

Relative Energy Deficiency in Sport: Performance and Health Implications in Track and Field

Dr. Sara Forsyth, MD

Braeden Charlton, BSc Hon



What will we be covering?

What is RED-S?

- Energy Availability
- Symptoms and Signs
- Health and Performance Outcomes

What can we do to prevent RED-S?

- Nutrition Strategies
- Training Strategies
- Monitoring Athletes

Case Studies

Input

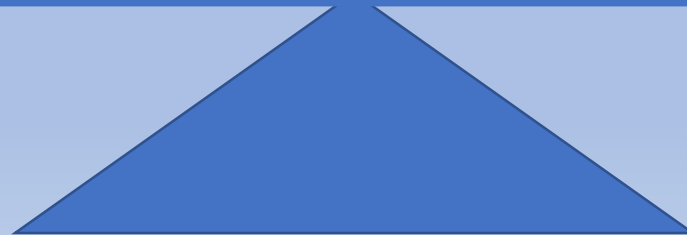
Calories/Energy

- Carbohydrates
- Protein
- Fats

Output

Overall Load

- Growth and Repair (i.e. Bone, Muscle)
- Exercise
- Environmental Stress (Heat, Altitude, etc.)
- School/Work



Energy Availability vs Energy Balance

Balance:

Calories in = calories out

Availability:

(energy intake-energy expenditure) per kilogram of fat free mass per day

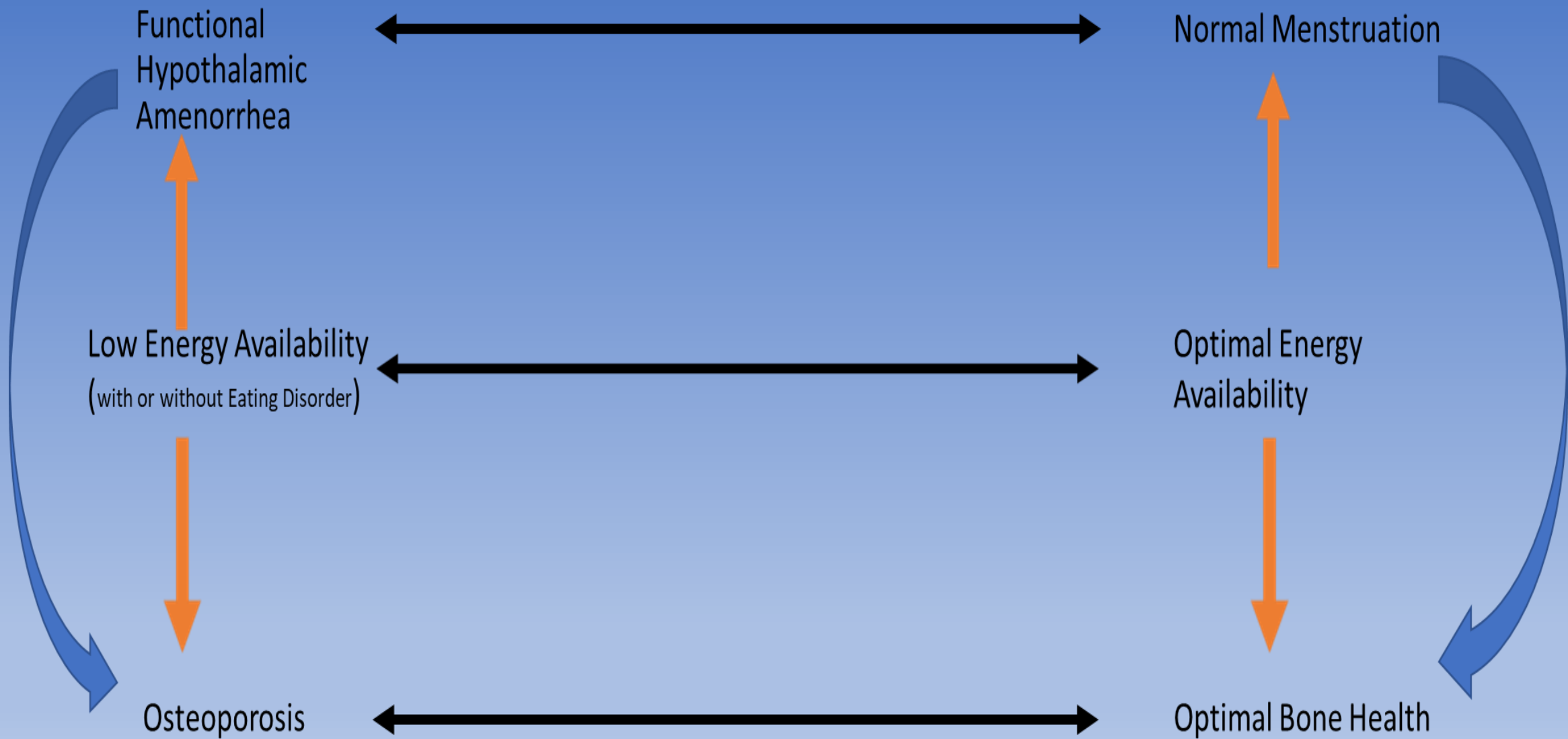
Impact of Low Energy Availability: Body Weight

