December 16, 2020
Zachary Zenko
Academic Editor
PeerJ

PeerJ#2020:10:53616:0:3:REVIEW
"The relationship between the female athlete triad and injury rates in collegiate female athletes" by Mutsuaki Edama

Dear Editor:

Thank you for your letter. We are grateful for the detailed feedback provided by the reviewers, which we feel has helped us to significantly improve the paper. Attached are our point-by-point responses to the reviewers' comments and our revised manuscript, which we hope will now meet with your approval. We believe that our revisions have addressed the issues raised by the reviewers and trust that the manuscript is now suitable for publication in *PeerJ*.

Thank you again for your thoughtful comments, and we look forward to hearing from you soon.

Sincerely,

Mutsuaki Edama

RESPONSE TO REVIEWER 1 (Vanessa Yingling)

1. Basic reporting
   The manuscript should be reviewed for consistency, tense and grammar. The references are complete and appropriate. The introduction does not build a case for the purpose and hypothesis. Both the Triad and REDs were introduced but there was no discussion of their differences or similarities. The main purpose was to use the Female Athlete Triad Cumulative Risk Assessment but previous uses of the tool were not included and the reason to use this tool was not clear. What are the instances of injury in female athletes? Why would this tool help?

⇒The paper has been thoroughly edited by a native English-speaking medical editor.

⇒The introduction has been re-worked to build a case for this study, as suggested.

The female athlete triad (hereafter referred to as triad) has three components: (1) low energy availability (LEA) with or without disordered eating (DE)/eating disordered (ED); (2) menstrual dysfunction; and (3) low bone mineral density (BMD) (De Souza et al. 2014a). An IOC consensus group has recently introduced a new umbrella term, that is, 'Relative Energy Deficiency in Sport' (RED-S), to describe the physiological and pathophysiological effects of energy deficiency in male and female athletes (Mountjoy et al. 2014). The authors assert that "RED-S is required to more accurately describe the clinical syndrome originally known as the Female Athlete Triad" that is a "more comprehensive, broader term for the overall syndrome, which includes what has so far been called the 'Female Athlete Triad' (Mountjoy et al. 2014)." RED-S is based on a relative energy deficit that is reported to affect various factors (Mountjoy et al. 2018). However, RED-S is insufficiently supported by scientific research to warrant adoption at this time. Recently, there have been many studies of bone stress fractures and amenorrhea, but their relationships with the occurrence of sports injury have not been examined. It was previously reported that the frequency of sports injuries was higher in women than in men, suggesting a relationship between the menstrual cycle and sports injuries (Hewett et al. 2007). It has been suggested that there is a strong relationship between the risk of both RED-S and sports injuries.

The advances in our understanding of risk factors and management of the triad are reflected in evidence based guidelines developed by the Female Athlete Triad Coalition in 2014 to help guide medical decision making for female athletes (De Souza et al. 2014a). The resulting Female Athlete Triad Cumulative Risk Assessment includes the following 6 items scored on a scale from 0 to 2: low LEA with or without DE/ED; low body mass index (BMI); delayed menarche; oligomenorrhea or amenorrhea; low BMD; and prior stress fracture (De Souza et al. 2014a). The resulting risk assessment score is used to classify an athlete into 1 of 3 categories: low risk (0-1 points), moderate risk (2-5 points), or high risk (6 points) (De Souza et al. 2014a).

Using risk assessment scores to help manage treatment for athletes is important, especially considering the evidence for adverse health consequences resulting from the triad. For example, a higher number of triad risk factors is associated with an increased risk for bone stress injuries and low BMD (Barrack et al. 2014; Tenforde et al. 2013). Furthermore, for female athletes who have one component of the triad, the risk of developing bone stress fractures is about 3 times higher than that of athletes with no components of the triad; the risk is about 5 times higher for those with two or more components (Mallinson & De Souza 2014). In addition, collegiate athletes with triad risk factors including oligomenorrhea/amenorrhea or increased risk assessment scores had higher grade bone stress fractures on MRI and longer return to play (Nattiv et al. 2013).

Therefore, this study aimed to clarify the relationship between the triad risk assessment score and the number of sports injuries. The hypothesis of this study was that the moderate and high-risk groups have higher injury rates than the low-risk group on the triad risk assessment score.

Barrack MT, Gibbs JC, De Souza MJ, Williams NI, Nichols JF, Rauh MJ, and Nattiv A. 2014. Higher incidence of bone stress injuries with increasing female athlete triad-related risk factors: a prospective multisite study of exercising girls and women. Am J Sports Med 42:949-958. 10.1177/0363546513520295

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

Hewett TE, Zazulak BT, and Myer GD. 2007. Effects of the menstrual cycle on anterior cruciate ligament injury risk: a systematic review. Am J Sports Med 35:659-668. 10.1177/0363546506295699

