

# Intermittent fasting in athletes: PROs and CONs

**Valeria Laza**

*Hygiene Discipline, Department of Community Medicine, “Iuliu Hatieganu” University of Medicine and Pharmacy Cluj-Napoca, Romania*

## **Abstract**

Weight loss is nowadays a hot topic for average people as well as for athletes. Intermittent fasting, an alternation between fast periods and normal eating periods, is the newest, in vogue diet trend to lose weight. It is not a calorie-restricted eating plan, it is a time-restricted approach. Whether intermittent fasting is good or bad, that depends on many factors. Although it could be considered a part of normal life, a life changer for some people, it might become a disaster for others.

There are many fasting protocols depending on the extent of fasting hours (from 12 to 20 hours a day) or days (from 1 to 2 days a week or more), the most observed type being the 16:8 model. The best individual plan for eating is seldom found by experimentation; what is important is to focus on healthy eating, to avoid/limit junk food, and to avoid dehydration.

In athletes, competing during intermittent fasting is contraindicated, and endurance training in fasting periods might boost the post-exercise recovery. So far, studies sustaining intermittent fasting have been contradictory and inconclusive, and the research methodology is not yet standardized. This type of eating habit could have many advantages as long as fasting is done wisely, and many disadvantages, with extra risks in athletes compared to average people.

**Keywords:** athletes, intermittent fasting, weight loss.

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## **Introduction**

Alongside water, air, shelter and a stable global environment, food is one of the 5 fundamental human needs. The criticism of rational nutrition was mentioned 2,500 years ago, and the accumulation of food and nutrition information during the last century was explosive. Nowadays we are witnessing a real “nutritional cacophony” in which it is difficult to choose between true and false, good and bad (Laza, 2017).

Human beings need a proper and energetically adequate diet, any (totally/partially) excessive or (totally/partially) poor nutrition regimen having serious effects on their health status.

The world population is currently confronted with a lack of food (famine, poverty), which affects over 800 million people, as well as with an excess of food, which in association with a sedentary lifestyle determines overweight and obesity, with serious obesity-associated conditions (Alamgir Khan et al., 2018).

Over centuries, physical beauty standards have evolved, and nowadays being overweight/obese is no longer a sign of wellness. Global epidemic obesity has allowed some companies to develop a plethora of more or less efficient and sustainable weight loss schemes. In

recent years, weight loss has been a hot topic for average people, as well as for athletes, regardless of the level of exercise. Intermittent fasting (IF) is the newest, in vogue diet trend to lose weight. IF means an alternation between fast periods and normal eating periods (non-fasting or feast days/hours). So far, studies sustaining IF have been contradictory and inconclusive, showing both health benefits and detriments (the research methodology is not yet standardized) (De Cabo & Mattson, 2019).

IF is not a diet, it is a time-restricted (scheduled approach) and not a calories-restricted eating plan, recreating the forced fasting of ancient humans during hunter-gathering periods. Our ancestors did not have the luxury of having a meal every 2 to 3 hours, yet they still enjoyed better physical health than most of us today. Some people might fast unknowingly by eating an early dinner and skipping breakfast the next day, so IF could be considered a part of normal life. Whether IF is good or bad, that depends on many factors; it could be a life changer for some people or a disaster/nightmare for others, depending on the aim, health status, and sex (Patterson & Sears, 2017).

Fasting is not similar to starvation. While starvation is an involuntary and severe absence of food for a long

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*Address for correspondence:* „Iuliu Hatieganu” University of Medicine and Pharmacy Cluj-Napoca, Romania, 400349, Louis Pasteur Str. No. 6

*E-mail:* v\_laza@yahoo.com

*Corresponding author:* Valeria Laza v\_laza@yahoo.com

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period of time, leading to serious suffering or even death, fasting is deliberated, controlled deprivation of some or all foods, beverages or both for a set period of time (a few hours up to a few days or weeks).

Fasting periods are often called “purification”, “detoxification”, or “cleanses”. Intermittent fasting has no standard duration and could follow many models.

There are many fasting protocols: shorter fasts (less than 24 hours), longer fasts (over 24 hours), and extended fasts (over 48 hours) (De Cabo & Mattson, 2019).

