The purpose of this study is to outline the experience of three elite, collegiate male endurance runners presenting with characteristics and potential male version of the Female Athlete Triad and undergoing clinical treatment and intervention for bone stress injuries (BSIs) and/or hypogonadotropic hypogonadism. Using data extracted from a larger, prospective study on nutrition interventions to prevent bone stress injuries, three athletes (two presenting with BSIs and the third presenting with significant hypogonadotropic hypogonadism) were followed throughout their collegiate athletic career. Each athlete exhibited nutritional deficits and consulted with a sports dietitian to optimize their energy status and facilitate recovery from their injury-related injuries. This case series provides clinical evidence that male endurance runners may be susceptible to a Triad parallel to the Female Athlete Triad, with significant clinical sequelae being the development of BSIs or hypogonadism that may stem from low energy availability.

Introduction

- The Female Athlete Triad is classified as a spectrum of 3 interrelated conditions: low energy availability (LEA), functional hypothalamic amenorrhea, and osteoporosis.1
- A potential similar condition in male athletes exists, consisting of: LEA, hypogonadotropic hypogonadism, and osteoporosis.2

Low energy availability:
- Achieved through either dietary restriction (with or without disordered eating), increasing energy expenditure, or both.
- May affect leptin secretions that then alter growth hormone, follicle-stimulating hormone, etc.

Hypogonadotropic Hypogonadism:
- Can be thought of as having low serum testosterone in males and low BMD in females.3
- Previous studies have reported subclinical decreases in testosterone in male athletes.1,4

Osteoporosis:
- LEA and hypogonadism may contribute to loss of bone mineral density (BMD), which may result in osteoporosis.
- Low BMD is a known risk factor for bone stress injuries (BSIs).5

Bone stress injuries:
- Overuse injuries caused by inadequate bone remodeling.
- Manifest most commonly as stress fractures in active individuals.
- Incidence shares a dose-response relationship with Triad-related risk factors (i.e., excessive exercising, low BMD 2-score, and low body mass index).3
- Treatment entails modified activity and gradual progression to pre-injury activity.6

Endurance Running:
- High caloric and nutrient needs required to sustain endurance running.
- Adequate calcium and vitamin D status may attenuate BSIs and stress fracture risk.7

Methods

- Case study design
- Data collected from a larger study on preventing BSIs in collegiate endurance runners through nutrition interventions.

Subjects

- 3 elite, male collegiate endurance runners

Procedures of the Larger Study

- Data collection at baseline and every subsequent year
  - Demographic questionnaire
  - Eating Disorders Examination Questionnaire (EDE-Q)
  - 3-day 24-hour recall or food frequency questionnaire
  - Exercise log or exercise patterns questionnaire
  - Body composition
  - Dual X-ray absorptiometry or air displacement plethysmography (Biovad*)

Nutrition Intervention by the sports registered dietitian (RD)
- Team nutrition talk
- 1-on-1 counseling sessions

Diagnosis of a BSI or hypogonadotropic hypogonadism
- Further intervention as indicated by standard of care
  - Routine visits with a sports physician
  - Weekly biweekly, or monthly visits with a RD to optimize energy status
  - Cross-training, physical therapy, psychological counseling

Results

- 2 athletes sustained BSIs (Athletes 1 & 2) while one athlete experienced significant hypogonadism (Athlete 3)
- Possible disordered eating behaviors in all 3 athletes
  - Drive-for-thinness
- All athletes had significant weight loss (1.4-5.9kg) prior to injury
  - Suboptimal energy intake

Table 1: Baseline characteristics of athletes at diagnosis of either their first BSI or hypogonadotropic hypogonadism.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Athlete 1</th>
<th>Athlete 2</th>
<th>Athlete 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>30</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178</td>
<td>168</td>
<td>183</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>66.8</td>
<td>62.3</td>
<td>62.2</td>
</tr>
<tr>
<td>Weight % ideal</td>
<td>77%</td>
<td>77%</td>
<td>77%</td>
</tr>
<tr>
<td>BMD (g/cm^2)</td>
<td>0.968</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>Visceral fat (kg)</td>
<td>10.50</td>
<td>10.50</td>
<td>10.50</td>
</tr>
<tr>
<td>Skeletal mass (kg)</td>
<td>75.70</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 2: Brief history of athletes in relation to whole body losses.

<table>
<thead>
<tr>
<th>Time</th>
<th>Weight (kg)</th>
<th>Time</th>
<th>Weight (kg)</th>
<th>Time</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>81.3</td>
<td>Pre</td>
<td>79.9</td>
<td>Pre</td>
<td>69.1</td>
</tr>
<tr>
<td>Post</td>
<td>68.1</td>
<td>Post</td>
<td>65.2</td>
<td>Post</td>
<td>60.4</td>
</tr>
<tr>
<td>Baseline</td>
<td>66.8</td>
<td>Baseline</td>
<td>66.9</td>
<td>Baseline</td>
<td>65.2</td>
</tr>
<tr>
<td>1 mo.</td>
<td>67.7</td>
<td>1 mo.</td>
<td>65.2</td>
<td>1 mo.</td>
<td>65.2</td>
</tr>
<tr>
<td>2 mo.</td>
<td>68.2</td>
<td>2 mo.</td>
<td>65.3</td>
<td>2 mo.</td>
<td>65.3</td>
</tr>
<tr>
<td>3 mo.</td>
<td>70.0</td>
<td>3 mo.</td>
<td>64.9</td>
<td>3 mo.</td>
<td>65.5</td>
</tr>
</tbody>
</table>

Table 3: Brief history of athletes in relation to whole body losses.

Discussion & Summary

- This study provides clinical evidence of a parallel Male Athlete Triad.
- Male endurance runners may be at increased risk for this parallel Triad and related injuries such as BSIs.
- Recovery necessitates a multidisciplinary care team, with a focus on optimizing energy status.

Limitations

- Case analysis
- Energy availability not measured

Future Research

- Prevalence of the Male Athlete Triad
- Comparing LEA and consequences between male and female athletes
- Consequences of low testosterone on reproductive and bone health in male athletes
- Validating the role of nutrition in preventing and/or treating the Triad in large-sample studies

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References