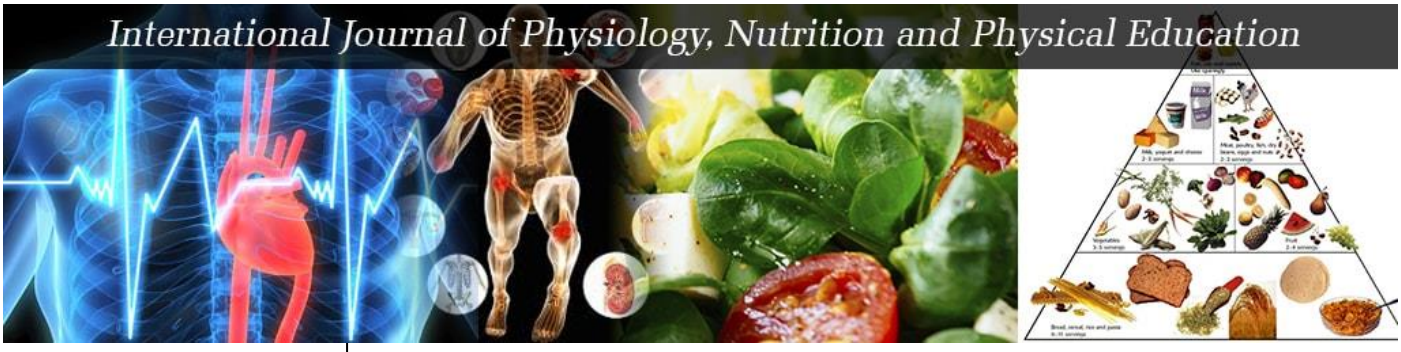

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Pre-participation screening: the use of Fundamental movement screening to predict injury in intervarsity level women hockey players

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Abstract
Hockey is one of the most popular sports in Kerala, the participation of women in hockey is on the rise in kerala. Previous studies shows that participation in hockey often resulted in traumatic and often serious musculoskeletal overuse injuries to the lower extremity. Pre- participation examinations, including musculoskeletal screening and functional performance testing, is an essential part of a multidisciplinary approach to prevent future injuries. Although the risk of injuries are multifactorial. Recently there has been increased recognition of muscular imbalance, poor neuromuscular control and core instability as potential risk factors for athletic injury. It has been also demonstrated that previous injury is a prominent risk factor for future injuries. Kiesel *et al*. suggest that the complex changes in motor control resulted in serious musculoskeletal injuries in athletes may be detected early by using movement oriented multitude of tests like Functional Movement Screen (FMS). Aim of the study was to determine if functional movement test can predict sports injuries in intervarsity level women hockey players. A total of 20 women hockey players between the age group of 16-20 years from Kottayam district of Kerala were selected as subjects for the study. The data of all the contact injuries of the subjects during the practice and competition during 2017-2019 were recorded. To maintain consistency with the previous studies a cut-off score of 14 on the FMS was used to assess differences in injury risk. Sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, disease prevalence, positive predictive value and negative value with 95% confidence intervals were calculated with Chi squared coefficient and a Fisher's exact test. The result of the study shows that the FMS can identify athletes who are more likely to suffer an in –season injury and therefore FMS cannot be recommended as a pre-season screening tool for injury prevention in women hockey players.

Keywords: Hockey, injury, movement, screen, in-season

Introduction
Field hockey is one of the popular game played widely across several countries around the world. In addition to the physical condition for playing hockey such as muscle strength, power, endurance, flexibility, speed, agility and skill the physiological capacity for the game such as elevated aerobic and anaerobic capacity are very much essential for higher level of performance. Frequent forward bending and changes of direction make up much of the physiological load of the competitive game, with players exposed to high level of eccentric loading. Participation in sports often associated with trauma or overuse injuries. Playing any sport comes with a considerable probability of injury. A review of the literature addressing injuries in hockey shows that lower extremity injuries are the commonly occurring injuries among them. Injuries occur due to musculoskeletal injures, muscular imbalance, poor neuromuscular coordination and core instability and previous injury are the prominent risk factor for future injuries. Such complex changes in motor control resulted in injuries can be predicted with a movement oriented tests such as functional movement screening (FMS).
FMS is a most popular tool used widely by the sports organizations and military personnel's to identify abnormal movement patterns. In FMS the assessor observes the performance of seven fundamental movements of the subject from zero to three based on the quality of movement. The higher score in FMS, subjects require stability, mobility and controlled neuromuscular execution of movements.

