The Role of Athletic Identity in the Etiology of Stress Fractures in Collegiate Runners

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Abstract

Background: The efficacy of the Athletic Identity Measurement Scale (AIMS) and Compulsive Exercise Test (CET) as a screening tool for identifying runners who are at high-risk for incurring a stress fracture. A screening tool that incorporates both physical and psychological risk factors may be key in preventing stress fracture incidence in collegiate runners.
Methods: A descriptive survey was designed and filled out by collegiate runners to collect information about various well-known risk factors as well as age, gender, anthropometric measures, injury history, competitive training years, weekly training mileage, and history of disordered eating. The AIMS and CET were included in the survey. Results were collected and analyzed for correlations.
Results: AIMS score and LESF incidence had a moderate positive correlation (r=0.44). AIMS score and LESF incidence within the past year had a weak positive correlation (r=0.38). CET score and shin splints incidence had a weak positive correlation (r=0.322).
Conclusion: A correlation was seen between stress fracture incidence and AIMS scores. However, this correlation is not strong enough to predict stress fracture incidence by itself.

Review of literature

Stress fractures result when bone formation cannot keep up with bone resorption.[1] This often results from overtraining, but certain risk factors can also predispose the active population to incurring a stress fracture. Identifying which risk factors are most indicative of actual incidence of stress fractures is important in order to find the best prevention. Many studies have found risk factors, both intrinsic and extrinsic, but we still do not have a standardized screening tool. This is due to the variable nature of a stress fracture's etiology; despite all the risk factors that we know about, we do not know to what extent they are significant or if some factors are more predictive than others. In addition, some of the known risk factors, such as bone mineral density (BMD) and foot alignment, are impractical to include in a screening tool that could be used as a part of the PPE.

Collegiate athletes and recruits in basic training are among the most researched populations in the etiology of stress fractures. Both of these groups have demonstrated a need for a screening tool because of their high stress fracture incidence[2,3], but the specific risk factors that lead to a stress fracture may differ. Shaffer et al. developed a screening tool using an algorithm

considering physical fitness in the development of stress fractures in a military population.[4] This screening tool is beneficial for this population, but collegiate athletes are usually already conditioned for their sport so the risk factors used to identify high-risk athletes will be different.

In athletic populations, stress fractures make up 1.9%-3.7% of all injuries, and this number is much higher in track and field athletes (11-21%).[2] Some of these numbers are surprisingly high and have been shown to increase when only female incidence rates are considered.[3] The theory behind higher stress fracture incidence in females is the female athlete triad: low energy availability, menstrual irregularity, and low bone density.[5] Menstrual dysfunction was studied by Duckham et al. and found to be positively correlated with stress fracture incidence. Amenorrhea specifically was independently related to stress fracture risk.[6] Another study found that absence of menstruation for 6 or more consecutive months within the past year was a significant factor in the stress fracture group.[7] While eating psychopathology is not an inherently female risk factor, it is most often found in female subjects and contributes to the female athlete triad. Duckham et al. also found a link between eating psychopathology and stress fracture risk in female endurance athletes, but this may have been an interaction with menstrual dysfunction and compulsive exercise.[6]

The roles of height, weight, and BMI in the etiology of stress fractures have been heavily studied. A study by Knapik et al. found that men with lower weight were at greater risk for stress fracture, and added that lower body weight is a risk factor for women as well.[1] Low weight may reflect low muscle mass and weaker bones. Height may also be a risk factor for men according to Knapik. He suggests height and weight may be a factor because long bone length in the lower body has a high correlation to body weight, especially in lower extremities.[1] Greater bone length increases the bending stresses placed upon the bone and places them at greater risk for injury.[1] However, this association between height and incidence of stress fracture may be more significant in men than in women. A study by Knapik et al. found that femoral length was not a risk factor in women although it was in men.[1] Longer bone length may contribute to lower bone strength in men but not in women.[1]

Low BMI is also a risk factor for men and women.[1] According to Knapik's study, when age and ethnicity were accounted for, higher BMI was not an indicator of stress fracture in men. In women higher BMI indicated less risk of stress fracture, especially in the multivariate analysis.[1] Reinking's study determining risk factors for lower extremity overuse bone injury (LEOBI) in collegiate athletes found that BMI was not a significant risk factor.[2] Knapik et al. also showed an interaction between age and BMI in women. As BMI increased, risk of stress fracture decreased, but incidence decreased more significantly in youngest and oldest age groups. He reasons that this may be due to a lower risk in younger women and older women having self-selected into basic combat training because of their lower injury risk.[1] Barrack et al. studied risk factors involving the female athlete triad (energy availability, menstrual function, bone mass) and concluded that low BMI (<21.0 kg/m²) was a significant risk factor whether considered alone or

in conjunction with related risk factors.[8] However, Reinking claims that abnormal BMI is only a risk factor in military populations, and that it seems to disappear in athletic populations.[2] This may be because in military populations a broad spectrum of body types are undergoing the same stressors whereas in collegiate athletics BMI may be similar in each sport and able to better withstand the same stressors.

