Use of the Functional Movement Screen for Male and Female Collegiate Cheerleaders

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Key Points:

- Sufficient mobility and stability are required to perform the challenging movements in cheerleading.
- Cheerleading FMS scores show significant differences in sex and performance position.
- Increased understanding of functional movement patterns may improve patient care.
- Functional movement screenings may help mitigate lost time due to injury.

Keywords:
Injury prevention, pre-participation examination, movement patterns

Abstract

Collegiate athletes are evaluated during pre-participation exams with tools, such as the Functional Movement Screen, to recognize potential injury risks. This study aimed to assess differences of Functional Movement Screen scores among male and female collegiate cheerleaders. There were significant differences in sex and performance position results, with the Functional Movement Screen averaging above the risk-indicating score of 14. The differences between sex and position may be related as males are often bases while females are often flyers (top girls). Increased understanding of functional movement patterns may help with injury prevention and rehabilitation.

Introduction

Orthopedic preventive care promotes movement, function, mobility and stability; however, there is no set standard for grading or measuring risk factors related to comprehensive movement patterns. In athletics, participants must have proper movement patterns and maintain neuromuscular control to perform efficiently. Therefore, a basic screening process, such as the Functional Movement Screen (FMS), could be utilized to identify injury-promoting risk factors.[1–3] The FMS is a musculoskeletal screening method used to assess weaknesses in the kinetic chain. It is a standard in terms of evaluating movement patterns and is referenced by USA Cheer, the governing body for cheerleading in the United States.[1–4]

Utilizing a standard for movement capability, such as the FMS, may identify dysfunctions more accurately, as normal range of motion or strength do not necessarily correlate with normal movement patterns and neuromuscular control. A study using the FMS demonstrated that athletes exhibiting pain and asymmetry had a stronger association with injury.[3] Without proper and efficient movements, muscular imbalances can occur and are known risk factors for strains, especially of the hamstring and quadriceps muscle groups.[5] Thus, healthcare providers should assess movement in pre-participation exams (PPEs) and screen for potential predisposed injury risks. Despite the abundance of descriptive functional movement data for several populations of athletes, little information can be found specific to cheerleading, which sustains 66% of injuries from improper or inadequate athletic readiness.[6–10]

Our study aimed to understand the functional movement capability of cheerleaders by utilizing FMS scores. Additionally, we evaluated the relationship between each participant's total years cheerleading, total collegiate years cheerleading, number of current competitive teams, designated competitive company, sex, and performance position (base or flyer) with FMS scores. The lack of published literature investigating functional movement patterns in cheerleaders illustrates the need for analyses such as the current study. With a more standardized approach to evaluating movement and potential muscular imbalances, musculoskeletal specialists, such as athletic trainers, may be better equipped to improve rehabilitation programs, injury prevention strategies, musculoskeletal dysfunctions, and injury rates among active populations.

Methods

Participants

One hundred thirty healthy male and female collegiate cheerleaders from four collegiate institutions volunteered to participate. Subjects received physician clearance prior to participation and were excluded from the study if they presented with any current injuries, recent surgeries, or pain that prevented them from physical activity. An Institutional Review Board approved this study, and all participants received and signed an informed consent form. Participants also filled out a health history questionnaire prior to screening.

Procedures

A single investigator, trained in FMS, conducted all evaluations to maintain consistency and avoid subjective differences in scoring (intrarater reliability = 0.81; 95% CI = 0.69-0.92).[11] Visual aids were shown to explain each movement (deep squat, hurdle step, inline lunge, shoulder mobility, impingement clearing test, active straight-leg raise (ASLR), trunk stability push-up, press-up clearing test, rotary stability, and posterior rocking clearing test) prior to data collection. Participants performed seven movement patterns and three clearing tests three times each. Movement patterns were scored on the FMS scale of 0-3.[1] A score of zero, which nullifies all other scores, was assigned to any movement where pain was reported.[1] Pain criteria was met when the movement was familiar and created discomfort, was produced by common movements, and demonstrated signs of concern or stress.[1] Discomfort criterion was met if the movement was unfamiliar, was produced with awkward movements, and showed no signs of concern or stress.[1] Screening continued if discomfort criterion was displayed, but was discontinued if the pain criterion was met.[1] Participants received a score of one if unable to perform or complete a movement pattern.[1] They received a two if the movement was performed, but there was some form of compensation noted.[1] Finally, a participant was scored a three if able to complete the functional movement with undisputed capability.[1] The clearing tests were not graded on a 0-3 scale, but instead were reported as positive if painful or negative if non-painful.[1] When the scorer wavered between scores for a movement, the lower of the values (0-3) was used (i.e. wavering between 1 and 2; score is 1). Participants viewed summed and final scores following the testing session.

