

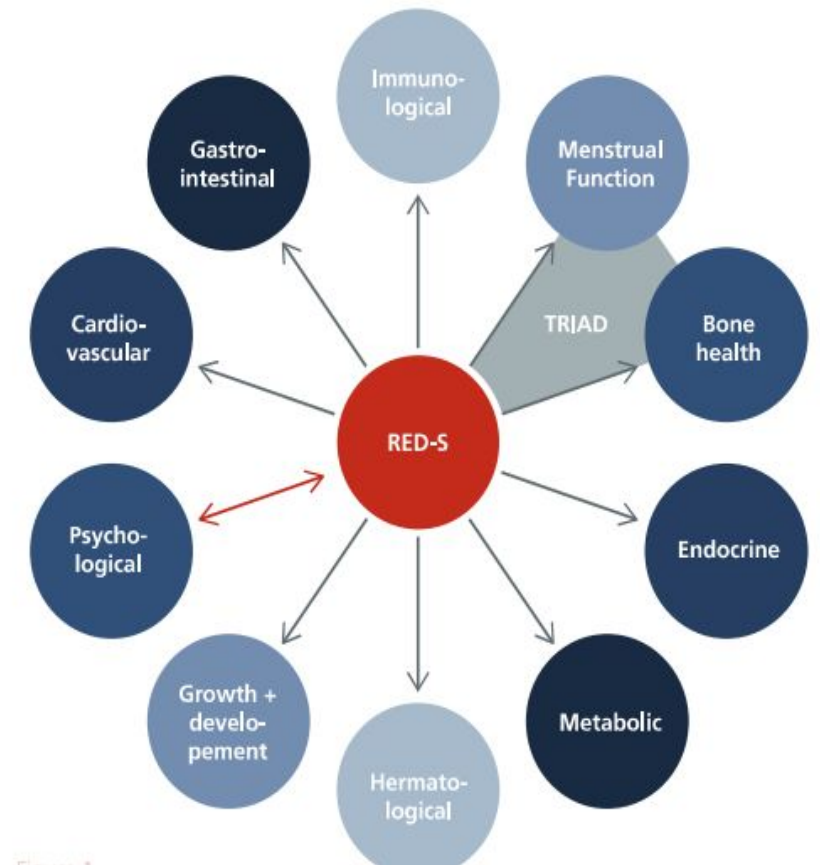
# Dietary Habits, Injury History, and Psychosocial Status Associations among College Athletes

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# Background

- Low energy availability (LEA)<sup>1</sup>
  - Energy available after exercise
- Relative Energy Deficiency in Sport
  - Imbalance between intake and expenditure
- Prior research has focused on female athlete triad<sup>2</sup>
  - Metabolic deficiencies → musculoskeletal injury<sup>3</sup>
- Influences on the energy intake patterns of athletes?



# Purpose

To determine whether associations exist between dietary habits, injury history, and psychosocial status among college athletes

# Methods

## Participants:

Student-Athletes within the athletics department at The University of Tennessee at Chattanooga

## Instruments:

- Eating Attitudes Test (EAT-26)
- Depression, Anxiety & Stress Scale
- Pittsburgh Sleep Quality Index
- Sport Fitness Index
- Overall Wellness Index
- Custom nutrition knowledge and dietary habits questionnaire

Overall Wellness Index - Question 1 of 10

Check each of the physical problems listed below that have ever interfered with your ability to function in a normal manner during normal day-to-day activities. Select all that apply. If none apply, select "none".

\* must provide value

Headaches  
 Pressure in head  
 Neck pain  
 Muscle aches  
 Nausea/vomiting  
 Light sensitivity  
 Joint aches  
 Urinary incontinence  
 General discomfort  
 None

| Impact of Previous Injuries limited                                  | Greater Than 1 Year Ago |            | Within Past 12 Months |            | Current Week |
|--|-------------------------|------------|-----------------------|------------|--------------|
|  | Infrequently            | Frequently | Infrequently          | Frequently |              |
| None OVER THE PAST 5 INJURIES limited<br>your ability to participate | 4                       | 3          | 2                     | 1          | 0            |

How many hours per week do you exercise? (on average):  
 Never  Rarely  1-2 times  3-4 times  5-6 times  7-8 times  9-10 times  11-12 times  13-14 times  15-16 times  17-18 times  19-20 times  21-22 times  23-24 times  Every day

