



# Dietary Fat

for Female Athletes

## Introduction

Fats are a fundamental yet often misunderstood component of a balanced diet. While there is often a prevailing misconception that fats should be limited or avoided, their role in the health and performance of female athletes is paramount. The information below will delve into the significance of fats in the diet, explore various types of fat, provide recommendations for intake, and offer strategies to effectively incorporate fats into the diet of female athletes.

## Understanding fats

Fats, scientifically known as lipids, stand alongside carbohydrates and proteins as one of the three macronutrients. Their importance is multifaceted:





	<b>Energy source</b>	Fats are an energy dense nutrient, providing 9 kilocalories (kcal) per gram. This dense energy reserve is particularly valuable for athletes engaged in endurance sports. While carbohydrates serve as the primary energy source, fats also provide energy to the working muscles, especially during low to moderate intensity activities.
	<b>Hormone production</b>	Fats are essential for the synthesis of steroid hormones, including the main female reproductive hormones, estrogen and progesterone.
	<b>Cellular structure</b>	Fats contribute to the formation of cell membranes through phospholipids and cholesterol. These lipids compose the lipid bilayer in cell membranes, which acts as a semi-permeable barrier, maintaining cell boundaries, regulating substrate transportation, and ensuring proper cell function.
	<b>Vitamin absorption</b>	Fat-soluble vitamins such as A, D, E and K, require the presence of dietary fats to be effectively absorbed.

Figure 1: Key roles of fat within the body

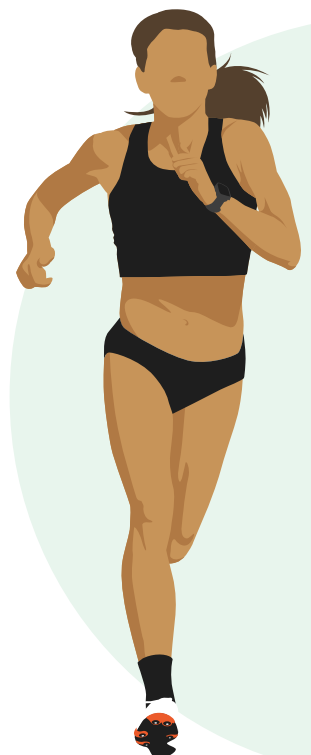
## The role of fat during exercise

One of the primary functions of fat in the body is to store energy for later use. Adipose tissue, also known as body fat, acts as a reservoir of stored energy in the form of triglycerides (Figure 2). Fat can also be stored in the muscle, this is known as intramuscular triglyceride and is an important fuel source during exercise. Compared to males, females have higher intramuscular triglyceride stores in their muscles and are more efficient at using them during exercise. The utilization of fat as an energy source during exercise varies based on exercise intensity and duration.

### During low to moderate intensity, steady-state activities such as long-distance running or cycling, the body primarily relies on fat oxidation for energy.

Research has shown that during exercise performed in a fasted state, females oxidize more fat to support the energy needs of exercise in comparison to males. By relying on fat as a primary energy source during low to moderate intensity exercise, the body preserves glycogen for high intensity movements. Slower depletion of muscle glycogen might suggest that female athletes are more fatigue resistant allowing them to perform well in long duration endurance events.

Endurance type training can enhance the body's capacity to use fat as an energy source, even during higher-intensity exercise. Endurance athletes might benefit from undergoing training sessions that are known to increase fat metabolism (i.e., fasted training) during the off-season, where the focus is more on muscle adaptation rather than performance.



## Lipid breakdown

The breakdown of lipids is called lipolysis and takes place in the adipose tissue and skeletal muscle

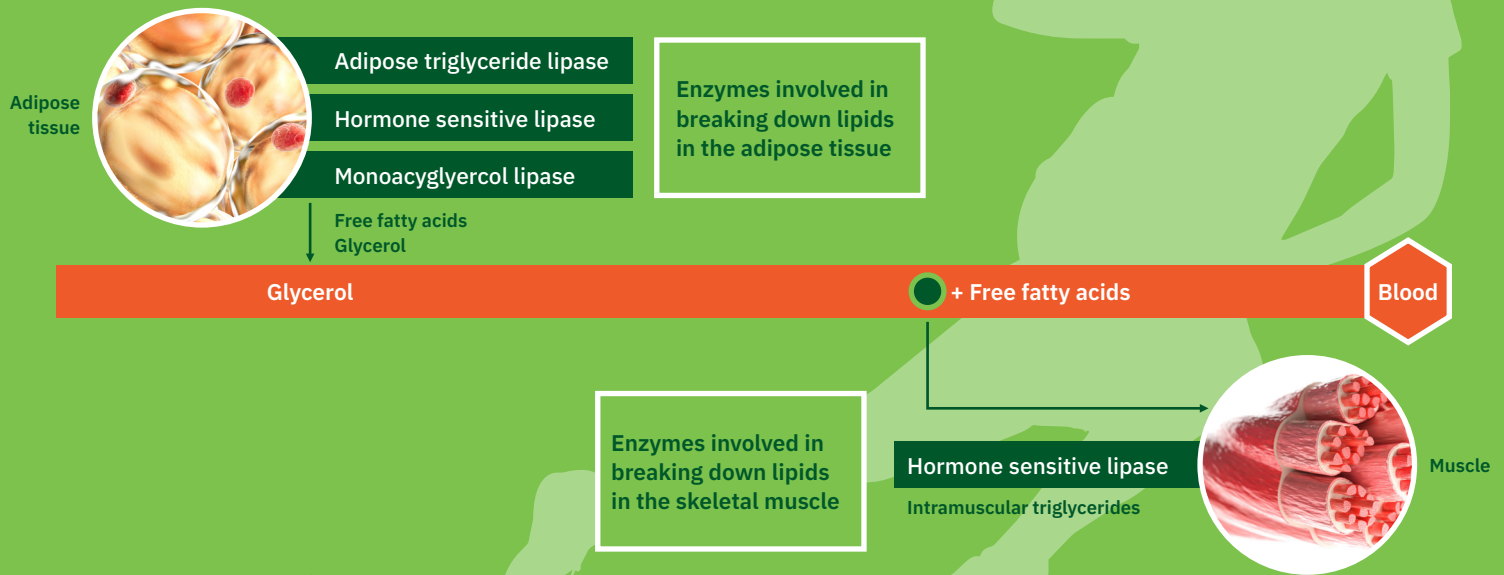


Figure 2: The breakdown of lipids

## Types of dietary fats

Dietary fats (i.e., triglycerides) have a backbone composed of a glycerol molecule and attached to this are three fatty acids (Figure 3). They are classified based on their chemical composition (Figure 4).

