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Abstract

Palmer, TG, Howell, DM, Mattacola, CG, and Viele, K. Self-perceptions of proximal stability as measured by the functional movement screen. *J Strength Cond Res* 27(8): 2157–2164, 2013—This mixed method study was designed to investigate self-perceptions before and after experiencing an activity that dynamically and statically challenges proximal stability of the pelvis, spine, and trunk. Twenty-eight, healthy Division II female soccer and volleyball collegiate players (17 soccer, 11 volleyball) completed a self-reported Tegner activity scale, pretest questionnaire and posttest interview. A self-perceived numeric rating of the athletes' proximal stability and performance on a functional movement screen (FMS) were recorded. A guided interview was used to examine the self-perceptions of proximal stability after the FMS testing session. Differences and correlations between the pretest and posttest ratings of proximal stability and FMS scores were analyzed using a 1-sample Kolmogorov-Smirnov test and Spearman's rank order correlation test, respectively. Residual standard error from a 1-way analysis of variance was used to explore the association between variables. Qualitative data were recorded and transcribed. There were significant differences between the pretest (3.4 ± 0.63) and posttest ratings (3.1 ± 0.49) of proximal stability ($p = 0.01$). The relationship between the pretest proximal stability ratings and the FMS scores was low ($r = 0.19$, $p = 0.33$), whereas posttest rating and FMS scores had a moderately high ($r = 0.68$, $p = 0.00$) correlation. There was a smaller residual standard error for the posttest ratings (1.7) when compared with the pretest ratings (3.2) with the FMS. Four qualitative themes emerged: (a) wanting to do well, (b) expectations of performance, (c) focused mental mindset, and (d) body control. Self-perceptions of proximal stability in female athletes were influenced by undergoing a test that stressed the proximal stabilizers. Combining assessments of self-perceptions and proximal stability may assist clinicians and athletes in targeting components of training.

Key Words active trunk control, spinal stability, sport performance

Introduction

Athletes typically have an understanding of their own abilities regarding physical fitness level and sport-performance-related outcomes (21,42,45). Self-perceptions have been reported to influence the performance of athletes in fitness related activities, such as performance assessments (28,38,46). Deficits in the ability to actively control and stabilize the pelvis, spine, or trunk has also been reported to influence sport-performance outcomes (19,36). Referred to as proximal stability, the synergistic control between the pelvis, spine, and trunk involves both dynamic and static postures, which influence performance outcomes for both low and high level tasks (33,43). Specifically, self-perceptions and poor proximal stability are proposed to influence athletic performance among female athletes (21). However, little is known about the relationship between self-perceptions and performance measures that challenge the proximal stabilizers among female athletes.

Athletes commonly have positive self-perceptions associated with sport performance (13,31). Changes in self-perceptions have been reported to positively correlate with improvements in strength and physical fitness levels after a training intervention. (21,38,41). Repeated performance assessments and task importance have also been shown to influence self-perceptions (15). Athletes are often subject to routine performance assessments and place a great deal of importance on performing well on these measures (16,40). Poor performance is sometimes associated with negative self-perceptions and external or environmental factors (3). On the other hand, if an athlete expects to succeed at a given performance assessment and does well, it may be attributed in part to positive intrinsic and personal self-perceived characteristics (3). To date, little is known regarding self-perception and performance on an assessment technique that challenge the synergistic control of the pelvis, spine, or trunk.

Performance assessments are commonly used to monitor sport performance and identify potential predisposing risk

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factors to injury, such as muscle weakness to the proximal segments. Several authors have suggested screening athletes before competition to identify weakness in the proximal pelvis, spine, or trunk (8,19,23,26,27). Weakness or lack of control about the proximal segments has been hypothesized to impact performance or predispose athletes to injury (8,19,47). The functional movement screen (FMS) has been a technique reported to challenge and assess the stability and control of the proximal segments about the pelvis, spine, and trunk (25). Commonly used as a screening tool, a composite score of ≤14 on the FMS has been associated with an increased risk of injury, days lost from employment and sport, and performance deficits for sport and industrial work settings (9,26,34,36). As such, the FMS has been reported to be a simple test that challenges movements similar to sport or active professions, which rely on a variety proximal stability (9,25,34,36).