### Shorter fasts

Are the most frequent intermittent fasting type:

The *12:12 model* means that a person fasts 12 hours out of 24, and the 12 remaining hours has a normal calories intake. Most of the types of fasting also include sleep hours.

The *16:8 model* is the most indicated and used type of IF, meaning that 8 hours represent the “eating window”, and 16 hours represent the “fast window”. This form is applied daily or almost daily, being very flexible. Practically, the first meal of the day could be at 9:00 am and the last one at 5:00 pm, so the “fast period” is between 5:00 pm (day 1) and 9:00 am (day 2), or between 6:00 pm and 10:00 am, or from 7:00 pm to 11:00 am, or 8:00 pm - 12:00 am, respectively. During the feast window, all daily calories can be consumed without restriction. This protocol is easy to follow, being supported by the daily circadian rhythm, and can be adapted to a person’s preference. It is important to consume dinner 2-3 hours prior to sleep (eating within 2-3 hours interferes with sleep quality and could promote weight gain) (Yamaguchi et al., 2013). Sometimes, the best individual plan for eating is found by experimentation. It is also important to focus on healthy eating (high-fiber, vegetable-rich diets), and to avoid/limit junk food. During the 16 fasting hours, regularly drinking water is extremely important to avoid dehydration. Other calorie-free beverages are tea (e.g. cinnamon herbal tea may suppress appetite) and coffee.

The *20:4 model* (also named *the warrior diet*) extends the fast period to 20 hours, the eating window being within the 4 remaining hours (e.g. from 2:00 pm to 6:00 pm) (1).

### Longer fasts

*Full day fasting* (FDF) spans 24 hours (from dinner to dinner, or from lunch to lunch), 2 to 3 times a week (it is known as the Eat-Stop-Eat diet). Practically, people eat at 10:00 pm on day 1, the next meal being at 10:00 pm on day 2. The meal is quite low in calories, and so the weekly caloric intake is diminished. Despite some benefits, this regimen is highly contraindicated in athletes competing in endurance sports, because through it the body uses fat for energy, and endurance sports demand a quicker way to obtain the necessary fuel (Horne et al., 2013).

*Weekly 24-hour fasting*: during 24 hours per week, the person fasts completely and consumes only liquids (Leonard, 2018; Gunnars, 2017). For different reasons (spiritual, dietary, medical), along with meditation, *water fasting* is nowadays quite popular in the wellness movements. Some people may not eat and drink nothing

but water, but this is not safe for everyone. Long water fasting for days is not advised, a safer alternative being preferable.

The *5:2 fast* represents the most popular and studied protocol, involving 5 regular eating days and two fasting days (which should not be consecutive). During the fasting days, the diet offers no much than 500-600 calories as a single meal or spread throughout the day. A model related to 5:2 is to fast every other day (*alternate day fasting - ADF*), which implies a caloric intake restriction to around 25% of the usual intake (Leonard, 2018; Gunnars, 2017). In humans, ADF might boost the ability of aerobic exercise to increase endurance (the muscle uses fats and ketones as fuel instead of carbohydrates), improves overall health and reduces risk factors for diabetes and cardiovascular diseases (Kroeger et al., 2018; Varady et al., 2013).

The *36-hour fast* means that the fasting window is for 36 hours (from dinner on day 1 to breakfast on day 3).

### Extended fasts

They are from 7 to 14 days most frequently and are only possible for some people, the risks of complications being high (vitamin, mineral and fluid imbalance) (Bertile et al., 2016).

### Metabolic changes during fasting

Human daily calorie needs are 1,600-2,400 for women, and 2,000-3,000 for men, depending on age, size, height, lifestyle, health status, and activity level. As people get older, caloric needs diminish because their metabolic rate also decreases (1,600 calories a day after 51 years of age). Caloric intake is covered by glycogen and fat ingested or deposited. During the fed state, the blood insulin level rises and stores the glucose (sugar) in liver and muscle as glycogen (Chaouachi et al., 2009). When the storage space for glycogen (limited but easily accessible) is reached, the liver turns the excessive glucose into fat (fat deposits in the body are huge, but more difficult to access). The liver glycogen deposit is rapidly depleted, and then liver glycogenolysis starts to properly supply glucose to the brain, while the muscle glycogen stores are little affected or unaffected.

