury to the medial collateral ligament of the knee. Many universities today are wearing both knee and ankle braces, routinely contradicting a position statement written in 1997 by the American Academy of Orthopedic Surgeons, which stated that braces should not be endorsed for regular use (Martin, 2001).

Female participation in NCAA athletic teams has risen by 80% since the year 1988, as well as male sports gaining an additional 20% to what was a large number already. The increase in number of participants has a corresponding increase in the number of sports injuries. Up to 63% of athletes who have suffered an injury in the past, are at risk for recurrent injury. Garrison et al. (2015) proposed that an association between preseason FMS scores and the development of injury in a population of college athletes could accurately predict future injury risk. This study identified injury in a broad sense in comparison to previous studies. Results of the study showed a strong association between athletes who had both a history of injuries and composite scores of 14 or less, to a 15% increase in injuries (Garrison et al., 2015). ICC values indicated that reliability of screening performed by a group of examiners with minimal training was strong.

Previous research has identified the importance of hip joint range of motion, and its effects on lumbar spine kinematics. Little information has been provided regarding core stability and how it may affect lower limb flexibility. The purpose of the study done by Moreside & McGill (2012) was to analyze the effects of four different exercise interventions on passive hip range of motion. Subjects were selected based on having limited hip mobility. Different variations of passive stretches, myofascial stretching, and hip-spine exercises were performed over a six-week period. At the end of the study, improvements were found in all intervention groups. Groups one and two, who performed hip stretching, observed large increases in passive range of motion, with hip extension increasing from the 8^{th} to 75^{th} percentile (Moreside & McGill, 2012). Participants in the core endurance and hip-spine disassociation groups resulted in greater passive range of motion, caused by an increase in torso stiffness and an axes of rotation directed more towards the hip (Moreside & McGill, 2012).

The human body can be considered a connected series of segments controlling basic mechanical concepts of movement; constraints limiting performance have the potential to promote injurious loading patterns. The FMS has been demonstrated to be an effective tool towards the prediction of injuries and has been used by many practitioners. Rating movement quality can be a difficult task, and it is not clear what tasks should be graded. For example, knee kinematics measured during movement tests provide information pertinent to ACL injury risk but does not yield information related to other musculoskeletal issues. Frost et al. (2012) sought out to investigate the utility of the FMS as a means to evaluate changes in an individual's movement patterns after an exercise intervention. This study raised questions regarding the ability of the FMS to characterize meaningful changes in movement quality after multiple testing sessions (Frost et al., 2012). After 12 weeks of training intervention, data collected did not support the hypothesis as no change was observed from average composite scores collected at the beginning of the study (Frost et al., 2012). Researchers believed there to be two primary issues that need to be considered with FMS testing. First, a broad range of movement patterns can be categorized with the same score. Secondly, scores may not reflect an individual's task performance (Frost et al., 2012).

Athletic Performance

At all levels of sports, athletic performance tests are used as a way to determine athletic performance skills, and effectiveness of training programs. The 1 repetition maximum strength (1RM) test has been considered a golden standard for testing strength, jumping, sprinting, and agility capabilities (Parchmann & McBride, 2011). Limited research has been done regarding the FMS and its abilities to accurately predict athletic performance. Researchers hypothesized that no significant correlation existed between FMS scores and 10m sprint times, 20m sprint times, vertical jump, and agility T test. For a long time, strength has been considered an accurate indication of proficiency and performance in various sports. Findings showed that in regards to FMS scores, neither total score, nor individual test scores correlated to any of the athletic variables tested. In contrast, 1RM showed significant relationship with all variables measured similar to previous studies conducted (Parchmann & McBride, 2011). The researchers did find a negative correlation between FMS in line lunge scores and T test agility times, indicating that higher FMS scores were related to slower T test agility times.

Little to no information exists for the use of the FMS test as a performance-predicting tool. The functional movement screen looks at the ability to perform locomotor, manipulative, and stabilizing actions while maintaining control of the kinetic chain. The use of the FMS has been primarily used to identify deficiencies that could lead to an increase in risk of injury. Deficiencies could theoretically influence sports performance as well, however links between athletic performance and the FMS have been minimal. Lockie et al. (2014) believed that gender is a contributing factor to the level of correlation between four physical performance variables, and that many previous studies failed to identify how FMS could be used to identify specific deficiencies within the body that could impact sport specific performance. Therefore, Lockie et al. (2014) analyzed relationships between FMS and athletic performance and typical team sport assessments for female athletes. Sport assessment tests included the sit and reach, 20m sprint, modified T test, and box jumps. The range of motion required by the FMS carried resemblance to those required in team sport movements. Contrary to the hypothesis, sports specific performance tests showed negative correlation to FMS testing. Higher left leg hurdle and active straight leg raise scores correlated with poor results of the T test (Lockie et al., 2014). Researchers believed that greater flexibility, and greater musculotendinous compliance may compromise power-based activities such as change of direction or sprinting (Lockie et al., 2014). The active straight leg raise test is a measure of flexibility of the hamstring, gastrocnemius and soleus, commonly done at a slow speed. Researchers believed that some FMS tests such as the active straight leg raise was not comparable of the fast paced movements commonly found in team sports.