Mallinson RJ, and De Souza MJ. 2014. Current perspectives on the etiology and

manifestation of the "silent" component of the Female Athlete Triad. Int J Womens Health 6:451-467. 10.2147/ijwh.S38603
Mountjoy M, Sundgot-Borgen J, Burke L, Carter S, Constantini N, Lebrun C, Meyer N, Sherman R, Steffen K, Budgett R, and Ljungqvist A. 2014. The IOC consensus statement: beyond the Female Athlete Triad--Relative Energy Deficiency in Sport (RED-S). Br J Sports Med 48:491-497. 10.1136/bjsports-2014-093502
Mountjoy M, Sundgot-Borgen JK, Burke LM, Ackerman KE, Blauwet C, Constantini N, Lebrun C, Lundy B, Melin AK, Meyer NL, Sherman RT, Tenforde AS, Klungland Torstveit M, and Budgett R. 2018. IOC consensus statement on relative energy deficiency in sport (RED-S): 2018 update. Br J Sports Med 52:687-697. 10.1136/bjsports-2018-099193
Nattiv A, Kennedy G, Barrack MT, Abdelkerim A, Goolsby MA, Arends JC, and Seeger LL. 2013. Correlation of MRI grading of bone stress injuries with clinical risk factors and return to play: a 5-year prospective study in collegiate track and field athletes. Am J Sports Med 41:1930-1941. 10.1177/0363546513490645
Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, and Warren MP. 2007. American College of Sports Medicine position stand. The female athlete triad. Med Sci Sports Exerc 39:1867-1882. 10.1249/mss.0b013e318149f111

2. In lines 60-62; It seems that RED-S is a well established theoretical concept, when in fact it’s the opposite. Based on the DeSouza 2014b reference that they provided, which doesn’t (currently) support the use of RED-S as a well-established model, should include some a disclaimer or limitations as to how the IOC actually misinterprets or is lacking evidence behind their claims.

⇒The introduction has been modified, as suggested.
(See No. 1.)

3. Raw data was shared in accordance with the Data Sharing policy.
The titles of the tables are incorrect for Tables Consistent terminology should be used for the tool Female Athlete Triad Cumulative Risk Assessment. The tables refer to the measure as female athlete triad coalition scoring category and triad risk categories, consistent terms are needed.

⇒The text has been corrected, as suggested (Raw data).

4. Experimental design
The main hypothesis of this work is interesting but is not supported by the current introduction. The background of why this is important is unclear and how the current data will contribute to the knowledge gap. The Introduction needs to be re-worked so the readers understand “why” this is an important topic and how these data will add to the knowledge gap in this area.

⇒The introduction has been re-worked, as suggested.
(See No. 1.)

5. Medical Examinations: Who completed the examinations and attaching the questionnaire would be helpful. Was injury self report?

⇒The information regarding the medical examinations has been added, as suggested.

Medical examinations and anthropometry were conducted from August 2018 to January 2019. The participants were asked about age at menarche, date of last menstrual period, number of menstrual cycles per 12 months, history of bone stress fracture (site and times), dietary restriction, and present or past history of ED/DE using the questionnaire form. Those with menstrual deficiency for >3 months (definition of the Japan Society of Obstetrics and Gynecology) or <6 menses in 12 months were classed as amenorrheic athletes (De Souza et al. 2014a). Data were collected by physical therapists (M.E.) and nutritionists (H.I. and F.H.)

Commented [1]: The data were not requested from medical records? Even if the physical therapist and nutritionist were asking the questions, the data were still self report.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

6. Anthropometry: Insufficient detail on all measures was given.
   The ultrasound methods and estimation of energy deficiency should each have their own sections to explain how the data was collected. It is unclear what measures were collected from the ultrasound device and how BMD was determined from the standard measures of Speed of Sound (SOS) and broadband ultrasound attenuation (BUA) that are collected from these methods (REFS).

⇒The details requested have been added in the anthropometry section.

Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). A BMD Z-score of < -1.0 in the heel is defined as low BMD (as defined by the Triad coalition in 2014) (De Souza et al. 2014a) The Triad is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used here in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology (http://jspe.umin.jp/gaiyou/index.html) was used.

Commented [2]: It is still unclear how BMD was determined from the ultrasonic bone densitometer that should report BUA and SOS. How was the foot positioned for the testing ie. the protocol of the test. And what is the reliability and repeatability of the lab.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

7. Ln 136 more information is needed on how the Z Scores from ultrasound measures were determined. Does the Female Athlete Triad Cumulative Risk Assessment allow for measures of BMD other than from DXA measurements?

⇒BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). A BMD Z-score of < -1.0 in the heel is defined as a low BMD (as defined by the Triad coalition in 2014) (De Souza et al. 2014a)

Commented [3]: again more detail on the methodology is needed. As well as if the output measures from ultrasound can be used in the FAT Cumulative Risk Assessment.

Commented [4R3]: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3891842/#:~:text=A%20number%20of%20devices%20are,and%20quantitative%20CT%20(QCT).

Commented [5R3]: So background on the relationship (correlations) between US measures and BMD should be added in particular for a young athletic population.

8. "Ultrasonic bone densitometry" is less accurate than "X-ray absorptiometry (DXA; Discovery DXA System)", but with the no risk of exposure.

⇒The text has been corrected as suggested (Number of injuries).

9. Ln 137 was the history of stress fracture self report or verified through medical records? How was a stress fracture vs a trabecular stress fracture determined?

⇒The text has been corrected as suggested (Materials and methods).

An injury survey during sports activities was conducted for one season from April 2018 to March 2019. The injury survey collected injuries that resulted in failure to participate in practice and competition for more than 24 hours after injury, referring to the injury survey items used by the IOC (Junge et al. 2008). Injured body part location and type of injury diagnosis were recorded. Data were collected by seven physical therapists and a medical doctor in field and hospital. Serious illnesses such as stress fractures were diagnosed at the hospital using X-rays and MRI by medical doctor.