During the fasting state, the insulin level falls and the body burns the stored glycogen and fat. The low level of insulin causes the blood vessels to expand and hence, there is more flow of oxygen and nutrients serving the working muscle and the other organs. After 8 to 12 hours of fasting – depending on the level of blood glucose - the body tries to preserve the little amount of blood sugar and rely on fat. As the body starts using fat as fuel, the hormones which regulate sugar and fat (growth hormone, cortisol, glucagon, adiponectin) and the growth hormone and adrenaline (also called epinephrine) are very high. Hormonal changes during IF could elevate blood sugar production (the dawn phenomenon) (Rybicka et al., 2011). The dawn phenomenon (the dawn effect) is an abnormal increase in blood sugar in people with diabetes between 2 am and 8 am. It is explained by a natural overnight release of counter-regulatory hormones which increases insulin resistance, raising the blood sugar.

## PROs and CONs of IF in athletes

Time-restricted eating regimens allow people to eat anything they want with rapid weight loss (Patterson & Sears, 2017).

IF is not a miracle weight-loss treatment, but is indicated for those who are lightly/moderately physically active, if they want to lose weight, to reduce glycemia, to reduce gut inflammation or to improve their intestinal microbiome.

## Health effects of IF

Some of which have been known since ancient times:

\* *Weight and fat loss* while the muscle mass is maintained: 0.2 to 0.8 kg/wk (Davis et al., 2016), or 4-15% weight loss in overweight (Tinsely et al., 2015; Varady, 2011; Wilson et al., 2018).

\* *Diminished hunger and food cravings.* Hunger comes and goes like a wave; it should be ignored and disappear after drinking a cup of tea/coffee (2). In longer fasts, hunger might increase on the next day and recede gradually to completely disappear by days 3-4, when the body energy is covered by fat. Eating a low-carb, ketogenic diet between fasting periods will reduce hunger (3).

\* *Improved metabolic health and restored insulin sensitivity* (by 20-31%) and *lower cholesterol* (LDL cholesterol decreases by 21% and triglycerides by 32%) and *lower belly fat* (Patterson et al., 2015; Chung et al., 2011; Chung et al., 2016). When the body cells are resistant to insulin, the body is more likely to store the eaten food as fat, and insulin resistance causes inflammation (4).

\* *Decreased blood pressure and heart rate*, and hence the heart health may improve, notably when weight loss is associated (5).

\* *The body becomes metabolically flexible* (easily able to burn fat as fuel and preventing the loss of lean mass). Varady showed in obese people only a 10% lean mass loss during IF, compared with 25% lean mass loss during daily caloric restriction (Varady, 2011; Barnosky et al., 2014).

\* *Human growth hormone (HGH) levels increase* by 2,000% during 24-hour fasting in men and by 1,300% in women. HGH enhances muscle recovery and growth (increased protein synthesis), wound healing, and speeds up fat loss (Varady et al., 2008).

\* *Great for the brain:* in fasting environment, a hormone named brain-derived neurotrophic factor (BDNF) is increased and as a result new nerve cells will grow more effectively (Shojaie et al., 2017; Malinowski et al., 2019; Fann et al., 2017).

\* *Activates the sympathetic nervous system* responsible for our fight-or-flight response (heart rate increases, digestion slows, and muscle tension increases) (Malinowski et al., 2019).

\* *Chronic disease prevention.* IF is good in preventing diabetes (but is not indicated for those who already have this disease) and cardiovascular diseases (in mice and rats, IF seems to reduce the risk of coronary artery disease; in humans, skipping breakfast and eating a late big meal at dinner elevates 5 times the risk to die from a heart attack, but these people are also likely to have other bad habits such as smoking, sedentary lifestyle, high stress, and long working hours); in some cancers, hypertension, non-alcoholic fatty

liver disease, and inflammatory bowel disease. How and why fasting reduces inflammation is probably explained by the fact that it produces fewer monocytes, the main reason for a healthy and long life in fasting subjects (Harvie et al., 2011; Harvie et al., 2013; Varady et al., 2013).