Socioeconomic Costs

When participating in physical activity, an inherent risk of injury can be assumed. Although injury is sometimes preventable, the health benefits associated with sports far outweigh any risks associated with involvement. Almost no previous research has been done assessing cost associated with sports injuries. Therefore Crumps et al. (2008) sought to evaluate all costs incurred from sports injuries directly or indirectly. A sports injury is defined as physical damage to sports participants that is a result of a sport activity (Crumps et al., 2008). Researchers defined direct medical costs as cost associated with medical care, hospitalization, medication, rehabilitation, and transportation. Crumps et al. (2008) estimated that in a span of one year, one insurance company received 23,432 sports injury claims for a total cost associated with injury of $4,512,320.32.

A study by Knowles et al. (2007) was conducted to estimate economic costs of injuries of high school athletes from 1996 to 1999. Health benefits from sports participation have been a large focus in recent years as obesity numbers continue to rise. Little to no research has been published regarding the detrimental consequences and important public health problems that sports participation entails. High school injuries have long been considered relatively minor and non-permanent, although costs of treatment, rehabilitation and other medical interventions have large economic impacts on insurance companies and families. Increasing the knowledge of sport injuries cost could help stimulate a need for injury prevention tools or equipment. Three types of costs were used for estimation: medical, earnings losses, and reduced quality of life. Results found that an accumulated cost of $941,000 per year in medical costs ($187 per athlete), $4.2 million per year in human capital costs ($838 per athlete), and $13.7 million per year in comprehensive costs ($2,733 per athlete) (Knowles et al., 2007). High school wrestling was associated with the highest mean costs per injury, but American football accounted for 41.4% of observed injuries. 57% of medical costs were that of American football (Knowles et al., 2007).

In America today, sports and physical activity are widely promoted for a healthy lifestyle, but a lack of research investigating injuries and associating costs exists. A growing trend of childhood obesity created a need for a call to action in 1996, when the U.S. Surgeon General recommended that 30 minutes of moderate activity per day can help combat negative health effects of obesity. Increasing levels of physical activity comes with the negative consequences of injury. Marshall & Guskiewicz (2003) summarized that a lack of evidence has been presented linking physical fitness and prevention of athletic injuries, and the same can be said for warm up, and stretching programs. Determinants of injury risk fall in the following order. First the nature of the injury itself, with contact sports carrying the greatest risk, and second the personal history of injury in the youth population. Marshall and Guskiewicz (2003) both believed that the General Surgeon's recommendations were not specific enough about physical activity that could provide cardio protective benefits while managing to minimize the risk of injury. Data collected by the National Health Interview Survey found that there are on average 26 sports and recreational injury episodes per 1000 persons per year (Marshall & Guskiewicz, 2003). Also noted was that between the ages of 5 to 24, sports injuries accounted for one out of every five injury episodes. Results warranted further studies to investigate how sports and activity could be made safer. One method that many research articles have shown is the presence of a certified athletic trainer, who practice as medical professionals at the sports setting (Marshall & Guskiewicz, 2003).

Measurement Tool

Bandura's theory of self-efficacy has been applied hundreds of times to field or career development and counseling. Self-efficacy is now accepted as an important tool in understanding and examining career development differences between male and females, ethnicity differences, education, and experience (Dyk, Siedlecki, & Fitzpatrick, 2016). Bandura defined confidence as the perception that one is competent and capable of fulfilling expectations, and self-efficacy is a form of personal judgment of how well someone can execute a course of action required in prospective situations (Dyk, Siedlecki, & Fitzpatrick, 2016). Confidence influences the degree of self-efficacy experienced because confidence means that an individual knows how to do something, but self-efficacy has to do with what an individual believes they can do. Dyk, Siedlecki, & Fitzpatrick (2016) believe that individuals with high self efficacy in any given area commonly exert higher levels of effort, and are persistent when approaching a difficult task. By utilizing the Bandura's self-efficacy survey, they concluded that confidence was an important characteristic of successful outpatients. Their findings indicated that high levels of self-efficacy exerted higher levels of confidence, effort and demonstration (Dyk, Siedlecki, & Fitzpatrick, 2016).

In Bandura's original theory, level of self-efficacy was distinguished by a "yes" or "no" response (Betz, Hammond, & Multon, 2005). This type of scale only allowed practitioners to measure a limited belief of confidence, zero certainty (0%), to complete certainty (100%). The use of the Likert-type scale was abbreviated from a 100-point scale to a 10-point confidence rating scale (Betz, Hammond, & Multon, 2005). At some point, researchers began to shorten the self-efficacy scale to a 5-point confidence scale. The 5-point scale has been used by many researchers to measure academic achievement, social self-efficacy, and skills confidence. Researchers Betz, Hammond, & Multon (2005) examined internal consistency reliability characteristics of the 5-point scale and the 10-point scale in comparison. Results indicated that the 5-point confidence continuum provided the same if not more reliability in comparison to the 10-point confidence continuum. 5-point scale alpha's ranged from .78 to .87 while 10-point alpha's ranged from .69 to .83 (Betz, Hammond, & Multon, 2005). These findings indicate that the shorter format is at least as effective as the original 10 level response format.

