

## Article

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## Adaptive Sports/Recreation Topic Categories

- Female Athlete Triad
- Relative Energy Deficiency in Sport (RED-S)
- Paralympic Athletes

## Research Questions

- What is the prevalence of factors (low energy availability (LEA), low bone mineral density (BMD), and menstrual dysfunction) associated with the Female Athlete Triad (Triad)/Relative Energy Deficiency in Sport (RED-S) in elite para athletes?
- What are the differences among sex, disability type, and sport type in health issues stemming from low energy availability?

## Methodology

- Electronic survey was distributed to 659 US elite para athletes training to qualify for the 2016 Rio Summer Paralympic Games or the 2018 Pyeongchang Winter Paralympic games.
- Since no validated questionnaire existed for data collection, investigators reviewed available studies to reach consensus on questions of the survey in order to characterize known Triad/RED-S components and health concerns in this population.
- Survey distribution and data collection occurred in July – August 2016. The following data were collected from participants:
  - Athlete characteristics: sex, age, race, disability type, primary sport type, and ambulatory status.
  - Factors associated with low energy intake were assessed using:
    - The Eating Disorder Examination Questionnaire (EDEQ) dietary restraint and pathologic behaviour subscales.
    - Self-reported history of a diagnosed eating disorder.
    - Height and weight to calculate body mass index.
    - Athletes' characterization of themselves as underweight, ideal weight, or overweight.
    - Athletes' report of whether they felt pressure or not to maintain a certain body weight to improve athletic performance.
  - Menstrual function in females was assessed using:
    - Self-reported history of menstrual cycles in the past 12-month period.
      - Evaluation for oligomenorrhea (6-9 menstrual cycles/year) or amenorrhea (less than 6 menstrual/year).
    - Age of menarche.
    - Participants were excluded from this section if > 50 years or if they were on oral contraceptive pills in the past 12 months.
  - Low BMD and stress reaction/fracture was assessed using:
    - Self-reported history of stress reaction or stress fracture, and total number experienced.

- Stress reactions or stress fractures had to be confirmed based upon whether they occurred after onset of disability, occurred in a plausible location, were related to sport, and were diagnosed with imaging (e.g. x-ray, MRI, or CT).
  - Potential diagnosis of low BMD, osteopenia, or osteoporosis by a dual x-ray absorptiometry (DXA) scan.
  - A known family history of low BMD, osteopenia, or osteoporosis.
- Finally, athletes were asked whether they had heard of the terms Female Athlete Triad or RED-S.

## Results

- 264 of the 659 para athletes who were contacted completed the survey; response rate = 40%. Final analysis included 260 athletes (150 males, 110 females; average age 31.7 +/- 11.5 years). Majority were Caucasian and had experienced either a spinal cord injury (30.4%) or lower extremity amputation (25.8%).
- Low energy availability
  - 3.1% reported history of a diagnosed eating disorder.
  - 18.5% had an elevated EDEQ dietary restraint subscale score and 32.4% had an elevated EDEQ pathologic behaviour subscale score.
  - 61.5% indicated they were currently attempting to change their body composition or weight to improve sport performance (63.3 % of male athletes and 59.1% of female athletes).
  - 46.7% of athletes considered themselves overweight; of these, 55% had a BMI > 25.
- Menstrual dysfunction of 105 females with available data
  - 13.4 % reported history of delayed menarche  $\geq 15$  years.
  - 25 female athletes (age  $33.7 \pm 9.1$  years) had menstrual dysfunction.
    - 24.0% had oligomenorrhea.
    - 20.0% had amenorrhea.
- Low BMD and history of stress reaction/stress fracture
  - 53 reported a history of stress reaction or stress fracture, but only 24 had a history of stress reaction or fracture that occurred after the onset of disability, occurred in a plausible location, was related to sport, and was diagnosed by imaging.
    - 13 athletes had a history of one stress reaction or fracture.
    - 11 had a history of two stress reactions or fractures.
  - 8.5% had a history of low BMD diagnosed by DXA scan.
  - 13.1% reported known family history of osteopenia or osteoporosis.
- Awareness of the Female Athlete Triad and RED-S
  - 8.1% of all athletes were aware of the Triad; 9.2% were aware of RED-S
- Sub analysis according to sport type or type of disability
  - Over 50% of athletes in the sports of cycling (males and females), soccer 7-a-side (males only), rowing (females only), and track and field (males only) met criteria with regard to concerns for weight.
  - Of 24 athletes reporting history of stress reaction or fracture, 42% of these were track and field athletes.
  - Over 50% of athletes with spinal cord injury (females only), cerebral palsy (females only), acquired central neurological injury (males and females), and visual impairment (males and females) reported weight concerns.

- Athletes with spinal cord injury accounted for 20.8% of bone stress injuries and 54.5% of those with history of low BMD.

### **Discussion/Conclusion**

- Few athletes reported a history of an eating disorder, but a significant number of athletes had elevated EDEQ scores indicating possible concerns regarding LEA.
- A significant number of athletes indicated negative self-perception toward body habitus and weight.
- Over half of athletes were attempting to change their body composition or weight for sport performance.
- These findings with regard to energy availability and perception of body habitus were comparable in both the female and male athletes.
- Over half of females < 50 years and not on oral contraceptive pills met criteria for oligomenorrhea or amenorrhea.
- 9% of athletes had a history of at least one bone stress injury, with a higher proportion being athletes with history of spinal cord injury.
- Awareness of the Triad and RED-S was low in both female and male athletes, regardless of sex, sport type, or disability type.
- Future research should further evaluate the associations between these factors and individual sports or disability types.

### **Article Strengths**

- This is the first study to assess the prevalence of factors associated with the Triad/RED-S across all sport and disability types in elite level para athletes.
- Multiple relevant factors related to low energy availability, menstrual status, and bone health were explored in the survey.

### **Article Weaknesses**

- Findings were based upon self-report (subjective assessment).
- Low response rate of 40% on the survey possibly resulted in response bias.
- Influence of racial/ethnic factors was not assessed.
- Low sample size, particularly in the assessment of menstrual status.
- BMI assessments may be of limited utility in populations such as amputees, short stature, spinal cord injury with resultant muscle atrophy, etc.
- Results indicate findings from the elite para athlete population; they may not be generalizable to all individuals with disabilities participating in adaptive sports.
- Survey instrument had not been validated.

### **Take Home Messages**

- Factors associated with LEA, menstrual dysfunction (females only), and impaired bone health were observed in elite Paralympic athletes, regardless of sex.
- Awareness of the Triad/RED-S is low in para athletes.
- Greater efforts should be made to advance screening efforts and to educate both female and male para athletes about the consequences of these concerns.
- Future research should evaluate the associations between these factors and individual sports or disability types.
- Efforts are needed to determine the energy requirements and the short- and long-term consequences of low energy availability to optimize athletic performance and overall health of elite para athletes.