\* *Delayed aging.* One hypothesis is that fasting can activate cellular mechanisms that boost immune function and reduce inflammation associated with chronic diseases (4). Despite the complexity of aging, the common process is a structural and functional progressive decline of the whole body, often preceded by a phase of chronic morbidity, which leads to death. Caloric restriction (CR) during fasting periods is a powerful, efficient approach influencing 9 cellular markers of aging (Picca et al., 2017; Carmona & Michan, 2016; Kenyon, 2011; Longo et al., 2015; Lopez-Otin et al., 2013; Lopez-Lluch & Navas, 2016). The goal of extended longevity in Western societies shifts to that of healthy aging, plus a longer lifespan, called "healthspan" (Passarino et al., 2016). The aging process is plastic, being accelerated or attenuated by many genetic and epigenetic (dietary) interventions (Kenyon, 2011). CR represents a nutrient-dense, well-balanced diet, with a reduction of caloric input by 20-40% without malnutrition. CR extends lifespan in rodents, and prevents some age-related diseases (obesity, type 2 diabetes, neurodegeneration, cardiomyopathy, cancer) (Most et al., 2017). Human studies in the area are rather limited and the benefits are not yet known. The "hormesis hypothesis" of CR suggests that the adaptive responses of cells and organs (induced by moderate stress) prevent worse damage caused by stronger similar stress (Mattson et al., 2017; Rattan, 2008; Testa et al., 2014; Horne et al., 2015; Anton et al., 2018).

The major question is whether the cause of extended longevity is due to daily caloric restriction (Most et al., 2017) or to protein intake restriction (Speakman et al., 2016). The positive effect of CR on human longevity was observed in the Kyushu Island, in the Okinawan population where the increased life expectancy was attributed to caloric restriction (Wilcox & Wilcox, 2014). This effect could be explained by neuroendocrine system modulation, hormetic stress response, increased systemic production of neurotrophic factors, reduced mitochondrial oxidative stress, decreased pro-inflammatory cytokine production and insulin resistance, decreased aging-associated signal and autophagy promotion (Moro et al., 2016; Mattson, 2017; Desgorges et al., 2016).

Short-term CR (10 weeks, 20% CR) tends to reduce the resting metabolic rate per kg of fat-free mass, systolic and diastolic blood pressure (Nicoll Rachel & Henein, 2018), glucose concentration (Velthuis-te et al., 1995), total cholesterol, LDL cholesterol, triglycerides, C-reactive protein, tumor necrosis factor (TNF-alpha1), insulin concentration, and to increase HDL cholesterol (Ravussin et al., 2015), insulin sensitivity (Larson-Meyer et al., 2006; Fontana & Partridge, 2015; Omodei & Fontana, 2011; Most et al., 2017). Short-term CR also promotes mitochondrial biogenesis in skeletal muscles. Long-term CR with optimal nutrition (CRON) means that caloric intake is restricted for an average of 15 years and the person consumes about 30% fewer calories than another one fed with a regular Western diet. This kind of diet decreases metabolic and hormonal

risk factors for type 2 diabetes, cardiovascular diseases, stroke, cancer, vascular dementia (Fontana & Partridge, 2015; Maughan et al., 2012). CR has a positive effect on DNA repair and telomere machinery, promoting genomic stability and healthy longevity (Vera et al., 2013).

\* *Fighting depression and anxiety.* During short fasting, the human body releases ghrelin, a hormone associated with an elevated mood (Zhang et al., 2015).

\* *Improved gut health.* Fasting refreshes the gut microbiome and improves digestion, reducing gas, diarrhea or bloating (Sutton et al., 2018).

\* *Effects on performance and muscle strength.* Although IF increases the growth hormone, which enhances lean body mass, it does not improve strength, and may even reduce exercise capacity (Moro et al., 2016). Early studies on this topic seem to indicate that IF might be an aid in rapid post-exercise recovery. Endurance training in a fasted state can facilitate more rapid re-activation of muscle protein translation (protein kinase levels indicating muscle growth doubled compared to those during training in a fed state) (Jaleel et al., 2013). Also, endurance training in a fasted state increases the capacity for fat oxidation in the trained muscle (Burke & Kiens, 2006), but feeding before, during and after each training session might have other potential benefits (Hawley et al., 2007).

### Potential side effects and risks

Intermittent fasting works well for some people and turn into a disaster for others depending on a number of lifestyle factors (Patterson & Sears, 2017). Hunger is seldom intense, at least during the adjustment stage, and the risk to develop binge eating behavior is possible.

- Headache. Some extra salt or mineral water might alleviate headache (Danielsson et al., 2019).