When in crisis: **The body conserves calories**

- by DECREASING **Resting Metabolic Rate** and sacrificing vital functions
- Thus an athlete can be in energy balance and in a state of LOW EA at the same time

So, body weight may be stable BUT at a cost.

“Most female athletes with long term LEA are reported to maintain a steady body weight and body comp within the normal range, independent of their reproductive function.”



Prevalence
of Triad and
Triad
related
Symptoms
and Signs

Low Bone Mineral
Density
22-30%

Menstrual dysfunction
6-79% of athletic
females

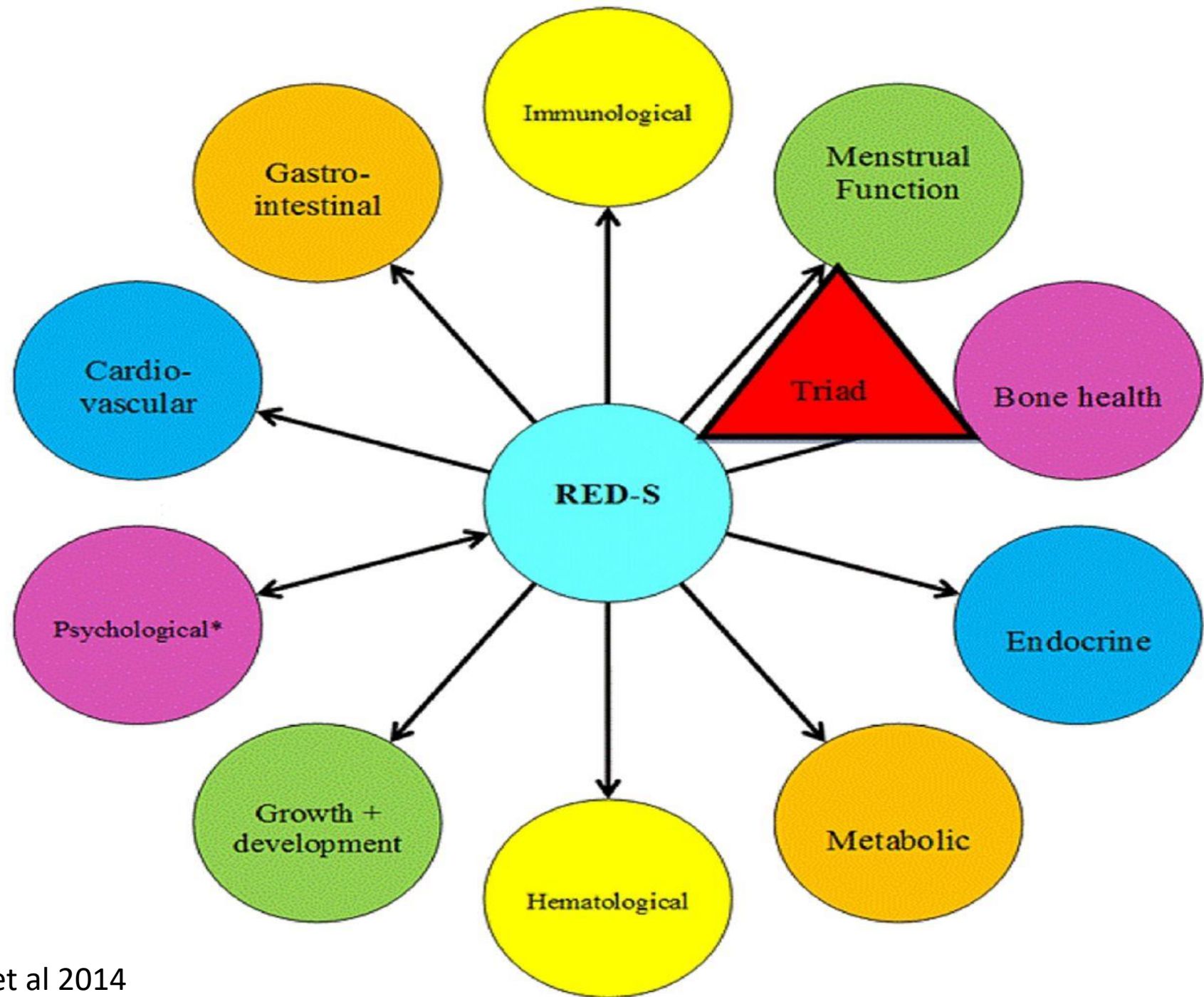
Low Energy Availability
1-62% with Eating
Disorders or Disordered
Eating Patterns