Junge A, Engebretsen L, Alonso JM, Renström P, Mountjoy M, Aubry M, and Dvorak J. 2008. Injury surveillance in multi-sport events: the International Olympic Committee approach. Br J Sports Med 42:413-421. 10.1136/bjsm.2008.046631

10. Ln 115-117 The triad is not defined by the energy availability but one factor of the triad is low energy availability. More detail on the classifications in De Souza et al should be included as well as references to other studies that have utilized this method to determine energy availability. Furthermore, the limitations of this approach should be addressed.

⇒The text has been corrected as suggested (Materials and methods).

Anthropometry

Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). The triad is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used

Commented [6]: so you were just trying to classify athletes who had less than 30kcal/kg of FFM/d? Have other studies used this criteria?

here in this study(De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

11. Ln 118-119: low EA is not entirely defined as BMI <17.5 kg/m^2. Athletes may have low EA but a 'normal' BMI. Looking at other methods such as detailed food intake and energy expenditure can be used to determine this (DeSouza 2014a).

⇒The text has been corrected as suggested (Materials and methods).

Anthropometry

Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). The triad is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used here in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

12. Injury Rate: Were the injury data collected based on medical reports or by team/athlete physical therapists during the season? How many physical therapists were reporting the data and how was consistency between therapists determined and verified?

⇒The text has been corrected as suggested (Number of injuries).

An injury survey during sports activities was conducted for one season from April 2018 to March 2019. The injury survey collected injuries that resulted in failure to participate in practice and competition for more than 24 hours after injury, referring to the injury survey items used by the IOC (Junge et al. 2008). Injured body part location and type of injury diagnosis were recorded. Data were collected by seven physical therapists and a medical doctor in field and hospital. Serious illnesses such as stress fractures were diagnosed at the hospital using X-rays and MRI by medical doctor.

Junge A, Engebretsen L, Alonso JM, Renström P, Mountjoy M, Aubry M, and Dvorak J. 2008. Injury surveillance in multi-sport events: the International Olympic Committee approach. Br J Sports Med 42:413-421. 10.1136/bjsm.2008.046631

13. Statistical analysis: More detail on the statistical analysis is needed. Which comparisons are testing the hypothesis from the introduction, “the moderate and high-risk 93 groups have higher injury rates than the low-risk group on the triad risk assessment score”. Also which statistical program was used.

⇒The details requested have been added, as suggested (Statistical analysis).

The Fisher exact test was used for comparisons differences in the risk categories for each sport, to compare differences in the number of injuries by risk categories for each sport, and to compare differences in injured body part-location and the type of injury diagnosis by risk category, and multiple comparisons were performed through use of the Ryan nominal level for post hoc testing. Statistical analyses were performed using SPSS (Version 26.0; SPSS Japan Inc., Tokyo, Japan). The level of statistical significance was P < .05.

14. Validity of the findings Results: Ln 157 Patients Characteristics, should not be referred to as patients but as participants or athletes. Could information on their age or duration of sports participation be added to these results.

⇒The additional information requested has been added (Results).

“Patients’ characteristics” was changed to “Athletes’ characteristics”.

15. Ln 167 Title of this section does not clarify the results that are being addressed. Can the exact p values be included in the text or table not just the reference to p < 0.05.

⇒The exact p values have been added, as suggested (Results).

Prevalence of the 7 events for 116 athletes assigned to triad risk categories

In swimming, there were significantly more in the low-risk category than in the moderate and high-risk categories (p=0.004). In athletics long-distance, there were significantly more in the moderate-risk category than in the low and high-risk categories (p=0.004) (Table 1). In each scoring category, there was a high proportion (41/116, 35.3%) with a history of bone stress fracture, particularly in athletics long-distance (7/8, 87.5%) (Table 2).

16. Ln 162: These data should be from parts of Table 2 but it is unclear where these numbers are from.

⇒Figure 1 was added.

17. Ln 175 add “one” to the “since there was only one participant…”

⇒The text has been corrected as suggested (Results).

Number of injuries by triad risk categories (Table 3)

Since there was only one participant in the high-risk category, the high and moderate-risk categories were combined for the analysis. The number of injuries was 65 (n=41) in one year. In the moderate and high-risk categories, there were significantly more in the injury group than in the non-injury group (p=0.01). In the low-risk category, there were significantly more in the non-injury group than in the injury group (p=0.01).

18. Ln 178-179 please report exact p values for these 2 comparisons.

⇒Exact p values are now reported, as suggested (Results).

Number of injuries by triad risk categories (Table 3)

Since there was only one participant in the high-risk category, the high and moderate-risk categories were combined for the analysis. The number of injuries was 65 (n=41) in one year. In the moderate and high-risk categories, there were significantly more in the injury group than in the non-injury group (p=0.01). In the low-risk category, there were significantly more in the non-injury group than in the injury group (p=0.01).

19. Ln 181-184 Is Table 4 needed and more detail on what Table 5 is illustrating.

⇒We believe that Table 4 is useful, and further detail on Table 5 has been provided, as suggested (Results).

Injured body part location and type of injury diagnosis by risk category

There was no significant difference in the injured body part location (Table 4). For stress fracture and bursitis, there were significantly more in the moderate and high-risk categories than in the low-risk category at injury diagnosis (p=0.023) (Table 5).