Studies proved that poor neuromuscular coordination and muscular imbalance resulting in poor biomechanics and serious injury in athletes. The seven test item in FMS are: 1) the deep squat which assess functional Mobility of the hips, knees and ankles, 2) the hurdle step which examines stride mechanics, 3) the in-line lunge which assesses mobility and stability of the hip and trunk, quadriceps flexibility and ankle and knee stability, 4) shoulder mobility which assesses range of motion and scapular stability, 5) the active straight leg raise which assesses posterior chain flexibility, 6) trunk stability push-up, and 7) the rotary stability test which assesses multi-plane trunk stability.

Few studies examined the use of the FMS for the prediction of injury in athletes and proved that the test was usesfull to predict injury in contact games like hockey. Kiesel *et al*. found that a score of 14 or less on the FMS resulted in an approximately 11 fold increase injuries risk when they examined the relationship between FMS score of 46 professional footballers and the incidence of serious injury. Study proved that poor fundamental movement pattern associated with injury in football players and that players with dysfunctional movement patterns, as measured by the FMS, are more likely to suffer an injury than those scoring higher on the FMS. Chorba *et al*. found that a score of 14 or lesson the FMS resulted in an appropriate 4 fold increase in the risk of lower extremity injuries in female collegiate soccer, volleyball and basketball athletes. It was concluded that compensatory movement pattern in female collegiate athletes can increase the risk of injury and athletes fundamental movement patterns can be identified by using the FMS.

One of the studies of O'connor *et al*. among US Marrines found that a score less than or equal to 14 on the FMS demonstrated a limited ability to predict all traumatic or overuse musculoskeletal injuries. If low FMS score can predict injuries of athletes, off –season conditioning might be used to restore dysfunctional mechanics to reduce risk. Kiesl *et al*, found that 52% of the players on a professional football team were able to improve their score from below to above the established threshold score for injury risk (≤14) in a seven week off-season conditioning program. Similarly, Peate *et al*. determined that firefighters enrolled in an eight week program to enhance functional movement reduced time lost to injury by 62% when compared with historical injury rates. No studies to date have assessed FMS scores as a predictor of injury in women hockey players. The purpose of this study is to see if injury in women hockey players can be predicted by a preseason FMS. It is hypothesized that athletes with an FMS score below 14 will have an increased number of injuries compared with a score of 14 or above.

Methods

For the purpose of the study the investigator adopted a systematic criteria for selection and elimination of subjects. Twenty women hockey players of Kottayam District, Kerala (Mean age16.24 ± .12 years) with a mean height and weight of 72 inches and 186 lbs respectively, participating during 2018-2019 season volunteered for the study. The investigator selected female athletes as subjects, since female frequently experience increased injuries rates compared to male in field hockey.

From the subjects volunteers for the study the investigator selected twenty women hockey players with in the age limit of 16-20 years who had not sustained an injury that prohibit full participation in preseason sports training and also eliminated injury sustained players with in thirty days preceding the testing. All participants were asked to provide a medical history from prior to their involvement in the study. A preliminary pilot study was conducted to eliminate the reliability of scoring based on video recording of their respective testing sessions.

Subjects were tested within ten days prior to their competitive sport seasons. The testing was conducted in using the FMS during daily practice session and scored by the investigator, and co- investigator. The FMS consists of seven movement tests, that include: Deep squat, Hurdle Step, In-Line Lunge, Shoulder Mobility, Active Straight Leg Raise, Trunk Stability Push-Up, and Rotary Stability. Injuries sustained by each subject during in season practices and competitions were reported. A systematic criteria was adopted by the investigator throughout the study for keeping a record of musculoskeletal injury of the subjects that require medical attention and occurred as a result of participation in practice and competition setting.

Data collection

The investigator collected data from the subjects (n=20) during the practice session. (Table.1) The FMS test administration and scoring was performed by the investigator in line with the standardized scoring procedure suggested by Cook *et al*.

Table 1.