The psychological component of a stress fracture is rarely studied, but may lead to keys in prevention, both for athletic trainers to implement and athletes and coaches to be aware of. A study by Moran et al. found in a military population that stress, subjective coping, and motivation were significantly higher in those who incurred a stress fracture than those who did not.[9] The stress fracture group also walked 16% more than the control group. The results of this study suggest that psychological factors have a tangible and quantifiable result. This is a significant finding but has not been researched in an athletic population.

Athletic identity can be defined as the "degree to which an individual identifies with the athlete role."[10] It has been hypothesized that high athletic identity may predispose one to negative health outcomes.[10] This has been studied in the context of eating disorder pathology,[10] but it may also have a link to stress fracture pathology. High scores on the Athletic Identity Measurement Scale (AIMS) have been predictive of higher scores on the Compulsive Exercise Test (CET) in long distance runners.[10] The CET attempts to measure the construct of compulsive exercise which involves "an association with weight and shape concerns, and persistent continuation in order to: (a) mitigate the experience of extreme guilt and/or negative affect when unable to exercise; and (b) avoid the perceived negative consequences of stopping."[10] Turton et al. give credence to the idea that compulsive exercise and athletic identity may cause an athlete to continue their sport against medical practitioners' advice.[10] Female endurance athletes who had CET scores above the median were at 7 times greater risk for stress fracture compared to those below the median.[10] Some examples of statements in the AIMS that participants agree or disagree with are "I consider myself an athlete", "I have many goals related to sport", "I feel bad about myself when I do poorly in sport." Some examples of statements from the CET are "I feel happier and/or more positive after I exercise", "If I miss an exercise session, I will try and make up for it when I next exercise", "If I cannot exercise, I worry that I will gain weight."[11]

In conclusion, many factors contribute to the development of stress fractures, and they do not affect all people to the same degree. Low weight and BMI were fairly consistent risk factors for both men and women, although they seemed to be more significant risk factors in women.[1,2,8] Low BMI was also a more significant risk factor in military populations, whereas athletic populations seemed to be more conditioned to their specific activity.[2] The female athlete triad is a key to understanding stress fractures in females.[5–7] Psychological components are also a significant aspect to the etiology of a stress fracture.[10]

My hypothesis was that the stress fracture group will have a higher percentage of participants that identify strongly as an athlete as measured by the AIMS.

Methods

Survey

The design of this study is a descriptive survey. It attempted to examine how athletic identity and compulsive exercise correlate with the incidence of stress fracture. Athletic identity was measured by the Athletic Identity Measurement Scale (AIMS). This psychometric scale has proven to be valid and has shown a relationship between athletic identity and compulsive exercise in long-distance runners in a study by Turton et al.[10] It is composed of 10 statements that the participant rates "strongly agree" to "strongly disagree" on a 7-point Likert scale. The other psychometric scale used in this study is the Compulsive Exercise Test (CET). It is a list of 24 statements that the participant must rate 0 ("never true") to 5 ("always true"). It is also valid and reliable for the purposes of this study.[11] The other components included in the survey questionnaire are age, gender, height, weight, competitive training years, weekly training mileage, history of stress fracture and shin splints, and history of disordered eating. Age of menarche and history of menstrual dysfunction was also included on the survey but was only asked of female participants. We obtained IRB approval on June 27, 2017.

Participants

Inclusion criteria were collegiate athletes on cross country or track and field teams, and 18 years or older. Exclusion criteria were track and field athletes that only compete in pole vaulting, jumping and throwing events.

An invitation to participate in the research study was sent by email to the athletic trainers of cross country and track and field collegiate teams in Ohio. This email message included an introduction to the research, an informed consent attachment, and a link to the survey on Qualtrics. By clicking the link participants indicated that they agreed to the terms of the informed consent.

Data analysis

Data collection was performed by Qualtrics. We were most interested in seeing the correlation between athletic identity and incidence of stress fracture within the past year. The alpha level was set at 0.05. Data for AIMS scores, CET scores, BMI, stress fracture incidence, stress fracture incidence within the past year, and shin splints incidence were put in a Microsoft Excel spreadsheet and uploaded into SPSS to be analyzed. We analyzed AIMS scores with stress fracture incidence, stress fracture incidence within the past year, and shin splints incidence. CET scores were correlated with stress fracture incidence, stress fracture incidence within the past year, and shin splints incidence. BMI was correlated with stress fracture incidence, stress fracture

incidence within the past year, and shin splints incidence. Shin splints incidence was correlated with stress fracture incidence and stress fracture incidence within the past year.