20. Discussion: The first paragraph of the discussion should highlight the main results on the data. Was the hypothesis supported? What was the main take away from these data. The second paragraph of the discussion should be in the results section. Paragraph 5 addresses the primary hypothesis and should be addressed earlier in the discussion. The limitations say that injury rate could not be determined but the first paragraph states “there have been no studies of the relationship between the triad risk assessment 190 score and sports injury rate.” Terminology and the use of injury risk and injury rate need to be defined and clarified throughout the manuscript.

⇒The discussion has been thoroughly re-worked, as suggested (Discussion).

Discussion

This study clarified the relationship between the triad risk assessment score and the one-year sports injury rate for female college students of multiple sports. To the best of our knowledge, there have been no studies of the relationship between the triad risk assessment score and the number of sports injuries.

Regarding the type of injury diagnosis by risk category, bone stress fracture and bursitis were significantly higher in the moderate and high-risk category than in the low-risk category. This result supported the hypothesis in this study. In previous studies, a higher number of triad risk factors was associated with an increased risk for bone stress injuries and low BMD (Barrack et al. 2014; Gibbs et al. 2014; Tenforde et al. 2013). Furthermore, for female athletes with one component of the triad, the risk of developing stress fractures was 2.5 times higher than that of athletes with no components of the triad; the risk was 4.7 times higher for those with two or more components (Mallinson & De Souza 2014). Therefore, this study was considered to have supported the results of the previous studies. However, it is necessary to examine bursitis in greater detail in the future.

In this study, there were 4/116 (3.4%) athletes with LEA with or without DE/ED, 6/116 (5.2%) with amenorrhea, and 0/116 (0.0%) with low BMD. No athletes had all three triad components. In previous studies of elite Japanese athletes, the number of athletes with LEA was 42/300 (14.0%), with amenorrhea was 117/300 (39.0%), and with low BMD was 68/300 (22.7%). Seventeen athletes (5.7%) had both amenorrhea and LEA, whereas 39 (13%) had both amenorrhea and low BMD, and two (0.7%) had low BMD and LEA. Sixteen (5.3%) had all three components of the triad. In previous studies of American collegiate athletes, the number of athletes with LEA was 2/323 (0.6%), the number with oligomenorrhea or amenorrhea was 64/239 (26.8%), and the number with low BMD was 19/323 (5.9%) (Tenforde et al. 2017). It was suggested that the cause may be related to the difference in competition level and measurement method.

In swimming, the number in the low-risk category was significantly higher than in the moderate and high-risk categories. In athletics long-distance, the number in the moderate-risk category was significantly higher than in the low-risk category. In a previous study, athletics (64/86; 74.4%) (Nose-Ogura et al. 2019), track (0/4; 0.0%) (Tenforde et al. 2017), cycling (3/4; 75.0%) (Nose-Ogura et al. 2019), swimming (7/11; 63.6%) (Nose-Ogura et al. 2019), gymnastics (7/7; 100.0%)(Nose-Ogura et al. 2019) (9/16; 56.2%) (Tenforde et al. 2017), rhythmic gymnastics (31/35; 88.6%) (Nose-Ogura et al. 2019), and cross-country (23/47; 48.9%) (Tenforde et al. 2017) were in the moderate or high-risk categories. Although there is no clear consensus, it was considered that there were many endurance and aesthetic sports athletes in the middle- and high-risk categories.

In addition, for each scoring category, there was a large proportion (41/116, 35.3%) with a history of bone stress fractures, particularly in athletics long-distance (7/8; 87.8%). In previous studies, female athletes were at a higher risk of bone stress fractures than male athletes (De Souza et al. 2014a; Nose-Ogura et al. 2019). It has also been reported that the frequency of bone stress fractures among 1616 female Japanese athletes and 537 controls (non-athletes) was 22.6% for athletes competing at the international level, 23.3% for athletes competing at the national level, 20.8% for athletes competing at the local level, 18.8% for athletes competing at other levels, and 4.3% for controls (Takamatsu & Kitawaki 2016). Therefore, the athletes in the present study had a high rate of bone stress fractures. Furthermore, it was thought that one needs to carefully consider the reason why significantly more athletes were in the moderate-risk category than in the low-risk category in athletics long-distance.

Several limitations must be considered in this study. First, the 1000 athlete exposures could not be calculated. Second, the survey of injuries during sports activities was conducted for one season from April 2018 to March 2019, but medical examinations and anthropometry were conducted from August 2018 to January 2019. Therefore, this was not a prospective study. In the future, prospective research was considered necessary. Third, accurate the Triad (defined as energy intake minus energy expenditure of exercise relative to fat-free mass <30 kcal/kg of FFM/d) was not measured in this study.