Indicate the most recent occurrence of the Physical Problem(s) selected (choose one):  
 \* must provide value  
 Current week  Within the past 12 months  More than a year ago

How often have you experienced the selected Physical Problem(s)?  
 \* must provide value  
 Frequently  Infrequently

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# Statistical Analysis

- Criterion status derived from EAT-26; Binary classification based on median value
- Discriminatory strength for each survey score was examined using receiver operating characteristic (ROC) analysis
- Optimal cut-points for each potential predictor variable identified in order to classify participants as “high risk” or “low risk” in relation to EAT-26 median
- Cross-tabulation and logistic regression analysis used to quantify associations with risk category, represented by odds ratio (OR)

# Patient Demographics and Survey Results

**Table 1: Patient Demographics**

|                         |   |
|-------------------------|---|
| Weight (kg)             | M: 187.69 ± 8.84<br>F: 171.55 ± 9.15  |
| Height (cm)             | M: 104.51 ± 31.3<br>F: 65.25 ± 12.0   |
| Age (years)             | 20.7 ± 1.7  |
| Sex                     | 14 M / 24 F   |
| Injuries in prev. 12 mo | 11  |
| Sport Played            | 11 Football<br>11 Softball<br>4 Volleyball<br>4 Tennis<br>3 Soccer<br>3 Track/Cross Country |

**Table 2: Mean and Median Values For All Surveys**

| <u>Survey</u>                  | <u>Mean ± SD</u> | <u>Median (Range)</u> |
|--------------------------------|------------------|-----------------------|
| Sport Fitness Index            | 26.5 ± 15.3      | 29.0 (0 - 60)         |
| Overall Wellness Index         | 24.3 ± 24.0      | 15.0 (0 - 90)         |
| Self-Reported Problems         | 6.7 ± 7.8        | 3.0 (0 - 29)          |
| Pittsburgh Sleep Quality Index | 5.6 ± 3.2        | 5.5 (0 - 14)          |
| Depression Subscore            | 2.6 ± 2.6        | 2.0 (0 - 10)          |
| Anxiety Subscore               | 2.0 ± 2.2        | 1.5 (0 - 9)           |
| Stress Subscore                | 3.9 ± 3.0        | 4.0 (0 - 11)          |
| EAT-26                         | 9.39 ± 8.99      | 6.0 (1 - 41)          |

# Results: Associations with High EAT Score

**Table 3: Results of Univariable Analyses**

| <u>Survey</u>                  | <u>AUC</u> | <u>Cut-Point</u> | <u>SN</u> | <u>SP</u> | <u>P-value</u> | <u>OR (95% CI)</u>  |
|--------------------------------|------------|------------------|-----------|-----------|----------------|---------------------|
| Self-Reported Problems         | 0.642      | ≥ 10             | 50        | 89        | 0.01           | 8.00 (1.45 - 44.30) |
| Overall Wellness Index         | 0.613      | ≥ 33             | 45        | 83        | 0.06           | 4.09 (0.89 - 18.72) |
| Depression Subscore            | 0.597      | ≥ 3              | 55        | 72        | 0.09           | 3.18 (0.82 - 12.34) |
| Anxiety Subscore               | 0.593      | ≥ 4              | 35        | 83        | 0.18           | 2.70 (0.58 - 12.60) |
| 12-mo Injury History           | --         | Yes              | 45        | 33        | 0.16           | 0.41 (0.11 - 1.53)  |
| Stress Subscore                | 0.574      | --               |           |           |                |                     |
| Sport Fitness Index            | 0.501      | --               |           |           |                |                     |
| Pittsburgh Sleep Quality Index | 0.406      | --               |           |           |                |                     |