Purpose

This study was constructed to determine health care provider's confidence and experience with functional movement screen testing. The study assessed the following questions:

1. Does the age, ethnicity, or sex of a health care professional play a role in the level of self-confidence using the FMS tool?

2. Does FMS certification lead to higher levels of self-confidence in comparison to health care professionals without certification?
3. Does clinical experience lead to higher levels of self-confidence?

Methods

The study was approved through Bowling Green State University's Human Subjects Review Board. A double blind sampling technique was used to recruit 1,000 participants from the National Athletic Trainers' Association (NATA). An additional 500 participants were chosen at random through the use of the FMS database provided on their website. Our survey was distributed to the selected participants via e-mail link to a Qualtrics generated survey. It is assumed that the health care professionals who responded to our survey responded truthfully, and participants understood the directions given to them in order to provide accurate information.

Measures

Based from Bandura's self-efficacy model (Betz, Hammond, & Multon, 2005) we created a 6-item Health Care Professional Self Confidence Scale (HCPSCS). Internal consistency and reliability of the instrument was assessed using Cronbach coefficient alpha with item analysis. The HCPSCS contained demographic questions and 6 separate questions regarding health care professional's level of self-confidence when utilizing and working with the FMS test. The participants are instructed to select the statement that accurately describes them. For each section on the survey, the scale range is, 1=strongly agree to 7=strongly disagree.

For the HCPSCS, the participant's self-confidence working with the functional movement screen can be identified. Mean ranges are from Extremely confident M=1-1.49, Moderately confident M=1.5-2.49, Slightly confident M=2.5-3.49, Neutral=3.5-4.49, Slightly unconfident M=4.5-5.49, Moderately unconfident M=5.5-6.49, and Extremely unconfident M=6.5-7.

Data Collection Procedures

By utilizing the anonymous FMS and NATA membership databases', we were able to contact 1,500 health care professionals by email explaining the purpose of our study. Subjects were informed that the study would only be used for research purposes and their results would be kept confidential. The email distributed included a link to the Likert survey where participants were informed that by filling out the survey, they are consenting to participate in the study. Subjects were also informed that they could withdraw from the study at any point. If subjects chose not to participate, the subjects can leave the survey website without any negative repercussions. Once the survey was completed, participants were asked to submit their completed survey for data analysis. A follow up email was sent out 1 week after the initial email to those who do not respond to the survey.

Data Analysis

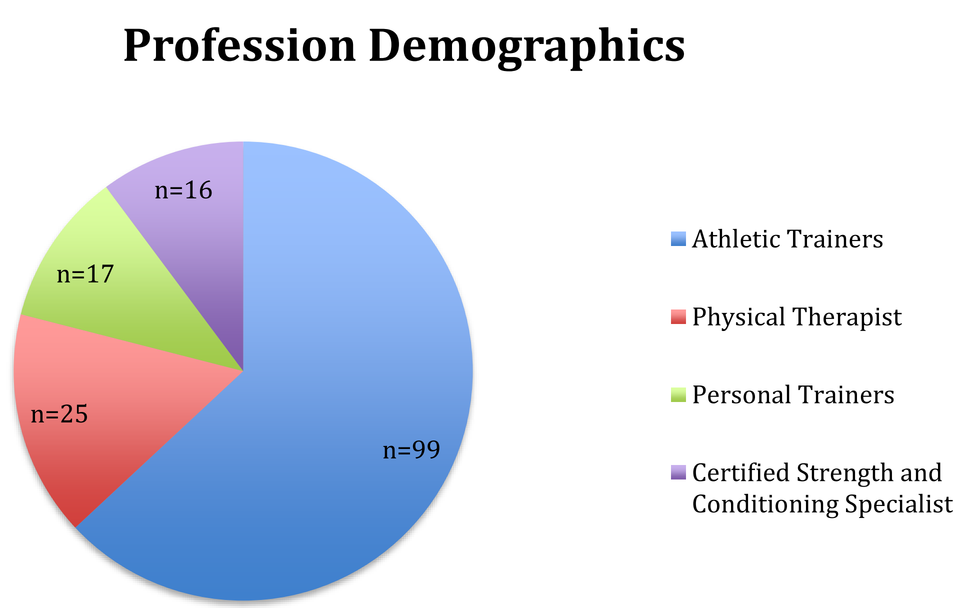
Quantitative data was analyzed using the Statistical Package for the Social Science 22.0 (SPSS) computer program. In order to determine internal consistency of the HCPSCS Cronbach coefficient alpha with item analysis was used. In order to differentiate between respondents, independent sample t-tests and one-way ANOVA with Tukey Post Hoc were performed.