FMS Score	Age in years	Athletes
15	17	1
19	18	2
13	16	3
17	19	4
19	20	5
12	16	6
19	17	7
16	18	8
14	17	9
17	18	10
18	16	11
20	19	12
14	17	13
12	17	14
17	19	15
15	20	16
13	18	17
15	21	18
14	17	19
19	18	20

Each player was given three trials on each of the seven sub-tests and received a score from zero to there on each side. The investigator followed systematic criteria for the collection of data as follows: 0) pain was reported during the movement; 1) failure to complete the movement or loss of balance during the movement; 2) completion of the movement with compensation; and 3) performance of the movements without any compensation. For each sub-test, the highest score from the three trails was recorded. An overall composite FMS score with a maximum value of 21 was then calculated. Injury data of the players like contact or non contact injury and occurrence of injury during the practice and competition sessions were also systematically recorded by the investigator till the end of the season 2018-19.

Data analysis

Based on the results of previous studies the investigator

applied a cut of score of 14 on the FMS to assess difference in injury risk in the subjects of study. For the purpose of study investigator created a 2x2 contingency table for grouping subjects scoring less than or equal to 14 and more than 14 and also recorded the score of subjects on injury during the completion and practice sessions. (Table.2) Sensitivity, specificity, odds ratios and negative likelihood ratios with confidence intervals set at 95% (C195) were also calculated. To determine the significance of association between the variable the investigator performed two different test of association such as Chi squared coefficient and Fishers exact test with a p value of <0.05.

Table 2: 2x2 contingency table for all the subjects under study (N=20)

Not injured	Injured	FMS Score
7	6	≤14
3	4	≥15

Results

The composite FMS score of 20 subjects were interpreted using the following data. The mean FMS score and standard deviation (SD) for all the subjects was found to be (n+20) was14.3 (=/-1.33). Similarly the mean FMS score for subjects who sustained an injury was 15.2 (=/-3.12) and those who were not injured was 14.7 (=/-3.12) respectively. The athletes those who stood with a FMS composite score of ≤ 14 (11), 70.2% sustained an injury over the course of the season while 59.0% of subjects who scored ≤ 13 and 53% of the subjects who scored ≤ 15 sustained injuries.

19 injuries were recorded during the season, six occurred in subjects with an FMS score of ≤14 and four in subjects with an FMS score of ≥15. All the injuries recorded are contact injures of the players throughout the season. There were no significant difference found in injury incidence between the two groups and FMS score, for finding out the association between the variables under study investigator applied the Fisher's exact test and Chi square test of association obtained a value of 0.2.

Table 3: Nature of injury and number of man -games lost

No of man games lost	Not injured	Injured	FMS Score
56	6	11	≤14
67	4	9	≤15

Discussion

The study was limited to a period of one year, all the subject representing the study are from the college sports hostel. For adopting a standard procedure investigator well informed the test procedure prior to the administration of the test. The injuries were generally categorized as either contact or non-contact and for more clarity the injuries were defined as those occurring due to microtrauma or overuse injuries. All the injuries occurred to the subjects during this study are contact injuries. It is therefore predict that in sport, like hockey injuries are high that the FMS may have limited utility in predicting the risk. Therefore a lower score on the FMS was not significantly associated with injury. The result of the study do not support the hypot hesis that low FMS score (≤14) in women hockey players predict the risk of incurring injuries over the course of a hockey season. The main limitation of the study are relatively small sample size based on convenience that limit the statistical strength of the data and the short duration of the study that limits our ability to see the effect of previous injuries significant enough to cause a player to miss games. Similarly the inability of the investigator to control hydration levels, prior sleep and nutrition pattern of subjects at the time of screening are also has an effect on the result of the study is also a limitation.

Conclusion

The result of the study demonstrated that compensatory and associated movement pattern can increase the contact risk of injury in women intervarsity level hockey players and limit their individual's capability in performance, and can be identified by using the functional Movement

Screening. A score of 14 or less on the FMS resulted in an increase in risk of lower extremity injury over the course of a competitive season. Therefore the statistical analysis of the data on composite FMS score shows that FMS can identify athletes who are more likely to suffer an in- season injury. In the present study based on the occurrence of injur y and preseason score on FMS, the investigator cannot recommended FMS as a pre- season screening tool for injury prevention for women hockey players.

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