The influences of stabilizing and controlling the proximal segments among female athletes have not been fully explored. Zazulack et al. (48) reported female athletes have a greater risk of knee ligament tears over male counterparts because of greater trunk displacement resulting from limitations in the musculature about the adjacent segments of the spine and pelvis . Limitations in proximal stability control were reported as a primary predictor of knee ligament injuries at 100% sensitivity and 72% specificity in female athletes ($p = 0.024$) but not a predictor in male athletes (48). Improvements in the ability to control the proximal segments among female athletes have been proposed to enhance lower extremity biomechanics, which may contribute to improved performance and potentially reduce injury susceptibility (32). More research is needed to better understand the role of proximal stability among female athletes and performance. Establishing the relationship between self-perceived and actual performance capabilities of the proximal segments may assist clinicians and athletes in establishing precise performance expectations (21).

The purpose of this concurrent mixed method study was to better understand the relationship between self-perceptions and performance on an assessment test using proximal stability in female collegiate athletes. We hypothesized that participating in the FMS assessment would result in a significant difference between pretest and posttest self-perceived ratings of proximal stability for female collegiate athletes. Additionally, the posttest self-perceptions of proximal stability were theorized to have a higher correlation with the FMS scores then those before the test. We anticipated that the athletes would be competitive while placing a great deal of importance and effort into the test (16,40). Positive and negative self-perceptions would be identified, and the pretest to posttest self-perceptions would change after experiencing the FMS test (3). This study is significant because performance assessments such as the FMS have not been used in tandem with measures of self-perceptions to evaluate female athletes. Knowing an athlete's self-perceptions regarding performance may offer an insight into the assessment and training protocols for sport (28,41). Perceptual information is likely to complement the interpretation of a performance allowing one to look beyond an actual score. The combination of perceptual information and scores on physical screening tests may offer clinicians and athletes a clear understanding of actual performance and expectations for performance (7,20,37).

Methods

Experimental Approach to the Problem

A concurrent mixed method study design (QUAL + QUAN) (12) was used to investigate female collegiate athletes' self-perceptions of their performance on an assessment test using functional movements that required proximal stability. The FMS assessment was used to challenge proximal stability about the pelvis, lumbar spine, and trunk among Division II collegiate females participating in soccer and volleyball. Concurrent with this data collection, qualitative interviews and questionnaires were administered on the same subjects and explored to identify potential themes regarding self-perceptions and proximal stability performance.

Subjects

Twenty-eight healthy, female, Division II collegiate soccer ($n = 17$) and volleyball ($n = 11$) players (mean age = 19 ± .85 years, height = 172.7 ± 3.6 cm, weight = 64.4 ± 6.7 kg) from the same university volunteered to participate in a single study session during off-season conditioning. The participants reported to a campus exercise physiology laboratory where they reviewed and signed an informed consent document. Study protocol and procedures were approved by a University Institutional Review Board.

All the participants were returning players with the average years of experience in their respective sports being 12 ± 3 years and a mean Tegner Activity score of 7.8 ± 0.91. Inclusion criteria were that the subjects be collegiate, female athletes between 18 and 22 years of age. Individuals reporting any major orthopedic injury within the past 3 months resulting in the inability to perform daily activities were excluded.

Procedures

Data collection consisted of 3 parts: (a) pretest proximal stability questionnaire, (b) a proximal stability assessment using the FMS, and a (c) posttest proximal stability interview. Interviews were recorded and transcribed for full analysis. All testing was performed by the primary investigator.

Before data collection, the term proximal stability was defined for all the participants as the ability to collectively control the pelvis, spine, and trunk with dynamic and static postures during low and high level tasks. The pretest proximal stability questionnaire (Figure 1) was developed on the basis of pilot data by the primary researcher. The questionnaire was used to gather demographic information such as age, year in school, position played, status as a starter, and years of experience playing. Self-perceived ratings of proximal stability were reported by using a numeric scale

Part 1: Demographic/Descriptive Information: This portion of the questionnaire asks questions pertaining to the sport you are currently participate.