Commented [7]: unclear sentence

Barrack MT, Gibbs JC, De Souza MJ, Williams NI, Nichols JF, Rauh MJ, and Nattiv A. 2014. Higher incidence of bone stress injuries with increasing female athlete triad-related risk factors: a prospective multisite study of exercising girls and women. Am J Sports Med 42:949-958. 10.1177/0363546513520295
De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218
Gibbs JC, Nattiv A, Barrack MT, Williams NI, Rauh MJ, Nichols JF, and De Souza MJ. 2014. Low bone density risk is higher in exercising women with multiple triad risk factors. Med Sci Sports Exerc 46:167-176. 10.1249/MSS.0b013e3182a03b8b
Mallinson RJ, and De Souza MJ. 2014. Current perspectives on the etiology and manifestation of the "silent" component of the Female Athlete Triad. Int J Womens Health 6:451-467. 10.2147/ijwh.S38603
Nose-Ogura S, Yoshino O, Dohi M, Kigawa M, Harada M, Hiraike O, Onda T, Osuga Y, Fujii T, and Saito S. 2019. Risk factors of stress fractures due to the female athlete triad: Differences in teens and twenties. Scand J Med Sci Sports 29:1501-1510. 10.1111/sms.13464
Takamatsu K, and Kitawaki J. 2016. Annual report of the Women's Health Care Committee, Japan Society of Obstetrics and Gynecology, 2016. J Obstet Gynaecol Res 42:1419-1438. 10.1111/jog.13130
Tenforde AS, Carlson JL, Chang A, Sainani KL, Shultz R, Kim JH, Cutti P, Golden NH, and Fredericson M. 2017. Association of the Female Athlete Triad Risk Assessment Stratification to the Development of Bone Stress Injuries in Collegiate Athletes. Am J Sports Med 45:302-310. 10.1177/0363546516676262
Tenforde AS, Sayres LC, McCurdy ML, Sainani KL, and Fredericson M. 2013. Identifying sex-specific risk factors for stress fractures in adolescent runners. Med Sci Sports Exerc 45:1843-1851. 10.1249/MSS.0b013e3182963d75

21. The conclusion states: “This study clarified the relationship between the triad risk assessment score and the one year sports injury rate for female college students of multiple sports.” It is not clear how the relationship has been clarified with the data presented. The discussion needs to convince the reader of this claim and in its current format the conclusion does not seem to be supported. In addition, the conclusion states “This was not a prospective survey, but its 255 results suggest that athletes with RED-S may be at increased risk of injury. “The authors used the Triad Cumulative Risk assessment so why is the conclusion focused on REDs? Both should be introduced and discussed in the manuscript, but should not be used interchangeably throughout the manuscript.

⇒The conclusion has been altered to reflect the reviewer’s suggestions (Conclusions).

In this study, regarding the number of injured athletes by risk category, in the moderate and high-risk categories, there were significantly more athletes in the injury group than in the non-injury group. In addition, there were significantly more athletes in the moderate and high-risk categories than in the low-risk category with bone stress fractures and bursitis. Its results suggest that athletes with the moderate and high-risk groups of Triad may be at increased risk of injury.

22. Comments for the Author: I am attaching a pdf with additional comments (footnotes) that can be. found on page 36.

[a]add injury?

⇒The text has been corrected as suggested (Key words).

Key words: RED-S; low energy availability; The Female Athlete Triad Cumulative Risk Assessment; Injury

[b]The main purpose of this paragraph is to highlight the importance of energy intake and injury? Both the triad and REDs have a component of energy deficiency in their definitions. But the main point of this paragraph is not set up well. Is the focus on injury? If so put the triad and the REDs in that context and are they similar or different and is that important.

⇒The introduction has been rewritten to address the reviewer's comments.
(See No. 1.)

[c]Risk factors for the triad are noted in this paragraph. Why is it important to determine the risk factors for the triad? The importance is not set up. well. in the first paragraph.

⇒The introduction now deals with the importance of determining the risk factors for the triad in the context of having been re-worked to address the reviewer's comments on the introduction.
(See No. 1.)

[d]The incidence of injury in female athletes should be introduced earlier and the factors that are associated with those injuries, low energy availability and menstrual irregularities. Then introduce both the triad and REDs

⇒The text of the introduction has been rewritten, as suggested.
(See No. 1.)

[e]Seems like this paragraph should be earlier. What are the "various factors" that REDs. affects?

⇒More detail has been provided in the introduction, as suggested.
(See No. 1.)

[f]How were they recruited? Volunteer basis? what were the criteria?

⇒This was part of the medical examination that we carry out for all athletes every year. It is conducted for all athletes who have given their consent.

[g]This section is a bit unclear. What is the. universities ethics committee named? Also the last 2 sentences could be combined.

⇒The information requested has been added.

All sports were at the national level of competition. The Niigata University of Health and Welfare of ethical approval to carry out the study within its facilities (18032). Written, informed consent was obtained from all subjects.

[h]Much more detail is needed on the specifics of data collection. And to explain the use of BMD as the outcome variable for ultrasound measures and not BUA and SOS.

⇒The detail requested has been added (Anthropometry).

BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). A BMD Z-score of < -1.0 in the heel is defined as low BMD (as defined by the Triad coalition in 2014) (De Souza et al. 2014a).

Commented [8]: BMD is not a direct measure from an ultrasound densitometer, it is unclear to the reader how measures of BUA and SOS were transformed into BMD.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

[i]more justification should be reported for not using standard practices of calculating LEA. Have other investigators used this approach?

⇒More justification has been provided (Anthropometry). Other investigators have, in fact, used this approach, and their work is cited.

Anthropometry

Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). A BMD Z-score of < -1.0 in the heel is defined as low BMD (as defined by the Triad coalition in 2014) (De Souza et al. 2014a). The Triad is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used here in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

[j]Was this the number of injuries over the span of time or for a certain number of exposure hours. The term rate can be misleading.

⇒The number of injuries is now reported, rather than the rates.

[k]which Chi-Squared test? Were there any sub analyses that were done. I am not an expert in this analysis but seems that more information is needed. Which program used. identification of variables etc.

⇒More information regarding the statistical analysis has been provided.