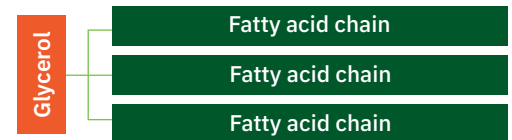


Figure 3: Dietary fat [triglyceride] structure

















<p><b>Saturated fats</b></p> <p>These fats are typically solid at room temperature and are prevalent in animal products such as butter, red meat, and dairy products. Excessive consumption of saturated fats can elevate low density lipoproteins (LDL) which can raise the level of 'bad' cholesterol in the blood, therefore limiting saturated fat intake is advised. The American Heart Association advises 5-6% of total calories to come from saturated fat.</p>	 Butter	 Cheese	 Eggs	 Fatty cuts of meat
<p><b>Monounsaturated fats</b></p> <p>Liquid at room temperature, these fats are found in foods such as olive oil, avocados, and nuts. They are recognized for their heart-healthy attributes and deserve a prominent place in the diet of athletes.</p>	 Almonds & pecans	 Avocados	 Olive oil	 Nuts & seeds
<p><b>Polyunsaturated fats</b></p> <p>The body requires both omega-3 and omega-6 fatty acids, both of which fall into this category. Sources include fatty fish (e.g., salmon, mackerel), flaxseeds, walnuts, and specific vegetable oils. Omega-3 fatty acids possess anti-inflammatory properties beneficial for post-exercise recovery (see below).</p>	 Fish	 Sunflower oil	 Flaxseeds	 Vegetable oils
<p><b>Trans fats</b></p> <p>Artificial trans fats are created when liquid oils are turned into solid fats, and are known to elevate LDLs and cholesterol levels. They are commonly found in processed and fried foods and should be avoided due to their negative health implications.</p>	 Pastries and pies	 Pizza	 Fried chicken	 Ice cream

Figure 4: Types of dietary fats

## Omega-3 Fatty Acids (O3FA)

O3FA have been found to have a variety of potential beneficial effects for health and performance, for example, promoting joint health, managing inflammation, protecting brain health and function, and facilitating muscle recovery. They are therefore of importance for athletes. Despite this, it has been shown that many athletes consume sub-optimal amounts of O3FA within their diet. There are three main types of O3FA which are alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). It is well-established that EPA and DHA, found in sources such as fish, are more readily absorbed by the body while ALA can be converted to EPA and DHA in the body, but this conversion is not highly efficient.

**Research has found that EPA may help to mitigate exercise-induced inflammation, potentially expediting recovery. EPA is also associated with bolstering cardiovascular health, essential for an athlete's endurance and overall performance.**

### O3FA recommendations

There are no established Recommended Dietary Allowance (RDA) or Daily Value (DV) guidelines for O3FA. Various dietary recommendations exist from different health authorities. For example:

- **Academy of Nutrition and Dietetics and Dietitians of Canada:**  
0.5 grams of EPA + DHA daily
- **European Food Safety Authority:**  
0.25 grams of EPA + DHA daily
- **American Heart Association:**  
Two servings of fish each exceeding 3.5 ounces per week

Athletes may require higher O3FA intake in comparison to the general population due to factors such as energy metabolism, training volume and exercise-induced inflammation. In addition, O3FA may be beneficial to athletes during periods of injury or immobilization. Individualized O3FA doses for athletes are recommended because daily requirements vary significantly among athletes, contingent on factors such as gender, body weight, metabolic rate, and training intensity. However, if a standardized dose is required then a daily dose of 1-3 g EPA + DHA may be appropriate.

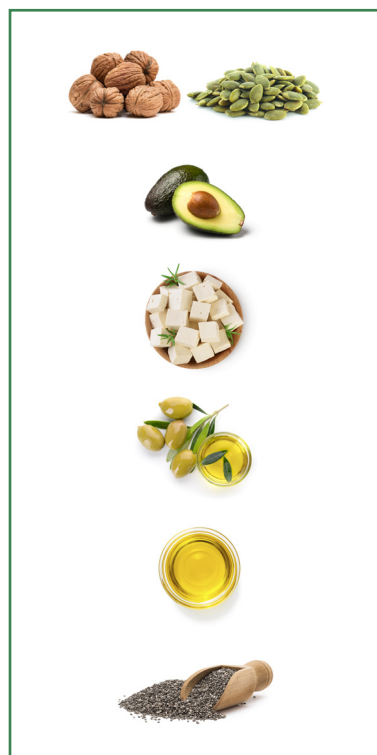
Athletes aiming to enhance their O3FA levels can do so through a combination of dietary sources and supplements (see Figure 5 and Table 1). Supplements come in various forms, including fish oil (typically in ethyl ester form), krill oil (rich in phospholipids and free fatty acids), and algae oil (a plant-based alternative). For athletes with specific dietary restrictions (e.g., vegetarians, seafood allergy, those who avoid fish), viable alternatives such as seaweed, kelp, algae-fortified foods, or algae-based O3FA supplements can be explored.