Demographic/Descriptive Information:
a. Sport ____________, Position played______, # Years playing experience ______
b. Level of current participation: Fr. So. Jr. Sr. Red Shirt, Age: _________
c. Starter: YES / NO
d. Using the Modified Tegner Activity Scale, please rate your current activity level. _______

Part 2: Proximal or "Core" Stability Rating and Description Questionnaire: The following section is designed to gather information about your proximal stability.

a. Rate your proximal stability on a scale of 1 to 5
(1 = very poor, 2 =poor, 3 = ok, 4 = good, 5 = excellent):_______

b. In your own words please indicate why you rated your proximal stability the way you did. Feel free to provide examples or descriptions that help with your explanation.

Figure 1. Pretest proximal stability questionnaire: Written responses. Each participant was asked to complete the written questionnaire.

ranging from a 1 (poor) to a 5 (excellent) as previously reported (5,37). The participants then responded to an open-ended questionnaire pertaining to "why" they perceived their proximal stability at a particular level. All the participants were encouraged to take as much time as needed to draft a response (12). In addition, a Tegner Activity Level Scale was used to evaluate the athletes' ability to perform at a given level of activity (5). Activity level choices ranged from the highest activity rating of a 10 (elite competitive sport participant) to the lowest level of a 1 (dysfunctional and sedentary) (5).

Proximal stability was assessed using the FMS, which has been identified as a reliable and valid alternative field test that requires no sophisticated equipment (23,24,30). The FMS consists of 7 movements including the deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and the rotary stability. In this study, testing was performed by demonstrating a movement and asking the athlete to repeat the movement. There was no instruction given to athletes to have them tighten their proximal muscles or any related corrective feedback. See Minick et al. (30) for a full description of the FMS procedures and scoring. Each movement is graded using an ordinal scale of a low score of 0 to a high score of a 3 with a possible cumulative score of 21 points. Kiesel et al. (25,26) and others (6,30,36) have used the FMS to assess injury risk among professional football athletes, firefighters, and military populations. The authors reported individuals scoring below a 14 on the FMS to be more susceptible to injury (25,26,36). Unfortunately, there are limited published data among the female athlete population (9).

The posttest proximal stability interview consisted of guided questions directed by the primary investigator (Figure 2). Established from pilot data, all the questions were open ended and related to the self-perceptions of proximal stability, experience of performing the FMS, and sport participation (12). The participants were not informed as to their score or level of performance on the FMS until the last question of the interview.

Each participant was interviewed following the Functional Movement Screen assessment. The following sample questions were used as an interview template for all participants. All responses were audio taped and transcribed by the primary investigator.

Question Outline:
a. How do you think you did?
b. You rated yourself a (provide the initial score) prior to the test.
1. Was that an accurate prediction?
2. Tell me more about that.
3. Would you change your rating? Why or why not?

c. Do you believe this test challenged your proximal stability? Why or why not?
d. Which of the following movements (Inline lunge, squat, trunk stability, rotation stability, straight leg raise, shoulder mobility)(athletes was shown photos of tests with the names)
1. Challenged your proximal stability the most?
2. Challenged your proximal stability similar to that of your sport?
3. Simulated the challenges playing your sport?

e. What do you think influenced your proximal stability performance the most during the test?
f. What did you think about while you were performing the test?
g. Was there one thought that was most predominate while being tested?
h. Do you think of similar things when you are competing in your events?
i. You scored (athlete was told comprehensive FMS score), What do you think about that?

Figure 2. Sample questions for guided interview. Each participant was interviewed after the Functional Movement Screen assessment. The sample questions were used as an interview template for all the participants. All the responses were audiotaped and transcribed by the primary investigator.

Statistical Analyses

Data analysis included quantitative and qualitative techniques. Information was separately analyzed and then merged to identify differences and similarities between the qualitative and quantitative data. Statistical power for the minimum study population at the $p \leq 0.05$ level and 80% power revealed a minimum of 4 subjects. Our sample size ($n = 28$) yielded a calculated power of 0.916 and a pretest to posttest comparison estimated effect size of 0.642 with a 95% confidence interval at 0.207. A 2-tailed, 1-sample Kolmogorov-Smirnov test was used to compare differences between pretest and posttest self-perceived ratings of proximal stability ($p < 0.05$). A Spearman's rank order correlation test was performed to determine the relationship between the FMS scores and the pretest and posttest self-perceived ratings of proximal stability. Residual standard error from a 1-way analysis of variance (ANOVA) was used to further explore the association between self-perceived ratings and performance on the FMS.