All 3 conditions
<4.3%

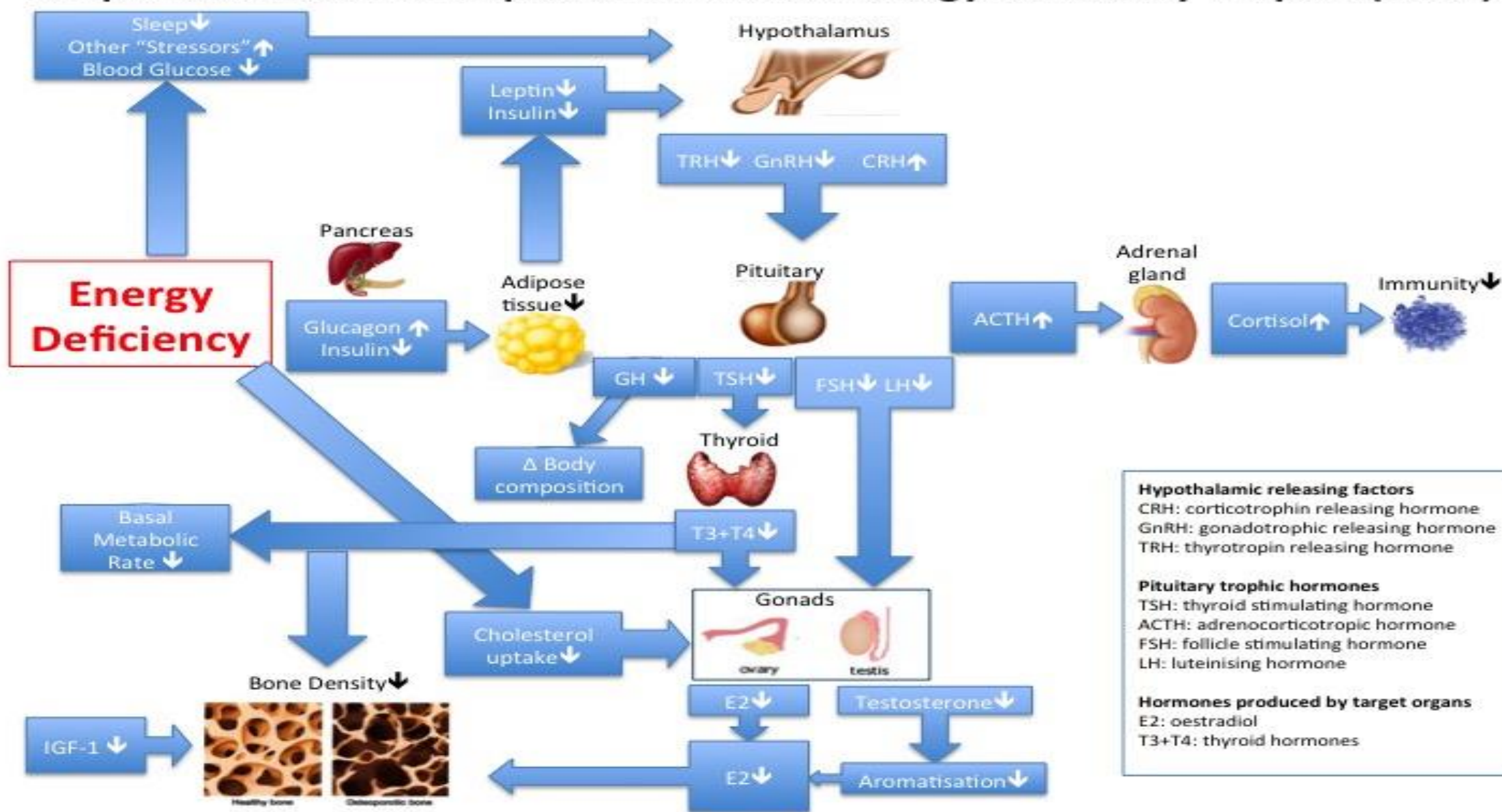
At least two
conditions
3-27%

RED-S:

Physiological Systems



Simplified endocrine response in Relative Energy Deficiency in sport (REDs)