The Fisher exact test was used for comparisons differences in the risk categories for each sport, to compare differences in the number of injuries by risk categories for each sport, and to compare differences in injured body part-location and the type of injury diagnosis by risk category, and multiple comparisons were performed through use of the Ryan nominal level for post hoc testing. Statistical analyses were performed using SPSS (Version 26.0; SPSS Japan Inc., Tokyo, Japan). The level of statistical significance was $P < .05$.

[l]Patients Characteristics, should not be referred to as patients but as participants or athletes.
Could information on their age or duration of sports participation be added to these results.

⇒"Patients Characteristics" was changed to "Athletes' characteristics", and age was added.

Recruitment
A total of 116 female college athletes (average age, 19.8 ± 1.3 years) were investigated; 67 were teenagers and 49 were in their 20s.

[m]Title of this section does not clarify the results that are being addressed. Can the exact p values be included in the text or table not just the reference to $p < 0.05$.

⇒The text has been changed, as suggested, and exact p values are provided.

Prevalence of the 7 events for 116 athletes assigned to triad risk categories
In swimming, there were significantly more in the low-risk category than in the moderate and high-risk categories (p=0.004). In athletics long-distance, there were significantly more in the moderate-risk category than in the low and high-risk categories (p=0.004) (Table 1). In each scoring category, there was a high proportion (41/116, 35.3%) with a history of bone stress fracture, particularly in athletics long-distance (7/8, 87.5%) (Table 2).

[n]add "one"

⇒The text has been corrected, as suggested (Results).

Number of injuries by triad risk categories (Table 3)

Since there was only one participant in the high-risk category, the high and moderate-risk categories were combined for the analysis. The number of injuries was 65 (n=41) in one year. In the moderate and high-risk categories, there were significantly more in the injury group than in the non-injury group (p=0.01). In the low-risk category, there were significantly more in the non-injury group than in the injury group (p=0.01).

[o]The analysis from the 116 athletes to the 65 injuries in one year should be explained better in the statistical section in the methods.

⇒A better explanation has been provided, as suggested.

The Fisher exact test was used for comparisons differences in the risk categories for each sport, to compare differences in the number of injuries by risk categories for each sport, and to compare differences in injured body part-location and the type of injury diagnosis by risk category, and multiple comparisons were performed through use of the Ryan nominal level for post hoc testing. Statistical analyses were performed using SPSS (Version 26.0; SPSS Japan Inc., Tokyo, Japan). The level of statistical significance was P < .05.

[p]Meaning that injury sites didn't overlap significantly amongst any of the participants?

⇒The reviewer is correct.

[q]very vague. What part of the relationship was clarified with these data?

⇒The text has been edited to provide greater clarity, as suggested.

In this study, regarding the number of injured athletes by risk category, in the moderate and high-risk categories, there were significantly more athletes in the injury group than in the non-injury group. In addition, there were significantly more athletes in the moderate and high-risk categories than in the low-risk category with bone stress fractures and bursitis. Its results suggest that athletes with the moderate and high-risk groups of Triad may be at increased risk of injury.

[r]Only these two injuries were significant?

⇒The reviewer is correct.

[s]or the triad? or athletes with a higher risk on the assessment?

⇒The text has been clarified, as suggested.

In this study, regarding the number of injured athletes by risk category, in the moderate and high-risk categories, there were significantly more athletes in the injury group than in the non-injury group. In addition, there were significantly more athletes in the moderate and high-risk categories than in the low-risk category with bone stress fractures and bursitis. Its results suggest that athletes with the moderate and high-risk groups of Triad may be at increased risk of injury.

[t]Update Label

⇒The label has been updated, as suggested (Table 2).

Table 2. Number of athletes in each event by female athlete triad coalition scoring category

[u]Give exact p-values (reference paper on p-values)

⇒Exact p values are provided, as suggested (Table 1).

[a]p=0.004 vs. moderate and high risk category, [b]p=0.004 vs. low and high risk category

[v]Update label

⇒The label has been updated, as suggested (Table 1).

Table 1. Prevalence of the 7 events for 116 athletes assigned to triad risk categories

[w]Is this table needed for the assessment of your hypothesis?

⇒Though no significant difference was found in "Injured body part location by risk category", we believe that it is necessary information for this study.

[x]May need an extra column for 'No-Risk' group

⇒The cumulative risk of stress fractures was defined as follows: a total score of 0-1 was low risk, a score of 2-5 was moderate risk, and a score of 6 was high risk (De Souza et al. 2014a).

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

[y]Where these the only significant injuries found? The differences in concussion, dislocation,

sprain and tendinopathy look significant

⇒There were differences in the numbers of concussions, dislocations, sprains and tendinopathy, but no significant differences. They tended to be especially common in contact sports.

RESPONSE TO Reviewer 2 (Anonymous)

1. Line 31: please specify age range of athletes as collegiate athletes can be a wide range of ages and this will influence the way BMD scores are interpreted, as well as the appropriateness of use of BMI as your sole marker of energy availability. Also identify which 7 sports you investigate here. This will help attract readers who are interested in these specific sports and provide context for the Results section of your abstract.

⇒The details requested have been added (Abstract, Materials and methods, Recruitment).

Abstract
Background
This study aimed to clarify the relationship between the Triad risk assessment score and the sports injury rate in 116 female college athletes (average age, 19.8 ± 1.3 years) in 7 sports at the national level of competition; 67 were teenagers and 49 were in their 20s.