Qualitative analysis consisted of initially coding each questionnaire and interview. Next, the responses for each question from all questionnaires and interviews were organized to examine across all the respondents and their answers to identify consistencies and differences. The resulting responses were then compiled into a single document, along with specific participant quotations that supported the integrated context from all the responses for each question. The responses were then placed into categories through a process of induction between the first and second researcher. Themes emerged from the data and were evaluated as stand-alone phrases or descriptors of self-perceived ideals related to proximal stability performance. This process was repeated several times by the investigators until 100% theme consensus was reached. Validation methods included peer review, memoing, audit trail, triangulation of quantitative data, and qualitative data (12).

Results

Quantitative Results

The mean difference between the pretest and posttest self-perceived ratings for proximal stability were statistically significant at 3.46 ± 0.63 and 3.10 ± 0.49, respectively ($p = 0.01$). The relationship between the pretest proximal stability ratings and the FMS scores were low ($r = 0.19$, $p = 0.33$), whereas the correlation between the posttest rating and FMS scores were moderately high ($r = 0.68$, $p = 0.00$). Analysis of the residual standard error or mean square values from a 1-way ANOVA were smaller for the posttest ratings (0.17) when compared with the pretest ratings (3.2) indicating a stronger association between performance on the FMS and the posttest ratings.

Qualitative Results

Four themes emerged from the questionnaire and the interviews: (a) Participants' *wanting to do well*, (b) *expectations of performance*, (c) having a *focused mental mindset*, and (d) *body control* (Figure 3). Each theme is described below, with supporting direct quotations from the participants.

Wanting to Do Well

A majority of the athletes stated wanting to be successful before, during, and after being tested on the FMS. The athletes expressed their belief that performing well on a proximal stability task meant they had potential to be a superior player, which would result in more playing time. Subject 12 stated, "I would like to think I can get more playing time for having a better core." Subject 4 replied, "If I am strong in my abs and mid-section, I can perform better, and my game is on." The players were focused on performing well individually in comparison with fellow teammates. Subject 4 expressed knowing how well she would do compared with her teammates, "As a starter, I am easily within the top 10% of the team with overall core strength and maybe the best core strength on team." The external influence of teammates and coach was evident. Subject 4 stated, "Sometimes it is hard as coach influences everything I do. I don't really want to do poorly because of him and my team. The coach thing is important for us to do well." Expressed similarly, subject 11 reported, "Coach affects me a little, but so do my teammates. I want to be able to perform with them and for them."

Expectations of Performance

The athletes expressed expectations of their own performance on the FMS. Subject 28 stated, "I guess in some of the areas I knew I wasn't strong. I did not do well; but I think I did ok in the other areas." However, the athletes were unfamiliar with the FMS, which lead to uncertain expectations for performance among self and teammates. Subject 12 expressed apprehension from testing as she

Wanting to do well	Athletes expressed a desire to be better players, to compete with or perform as well as teammates, and to please coaches or teammates
Expectations of performance	Athletes' self-perceptions of performance on the FMS, including what coaches and teammates thought about their performance, and not knowing what to expect
Focused mental mindset	Athletes' cognitive awareness of their performance; thinking or concentrating about the movements involved in the FMS
Body control	Athletes' perceptions that coordination, strength, flexibility, and balance were necessary to be successful on the FMS

Figure 3. Qualitative themes of self-perceptions regarding proximal stability performance.