Results

Demographics

A total of 166 health care professionals participated in this study (11% response rate). Males accounted for 60% (n=100) and females 39% (n=66) of respondents. Athletic Trainers accounted for 63% (n=99) of respondents, Physical Therapist were 16% (n=25), Personal Trainers 11% (n=17), and Certified Strength and Conditioning Specialist 10% (n=16). A majority (56%) earned master's degrees, 20% doctoral degrees, 11% bachelor degrees, and 8% doctoral degrees. Forty-five percent (n=76) of respondents were between the ages of 30 to 40 year olds, and ages 19 to 29 were 24% (n=40). Fifty-six percent (n=94) of respondents were FMS certified. Forty-seven percent of respondents (n=78) reported having 3-10 years of experience within healthcare.

Figure 1.



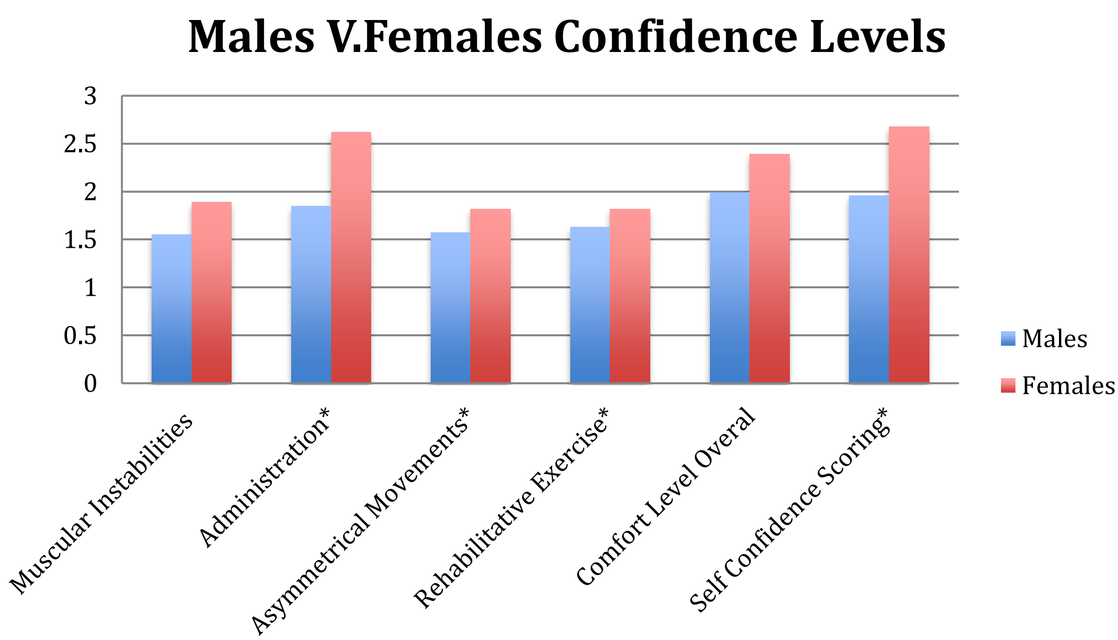
Instrumentation

Cronbach coefficient alpha with item analysis of the HCPSCS was $\alpha = .85$, with an item analysis ranging from $\alpha = .77$ to .85.

Statistical Analysis

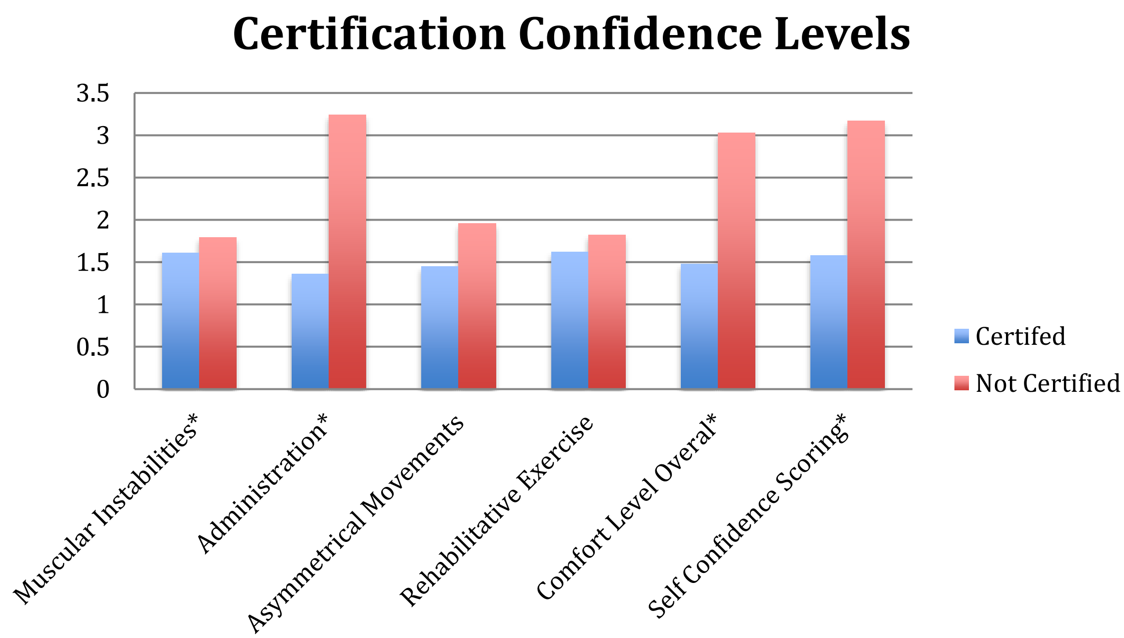
Independent sample t-tests were conducted to determine differences in confidence between males and females and FMS certified to non-certified instructors. Males showed higher levels of confidence with all 6 items, however only 4 were significantly different. Males were moderately confident administering the FMS compared to females who were only slightly confident, *M*=1.85±1.3 vs. *M*=2.62±1.7; t (155)=-3.13, p=. 011. Males were moderately confident identifying asymmetries of human movement compared to females who were only slightly confident, *M*=1.57±. 73 vs. *M*=1.82±. 61; *t* (164)=-2.30, *p*=. 018. Males were moderately confident implementing rehabilitative exercises based on FMS findings compared to females who were slightly confident, *M*=1.63±. 86 vs. *M*=1.82±. 61; *t* (164)=-1.54, *p*=. 002. Males were moderately confident scoring the FMS consistently and reliably compared to females who were only slightly confident, *M*=1.96±1.18 vs. *M*=2.68±1.58; *t* (153)=-3.27, *p*=. 003. No significant differences were observed between males and females identifying muscular instabilities or comfort levels administering the FMS test. No significant findings were observed between any ethnicity groups.