Relative Energy Deficiency in Sport

RED-S

Hematological
Cardiovascular
Gastrointestinal
Immunological

Endocrine

Psychological

Menstrual
function

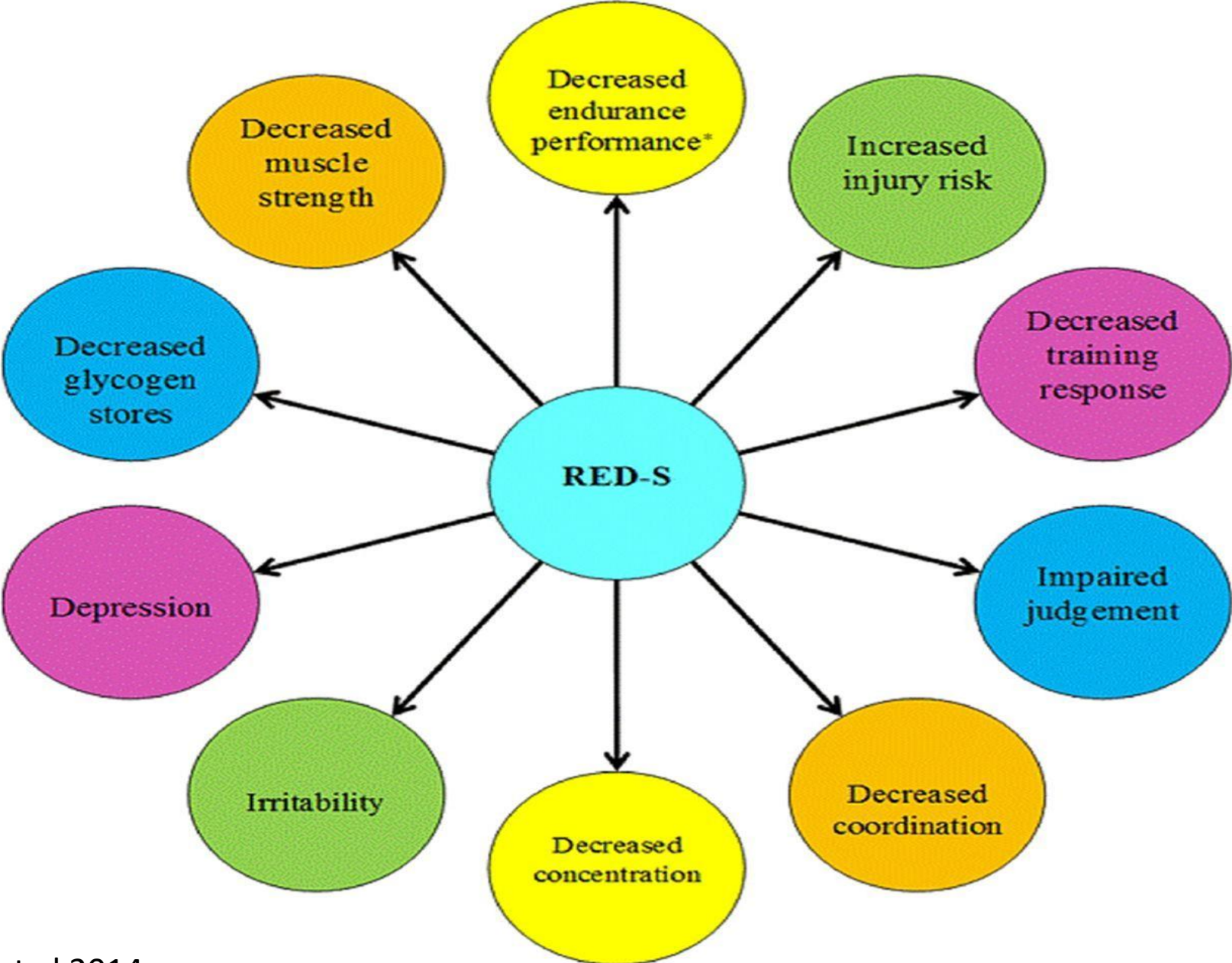
Bone
health

Metabolic

↓ **Growth**
↓ **Development**
↓ **Performance**

RED-S:

PERFORMANCE



Performance Impacts

- Impaired recovery & cognition
- Increased risk of injury and illness → prevents consistent high quality training.
- Decreased neuromuscular performance and reaction time

of training sessions missed due to injury, negatively correlates with attainment of predicted performance outcomes

Common Signs

Males

- History of stress injuries at trabecular rich sites
- Frequent weight fluctuations
- Low ferritin/low iron
- Low testosterone

Females

- Irregular menstruation
- History of stress fractures
- Frequent weight cycling

Behaviourial Signs

Self criticism, especially concerning body weight, size and shape, and performance	Compulsiveness and rigidity regarding eating and exercising	Claims of feeling fat despite being thin
Unusual weighing behaviour (i.e. excessive weighing, refusal to weigh for health or safety reasons, negative reaction to being weighed)	Excessive or obligatory exercise beyond that recommended for training or performance	Exercising while injured despite medically prescribed activity restriction