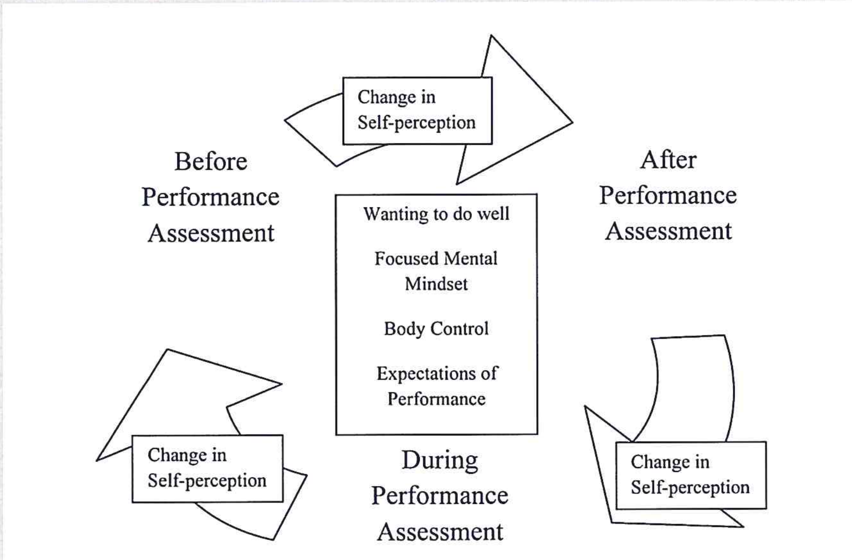

Figure 4. Self-perceptions of proximal stability before, during, and after FMS performance as the athletes attempt a task a period of reflection whereby expectations, self-perceptions, and performance outcomes are compared before, during, and after experiencing the task. Resulting in an altered self-perceptions regarding performance.

reported, "not knowing or not being familiar with performing the motions made me nervous." Several athletes expressed an expectation related to the performance of fellow teammates. Subject 1 reflected on the performance of others, "I have good core stability compared to most people, but compared to my teammates I am one of the weaker ones." Subject 4 compared herself with others; "It's important how I compare to others or what I lack. I know where I am in comparison to my teammates." Several athletes reported the test was unfamiliar, as expressed by subject 8: "Ok, some movements felt awkward to do. They were not familiar." Subject 13 concurred with, "I was not sure what to expect. The exercises were slower than what I am used to. They were not high paced, but they were controlled."

Focused Mental Mindset

The athletes' desire to compete and be successful was evident with extensive concentration and intent on the test movements. Subject 7 expressed, "Yes, I was constantly focused on keeping core tight and balanced. You showed a movement and I would repeat it in my head and work at it mentally to feel it." Subject 4 responded, "I really focused on looking forward and keep my center balanced. Concentrating on body movements, my form and *thinking* about balance."

Body Control

Controlling body position or having adequate strength, coordination, balance, and flexibility were key elements identified by several of the athletes both before and after being tested on the FMS. Subject 24 identified areas to further develop; "I need more balance, strength, and flexibility." Subject 12 reported, "Yes, the need to maintain a solid core and have balance to perform. These tests do that. I was tightening everything in my body to not mess up." Subject 20 expressed the importance of the kinetic chain movements with, "I was not in control of all the movements. My legs and body kept shaking."

Discussion

Although it has been previously documented that self-perceptions influence physical performance (23,41,42), this is the first study to evaluate self-perceptions and proximal stability as measured by the FMS among female athletes. We hypothesized that self-perceptions of proximal stability would be influenced after experiencing the FMS test for female collegiate athletes. The 4 themes (wanting to do well, expectations of performance, focused mental mindset, and body control) provide qualitative description of both positive and negative influences regarding the self-perceptions of proximal stability performance. The statistically significant difference between the pretest to posttest proximal stability ratings ($p = 0.002$) and the shift in the relationship between the ratings and the actual performance scores on the FMS (pretest $r = 0.27$, posttest $r = 0.79$) also support our hypothesis.