Figure 2.



Differences of confidence were also observed between certified and non-certified FMS instructors. Certified FMS instructors had a moderate level of confidence identifying muscular instabilities in comparison to non-certified FMS instructors who had slight confidence, *M*=1.61±. 79 vs. *M*=1.79±. 60; *t* (164)=-1.65, *p*=. 028. Certified FMS instructors were extremely confident administering the FMS test while non-certified FMS instructors had only slight confidence, *M*=1.36±. 659 vs. *M*=3.24±1.73; *t* (155)=-9.44, *p*=. 000. Certified FMS instructors were extremely confident with their comfort level of the FMS tool, while non-certified FMS instructors were only slightly confident, *M*=1.48±6.51 vs. *M*=3.03±1.51; *t* (164)=-9.85, *p*=. 000. Lastly, certified FMS instructors were moderately confident with scoring criteria and doing it consistently, while non-certified instructors had only slight confidence, *M*=1.58±. 804 vs. *M*=3.17±1.51;*t* (153)=-8.49, *p*=. 000. No significant differences were observed between certification and identifying asymmetrical movement patters or identifying muscular weaknesses.

Figure 3.



One-way ANOVA followed by a Tukey post-hoc analysis was used in order to determine confidence levels between respondent's years of experience in general, years of experience as an FMS instructor, and age. We assumed that health care professionals with more years of experience would have a higher overall level of confidence than younger, inexperienced health care professionals. Nineteen to 29 year olds were more confident than any other age group when identifying asymmetrical human movement patterns, $F(4,161)=4.27$, $p=.003$. 19-29 year olds were also more confident than 30 to 40 year olds in developing and implementing rehabilitative exercise, $F(4,161)=2.81$, $p=.027$.

Health care professionals who had ≤ 2 years of experience showed higher levels of confidence than any other respondent's experience group when identifying muscular weaknesses, $F(4,162)=2.39$, $p=.001$, similarly those who had ≤ 2 years of experience had a higher level of confidence than any other group identifying asymmetrical movement patterns, $F(4,162)=2.65$, $p=.000$. Furthermore, health care professionals with ≤ 2 years of experience had higher levels of confidence than all other experience levels when designing and implementing rehabilitations based on FMS findings, $F(4,162)=2.65$, $p=.002$.

Health care professionals who had work experience ≥ 21 years had higher levels of confidence administrating the FMS test than those in the 16 to 20 years of experience, $F(4,161)=2.52$, $p=.044$. Health care professionals with ≥ 21 years of experience had the higher levels of confidence scoring the FMS consistently and reliably than groups with 11 to 20 years of experience, $F(4,150)=7.65$, $p=.002$.

Finally, one-way ANOVA indicated significant differences between certified FMS instructors with ≤ 2 years of experience in 4 items. Certified FMS instructors with ≤ 2 years of experience felt more confident administering the FMS test, and identifying muscular asymmetries, $F(3,87)=4.46$, $p=.006$ and $F(3,90)=3.57$, $p=.017$ respectively. When measuring overall confidence with the FMS test, and confidence in abilities to consistently and reliably score the FMS, certified FMS instructors with ≤ 2 years of experience showed higher levels of confidence in comparison to any other group, $F(3,90)=3.10$, $p=.000$ and $F(3,87)=4.10$, $p=.000$.