Restlessness, difficulty relaxing	Body image dissatisfaction	Changes in behaviour from open, positive and social to suspicious, dishonest, and sad
History of depression	Use of laxatives/diuretics	Substance abuse, whether legal, illegal, prescribed, over the counter medications, or other substances
Binge eating, and agitation when bingeing is interrupted	Secretive eating, or ritualistic eating patterns	Dieting that is unnecessary for health, sport performance, or appearance
Evidence of vomiting unrelated to illness	Frequent weight fluctuations or pressure to lose weight	History of chronic injuries



Nutrition Strategies



- Used primarily for muscle/tissue repair
- Can be used for energy IF not enough carbohydrates or fats
- Legumes, nuts, meats, dairy

Protein

Fats



- Energy storage as triglycerides
- Hormone synthesis
- Slow burning
- Heart primarily uses Fatty Acids for energy
- ~106 ATP per palmitic acid chain via Beta-oxidation
- Oils, meat, dairy, legumes, nuts

Vitamins

- Vitamin A
- B- Vitamins
- Vitamin C
- Vitamin D
- Vitamin E
- Vitamin K

Minerals

- Iron
- Potassium/Sodium
- Calcium
- Magnesium
- Phosphorus



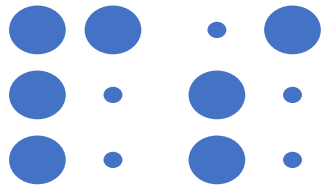


Training Strategies

Exercise: How much is too much?