The female athletes in this study recorded significant differences from pretest to posttest ratings after the FMS ($p = 0.01$). However, the differences in self-perceptions ratings did not improve from pretest (3.46 $\pm$ 0.63) to posttest (3.10 $\pm$ 0.49). Jones et al. (21) reported significant improvements in self-perceptions of physical ability among female collegiate athletes after a 12-week training intervention ($p <$ 0.01) . The authors concluded that female athletes have good self-perceptions regarding improvements in strength and their ability to perform after experiencing resistance training (21). In this study, the decrease in self-perceived ratings indicates the athletes may have had poor self-perceptions regarding proximal stability before experiencing the FMS (38). This overestimate of *performance expectation* was evident throughout the interviews. Subject 7 reflected, "I thought I was a lot better than what I did on the test." Subject 23 noted, "At the beginning of the preseason I did core training. I felt my core was good, so I did not do any more after that and I am not sure if I should have continued to train it."

From these responses, it seems reasonable that athletes that have poor proximal stability may have higher self-perceived ability than the actual proximal stability performance capabilities. The FMS provided a point of reference that the athletes could use to establish more precise self-perceptions of performance.

Self-perceptions have been reported to improve after exposure to a task (13). The shift from low ($r = 0.19$, $p = 0.33$) to the moderately high ($r = 0.68$, $p = 0.00$) correlations indicates a stronger relationship between the posttest ratings and FMS performance scores rather than the pretest ratings. As previously reported, the improved correlations are likely more indicative of the athletes' improved perceptions regarding their actual performance (14,15,21,38). It has been reported that athletes have heightened self-perceptions of performance after the exposure of an activity, such as a test or intervention (2,15,21). The smaller residual standard error for the posttest ratings (0.17 compared to pretest rating of 3.2) from the 1-way ANOVA indicates the association between the ratings and the FMS was likely stronger after the test. Improved self-perceptions may equip athletes with a more accurate understanding of actual performance expectations of success and failure (15,38). As stated by subject 23, "Now having been *mentally* and *physically* schooled, I obviously need to train more core and trunk. I have a better *understanding* about what it *means* to *control* my core and body." Subject 16 further expressed, "This is good to know. Comparing to what I thought prior to the test and what I know now. I have a better idea of what I need to do to succeed." As previously reported to influence an individual's empowerment and performance, such quotes represent a self-seeking ideal directed toward targeting potential solution(s) to a problem (38). This patient-centered awareness has been hypothesized to equip athletes with positive self-perceptions that can influence performance outcomes, motivation, self-esteem, and participation (1,7,17,39,46). Exposure to the FMS or similar tasks may have allowed female athletes to develop a closer relationship with their proximal stability, which may enhance the athletes' self-perceptions toward future performance tasks involving proximal stability (21,38).

Both positive and negative self-perceptions expressed by the athletes seem to have been influenced by the FMS experience (1,3,16,40,42). Positive and motivational feedback was expressed by those athletes that did not change the pretest to posttest ratings after the FMS (3,13). Subject 4 confidently stated, "Expecting to perform well, I felt that I could do better than most and was confident in my core strength." This is consistent with previous reports that athletes who express high self-perceived performance expectations score well on strength tests (21). Conversely, changes in self-perceptions because of poor performance are often reported to have negative connotations (3). Negative self-perceptions were evident among those that lowered their ratings after being tested on the FMS (3). Subject 7 expressed, "I had some bad stability. Maybe I am not very strong or coordinated? I could not control my body. I just didn't feel good today. I don't have good flexibility or balance." Other athletes were able to use their self-perceptions to identify strengths and weaknesses associated with performance. Subject 21 stated, "I feel like I did okay, I have less strength and flexibility, but good balance." Subject 22 expressed a harsh self-evaluation, but insight for future development, "Not too good! I am not very flexible and have poor balance; but I now know what I need to work on." Such data suggest that change in self-perceptions may offer female athletes a unique insight into enhancing conditioning or injury prevention practices directed toward future tasks that involve proximal stability (3,21).