- Mental and physical tiredness/exhaustion, especially in morning exercisers (when exercising on an empty stomach), due to modest hypoglycemia (Grajower & Horne, 2019).

- Risk of hypoglycemia in patients with thyroid disease: weakness, dizziness, nausea, shakiness, irritability, blurred vision, sweating, paleness (Rothschild et al., 2014).

- Inability to focus, frustration

- Excessive eating during the 8-hour eating window (during fasting, appetite hormones and the hunger center are drifting, and hence fasters eat more; it is in the human nature to crave for a reward after an intense workout or exercise, so plunging into unhealthy eating behavior is possible) (Schiavo-Cardozo et al., 2013; Crispim et al., 2011).

- Negative effect on female fertility. In animal studies, 2 weeks of IF in female rats stopped the menstrual cycle (while their ovaries shrank); in male rats, it resulted in lower testosterone production. In athletic women with a low body fat percentage, IF might increase the risk of irregular menses, and lower the chance of conception (He et al., 2019). Lean women are more susceptible to neuroendocrine dysfunction, anovulation and a lengthened follicular phase compared to normal weight females (Alvero, 1998; He et al., 2019).

- Constipation

- Fasting diets are rigid and rule-based

- IF is a good strategy for cutting mindless late-night snacking, but it can also work against mindful eating habits (when simply eating by the clock).

### Extra concerns of IF in athletes

- Female athletes have a high level of hepcidin (a hormone that regulates iron absorption: high hepcidin levels inhibit iron absorption, possibly due to inflammation). During intensive training sessions, females have a high level of hepcidin, and therefore they have an increased risk for anemia. The best window of opportunity for peak iron absorption is in the morning, when hepcidin is lowest. IF most frequently means skipping breakfast, and could increase the risk for anemia (Pakkir Maideen et al., 2017).

- IF could reduce testosterone. Testosterone is important for muscle synthesis, performance, strength, and general vitality. During the fasting window, a drop in testosterone was observed, especially in male subjects (Peos et al., 2019).

- Since fasting is associated with a variable calorie restriction, it could be difficult for athletes to cover their calorie intake through a 4 or 8 hours eating window (Moro et al., 2016; Tinsley et al., 2017; Levy & Chu, 2019). It is indicated to consume a meal within 2 hours after a competition in order to restore glycogen deposits (Burke et al., 2017).

### Contraindications of IF

For professional athletes training twice a day or more, 16+ hours of fasting might not be a good idea.

The other contraindications to adopting such a type of diet are (Stockman et al., 2018):

- Diabetes (IF is beneficial in diabetes prevention, not for patients with diabetes or other metabolic diseases).

- People on medication for blood pressure or cardiovascular diseases (they are prone to electrolytic anomalies), and those under treatments requiring food (Danielsson et al., 2019).

- Eating disorders

- Depression and anxiety (depression is relieved in short-term, not in long-term calorie restriction).

- Pregnancy, breastfeeding, and women trying to conceive

- Low blood pressure (IF decreases blood pressure)

- Underweight

- Older adults (fasting can have negative effects on their immune system)

- Subjects under 18 years of age (children and teenagers)

- Uncontrolled migraines

- Subjects undergoing blood transfusion

### Conclusions

1. The newest diet trend in the last decades is intermittent fasting, adopted by numerous athletes, celebrities and average people. Part of the fascination with intermittent fasting arises from research on animals showing that fasting may reduce cancer risk and slow aging.

2. Intermittent fasting means eating within a certain window and fasting the rest of the time (hours/days).

3. Although fasting between dinner and breakfast the next day (12 to 14 hours) could be considered a part of normal life and might have numerous positive effects, there are many disadvantages.

4. There are many short-term or long-term/extended-term fasting protocols. Competing in endurance sports (which demand a quicker way to obtain the energy, e.g. from digesting food) during fasting is contraindicated. Some sports could be more affected than others, and partial or total fast may be challenging for athletes, who need to develop effective and appropriate coping strategies to adapt.

5. Endurance training in a fasted state could have some metabolic advantages, but feeding before, during and after each training session might have other potential benefits.

6. Many athletes need a morning meal; the results are better when eating before training. For athletes, there are other safe, healthy and less extreme ways to lose weight.

### Conflict of interest

Nothing to declare

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