What is the RED-S CAT?

The RED-S CAT is a clinical assessment tool for the evaluation of athletes/active individuals suspected of having relative energy deficiency and for guiding return to play decisions. The RED-S CAT is designed for use by a medical professional in the clinical evaluation and management of athletes with this syndrome. The RED-S CAT is based on the IOC Consensus Statement on RED-S, 2014.1

This tool may be freely copied in its current form for use by sport organizations and the athlete medical team entourage. Alterations to the tool or reproduction for publication purposes require permission from the International Olympic Committee.

NOTE: The diagnosis of RED-S is a medical diagnosis to be made by a trained health care professional. Clinical management and return to play decisions for athletes with RED-S should occur under the guidance of an experienced sports medicine team.

What is Relative Energy Deficiency in Sport?

The syndrome of RED-S refers to impaired physiological functioning caused by relative energy deficiency, and includes but is not limited to impairments of metabolic rate, menstrual function, bone health, immunity, protein synthesis, and cardiovascular health.

The cause of RED-S is the scenario termed “low energy availability”, where an individual’s dietary energy intake is insufficient to support the energy expenditure required for health, function, and daily living, once the cost of exercise and sporting activities is taken into account.

The potential health consequences of RED-S are depicted in the RED-S conceptual model (See Figure 1). Psychological problems can be both the result of and the cause of RED-S.

Screening for RED-S

The screening and diagnosis of RED-S is challenging, as symptomatology can be subtle. A special focus on the athlete at risk is needed. Although any athlete can suffer from RED-S, those at particular risk are those in judged sports with an emphasis on the aesthetic or appearance, weight category sports, and endurance sports. Early detection is of importance to maintain and improve performance and prevent long-term health consequences.

Screening for RED-S can be undertaken as part of an annual Periodic Health Examination and when an athlete presents with Disordered Eating (DE)/Eating Disorders (ED), weight loss, lack of normal growth and development, endocrine dysfunction, recurrent injuries and illnesses, decreased performance/performance variability or mood changes.
## RED-S Risk Assessment Model for sport participation

This model can be incorporated into the Periodic Health Examination. Depending on the findings on history and physical examination, the athlete is classified into one of the 3 following categories: **Red Light**: High risk, **Yellow Light**: Moderate risk, **Green Light**: Low risk.

<table>
<thead>
<tr>
<th>HIGH RISK</th>
<th>MODERATE RISK</th>
<th>LOW RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RED LIGHT</strong></td>
<td><strong>YELLOW LIGHT</strong></td>
<td><strong>GREEN LIGHT</strong></td>
</tr>
<tr>
<td>Anorexia nervosa and other serious eating disorders</td>
<td>Prolonged abnormally low body fat measured by DXA* or anthropometry</td>
<td>Appropriate physique that is managed without undue stress or unhealthy diet/ exercise strategies</td>
</tr>
<tr>
<td>Other serious medical (psychological and physiological) conditions related to low energy availability</td>
<td>Substantial weight loss (5–10% body mass in one month)</td>
<td>Healthy eating habits with appropriate EA</td>
</tr>
<tr>
<td>Use of extreme weight loss techniques leading to dehydration induced hemo-dynamic instability and other life threatening conditions.</td>
<td>Attenuation of expected growth and development in adolescent athlete</td>
<td>Healthy functioning endocrine system</td>
</tr>
<tr>
<td>Low <strong>EA</strong> of prolonged and/or severe nature</td>
<td>Reduced bone mineral density (either in comparison to prior DXA or Z-score &lt; -1 SD)</td>
<td>Healthy bone mineral density as expected for sport, age and ethnicity</td>
</tr>
<tr>
<td>Abnormal menstrual cycle: functional hypothalamic amenorrhea &gt; 3 months</td>
<td>History of 1 or more stress fractures associated with hormonal/ menstrual dysfunction and/or low EA</td>
<td>Healthy musculoskeletal system</td>
</tr>
<tr>
<td>No menarche by age 15y in females</td>
<td>- Severe ECG abnormalities (i.e. bradycardia)</td>
<td>- Athletes with physical/ psychological complications related to low EA/ disordered eating</td>
</tr>
<tr>
<td>Diagnostic testing abnormalities related to low EA</td>
<td>- Prolonged relative energy deficiency</td>
<td>- Healthy eating habits with appropriate EA</td>
</tr>
<tr>
<td>- Disordered eating behavior negatively affecting other team members</td>
<td>- Lack of progress in treatment and/or non-compliance</td>
<td>- Reduced bone mineral density (either in comparison to prior DXA or Z-score &lt; -1 SD)</td>
</tr>
</tbody>
</table>

* **EA**: Energy availability; **DXA**: Dual energy X-ray absorptiometry.

### Treatment of Relative Energy Deficiency in Sport (RED-S)

Athletes categorized in the red light and yellow light zones should receive medical evaluation and treatment. The treatment of RED-S should be undertaken by a team of health professionals including a sports medicine physician, sports dietitian, exercise physiologist, athletic therapist or trainer, sports psychologist/sports psychiatrist as needed. Patient confidentiality must be maintained. Treatment should focus on correcting the relative energy deficit through increasing energy intake and/or decreasing energy output. Intake of nutrients and other vitamins should follow established guidelines. Repeat assessment of BMD should occur at intervals of 6–12 months, depending on clinical presentation and initial values.