Data Analysis

Microsoft Office Excel 2012 (Microsoft Office, Seattle, WA, USA) for Windows and IBM SPSS Version 19.0 (IBM Corporation, New York, NY, USA) were used to analyze all data. Descriptive statistics were calculated, and multiple one-way analysis of variance (ANOVAs) were performed to identify any statistical differences between groups. ANOVA calculations were performed for university, squad, years of experience, competitive company, sex, and position with an alpha level of 0.05 used to determine significance. One university had multiple squads, so they were analyzed separately. The squads were classified as: large co-ed squads with an equal male to female ratio, small co-ed squads with significantly more females than males, or

all-female squads. Within squads, different performance positions have different physical requirements, so participants were analyzed on the position in which they participate.

Results

The FMS scoring average for all participants (N=130) was above the predisposition score of 14, indicating decreased risk of injury 15.70 ± 2.64.[1,12–17] Table 1 demonstrates scores by university while Table 2 demonstrates scores by squad. Analysis of the four universities indicated that there was no significant difference between universities [$F_{(3,126)}$, $p = 0.59$], squad (Table 2), years cheerleading [$F_{(15,114)}$, $p = 0.67$], collegiate years cheerleading [$F_{(6,123)}$, $p = 0.43$], number of competitive teams a participant currently cheers on [$F_{(1,128)}$, $p = 0.82$], or designated competitive company [$F_{(1,128)}$, $p = 0.98$]. There was a significant difference in scores for sex [$F_{(1,128)} = 11.22$, $p \leq 0.00$] (Table 3) and position [$F_{(4,125)} = 9.26$, $p = 0.00$] (Table 4). Males demonstrated lower scores in inline lunge, ASLR, and trunk stability, while females had lower push-up scores compared to their counterparts. In general, males demonstrated poor core stabilization, compromised scapular and hip stability, and limited knee, hip, spine, and shoulder mobility. Females scored lower in core and hip stability, scapular mobility and stability, and upper body strength.

Table 1: University FMS Scoring Averages

University	Deep Squat	Hurdle Step	Inline Lunge	Shoulder Mobility	ASLR	Push-Up	Trunk Stability	Mean	SD
1	2.19	2.19	2.74	2.37	2.33	2.48	1.85	16.15	2.27
2	1.77	1.91	2.45	2.14	2.23	2.68	1.95	15.14	2.51
3	2.10	2.05	2.45	1.95	2.55	2.75	1.90	15.75	3.39
4	2.02	2.11	2.70	2.08	2.67	2.33	1.80	15.87	2.40
							Total	15.73	2.64

Table 2: Squad FMS Scoring Averages

University	Deep Squat	Hurdle Step	Inline Lunge	Shoulder Mobility	ASLR	Push-Up	Trunk Stability	Mean	SD
Large Coed 1	2.19	2.19	2.74	2.37	2.33	2.48	1.85	16.15	2.27
Large Coed 2	1.77	1.91	2.45	2.14	2.23	2.68	1.95	15.14	2.51
Large Coed 3	2.10	2.05	2.45	1.95	2.55	2.75	1.90	15.75	3.39
Small Coed 5	1.93	2.00	2.71	2.50	2.86	2.29	1.79	16.07	1.90
All-girl 6	1.94	2.00	2.67	1.94	2.61	2.11	1.83	15.11	2.27
							Total	15.65	2.50

Table 3: Sex FMS Scoring Differences

Sex	Deep Squat	Hurdle Step	Inline Lunge	Shoulder Mobility	ASLR	Push-Up	Trunk Stability	Mean
Male	2.00	1.92	2.46	1.77	2.08	2.88	1.77	14.82
Male SD	0.89	0.48	0.71	0.86	0.80	0.59	0.43	2.80
Female	2.00	2.08	2.69	2.19	2.69	2.08	1.88	16.29
Female SD	0.63	0.63	0.47	0.94	0.55	1.26	0.33	2.17

Table 4: Position FMS Scoring Differences

Position	Mean	SD	Minimum	Maximum
Flyer	19.00	1.41	18	20
Base	13.52	2.88	8	18
Flyer/Tumbler	16.48	2.02	10	20
Base/Tumbler	15.72	2.15	11	20
Flyer/Base/Tumbler	18.00	2.65	15	20
Total	15.72	2.53	8	20

Discussion

To our knowledge, this is the first study to focus on cheerleading in conjunction with FMS scores. Location, coaching, training regimen, and competitive company did not significantly affect FMS scores amongst collegiate cheerleaders. However, the sex and position variables demonstrated significant differences in FMS scores.