### Fish



Salmon, mackerel, tuna, cod, sardines

### Non-fish alternatives



Walnuts and pumpkin seeds

Avocados

Soy products: beans, milk, tofu, edamame, soybean oil

Olives [oil]

Vegetable oils: canola and linseed

Chia seeds

### Supplements



Fish oil

Krill oil

Algae oil

Figure 5: Sources of omega-3 fatty acids

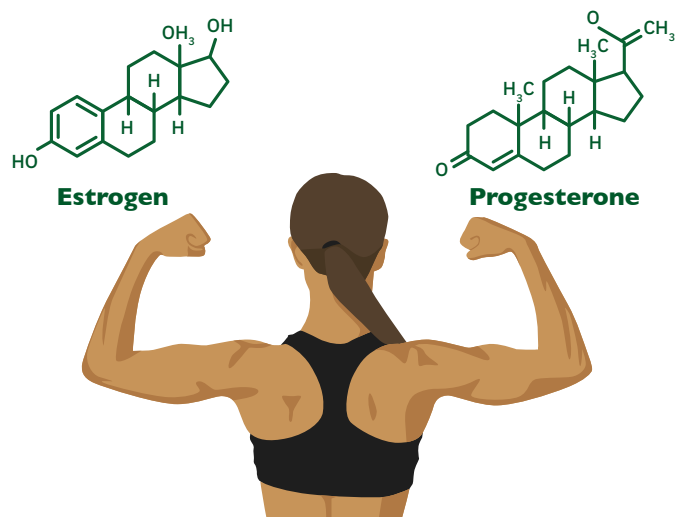
Table 1: Dietary sources of omega-3 fatty acids

	Source	Serving	EPA	DHA	ALA
<b>EPA &amp; DHA sources</b>	Salmon (cooked)	3 ounces	1.2 g	0.6 g	-
	Herring (cooked)	3 ounces	0.9 g	0.8 g	-
	Bluefin tuna (fresh)	3 ounces	0.8 g	0.2 g	-
	Sardines (canned, drained)	3 ounces	0.7 g	0.5 g	-
	Mackerel (cooked)	3 ounces	0.6 g	0.4 g	-
	Salmon (canned, drained)	3 ounces	0.6 g	0.3 g	-
	Sea bass (cooked)	3 ounces	0.5 g	0.2 g	-
	Cod liver oil	1 teaspoon	0.5 g	0.3 g	-
	Trout (cooked)	3 ounces	0.4 g	0.4 g	-
	Oysters (cooked)	3 ounces	0.2 g	0.3 g	-
	Tuna (canned)	3 ounces	0.1 g	0.2 g	-
	Scallops	3 ounces	0.1 g	0.1 g	-
	Shrimp	3 ounces	0.1 g	0.1 g	-
	Lobster	3 ounces	0.1 g	0.1 g	-
<b>ALA sources</b>	Flaxseed oil	1 tablespoon	-	-	7.3 g
	Chia seeds	1 ounce	-	-	5.1 g
	Walnuts	1 ounce	-	-	2.6 g
	Flaxseeds	1 tablespoon	-	-	2.4 g
	Canola oil	1 tablespoon	-	-	1.3 g
	Soybean oil	1 tablespoon	-	-	0.9 g
	Edamame	½ cup	-	-	0.3 g
	Refried beans (canned, drained)	½ cup	-	-	0.2 g

EPA; Eicosapentaenoic acid, DHA; Docosahexaenoic acid, ALA; Alpha-linolenic acid

## The role of fat in hormone production

Fats play a pivotal role in the production of estrogen and progesterone, two hormones critical to female physiology. These hormones are synthesized from cholesterol, a lipid. Cholesterol acts as the precursor molecule to produce steroid hormones, including estrogen and progesterone. Specialized cells, primarily in the ovaries and adrenal glands, convert cholesterol into these hormones. Adequate dietary fat intake ensures a sufficient supply of cholesterol, facilitating the body's ability to synthesize estrogen and progesterone. These hormones, in turn, regulate various aspects of the menstrual cycle, reproductive health, and overall well-being in females, highlighting the essential role of dietary fats in hormonal balance and female physiology.