Results

Of the 53 participants 18.9% were male (n=10), and 81.1% were female (n=43). Of the 45 participants that completed the survey, 20.0% were male (n=9), and 80.0% were female (n=36). Incomplete surveys were discarded and excluded from all data. Thirty-seven participants (82.2%) were between the ages of 18-21, and eight (17.8%) were 22 years or older. The mean age of this sample was 20.2 years old, and the mean years of experience running was 6.0 years. Eighteen (40.0%) participants had been diagnosed with a lower extremity stress fracture, and twenty-seven (60.0%) had not. Twenty-one (46.7%) had been diagnosed with shin splints, twenty-four (53.3%) had not. Of those who had a stress fracture, 9 (50.0%) have had one within the last year while 9 (50.0%) had not. Of the female participants, 16 (44.4%) have experienced menstrual dysfunction. Out of those 16 participants, 8 (50.0%) described it as oligomenorrhea, 7 (43.8%) described it as amenorrhea, and 1 (6.2%) participant did not answer this question due to an error in Qualtrics that did not display the question to them. Of all the participants, 3 (6.7%) had been diagnosed with an eating disorder, and 42 (93.3%) had not. Out of those who reported they had not been diagnosed with an eating disorder, 11 (26.2%) said they have struggled with disordered eating without getting a diagnosis, and 31 (73.8%) have not.

There was a moderate positive correlation between AIMS score and stress fracture incidence (r=0.436, p=0.003). There was a weak positive correlation between AIMS score and stress fracture within the last year (r=0.378, p=0.011) and between CET score and shin splint incidence (r=0.322, p=0.049). CET score with stress fracture incidence (r=0.067, p=0.690) and stress fracture within the last year (r=0.101, p=0.545) showed very weak positive correlations with no statistical significance. BMI and stress fracture incidence had a very weak negative correlation with no statistical significance (r=-0.033, p=0.830). BMI and stress fracture incidence within the last year had a weak positive correlation with no statistical significance (r=0.240, p=0.112). AIMS score and shin splints incidence had a very weak positive correlation with no statistical significance (r=0.172, p=0.258). BMI and shin splints incidence had a very weak positive correlation with no statistical significance (r=0.019, p=0.901). Stress fracture incidence and shin splints had a very weak positive correlation with no statistical significance (r=0.055, p=0.722). Stress fracture incidence within the last year and shin splints incidence had a very weak negative correlation with no statistical significance (r=-0.022, p=0.885).

Discussion

While this study has some significant findings, it is simply a stepping stone for more research in this area. There is a moderate positive correlation between AIMS scores and stress fracture incidence in this sample. The correlation between AIMS scores and stress fracture within the last year is weaker, but the p value showed that it is likely not due to chance. The weaker correlation

may be due to the small numbers of this sample. These results are significant to showing that there is a psychological component to stress fracture incidence. Other factors like low BMI, menstrual dysfunction, and disordered eating are known to predispose runners to stress fractures, and athletic identity could be the next addition to this list. While this sample is small, and findings may not be conclusive, high athletic identity may be a risk factor that could be used to flag high-risk individuals for stress fractures.

Another significant finding is the weak positive correlation between CET scores and shin splints incidence. This is another confirmation of the psychological component of stress injuries. Compulsive exercise and athletic identity are not measuring the same thing, but they both show a tendency for an athlete to push their body past what is healthy for it because of a certain mindset.

More research needs to be done to confirm these findings in a larger sample and across more populations than collegiate runners. Additionally, most of the participants were females, and so the data may be biased. Another limitation is a limited ability to analyze the statistics. There are several components to this survey that were not analyzed in depth because of a time constraint and the complexity of the data. For example, questions about mileage, menstrual irregularity, and disordered eating were not analyzed to see their effect on stress fractures for this sample. Much more time and expertise would be needed to fully analyze the results of this survey. More research should also be done in order to find how predictive this survey is of stress fracture incidence in a cross country or track season.

Conclusion

This study has established that there is a psychological component to stress fracture incidence and shin splints incidence. This points to another risk factor that can be used to screen athletes for their risk of stress fracture. It also gives clinicians a way to counsel their athletes to aid in injury prevention. The belief that an athlete's identity is entirely in their sport can lead to injury so it is important to show athletes that they are more than their role in sport. More research should be done to determine the extent to which athletic identity predisposes an athlete to stress fracture incidence.

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