The relationship between self-perceptions and proximal stability performance is as follows: Based on our findings, and supporting literature, a model was developed describing how female athletes' self-perceptions of proximal stability changes before, during, and after their performance on the FMS (Figure 4). Before performing the FMS, the athlete undergoes a process of mental preparation where performance expectations are established. *Wanting to do well* likely motivates the athlete to prepare for success in completing a task (38). To accomplish success, the athletes' *expectations of performance* are explored and assist in establishing a level of self-efficacy (13,38). Often driven by an emotion, experiences allow athletes to establish expected levels of capability by developing relationships between actions and outcomes (3,13,14,38). During the performance task, the athlete must be *mentally focused* as they reflect on current expectations, knowledge or past experiences. Having a *focused mental mindset* reinforces cognition and the development of skill acquisition. Various levels of cognition are often necessary to complete assessment tasks that are unfamiliar to an athlete's environment or their disposition (14). Thus, the athlete's dedication to being focused is likely to promote success. If performance fails to meet an athlete's expectations, an adaptation in self-perceptions is expected. Exposure to the FMS allowed the athletes an opportunity to identify those attributes necessary for *body control* while performing the task. As the task progressed toward completion, the athlete entered a period of reflection whereby expectations, self-perceptions, and performance outcomes are compared. It appears that this collaboration occurs at 3 levels; before, during, and after experiencing the FMS. It is reasonable to propose that the proximal stability demands experienced during the FMS could have improved the athletes' self-perceptions regarding proximal stability performance.

Our study was limited by the inability of the Tegner activity scale to distinguish between different levels of activity among our highly competitive athletes. However, this finding did help to clarify that the female athletes were a very homogeneous group. The questionnaires used to guide the pretest and posttest interviews were developed from previous publications and pilot data, which resulted in limited reliability for these instruments. Future research may look to assess these measures among competitive athletes. Additionally, the data describe only a small number of Division II, female collegiate soccer and volleyball players. Although the generalizability of our data is limited, there are implications for practice among volleyball and soccer female athletes, as noted above. Future studies should investigate differences among larger cohorts, sexes and various intervention groups.

In conclusion, exposure to the FMS influenced the self-perceptions regarding proximal stability performance among a group of Division II female athletes. Both the quantitative and qualitative data gained from the tandem measures of self-perceptions and the FMS suggest a useful model for testing proximal stability. Contrary to previous reports, the female athletes in this study appear to have had poor self-perceptions of performance capabilities for proximal stability. However, self-perceptions appear to have been enhanced after experiencing challenges at the pelvis, spine, and trunk offered by the FMS. Both positive and negative self-perceptions expressed by the athletes seem to offer a unique insight into influencing future performance outcomes that necessitate proximal stability. The collaborative experiences gained before, during, and after the FMS may empower female athletes in developing more precise self-perceptions related to proximal stability. Further analysis of the qualitative responses suggests the feedback gained from self-perceptions and the FMS may offer an additional insight into training and prevention practices. The tandem measures may allow both clinicians and athletes to establish more consistent and collaborative performance goals that meet the specific needs of the athlete and sport.

Practical Applications

Clinicians, coaches, and athletes are continually looking to maximizing testing and training interventions to reduce the occurrence of injury and contribute to better performance. It has been reported that poor FMS scores and proximal stability deficits in female athletes can contribute to a higher incidence of injuries and decrements in performance measures (9,18,36). Specific strength training interventions targeting poor movement patterns and the proximal stabilizers have been proposed to improve lower extremity kinematics, which are likely to reduce injury susceptibility among female athletes (19,29,36,47). However, to date self-perceptions and proximal stability performance measures have not been used in tandem to assess or monitor training (16,21,41).

More often quantitative measures, such as movement screens, (36) static hold times, (4) or strength and power outputs (11,32,35) are used to monitor or determine proximal stability effectiveness. The FMS may assist athletes in experiencing sport related movements that necessitate proximal stability. The FMS does not duplicate the exact speed and dynamics of sport but mimics the unpredictable nature of sport (10). Unfamiliar testing stimuli have been proposed to reinforce or alter perceptual awareness and result in positive influences on performance (21,38). Therefore, it seems reasonable to use the FMS in combination with self-perceptions not only for assessment but for monitoring training progressions as well. The information gained from the tandem measures may allow both clinicians and athletes to establish more precise and collaborative performance goals (17,22,44). A lucid understanding of a player's capabilities, (3,15,21,41) may allow for improved conditioning prescriptions that align with the athlete's true performance ability (16,38,41). Because poor proximal stability has recently been identified as a major concern among female athletes as a potential contributor to injury (19), tandem measures may offer additional insight into injury prevention practices and sport performance as a whole.

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