### Relative Energy Deficiency in Sport (RED-S) risk assessment decision making steps for determining readiness for returning to play

Prior to returning an athlete to sport/physical activity following time away for RED-S treatment, an assessment of the athlete’s health and the requirements of his/her sport should be undertaken following the step-wise approach:

<table>
<thead>
<tr>
<th>STEPS</th>
<th>RISK MODIFIERS</th>
<th>CRITERIA</th>
<th>RED-S SPECIFIC CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STEP 1</strong> Evaluation of Health Status</td>
<td>MEDICAL FACTORS</td>
<td>- Patient Demographics &lt;br&gt; - Symptoms &lt;br&gt; - Medical History &lt;br&gt; - Signs &lt;br&gt; - Diagnostic Tests &lt;br&gt; - Psychological Health &lt;br&gt; - Potential Seriousness</td>
<td>- Age, sex &lt;br&gt; - See Yellow Light column in RED-S Risk assessment model</td>
</tr>
<tr>
<td><strong>STEP 2</strong> Evaluation of Participation Risk</td>
<td>SPORT RISK MODIFIERS</td>
<td>- Type of Sport &lt;br&gt; - Position Played &lt;br&gt; - Competitive Level</td>
<td>- Weight sensitive, leanness sport &lt;br&gt; - Individual vs. team sport &lt;br&gt; - Elite vs. recreational</td>
</tr>
<tr>
<td><strong>STEP 3</strong> Decision Modification</td>
<td>DECISION MODIFIERS</td>
<td>- Timing and Season &lt;br&gt; - Pressure from Athlete &lt;br&gt; - External Pressure &lt;br&gt; - Conflict of Interest &lt;br&gt; - Fear of Litigation</td>
<td>- In/out of season, travel, environmental factors &lt;br&gt; - Mental readiness to compete &lt;br&gt; - Coach, team owner, athlete family, sponsors support &lt;br&gt; - If restricted from competition</td>
</tr>
</tbody>
</table>

### Return to Play Model

Following clinical reassessment utilizing the 3 step evaluation outlined above, athletes can be re-classified into the **High Risk – Red Light**, **Moderate Risk – Yellow Light** or **Low Risk – Green Light** categories. The RED-S Risk Assessment Model is adapted to aid clinicians’ decision making for determining an athlete’s readiness to return to sport/physical activity.

The **RED-S Return to Play Model** outlines the sport activity recommended for each risk category.

### Sport Participation based on Risk Category

**High Risk – Red Light**: no clearance for sport participation

Due to the severity of his/her clinical presentation, sport participation may pose serious jeopardy to his/her health and may also distract the athlete from devoting the attention needed for treatment and recovery.

**Moderate Risk – Yellow Light**: clearance for sport participation only with supervised participation and a medical treatment plan.

Re-evaluation of the athlete’s risk assessment should occur at regular intervals of 1–3 months depending on the clinical scenario to assess compliance and to detect changes in clinical status.

**Low Risk – Green Light**: full sport participation.

---

**NOTES on diagnostic tools for Low EA:**

Although low EA is a key factor in RED-S, at the present time there is no standardised protocol for undertaking an assessment of EA in free-living athletes. Some sports nutrition experts may have developed tools to monitor EA in which they have confidence, and may use these to screen for problems or guide dietary counselling. However, a universal recommendation to measure EA is unwise in the absence of a protocol that is sensitive, reliable, time-efficient and cost-effective.
APPENDIX

Relative Energy Deficiency in Sport (RED-S) Treatment Contract

RED-S Treatment Contract for ____________________________

Multidisciplinary Team:
- (Physician) ____________________________
- (Psychotherapist/Psychiatrist) ____________________________
- (Exercise physiologist) ____________________________
- (Dietitian) ____________________________
- (Other) ____________________________

Requirements
Meet with:
- The psychotherapist at intervals recommended by the health professional treatment team
- The dietitian at intervals recommended by the health professional treatment team
- The physician at intervals recommended by the health professional treatment team
- Follow the adapted training plan developed by the health professional treatment team
- Follow daily meal plan developed by the health professional treatment team
- If underweight, weight gain expected to be ____________________________ kg per week/weight stable within week ____________________________
- If underweight, must achieve minimal acceptable body weight/fat of ____________________________ kg/percent by ____________________________
- Regular weigh-in at the following time intervals of ____________________________ week(s)
- After this date, ____________________________ (dd/mm/yyyy), must maintain weight and % fat at or above minimal acceptable body weight/fat mass of ____________________________ (kg/%)  
- Other ____________________________

If ALL requirements are met and the eating behavior (and other severe conditions) are normalized the Team Physician will decide if cleared for competition.

I, ____________________________ have read this contract and all of my questions were answered.

Athlete Name ____________________________ Athlete Signature ____________________________ Date ____________________________

Team Physician Name ____________________________ Team Physician Signature ____________________________ Date ____________________________

References

Contributing Authors
- Margo Mountjoy (CAN)  IOC Medical Commission Games Group
  McMaster University Medical School
  Department of Sports Medicine
  The Norwegian School of Sport Sciences
- Jorunn Sundgot-Borgen (NOR)  Sports Nutrition, Australian Institute of Sport
- Louise Burke (AUS)  University of Northern Colorado
- Susan Carter (USA)  University of Colorado Medical School
- Naama Constantini (ISR)  Orthopedic Department, Hadassah-Hebrew University Medical Center
- Constance Lebrun (CAN)  Department of Family Medicine,
  Faculty of Medicine & Dentistry, and Glen Sather Sports Medicine Clinic, University of Alberta
- Nanna Meyer (USA)  University of Colorado, Health Sciences Department
- Roberta Sherman (USA)  The Victory Program at McCallum Place
- Kathrin Steffen (NOR)  The Norwegian School of Sport Sciences
- Richard Budgett (SUI)  IOC Medical and Scientific Department
- Arne Ljungqvist (SWE)  IOC Medical Commission
- Kathryn Ackerman (USA)  Divisions of Sports Medicine and Endocrinology,
  Boston Children’s Hospital, Neuroendocrine Unit
  Massachusetts General Hospital, Harvard Medical School