Discussion

The primary purpose of this study was constructed to determine health care professional's self-confidence with the use of the FMS tool. We also explored if years of FMS certification would play a role in self-confidence administering the FMS. The discussion is organized relative to confidence differences between sex, certification status, and age/years of experience. In general, there were no differences according to ethnicity. We found that males self reported being more confident than females, certified instructors reported being more confident than noncertified instructors, and younger/less experienced clinicians reported being more confident than older/more experienced clinicians.

Our study indicated that there were no significant differences between ethnic groups in confidence level. Males showed higher levels of confidence in 66% of our survey items. Our findings indicated that male health care professionals were *moderately confident* in four of the six confidence items, while women were only *slightly confident* in the same four items. Our findings supported research done by Baker (2010) indicating that men express more confidence with general clinical skills, and commonly portray themselves as experts. Gender gaps can be commonly found in various types of jobs, rank, salary and areas of specialization (Baker, 2010). These findings could be used by the FMS Company to re-evaluate teaching techniques to both male and females. FMS courses are characterized as large group based learning environments in which practitioners are allowed to practice and learn amongst themselves. This open group based classroom may not fit all learning personalities as indicated by Gurian, (2002). The FMS could use these findings to re-evaluate course materials, class sizes, and instructor teaching techniques that are used to teach both sex groups.

Participants who were certified FMS instructors showed higher levels of confidence with four items. Participants with certification were *extremely confident* with the FMS test overall, and administering the FMS while those without certification were only *slightly confident*. Certified instructors showed moderate levels of confidence identifying muscular instabilities, and accurately scoring the FMS while those without certification were only slightly confident. These findings indicate that although both groups showed various levels of confidence, certification appears to boost confidence levels. Sufficient evidence has shown that certification leads to improved outcomes, and demonstrates to the general public that practitioners have met standards of competence in their education (Shackman, 2015). The public values credentials as a means to identify those who are at least minimally competent. Myers & Sadaghiani (2010) noted that certification could help improve consistency, knowledge, training, and increases credibility by enhancing recognition of evaluators and professionals although insufficient evidence indicates whether certification of any kind can improve program outcomes. Our findings support these findings; therefore certification is important because it helps increase rater self-confidence administering, scoring, and utilizing the FMS tool. These heightened levels of confidence may have positive effects on participant's willingness to complete the test, and improve testing results.

One unexpected finding was that younger participants (age 19-29 years) reported being more confidant identifying asymmetrical movements, and developing rehabilitative exercises. Furthermore, health care professionals with less than two years of experience showed higher levels of confidence identifying muscular weaknesses, identifying asymmetrical movements, and designing and implementing rehabilitative exercises based on FMS findings. While this finding was unexpected, it is not unexplainable. It is possible that younger less experienced clinicians had either more training and familiarity with FMS from their more recent educational programming or perhaps felt more confident because of being a newly credentialed practicing clinician. FMS instructors with less than two years of experience had higher levels of confidence administering the FMS test, identifying muscular asymmetries, and scoring the test consistently. These findings as well as the ones above indicate that younger participants had higher levels of confidence. This age group of respondents are commonly referred to as the Generation Y or Millennials, and are commonly known for their self-confidence, ability to promote professional competence, identity, and prepared participants for the workplace (Twenge, 2009), which may have contributed to these findings. However, health care professionals with more than 21 years of experience, regardless of certification, expressed more confidence administering the FMS test, and scoring the FMS consistently and reliably.

Our findings indicate that the FMS can be considered a reliable, and useful tool among practitioners with various amounts of experience. Leeder, Horsley, & Herrington (2013) found high levels of inter-rater reliability across groups of untrained practitioners. Practically, the FMS tool can be considered a useful clinical tool if successfully implemented by various levels of experienced practitioners with no formal training.

Limitations

Our study had several intrinsic limitations. After completion of an extensive review of literature, no instrumentation specific to health care professional self-confidence measurement with the use of the FMS test was found. Therefore, a study was created using theories driven from Bandura's self-efficacy model to establish a validated instrument to measure self-confidence. Participants were chosen from two separate databases. Individuals chosen through the FMS database were selected at random through a website database and could not be provided at random. Furthermore, it is difficult to establish external validity with such a limited and targeted sample population. However, we believe that these findings offer a contribution to the existing literature on FMS screening and clinician confidence, which adds value for future researchers.

Other Findings

The findings of our study can be used to support previous studies measuring inter-rater and intra-rater reliability of the FMS test. Our study showed high levels of confidence for various age groups and various experience groups. A study done by Teyhen et al. (2012) measured high levels of inter reliability of novice raters, supporting the FMS as a reliable tool to screen diverse, physically active populations.

Further Research

Further research should look to develop the understanding of what makes an athletic trainer confident when working with the FMS tool. Self-confidence with other injury prevention and movement assessment tools such as the Y balance test, star-execution test, and various forms of the FMS test should be studied and compared in order to identify the most reliable and valid instrument. This study had several intrinsic limitations. A comprehensive literature review failed to identify any instrument specific to this topic, thus a survey was created using the Bandura's self-efficacy model to establish a validated instrument to measure self-confidence.

