RED-S CAT™

Relative Energy Deficiency in Sport (RED-S) Clinical Assessment Tool (CAT)

For use by medical professionals only

Name Date: Examiner:

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.

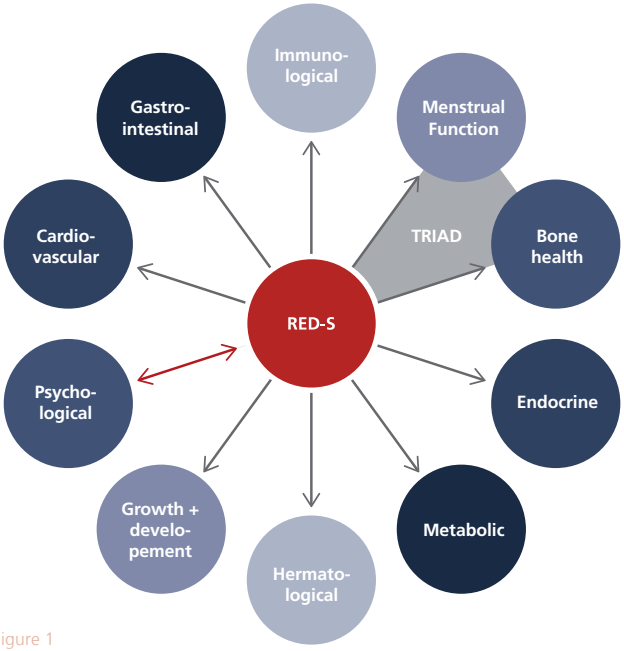

Figure 1

RED-S may also affect athlete sport performance. The potential effects of RED-S on sport performance are illustrated in Figure 2:

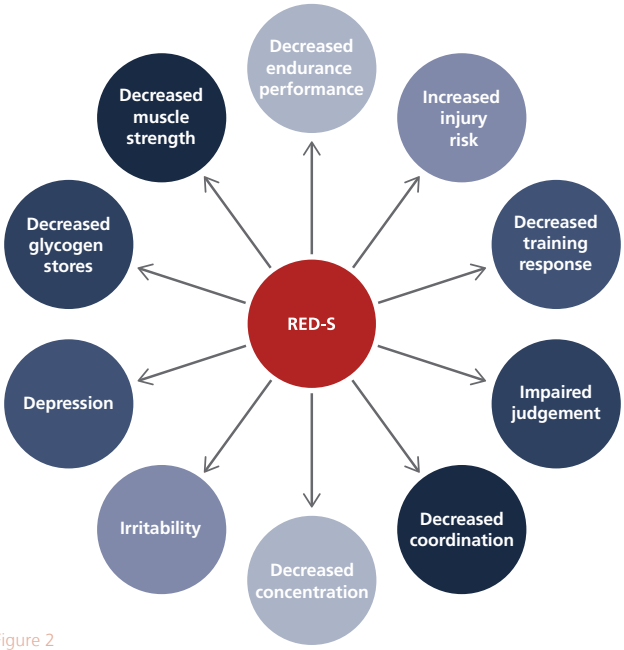

Figure 2

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.

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

* dual energy X-ray absorptiometry

**EA: Energy availability = Energy intake – Energy cost of exercise (additional energy expended in undertaking exercise).

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.

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": cleared 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.

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 dietician, 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.

The use of an athlete contract is also recommended. (*See Appendix*)

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:

STEPS	RISK MODIFIERS	CRITERIA	RED-S SPECIFIC CRITERIA
STEP 1 Evaluation of Health Status	MEDICAL FACTORS	- Patient Demographics - Symptoms - Medical History - Signs - Diagnostic Tests - Psychological Health - Potential Seriousness	- Age, sex - See Yellow Light column in RED-S Risk assessment model - Recurrent dieting, menstrual health, bone health - Weight loss/fluctuations, weakness - Hormones, electrolytes, electrocardiogram, DXA - Depression, anxiety, disordered eating/eating disorder - Abnormal hormonal and metabolic function - Cardiac arrhythmia - Stress fracture
STEP 2 Evaluation of Participation Risk	SPORT RISK MODIFIERS	- Type of Sport - Position Played - Competitive Level	- Weight sensitive, leanness sport - Individual vs. team sport - Elite vs. recreational
STEP 3 Decision Modification	DECISION MODIFIERS	- Timing and Season - Pressure from Athlete - External Pressure - Conflict of Interest - Fear of Litigation	- In/out of season, travel, environmental factors - Mental readiness to compete - Coach, team owner, athlete family, sponsors support - If restricted from competition

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.

HIGH RISK RED LIGHT	MODERATE RISK YELLOW LIGHT	LOW RISK GREEN LIGHT
- No competition - No training - Use of written contract	- May train as long as he/she is following the treatment plan - May compete once medically cleared under supervision	- Full sport participation

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 daily meal plan developed by the health professional treatment team
- Follow the adapted training 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

Mountjoy M, Sundgot-Borgen J, Burke L, et al. IOC Consensus Statement. Beyond the Triad – RED-S in sport. Br J Sports Med. 2014; 48: 491-7.

Contributing Authors

Margo Mountjoy (CAN)	IOC Medical Commission Games Group McMaster University Medical School
Jorunn Sundgot-Borgen (NOR)	Department of Sports Medicine The Norwegian School of Sport Sciences
Louise Burke (AUS)	Sports Nutrition, Australian Institute of Sport
Susan Carter (USA)	University of Northern Colorado 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)	Department of Sports Medicine, 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