Mobility and stability are necessary for pain-free, functional movement. When these are imbalanced, they can predispose individuals to injury or cause pain.[15,18–20] Of the cheerleaders studied, there was a distinct difference in mobility and stability between males and females. Specifically, female cheerleaders demonstrated better overall mobility, while male cheerleaders tended to have greater chest strength. In addition to these different results relative to sex, clinicians should also recognize an athlete's performance position and its inherent requirements. Bases support and stabilize other athletes, usually at chest level or overhead, while flyers maintain different body positions in the air either through stunts or basket tosses.[4,10,21,22] Flyer body positions usually require joint mobility and flexibility that exceed normal limits for the general population.[23,24] The findings relative to sex and position are likely due to the fact that females are known to be flyers while males are more commonly bases. Both sexes can develop muscular imbalances from favoring one side of the body due to performing cheerleading body positions.[25]

Predominantly, flyers perform single-leg stunts on their right leg and bases support single-arm stunts with their right arm. Therefore, these differences across sex and position should be cross-referenced so clinicians can improve upon their preventative or rehabilitative plans to maintain mobility and stability and develop targeted exercise regimes, which could be beneficial in injury prevention.[26] FMS may indicate possible susceptibility to injury but cannot establish a cause-and-effect relationship on its own.[27] However, the FMS may be a useful tool in injury prevention, establishing baseline scores for return to play, and improving movement patterns to enhance athletic performance.[4] In equating the FMS to injury prevention, the current results were similar to a study of 46 professional football players, which showed a pre-season average score of 14.3 for players who subsequently sustained injuries or lost at least 3 weeks of time playing, and an average score of 17.4 for players who remained uninjured during that following season.[15] Our results revealed an average FMS score of 15.7 ± 2.64 for all universities. To provide perspective, a systematic review and meta-analysis evaluated nine studies utilizing the FMS for its injury predictive value and found a significant correlation to injury with scores less than or equal to 14.[11] Cheerleaders specifically have been found to have lower rates of injury relative to other sports, as evidenced by a study examining more than 800 cheerleading teams from around the United States.[28] Despite the majority of the cheerleaders in the current study scoring above 14 on the FMS, it may be beneficial for injury prevention for cheerleaders to receive targeted exercises to improve FMS scores similar to those of the uninjured football players.[15]

Clinical Implications

Cheerleading attracts nearly 4 million participants annually in the United States.[10,29] Clinicians must familiarize themselves with the sports-specific demands and inherent risks. Medical staff, especially athletic trainers, should start the season with proper PPEs for early detection of any pre-existing conditions that may affect athletic performance both in injury risk and physical readiness.[4,30–33] The current study indicates that cheerleaders may average over the predisposition score of 14, but they may benefit from clinician intervention to improve their movement patterns, neuromuscular control, and athletic capability.

Common cheerleading injuries that may be associated with faulty movement patterns are sprains and strains of the neck, shoulder, wrist, low back, knee, and ankle, which may also be associated with their position.[4,10,20,21] Specifically, ankle sprains and low back strains are most prevalent.[4,10] Clinicians should be aware that faulty movement patterns require corrective exercises, habitual movement changes, and muscular lengthening sessions.[1]

Females dominate the sport, accounting for roughly 97% of total cheerleaders.[20,29,34] Additionally, females are more prone to less than adequate hamstring to quadriceps ratios and higher anterior cruciate ligament injury rates. Therefore, as highlighted by our results, clinicians should account for differences in sex and position highlighted when managing cheerleading injuries.[10,21,22,35] By providing functional movement screenings to athletes, clinicians may help decrease injury rates and potential issues for pain or discomfort, therefore mitigating lost time and alleviating financial burden.

Limitations and Future Research

Potential limitations to this study were that the sample used may lack generalizability to all cheerleaders, and the movements were performed in various locations. Future studies could observe the change of scores for a single team over a college career to determine implications for change over time or compare baseline scores between sports to differentiate injury risks for different sports. In general, investigations of the FMS should better establish its findings' relationship to injury and athletic performance.

Conclusion

The FMS scores of the current study demonstrate variability in mobility and stability between males and females and the positions on a cheerleading squad. Findings suggest the need for further investigations on different sample populations, athletic and non-athletic. With increased understanding of functional movement patterns, mobility, and stability, in addition to their relation to injury, better prevention and rehabilitation programs for athletes can be developed.

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