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Relative energy deficiency in sport (REDs)

1. Relative energy deficiency in sport (REDs)

Relative energy deficiency in sport (REDs) is the newer, comprehensive term that incorporates the 'female athlete triad'.

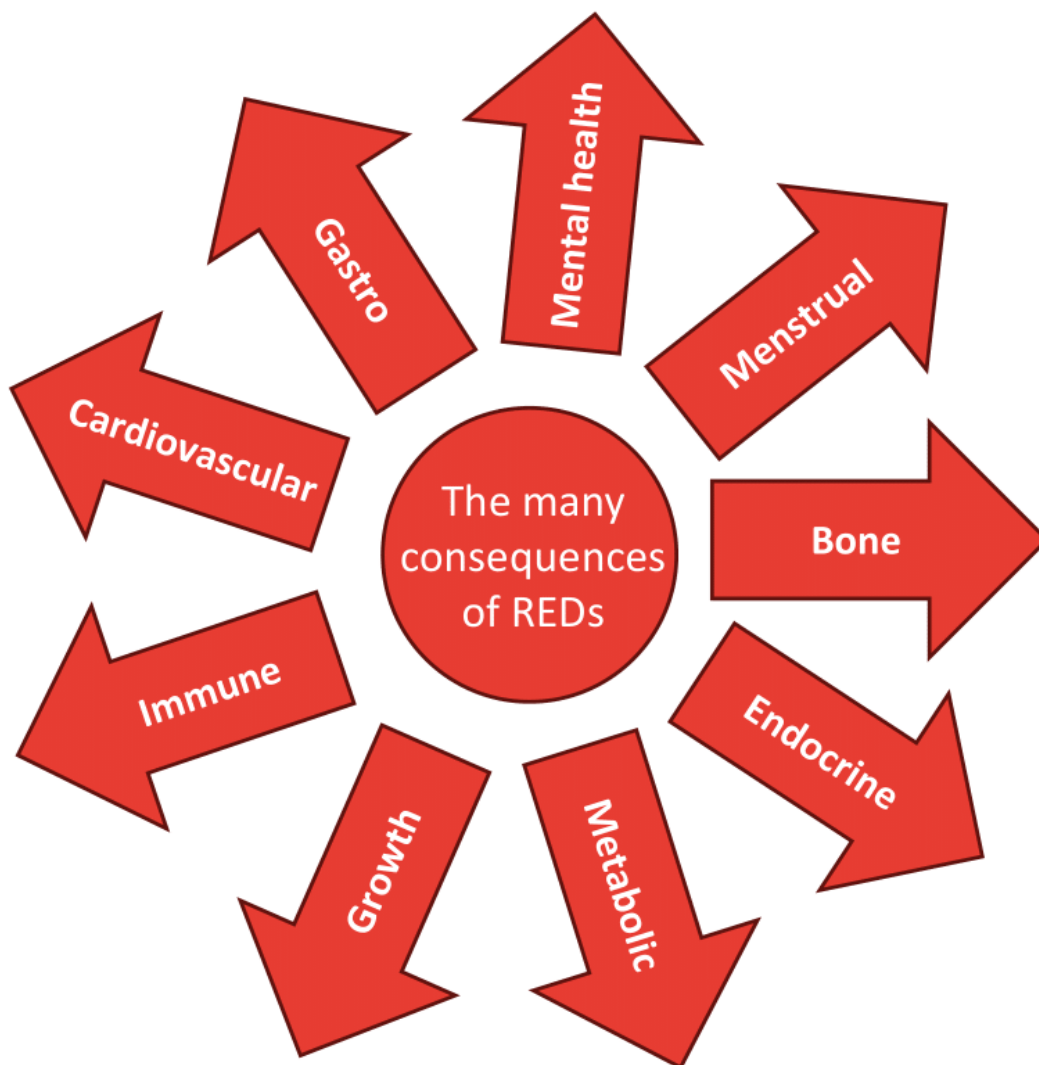
Here, we review the condition and identify 5 pitfalls to avoid.