Materials and methods
Recruitment
A total of 116 female college athletes (average age, 19.8 ± 1.3 years) were investigated; 67 were teenagers and 49 were in their 20s. They were involved in 7 sports (swimming, athletics sprint, athletics long-distance, athletics throwing/jumping, soccer, basketball and volleyball).

2. Line 35: Low energy availability cannot be defined by BMI. See Melin et al 2014 for LEAFQ, or consider using RMR measures. Low BMI is simply a low BMI and should not be used as a sole measure of low energy availability.

⇒The text has been edited taking into account the reviewer's comment.

Materials and methods
Anthropometry
Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). The triad

is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used here in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

The Female Athlete Triad Cumulative Risk Assessment

BMI was scored for athletes over 20 years old, but IBW was used for teenagers. Athletes with a BMI ≤17.5 kg/m^2 or IBW <85% received a score of 2, and athletes with a BMI between 17.6 and 18.4 kg/m^2 or IBW <90% received a score of 1. A score of 0 was given to athletes with a BMI ≥18.5 kg/m^2 or IBW ≥ 90%.

RESULTS

The three triad components

There were 4/116 (3.4%) athletes with LEA with or without DE/ED (defined as actual body weight of IBW <85% for teenage athletes and a BMI ≤17.5 kg/m2 for athletes in their 20s), 6/116 (5.2%) athletes with amenorrhea (>3 months or <6 menses in 12 months), and 0/116 (0.0%) athletes had low BMD (Z-score <-1.0). No players had all three triad components.

Table1.2.3.4.5 have been corrected.

3. Line 35: amenorrhea= no menstrual cycle, oligomenorrhea= abnormal menstruation, eumenorrhea= normal menstruation. I think distinguishing between completely absent menstruation and irregular menstruation is important and clinically useful. This line doesn't make sense having read your article in full.

⇒Classified as amenorrhea (>3 months or <6 menses in 12 months), oligomenorrhea (6-9 menses in 12 months), and eumenorrhea (>9 menses in 12 months) in the "The Female Athlete Triad Cumulative Risk Assessment".

4. Line 40: Try to include some brief figures here (how significant? What proportions? etc). Word count limits are challenging, but this will make your abstract more compelling.

⇒The details requested have been added (Abstract).

Results
In swimming, significantly more athletes were in the low-risk category than in the moderate and high-risk categories (p=0.004). In athletics long-distance, significantly more athletes were in the moderate-risk category than in the low and high-risk categories (p=0.004). In the moderate and high-risk categories, significantly more athletes were in the injury group, whereas significantly more athletes in the low-risk category were in the non-injury group (p=0.01). Significantly more athletes at moderate and high risk had bone stress fractures and bursitis than athletes at low risk (p=0.023).

5. Line 68 to 69: Here you have stated that BMI, BMD and LEA are three separate risk factors. BMI is not a sole measure of LEA

⇒The reviewer is correct. In this study, the Triad was defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.

The limitations have been changed appropriately.
Several limitations must be considered in this study. First, the 1000 athlete exposures could not be calculated. Second, the survey of injuries during sports activities was conducted for one season from April 2018 to March 2019, but medical examinations and anthropometry were conducted from August 2018 to January 2019. Therefore, this was not a prospective study. In the future, prospective research was considered necessary. Third, accurate the Triad (defined as energy intake minus energy expenditure of exercise relative to fat-free mass <30 kcal/kg of FFM/d) was not measured in this study.

6. Line 101: If written and informed consent was gained, it is assumed you have explained the study content (can leave out sentence "The study content was fully explained to the subjects")

⇒The text has been edited as suggested (Materials and methods, Recruitment).

Recruitment
All sports were at the national level of competition. The Niigata University of Health and Welfare of ethical approval to carry out the study within its facilities (18032). Written, informed consent was obtained from all subjects.

7. Line 114: Please include reference to protocols used/ validity studies outlining appropriateness of ultrasonic bone densitometry in your population.

⇒"Ultrasonic bone densitometry" is less accurate than "X-ray absorptiometry (DXA; Discovery DXA System)", but with the no risk of exposure.

8. Line 117: De Souza et al do mention BMI as an overt sign of LEA, however by using this as your only measure of LEA, you potentially fail to identify athletes with higher BMI but who have low EA. It would have been more appropriate, even if complicated, to have conducted calculations involving FFM as you mention. Or use the LEAFQ (Melin 2014) It is also very important to state the age range of your athletes. Under age 20, BMI is not appropriate. See below from De Souza: "As a first pass, overt signs of low EA can be indicated by low energy stores such as a BMI ,17.5 kg/m^2 or in adolescents ,85% of expected body weight. In adolescents, absolute BMI cut-offs should not be used. The BMI percentile method for calculating estimated body weight examines an adolescent's weight in relation to the 50th BMI percentile (which is their expected body weight).66 Deviations for this point are used as an indicator of medical stability to set a target weight and to assess progress in adolescents with DE and ED.66 Body mass index percentiles adjusted for age and gen- der are recommended until age 20 by the Centers for Disease Control and Prevention (www.cdc.gov/growcharts). When body weight is not particularly low, more detailed information regarding food intake and energy expenditure is necessary to diagnose low EA. Other markers of low EA in the absence of DE and recent weight loss that should be explored include physiological signs of adaptation to chronic energy deficiency such as reduced resting metabolic rate (RMR),4,67 low triiodothyronine (low T3),4,67 and a ratio of measured RMR/predicted RMR less than 0.90.7,68–70"

⇒The text has been corrected as suggested.