Conclusion

Health care professionals with FMS certification were extremely confident in their abilities to perform the FMS test, and to score it accurately. Individuals without certification still showed confidence in their abilities, thus we concluded that certification could increase levels of confidence among practitioners utilizing the FMS test. Novice health care professionals also showed increased levels of confidence utilizing the FMS tool. These findings support the findings of Leeder, Horsley, & Herrington (2013) and Onate et al. (2012) indicating that clinical experience does not affect the reliability of using the FMS. The FMS can be considered a reliable and cost and time effective screening assessment that can be useful with little to moderate amounts of training. Health care professionals should engage in continuing education opportunities such as the FMS where they can be instructed how to properly use and score the injury prevention tool accurately.

References

Betz, N. E., Hammond, M. S., & Multon, K. D. (2005). Reliability and validity of five-level response continua for the career decision self-efficacy scale. *Journal of Career Assessment*, *13*(2), 131-149.

Bushman, T. T., Grier, T. L., Canham-Chervak, M., Anderson, M. K., North, W. J., & Jones, B. H. (2016). The functional movement screen and injury risk: Association and predictive value in active men. *The American Journal of Sports Medicine*, *44*(2), 297-304.

Constantine, M., & Carpenter, D. C. (2012). Bringing masters' level skills to the clinical setting: What is the experience like for graduates of the master of science in manual therapy programme? *Physiotherapy Theory and Practice*, *28*(8), 595-603.

Cook, G., Burton, L., & Hoogenboom, B. (2006). Pre-participation screening: The use of fundamental movements as an assessment of function - part 1. *North American Journal of Sports Physical Therapy: NAJSPT*, *1*(2), 62.

Cumps, E., Verhagen, E., Annemans, L., & Meeusen, R. (2008). Injury rate and socioeconomic costs resulting from sports injuries in flanders: Data derived from sports insurance statistics 2003. *British Journal of Sports Medicine*, *42*(9), 767-772.

Frost, D. M., Beach, T. A. C., Callaghan, J. P., & McGill, S. M. (2012). Using the functional movement screen™ to evaluate the effectiveness of training. *Journal of Strength and Conditioning Research*, *26*(6), 1620-1630.

Garrison, M., Westrick, R., Johnson, M. R., & Benenson, J. (2015). Association between the functional movement screen and injury development in college athletes. *International Journal of Sports Physical Therapy*, *10*(1), 21.

Gist, M. E. (1987). Self-Efficacy: Implications for Organizational Behavior and Human Resource Management. *Academy Of Management Review*, *12*(3), 472-485.

Gnacinski, S. L., Cornell, D. J., Meyer, B. B., Arvinen-Barrow, M., & Earl-Boehm, J. E. (2016). Functional movement screen factorial validity and measurement. *Journal of Strength and Conditioning Research*, *30*(12), 3388.

Gribble, P. A., Brigle, J., Pietrosimone, B. G., Pfile, K. R., & Webster, K. A. (2013). Intrarater reliability of the functional movement screen. *Journal of Strength and Conditioning Research, 27*(4), 978-981.

Gulgin, H., & Hoogenboom, B. (2014). The functional movement screening (FMS)™: An inter-rater reliability study between raters of varied experience. *International Journal of Sports Physical Therapy, 9*(1), 14-20.

Gurian, M., & Ebrary Education Subscription Collection. (2002;2001;). *Boys and girls learn differently: A guide for teachers and parents* (1. Aufl.;1; ed.). Hoboken: Jossey-Bass [Imprint].

Hafeez, I. (2015). The use of braces in athletes for injury prevention. *Connecticut Medicine, 79*(3), 167.

Hauret, K., Jones, B., Bullock, S., Canham-Chervak, M., & Canada, S. (2010). Musculoskeletal injuries description of an under-recognized injury problem among military personnel. *American Journal of Preventive Medicine, 38*(1), S61-S70.

Kazman, J. B., Galecki, J. M., Lisman, P., Deuster, P. A., & O'Connor, F. G. (2014; 2013;). Factor structure of the functional movement screen in marine officer candidates. *Journal of Strength and Conditioning Research, 28*(3), 672-678.

Kiesel, K., Plisky, P., & Butler, R. (2011). Functional movement test scores improve following a standardized off- season intervention program in professional football players. *Scandinavian Journal of Medicine & Science in Sports, 21*(2), 287-292.

Knowles, S. B., Marshall, S. W., Miller, T., Spicer, R., Bowling, J. M., Loomis, D., Mueller, F. O. (2007). Cost of injuries from a prospective cohort study of North Carolina high school athletes. *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention*, *13*(6), 416-421.

Leeder, J. E., Horsley, I. G., & Herrington, L. C. (2016). The inter-rater reliability of the functional movement screen within an athletic population using untrained raters. *Journal of Strength and Conditioning Research, 30*(9), 2591-2599.

Lockie, R., Schultz, A., Callaghan, S., Jordan, C., Luczo, T., & Jeffriess, M. (2015). A preliminary investigation into the relationship between functional movement screen scores and athletic physical performance in female team sport athletes. *Biology of Sport, 32*(1), 41-51.