The article is based on a BJGP review on REDs (BJGP 2022;72:295), the most recent International Olympic Committee (IOC) statement (BJSM 2024;57:1073) and some older articles, referenced along the way, which predate the name changes.

This article was reviewed in January 2024.

1.1. Definition

The term REDs refers to impaired physiological function resulting from relative energy deficiency. It can have effects on multiple systems, as shown in this diagram:



What is meant by 'relative energy deficiency'?

This is a fancy way of saying that a person burns more calories than they

consume for a significant length of time.

A short-term period of energy deficit isn't problematic – for example, going on a diet or reduced appetite during a period of stress – but prolonged energy deficit can lead to problems. This is known as REDs.

Newer evidence suggests that specific *low-carbohydrate availability* may confer a disproportionate risk of developing REDs when compared with a more 'balanced' energy deficit with greater carbohydrate content.

1.2. Who does REDs affect?

While we refer to 'sport' and 'athletes' in this article, it is important to point out that this disorder may affect any person who is exercising – ranging from elite athlete to occupational or recreational 'keep fit' levels. Although defined as 'in sport', the condition logically extends to include those engaging in active performing arts (e.g. dancers) or those in physically active jobs, e.g. postal delivery worker, refuse collection.

Pitfall 1:

You don't have to be an athlete to have REDs.

It can happen in those who exercise across ANY activity, at ANY age, at ANY ability.

1.3. Disordered eating in REDs

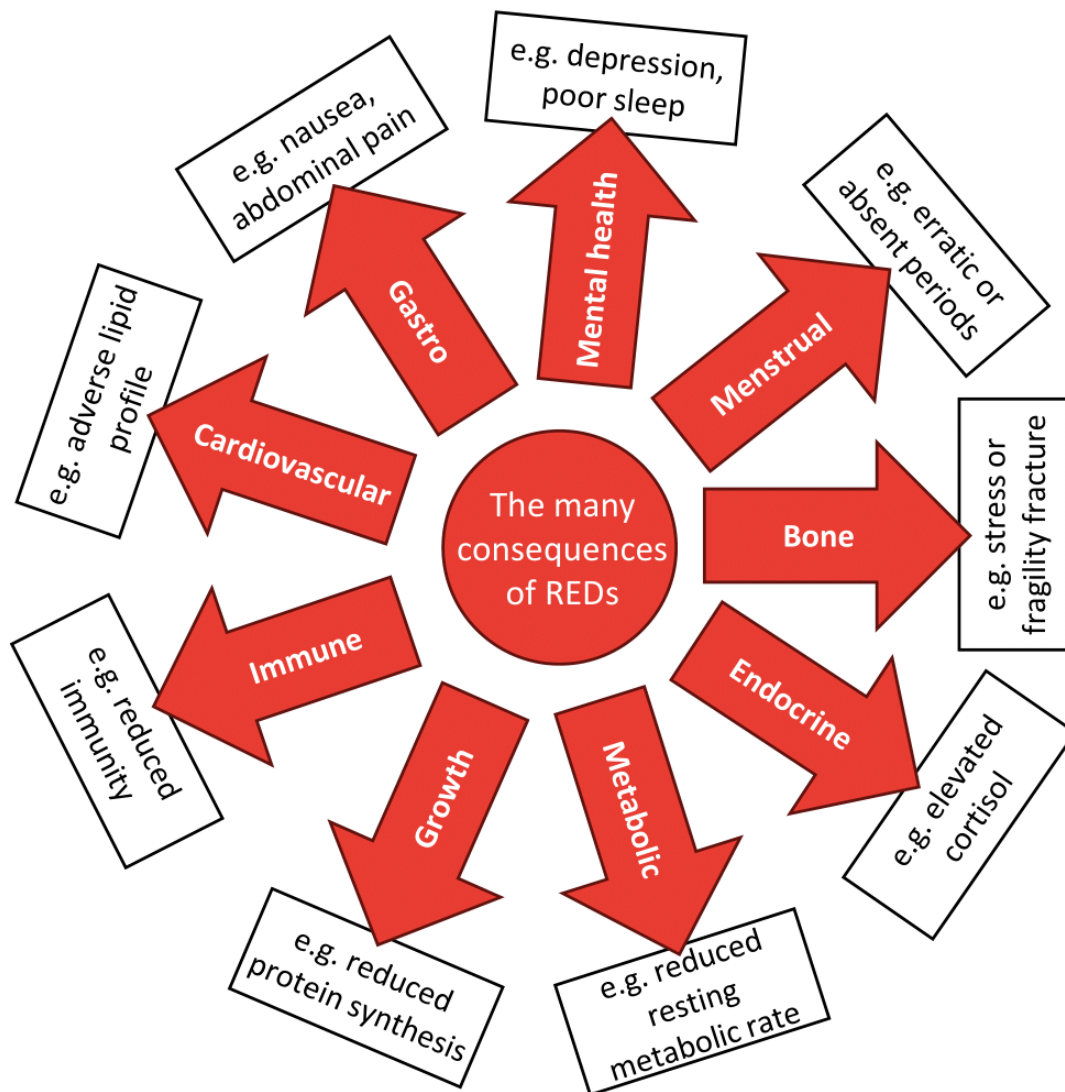
The disordered eating in REDs may be somewhere on a spectrum ranging from near-normal eating to disordered eating that meets the DSM criteria

for an eating disorder and all the sequela of this (see our linked article on *Eating disorders*). In some athletes, a formal diagnosis of an eating disorder may precede REDs, while in others, it may develop as part of REDs.

Disordered eating is relatively prevalent among high-level athletes. Among elite adult athletes, around 20% of females and 8% of males have disordered eating. Some sports are associated with higher prevalence; these tend to be those where there is a perceived advantage in being light (e.g. cycling or fell running) or where there is an aesthetic focus (gymnastics or performing arts such as ballet).

1.4. The health consequences of REDs

REDs can affect many bodily systems, with both short-term and long-term health consequences, including increased cardiovascular risk (BJSM 2014;48:491). This diagram illustrates the wide-ranging consequences.



Hormonal and metabolic imbalance

Reduction in energy availability can interfere with hypothalamic GnRH secretion, in turn restricting LH pulsatility. This can cause something called functional hypothalamic amenorrhoea (see our article on this topic for more details). Rapid or significant fat-mass reduction may also alter menstrual function.

Pitfall 2:

It is NOT normal to suffer menstrual disturbance due to level of exercise.

It is NOT normal to lose morning erections due to level of exercise.

Either may indicate the presence of hypogonadotropic hypogonadism (BJGP 2022;72:295).

Both are red flags.

Bone health

Oestrogen and testosterone (present in males and females) promote mineralisation of bone.

Low testosterone levels are associated with low bone mineral density in males.

In female athletes, the osteogenic effects of exercise are attenuated in the presence of chronic amenorrhoea (BJSM 2014;48:491).

These changes increase the risk of a stress or fragility fracture.

Relative energy deficiency has been shown to induce a rate of bone mineral density loss similar to that seen in astronauts who perform 2 hours per day of gravity-simulated exercise on the international space station (BMJ Open Sport & Exercise Medicine 2019;5:e000523).

1.5. Recognition of REDs

REDs often presents with vague symptoms, making it difficult to recognise.