# Results: Associations with High EAT Score

**Table 4: Results of Univariable Analyses for Self-Reported Problems**

| Category                 | AUC          | Cut Point  | SN        | SP        | Sig.         | OR (95% CI)                    |
|--------------------------|--------------|------------|-----------|-----------|--------------|--------------------------------|
| Q1 Physical              | 0.531        | --         |           |           |              |                                |
| Q2 Sleep                 | 0.590        | --         |           |           |              |                                |
| <b>Q3 Muscle Control</b> | <b>0.692</b> | <b>≥ 1</b> | <b>45</b> | <b>94</b> | <b>0.007</b> | <b>13.91<br/>(1.54-125.63)</b> |
| Q4 Balance               | 0.592        | --         |           |           |              |                                |
| Q5 Abnormal Sensation    | 0.524        | --         |           |           |              |                                |
| Q6 Mood/Emotional        | 0.599        | --         |           |           |              |                                |
| <b>Q7 Behavioral</b>     | <b>0.707</b> | <b>≥ 1</b> | <b>45</b> | <b>94</b> | <b>0.007</b> | <b>13.91<br/>(1.54-125.63)</b> |
| Q8 Memory                | 0.593        | --         |           |           |              |                                |
| <b>Q9 Thinking</b>       | <b>0.642</b> | <b>≥ 2</b> | <b>40</b> | <b>89</b> | <b>0.048</b> | <b>5.33<br/>(0.95-29.81)</b>   |
| Q10 Language             | 0.578        | --         |           |           |              |                                |

**Table 5: Results of Univariable Analyses for Overall Wellness Index Scores**

| Category                     | AUC          | Cut Point  | SN        | SP          | Sig.         | OR (95% CI)                      |
|------------------------------|--------------|------------|-----------|-------------|--------------|----------------------------------|
| Q1 Physical                  | 0.460        | --         |           |             |              |                                  |
| Q2 Sleep                     | 0.464        | --         |           |             |              |                                  |
| <b>Q3 Muscle Control</b>     | <b>0.665</b> | <b>≥ 2</b> | <b>40</b> | <b>94</b>   | <b>0.015</b> | <b>11.33<br/>(1.25-102.93)</b>   |
| Q4 Balance                   | 0.522        | --         |           |             |              |                                  |
| <b>Q5 Abnormal Sensation</b> | <b>0.600</b> | <b>≥ 2</b> | <b>20</b> | <b>100</b>  | <b>0.066</b> | <b>9.00<br/>(0.716-113.115)*</b> |
| <b>Q6 Mood/Emotional</b>     | <b>0.608</b> | <b>≥ 5</b> | <b>40</b> | <b>83</b>   | <b>0.11</b>  | <b>3.33<br/>(0.723-15.374)</b>   |
| <b>Q7 Behavioral</b>         | <b>0.703</b> | <b>≥ 2</b> | <b>45</b> | <b>94</b>   | <b>0.007</b> | <b>13.91<br/>(1.54-125.63)</b>   |
| Q8 Memory                    | 0.581        | --         |           |             |              |                                  |
| <b>Q9 Thinking</b>           | <b>0.628</b> | <b>≥ 4</b> | <b>35</b> | <b>0.89</b> | <b>0.088</b> | <b>4.308<br/>(0.76-24.38)</b>    |
| Q10 Language                 | 0.571        | --         |           |             |              |                                  |

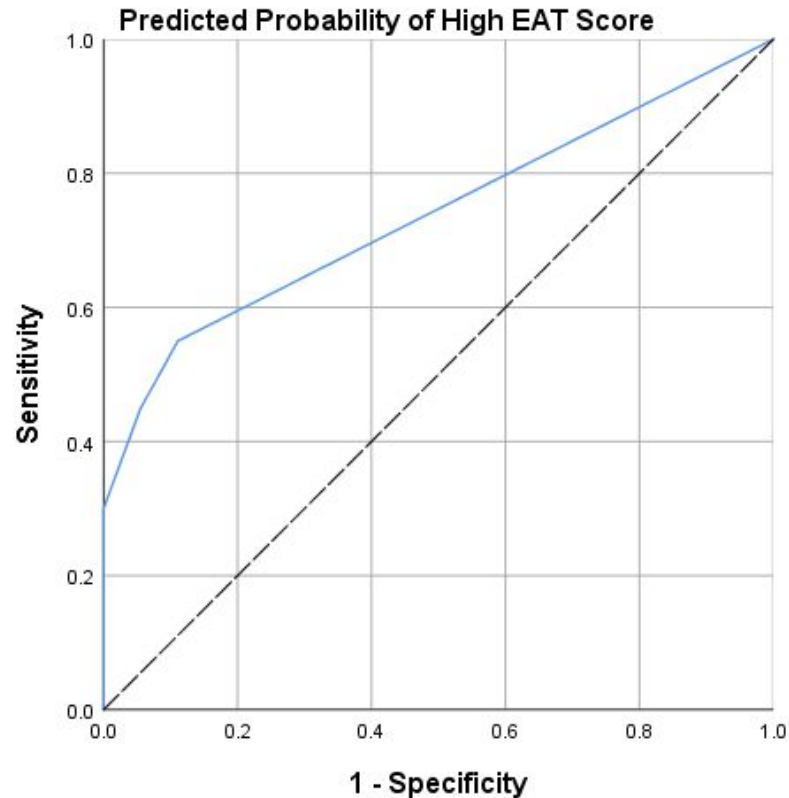


# Results: Frequency of Symptoms among High EAT Score

**Table 6: Frequency of Symptom Reporting**

| <u>Muscle Control Symptoms</u>  | <u># Reported</u> | <u>Behavioral Symptoms</u> | <u># Reported</u> |
|---------------------------------|-------------------|----------------------------|-------------------|
| Muscle twitching                | 6/6               | Apathy/lack of motivation  | 7/8               |
| Muscle weakness                 | 4/5               | Altered eating habits      | 4/4               |
| Muscle Jerking                  | 1/1               | Agitation/aggression       | 2/2               |
| Tremors                         | 1/1               | Repetitive Behaviors       | 2/2               |
| Difficulty using hands and feet | 1/1               | Loss of inhibition         | 1/1               |
| Trouble Swallowing              | 1/1               | Obsession/Compulsion       | 1/1               |
| Difficulty walking              | 1/2               | Extreme religiosity        | 0/0               |
| Trouble Using Tools             | 0/0               | Delusions                  | 0/0               |
| Changed Handwriting             | 0/0               | Personality Changes        | 0/0               |
| Involuntary movements           | 0/0               | Violent outbursts          | 0/0               |
|                                 |                   | Criminal behavior          | 0/0               |
|                                 |                   | Impaired hygiene           | 0/0               |
|                                 |                   | Hallucinations             | 0/0               |

# Results: 2-Factor Logistic Regression Model



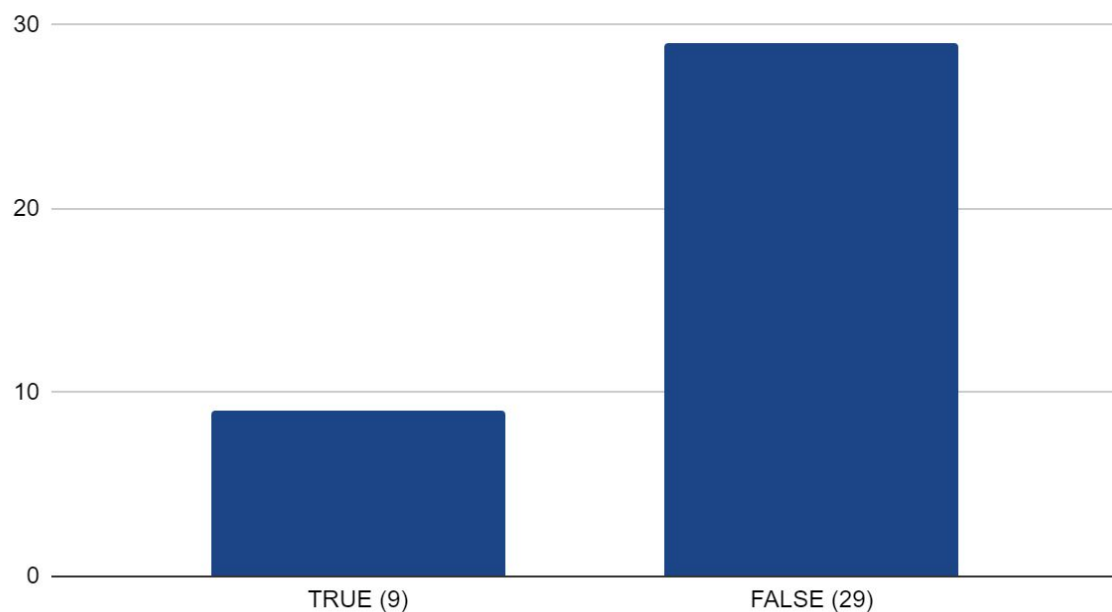
- Logistic regression model estimates of log odds converted to probability (0-1.00) for High EAT Score
- 2-Factor logistic regression model demonstrated strong discrimination
  - Score of  $\geq 2$  on OWI Questions #3 and #7
- 0.738 AUC

Figure 4

Diagonal segments are produced by ties.