## Recommended fat intake for female athletes

The American Dietetic Association recommends that fats should constitute 20-35% of total daily calorie intake. For female athletes, it is imperative to:

- Emphasize sources of healthy fats, including avocados, nuts, seeds, and oily fish
- Limit saturated and trans fats commonly found in processed and fried foods
- Ensure O3FA are incorporated into the diet

### Incorporating fats into the diet

Female athletes should prioritize healthy fat sources such as avocados, nuts, seeds, and fatty fish while being vigilant about saturated and trans fat intake (Figure 6). Tailoring fat consumption within a personalized nutrition plan designed to meet an athlete's unique needs can unlock the full potential of fats for female athletes.

Female athletes can seamlessly integrate fats into their diet through various foods and cooking methods:

- Drizzle olive oil on salads and vegetables
- Include a handful of nuts or seeds as a convenient snack, or use as a topping on meals e.g., salads
- Consume oily fish such as salmon
- Utilize avocados as a topping for sandwiches or salads, or as an ingredient in smoothies
- Elevate the nutritional value of breakfast by incorporating nut butter into oatmeal or pairing it with fruit

## Summary

Fats play an important role to support the health and performance of all athletes, including females. They serve as a valuable energy source, contribute to cellular structure, aid hormone production and vitamin absorption, and play a crucial role during exercise. Understanding the types of dietary fats and making informed choices can significantly impact an athlete's health and performance. Omega-3 fatty acids potentially offer unique benefits, such as improved joint health and muscle recovery, as well as inflammation reduction, which can be advantageous for female athletes. By following recommended fat intake guidelines and incorporating healthy fats into their diets, female athletes can unlock the full potential of these essential nutrients, supporting their overall health, endurance, and athletic success.



**Avocado with toasted nuts and sprouts**



**Salmon with grilled avocado and olive oil rub**



**Chia pudding with walnuts and sunflower seeds**



**Smoked mackerel with chickpeas**



**Soaked almonds**



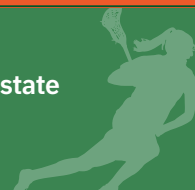
**Mixed nut granola bars**

**Figure 6: Meals and snacks incorporating 'healthy' fats**

# DIETARY FAT

**Fat:**  
**9 kcal per gram**

Primary source of energy during low to moderate intensity, steady state activities e.g., long-distance running or cycling



## Role of fat:



Energy source



Hormone production



Cellular structure



Vitamin absorption

## Dietary sources of fat

### Saturated fats

Limit consumption to 5-6% of total calories



Butter



Cheese



Eggs



Fatty cuts of meat

### Polyunsaturated fats

Includes omega-3 and omega-6 fatty acids



Fish



Sunflower oil



Flaxseeds



Vegetable oils

### Monounsaturated fats

Recognised for their positive benefits to heart health



Almonds & pecans



Avocados



Olive oil



Nuts & seeds

### Trans fats

Elevate LDLs and cholesterol therefore consumption should be limited



Pastries and pies



Pizza



Fried chicken



Ice cream

## Omega-3 fatty acids

May help optimize athletic performance by:



Promoting joint health



Managing inflammation



Protecting brain health and function



Facilitating muscle recovery

### Fish



Salmon, mackerel, tuna, cod, sardines

### Non-fish alternatives



Avocados



Walnuts and pumpkin seeds



Soy products: beans, milk, tofu, edamame, soybean oil



Olives (oil)



Vegetable oils: canola and linseed



Chia seeds

### Supplements



Fish oil



Krill oil



Algae oil

## References and resources

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