It may be harder to spot in male athletes and in the absence of weight loss. It

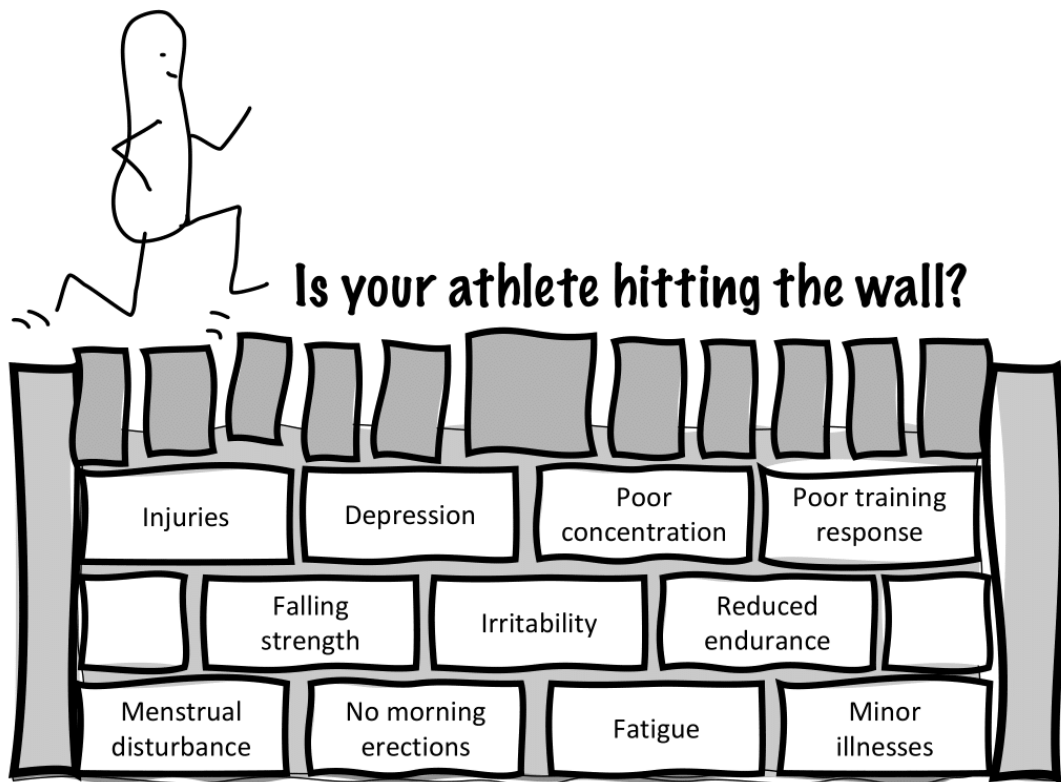
is a diagnosis of exclusion.

Pitfall 3:

REDs can sometimes occur in athletes with a normal BMI (BJGP 2022;72:295).

(We think this ONLY applies to athletes, not non-athletes – and we say this because it is likely to apply to those with very low body fat levels but high muscle mass (making BMI normal)).

Athletes sometimes say that they have “hit the wall”. Take a look at our REDs wall which lists some of its key features:



1.6. Assessment and diagnosis of REDs

If you suspect REDs, consider eating disorder screening and the following tests (BJGP 2022;72:295):

ALL athletes	Female athletes	Male athletes
<ul style="list-style-type: none"> • FBC. • Thyroid function. • Ferritin. • B12. • Vitamin D. • 9am cortisol. • Prolactin. 	<ul style="list-style-type: none"> • FSH. • LH. • Oestradiol. • Pregnancy test. • Testosterone (female). 	<ul style="list-style-type: none"> • LH and testosterone (male).
<p>Consider:</p> <ul style="list-style-type: none"> • Coeliac screen and/or calprotectin if GI disturbances. • Bone density scan if higher risk of osteoporosis on fracture risk assessment, e.g. previous fracture, amenorrhoeic. 		

Pitfall 4:
Normal blood tests do not exclude a diagnosis of REDs!

The IOC produced a [risk stratification tool \(called REDs CAT2\)](#) designed to be used by athletic health and performance teams. It is not designed for primary care so we will not include further details here.