- Injury rates shown to increase in three ways: early specialization, doing more hours of physical activity than age in years per week, and training more than 8 months per year
- Ensure rest periods to get adequate training response
- Multi-sport athletes must have special considerations

External Stressors



School/Work

Varying level of difficulty and stress depending on age, cognitive function



Lifestyle

Sleep
Relationships
Other hobbies
(music, acting, clubs, etc)



Environmental Stressors

Heat
Altitude
Humidity
Allergies

Monitoring Athletes



BE ATTENTIVE



ASK QUESTIONS

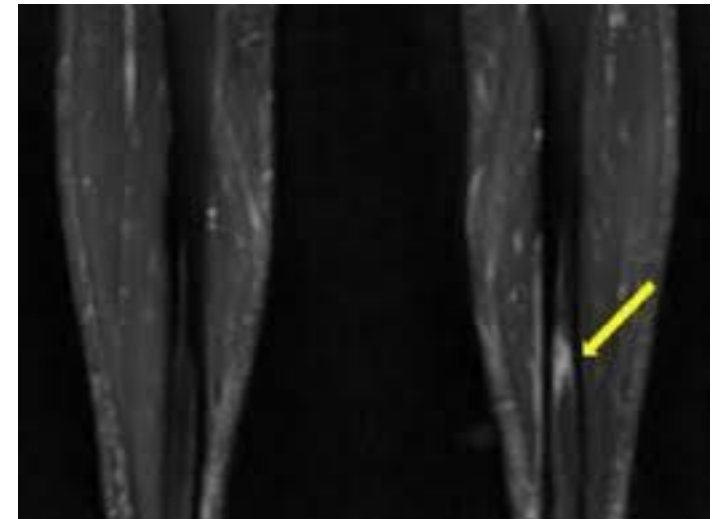


Case Studies



Case Report: Part 1

- * 14 yr old female presents with first episode of BSI: Right Tibia
- * History of current injury
- * Activity History
- * Prior traumatic #s or BSI
- * Developmental/Menstrual History
- * Diet History
- * Personal Medical History
 - * Medications, review of systems
- * Family History



Case Report: Part 1

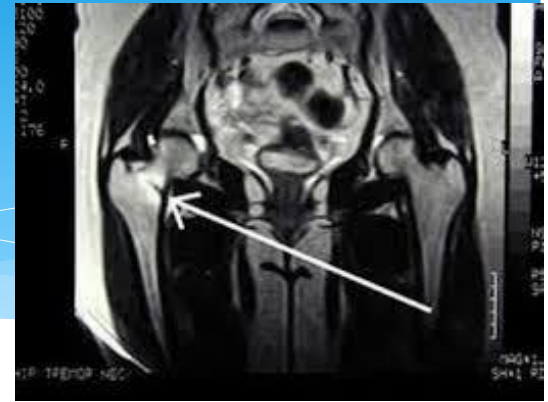
* Medical history: Key Points

- * No prior traumatic or pathological fractures.
- * Started pubertal development at age 11
- * No periods
- * mother and sister menarche age 12
- * No purposeful caloric restriction (LEAF neg)
- * Missed approx. 6 weeks last season due to injury (heel pain, knee pain etc)
- * No medications (Nsaids, inhaled CS etc)



Case Report: Part 2

- * 2 years later presents with groin pain.
 - * DX: BSI pelvis (high risk BSI)
- * Menarche age 15, no regular cycle.
- * No nutritional changes undertaken since the 1st BSI
- * Training log ?
- * Further investigations:
 - * LEAF neg
 - * DEXA: BMD lumbar spine below age matched expected values for bone age
 - * Hormone levels low
 - * Serum Vit D low
 - * Low iron stores



