

# Difference Between Hypertrophy and Atrophy

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## Key Difference – Hypertrophy vs Atrophy

Hypertrophy and atrophy are two of the most common cellular changes seen in both physiological and pathological conditions. An increase in the size of the cells that results in an increase in the size of the affected organ is defined as hypertrophy whereas the reduction of the size of an organ or a tissue due to a decrease in the size and number of cells is defined as atrophy. **In hypertrophy, the number of cells of the affected organ remains the same despite the increase in its size; however, in atrophy, the reduction of the size of the organ is accompanied by a decrease in the number of functional cells.** This is the key difference between hypertrophy and atrophy.

## What is Hypertrophy?

An increase in the size of the cells that results in an increase in the size of the affected organ is defined as hypertrophy. There is no change in the number of cells. When the physiological or the pathological stress on an organ increases, the organ responds to it by trying to enhance the efficiency of its functions through an increase in its functional tissue mass. Cells that are capable of division achieve this via both [hyperplasia and hypertrophy](#) but cells that are indivisible increase their tissue mass through hypertrophy.

When the organ is hypertrophied as a result of an increase in the functional demand or due to the stimulation coming from growth factors or [hormones](#), this is called a physiological hypertrophy. The development of muscles in bodybuilders happens as a result of this physiological hypertrophy.



**Figure 01: Hypertrophy**

The uterine enlargement during pregnancy is induced by the hormonal stimulation. Hypertrophy is also associated with a reactivation of fetal or neonatal forms of proteins.

## **What is atrophy?**

The reduction of the size of an organ or a tissue due to a decrease in the size and number of cells is defined as atrophy. Atrophy can either be physiological or pathological.

### **Physiological Atrophy**

The disappearance of notochord and [thymus](#) gland during the development of a child happens as result of physiological atrophy. The regression of the size of the [uterus](#) is also due to this event.

### **Pathological Atrophy**

When the atrophy is incited by pathological causes, it is called pathological atrophy.

## Causes of Pathological Atrophy

- A reduction in the workload

It is a common observation that the muscles attached to a fractured bone tend to get smaller with time. This happens due to the reduction in workload on those muscles.

- Loss of innervation

A damage to the nerves innervating a certain structure can impair the supply of nourishment and oxygen to the particular structure. This can lead to a reduction in the size of the affected [organ or tissue](#).

- A reduction in the blood supply

When the blood supply to an organ is diminished, the organ will not receive adequate nutrients to carry out its metabolic functions. As a result, the size of the organ decreases.

- Inadequate intake of nutrition
- Loss of endocrine stimulation
- Pressure

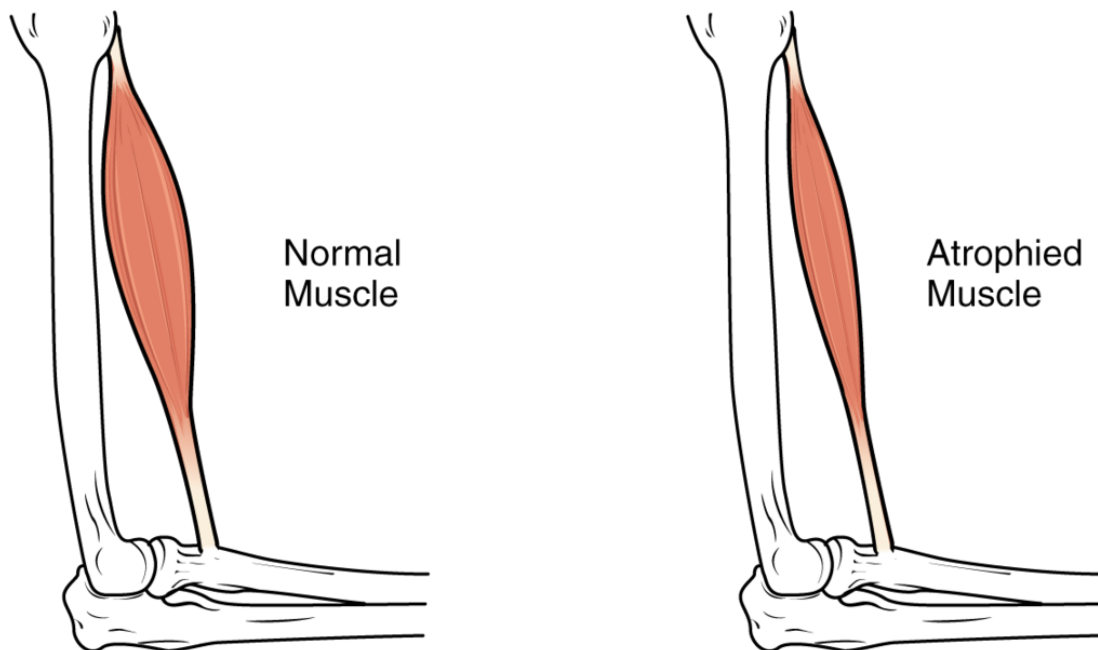


Figure 02: Atrophy

## Mechanisms of Atrophy

Atrophy can occur either due to a decrease in the [protein synthesis](#) or an increase in the degradation of proteins. A reduction in the protein synthesis is secondary to a decrease in the metabolic activity. The increase in the protein degradation is often due to the activation of the ubiquitin-proteasome pathway.

## What is the Similarity Between Hypertrophy and Atrophy?

- