

Running on empty: Female athletes' health and performance at risk from not eating enough

August 15 2023, by James McKendry and Mikkell Oxfeldt



Credit: AI-generated image ([disclaimer](#))

For athletes and highly physically active individuals, a well-planned and executed [nutrition](#) and [exercise training](#) regimen are critical to maximizing training and pursuing peak performance.

Many people are aware that habitually consuming more calories than is expended can lead to [weight gain](#). It also increases the risk of developing obesity and other metabolic [health](#) concerns such as [Type 2 diabetes](#).

However, [female athletes](#) and highly active women are at an increased risk of quite the opposite problem; that is, not eating enough.

When [energy intake](#) is reduced by too much for too long, or not increased to match the demands of their training, the consequences for exercise performance, muscles and health can potentially be severe.

Low energy availability

Food provides our bodies with energy to carry out basic bodily processes, such as regulating metabolism and promoting cell repair and growth from exercise training.

When the energy consumed from food becomes insufficient to meet the demands of high physical activity levels in athletes, a state of imbalance occurs called [low energy availability](#). Low energy availability is the underlying cause of the sporting phenomenon known as [relative energy deficiency in sport \(RED-S\)](#).

RED-S refers to a syndrome where several physiological functions outside the context of exercise are impaired. These include metabolic rate, menstrual function and bone health.

While it varies considerably between sports, it is estimated that [25% to 60% of athletic women](#), consciously or unconsciously, may be in a state of low energy availability.

There are a whole host of reasons why one may be in a state of low energy availability. Mental health issues such as an [eating disorder](#), a

desire to achieve a particular body image due to social media pressures, or taking part in weight-sensitive or aesthetic sporting events such as combat sports or gymnastics all [increase the risk of low energy availability](#).

However, it can be extremely difficult to establish the true prevalence of low energy availability or RED-S for [several reasons](#): the symptoms can be subtle, we often rely on self-reported assessments and athletes may wish to hide its presence for sociocultural reasons. There is also no widely established biomarker to screen for RED-S.

Health and performance concerns

In an energy crisis, the body will prepare for a period of starvation—entering "survival mode"—by trying to preserve as much energy as possible by reducing the most energy-consuming processes.

[Low energy availability](#) can disrupt hormones and metabolism in as little as five days. If this persists, long-term energy deprivation can lead to more severe health issues such as menstrual cycle irregularities, impaired bone health and increased risk of injury.

We are a team of muscle physiologists—from Canada and Denmark—who study nutrition and female physiology. We recently [conducted a study](#) to understand how low energy availability impacts the muscles and metabolism of female athletes.

We put 30 young, healthy female athletes through an intense exercise training program designed to increase [muscle mass](#) and strength, and improve cardiovascular fitness. At the same time, and with their prior informed consent, we controlled their dietary intake and reduced the energy they consumed to around half of what is considered optimal.

In this study, we showed that reducing the energy available for the body for just 10 days impairs the muscle-building response during intense exercise training. It also led to a rapid loss of lean mass, reduced resting [metabolic rate](#) (the number of calories burned at rest) and altered thyroid hormones.

We know that protein intake is essential to [maximize gains in muscle mass](#) with exercise training. One may think that if the women involved in the study were exercising intensely and consuming enough protein, they would be protected against muscle loss during this [energy crisis](#).

Unfortunately, this was not the case. The negative consequences of low energy availability occurred despite consuming protein at about 2.2 grams per kilogram of lean body mass per day—about twice the [recommended daily allowance](#)

As little as 10 days of low energy availability can have grim consequences for muscle.

Low energy availability in elite sports

Numerous examples exist of athletes passing out on stage or suffering health scares because of dangerous weight-cutting practices. This is because public weigh-ins and drastic weight cuts are prominent features of several sporting disciplines, such as weightlifting and combat sports. These practices contribute to a toxic culture where many female athletes constantly strive to lose weight.

Our results show that low energy availability can have short-term and potentially long-lasting negative consequences for female athletes' training outcomes and overall health. Hopefully, this study provides athletes and coaches with a more nuanced understanding of the possible side-effects of weight-cutting and low energy availability.

Something needs to change

Current estimates suggest that [fewer than 50% of professionals](#)—physicians, coaches, physiotherapists, athletic trainers and school nurses—can identify the condition, emphasizing the need for improving knowledge on low energy availability.

The International Olympic Committee has recently developed a [RED-S Clinical Assessment Tool](#). The tool needs further validation, but it aims to identify and separate athletes into high-risk, moderate-risk and low-risk categories and facilitate return-to-play decisions.

Moving forward, to prevent low energy availability from affecting female athletes' health and performance, we must strive to increase awareness of the condition, improve our ability to identify those at risk, and provide appropriate support and treatment options to individuals suffering from low energy availability.

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