Case Report: Part 3

Multidisciplinary team approach

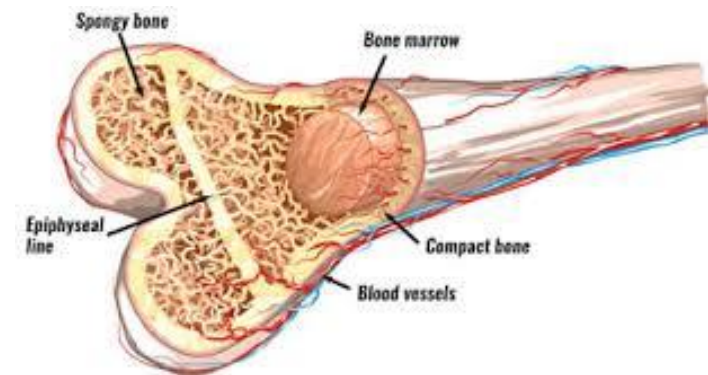
- * Medical support
- * Registered Sports Dietician
- * Sports Psych
- * Coach
- * Altered training plan based on RED-S RTS tool



Case Report: Part 4

LONG TERM GOALS

- ✓ Optimize nutritional status (Pre/post workout, BF, Ca/Vit D, ferritin levels)
- ✓ Regulation of menstrual without pharmacological intervention
- ✓ Restoration of bone health
- ✓ Happy, Healthy and Resilient Athlete



Take Home Points from Case Study

- * Pubertal development should follow a predictable sequence
- * RED-S is a **medical** diagnosis of exclusion
- * Early diagnosis and effective management of RED-S is essential to prevent irreversible impacts on lifetime bone health

Low energy availability surrogates correlate with health and performance consequences of Relative Energy Deficiency in Sport

Kathryn E Ackerman,^{1,2} Bryan Holtzman,¹ Katherine M Cooper,¹ Erin F Flynn,¹ Georgie Bruinvels,^{3,4} Adam S Tenforde,⁵ Kristin L Popp,⁶ Andrew J Simpkin,^{4,7} Allyson L Parziale¹

Objective: The purpose of this cross-sectional study was to examine the association of low EA with RED-S health and performance consequences in a large clinical population of female athletes.

Conclusion: These findings demonstrate that low EA measured using self-report questionnaires is strongly associated with many health and performance consequences proposed by the RED-S models.

LEA in Males

Sports Med
DOI 10.1007/s40279-015-0411-y

REVIEW ARTICLE

Parallels with the Female Athlete Triad in Male Athletes

Adam S. Tenforde¹ · Michelle T. Barrack² · Aurelia Nattiv³ · Michael Fredericson⁴

“Although research is lacking on the severity of the clinical sequelae of energy deficiency in the male athlete, the health issues appear to parallel the Triad in the female athlete, including low energy availability with or without DE, reduced sex steroids including testosterone, and impaired bone health”

Within-Day Energy Deficiency (WDED)

International Journal of Sport Nutrition and Exercise Metabolism, 2018, 28, 419-427

<https://doi.org/10.1123/ijsnem.2017-0337>

© 2018 Human Kinetics, Inc.

Human Kinetics

ORIGINAL PAPER

Within-Day Energy Deficiency and Metabolic Perturbation in Male Endurance Athletes

ORIGINAL ARTICLE

Within-day energy deficiency and reproductive function in female endurance athletes

I. L. Fahrenholtz, A. Sjödin, D. Benardot, Å. B. Tornberg, S. Skouby, J. Faber, J. K. Sundgot-Borgen, A. K. Melin ✉

Key Points

- * RED-S occurs in males and females
- * Underlying issue is LEA
- * Far reaching and significant physical and medical health impacts
- * Screening and identification with history and tools: Medical Diagnosis
- * Management with multidisciplinary approach/team and frequent reassessment
- * RTP tools
- * Focus on education, self-care and load management