1.7. Management

The aim is to modify diet and exercise behaviour, increase energy availability and normalise weight. Ideally, this should be through a multidisciplinary team with input from a sports physician, dietitian and psychologist.

Consider signposting to the British Association for Sport and Exercise Medicine's [Health for Performance](#) website and [Project Red-S](#). In primary care, we can offer education and involve secondary care teams if necessary.

Research suggests that increased energy status should lead to resumption of menstrual function within months, but bone mineral density can take years to recover.

Calcium and vitamin D

To facilitate bone health:

- Optimal calcium intake should be 1000–1300mg/day.
- Vitamin D intake should be 600IU/day (aiming for a level of 32–50ngl).

Would combined hormonal contraception (CHC) help?

Pitfall 5:

Do not prescribe CHC to 'stimulate' or 'control' the menstrual cycle.

- The combined pill does not restore spontaneous menses, but induces a 'false' withdrawal bleed which can mask the problem.
- **Studies have found that CHC use is not associated with improved bone mineral density in amenorrhoeic athletes AND**
- The combined pill may actually worsen bone mineral density because it doesn't normalise metabolic factors impairing bone health (BJGP 2022;72:295).

There is currently insufficient evidence to recommend a contraceptive ring or patch to improve bone mineral density.

Is there ANY role for hormones?

Hormones may be considered for:

- Symptoms of vaginal oestrogen deficiency, e.g. dyspareunia and dryness (use a topical oestrogen).
- Subfertility: refer!
- Impaired bone health ONLY IF unresponsive to non-pharmacological treatment. There is no published data examining the use of transdermal oestrogen in athletes, but the consensus guidelines suggest using:
 - 100mcg oestradiol patch continuously, with oral 200mg micronised progesterone or 5–10mg medroxyprogesterone acetate 12d per month. This is not contraception! (An IUS may be an alternative progestogen option with contraceptive benefits.)
 - The Endocrine Society guidelines on functional hypothalamic amenorrhoea recommend HRT if amenorrhoea persists after 6–12 months of non-pharmacological interventions (FCEM 2017;102:1413).

What about bisphosphonates?

There is little data looking at the role of pharmacotherapy in treating low bone mineral density with or without fracture in athletes. Concerns exist regarding:

- Use of an off-licence treatment in premenopausal women.
- Risk of teratogenicity in the event of pregnancy because bisphosphonates have a long half-life.
- The association with atypical femoral fractures and osteonecrosis of the jaw.

This is a specialist decision!

1.8. History of REDs



1986: first described as the 'female athlete triad': disordered eating, amenorrhoea and osteoporosis (JAMA 1986;256:380).

2007: the International Olympic Committee refined the definition to "the relationship between three inter-related components: energy availability, menstrual function and bone health" (Med Sci Sports Exerc 2007;39:1867).

2014: renamed RED-S by the International Olympic Committee because the non-menstrual manifestations are seen in male athletes (BJSM 2014;48:491).

2023: renamed REDs with a lower case 's' in recognition that the condition is not limited to those involved in sport. The International Olympic Committee also added information on the role of low-carbohydrate

availability, the impact of the condition on males and updated information on the role of mental health in REDs.

	<p>Relative energy deficiency in sport (REDs)</p> <ul style="list-style-type: none">• May affect physically-active males and females.• It is due to low energy availability.• Early recognition is needed to prevent progression, but it can be hard to spot!• Menstrual irregularities or amenorrhoea are not a normal response to athletic training.• First-line management is to gain weight and restore energy balance through diet and exercise modification.• Do not prescribe combined hormonal contraception to manage the condition.
	<p>Useful resources:</p> <p><u>Websites</u> (all resources are hyperlinked for ease of use in Red Whale Knowledge)</p> <ul style="list-style-type: none">• Project Red-S• BASEM Health 4 Performance

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