Materials and methods
Anthropometry

Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). The triad is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used here in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

9. Line 151: Please state that you recorded data pertaining to body area injured and classification of injury

⇒The necessary information has been added, as suggested.

An injury survey during sports activities was conducted for one season from April 2018 to March 2019. The injury survey collected injuries that resulted in failure to participate in practice and competition for more than 24 hours after injury, referring to the injury survey items used by the IOC (Junge et al. 2008). Injured body part location and type of injury diagnosis were recorded. Data were collected by seven physical therapists and a medical doctor in field and hospital. Serious illnesses such as stress fractures were diagnosed at the hospital using X-rays and MRI by medical doctor.

10. Line 162: Do you think that if DXA was used for whole body, lumbar spine, hip etc measures this would reveal different results to calcaneal US? Especially as some of your athletes were weightbearing and some were not? This may be worthwhile discussing.

⇒“Ultrasonic bone densitometry” is less accurate than “X-ray absorptiometry (DXA; Discovery DXA System)”, but with the no risk of exposure. This device was a measuring instrument that targets only the calcaneus.

11. Line 187: Your study is very similar to Tenforde et al 2017, however you have looked not just at bone stress injuries, but many injury types. This does add to the pool of literature. Your study also uses US for BMD measurement, unlike others that use DXA, which is a solid advantage in terms of reducing radiation to young participants. I think you should emphasise these points further earlier in your article/abstract as a standout. Please also
specify why DXA (gold standard) was not used.

⇒“Ultrasonic bone densitometry” is less accurate than “X-ray absorptiometry (DXA; Discovery DXA System)”, but with the no risk of exposure. We have modified the text as suggested.

Methods
Bone mineral density (BMD) was measured on the heel of the right leg using an ultrasonic bone densitometer.

12. Line 200: In what aspects are your athletes well managed? Please provide detail as to what “well managed” means… do you mean in terms of lower injury occurrence or a greater number of athletes in lower risk groups? Even so, if your method of categorising was BMI alone, this may affect your results.

⇒The text has been corrected as suggested.

It was suggested that the cause may be related to the difference in competition level and measurement method.

13. Line 220: Compelling argument- I wonder whether your use of BMI solely as a criteria for LEA has affected your risk classification? Perhaps some of your low risk athletes have normal BMI but still have LEA? Which risk factors did you find bumped your moderate risk athletes into that group? Was it history of injury or menstrual regularity etc?

⇒The information requested has been added.

Materials and methods
Anthropometry

Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). The triad is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used here in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.

De Souza MJ, Nattiv A, Joy E, Misra M, Williams NI, Mallinson RJ, Gibbs JC, Olmsted M, Goolsby M, and Matheson G. 2014a. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. Br J Sports Med 48:289. 10.1136/bjsports-2013-093218

14. Line 240: Are there reasons you suspect athletes with LEA may be more at risk of bursitis? Is there any existing literature on this topic? Further detail in this comment would be useful (why bursitis and not other injuries like ligament sprains, muscle tears etc?). Is it the nature of the sports they are involved in (land vs water, ball sports vs aesthetic etc). Which areas of the body did the athletes experience bursitis? This is a relatively new concept, would be interesting to have more info.

⇒As a result of being examined by a medical doctor (mainly around the knee), it is necessary to examine bursitis in greater detail in the future.

15. Table 2: Please clarify numerically low, moderate and high BMI (correlate Table with Line 128/129)

⇒The text has been corrected as suggested (Table 2).

16. Table 5: Please state/clarify in your methods re diagnosis of injury. Were the injury diagnoses made by a physiotherapist? Or taken from medical records by the physiotherapist? What were your criteria in diagnosing concussion (eg concussion tool)? What criteria warranted stress fracture vs stress reaction for example? I notice you don't have a separate diagnostic category for stress reaction. Were these differentiated? Was any kind of imaging used in diagnosis for specific injuries, for example X Ray or MRI? Please clarify. Injuries like sprains and strains and even bursitis are difficult to diagnose well with clinical orthopaedic tests alone.

⇒The details requested have been provided.

Injured body part location and type of injury diagnosis were recorded. Data were collected by seven physical therapists and a medical doctor in hospital mainly.

17. Conclusion: Thank you for your submission. I find your broadening the scope of injury surveillance beyond bone stress injury interesting. I do however have strong methodological concerns regarding your choice of BMI as a sole marker of energy availability. I worry that this may influence the results of your paper.

⇒The text has been modified to address the reviewer's concerns (Materials and methods).

Anthropometry

Height (cm) and body weight (kg) were measured using a body composition monitor (DC150, TANITA, Tokyo, Japan). BMD was measured on the heel of the right leg using an ultrasonic bone densitometer (AOS-100SA, Hitachi Aloka Medical, Tokyo, Japan). The triad is defined as energy intake minus energy expenditure of exercise relative to fat-free mass (FFM) <30 kcal/kg of FFM/d (De Souza et al. 2014a), but it is too complicated to calculate energy balance this way during medical examinations. Alternatively, the ACSM defines LEA in adolescent athletes as a body weight <85% of ideal body weight (IBW), and in adult athletes, a BMI ≤17.5 kg/m^2 (De Souza et al. 2014a). Therefore, these criteria were used here in this study (De Souza et al. 2014a). BMI was calculated as body weight (kg)/height (m^2). To measure IBW, the formula recommended by The Japanese Society for Pediatric Endocrinology was used.