Marshall, S. W., & Guskiewicz, K. M. (2003). Sports and recreational injury: The hidden cost of a healthy lifestyle. *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention, 9*(2), 100-102.

Meeuwisse, W., & Fowler, P. (1988). Frequency and predictability of sports injuries in intercollegiate athletes. *Canadian Journal of Sport Sciences*, *13*(1), 35-42.

Mokha, M., Sprague, P. A., & Gatens, D. R. (2016). Predicting musculoskeletal injury in national collegiate athletic association division II athletes from asymmetries and individual-test versus composite functional movement screen scores. *Journal of Athletic Training, 51*(4), 276-282.

Moreside, J. M., & McGill, S. M. (2012). Hip joint range of motion improvements using three different interventions. *Journal of Strength and Conditioning Research*, *26*(5), 1265-1273.

Myers, K. K., & Sadaghiani, K. (2010). Millennials in the workplace: A communication perspective on millennials' organizational relationships and performance. *Journal of Business and Psychology*, *25*(2), 225-238.

Okada, T., Huxel, K. C., & Nesser, T. W. (2011). Relationship between core stability, functional movement, and performance. *Journal of Strength and Conditioning Research*, *25*(1), 252-261.

Onate, J. A., Dewey, T., Kollock, R. O., Thomas, K. S., Van Lunen, B. L., DeMaio, M., & Ringleb, S. I. (2012). Real-time intersession and interrater reliability of the functional movement screen. *Journal of Strength and Conditioning Research*, *26*(2), 408-415.

Parchmann, C. J., & McBride, J. M. (2011). Relationship between functional movement screen and athletic performance. *Journal of Strength and Conditioning Research*, *25*(12), 3378-3384.

Shackman, G. (2015). Accreditation, Certification, Credentialing: Does It Help?. *New Directions for Evaluation*, *2015*(145), 103-113.

Shojaedin, S. S., Letafatkar, A., Hadadnezhad, M., & Dehkhoda, M. R. (2014). Relationship between functional movement screening score and history of injury and identifying the predictive value of the FMS for injury. *International Journal of Injury Control and Safety Promotion*, *21*(4), 355-360.

Shultz, R., Anderson, S., Matheson, G., Marcello, B., & Besier, T. (2013). Test-retest and interrater reliability of the functional movement screen. *Journal of Athletic Training, 48*(3), 331-336.

Stobierski, L., Fayson, S., Minthorn, L., McLeod, T., Welch, C., & Athletic Training Program, A.T. Still University, Mesa, AZ. (2015). Reliability of clinician scoring of the functional movement screen to assess movement patterns. *Journal of Sport Rehabilitation*, *24*(2), 219-222.

Teyhen, D., Shaffer, S., Lorenson, C., Halfpap, J., Donofry, D., Walker, M., . . . Childs, J. (2012). The functional movement screen: A reliability study. *Journal of Orthopaedic & Sports Physical Therapy*, *42*(6), 530-540.

Van Dyk, J., Siedlecki, S. L., & Fitzpatrick, J. J. (2016). Frontline nurse managers' confidence and self- efficacy. *Journal of Nursing Management*, *24*(4), 533-539.

Zazulak, B. (2007). Deficits in neuromuscular control of the trunk predict knee injury risk: A prospective biomechanical-epidemiologic study. *Am J Sports Med*, *35*(7), 1123-1130.

Appendix A:

The Health Care Professional Confidence Scale

Please answer the questions based on your capabilities right now as a health care professional and how confident you are utilizing the functional movement screen at the present time.

Do you feel confident identifying muscular instabilities and weaknesses that may lead to injury as a clinical professional?

- Extremely confident
- Moderately confident
- Slightly confident
- Neutral
- Slightly unconfident
- Moderately unconfident
- Extremely unconfident

Do you feel confident identifying asymmetries in human movement patterns as a clinical professional?

- Extremely confident
- Moderately confident
- Slightly confident
- Neutral
- Slightly unconfident
- Moderately unconfident
- Extremely unconfident

Do you feel confident designing and implementing rehabilitative exercises based on identified muscular weaknesses or identified asymmetrical human movements as a clinical professional?

- Extremely confident
- Moderately confident
- Slightly confident
- Neutral
- Slightly unconfident
- Moderately unconfident
- Extremely unconfident

How confident do you feel administering a Functional Movement Screen test?

- Extremely confident
- Moderately confident
- Slightly confident
- Neutral
- Slightly unconfident
- Moderately unconfident
- Extremely unconfident

I feel confident in my ability to score FMS criteria consistently and reliably?

- Extremely confident
- Moderately confident
- Slightly confident
- Neutral
- Slightly unconfident
- Moderately unconfident
- Extremely unconfident

What is your confidence level with the Functional Movement Screen tool?

- Extremely confident
- Moderately confident
- Slightly confident
- Neutral
- Slightly unconfident
- Moderately unconfident
- Extremely unconfident