# Results: Nutrition Knowledge among High EAT Score

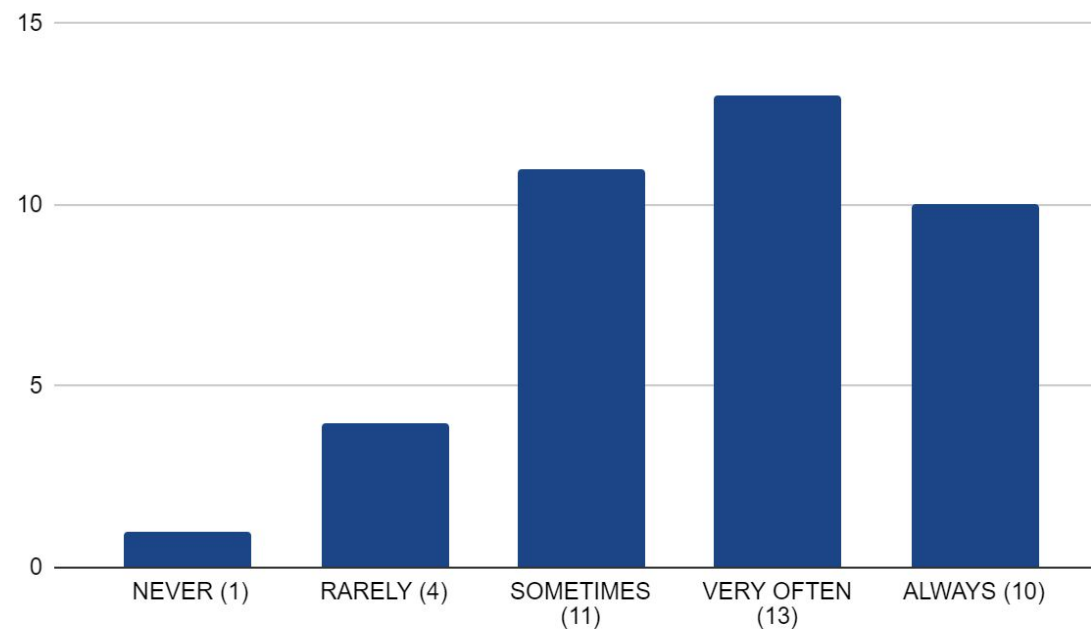
Q4: You will burn more fat if you work out on an empty stomach



Sensitivity: 45%      OR: 29.46  
Specificity: 100%    95% CI: 2.49 - 348.72

Figure 1

Q7: I eat three meals a day and snacks



Sensitivity: 45%      OR: 3.18  
Specificity: 100%    95% CI: 0.82-12.34

Figure 2

# Clinical Relevance

- Student-athletes with a high EAT score self-reported more behavioral, cognitive, mood, and motor control problems than those with a low EAT score
- No relationship between EAT score and sleep quality, self-reported function, or incidence of injury in the previous 12 months could be identified
- The Overall Wellness Index might be an effective screening tool
- Study results are limited due to the small sample size and lack of direct quantification of dietary intake
- Future research should seek to use more direct measures of energy availability and prospective assessment of injury risk

# References

1. Loucks AB, Kiens B, & Wright HH. (2011). Energy availability in athletes. *Journal of Sports Sciences*, 29 Suppl 1, S7-15. doi:10.1080/02640414.2011.588958
2. Tenforde AS, Carlson JL, Chang A, Sainani KL, Shultz R, Kim JH, Fredericson M. (2017). Association of the Female Athlete Triad Risk Assessment Stratification to the Development of Bone Stress Injuries in Collegiate Athletes. *The American Journal of Sports Medicine*, 45(2), 302-310. doi:10.1177/0363546516676262
3. Ackerman KE, Holtzman B, Cooper KM, Flynn EF, Bruinvels G, Tenforde AS, Popp KL, Simpkin AJ, Parziale AJ. (2018). Low energy availability surrogates correlate with health and performance consequences of relative energy deficiency in sport. *Br J Sports Med*. Accessed: 2/28/2020, doi: 10.1136/bjsports-2017-098958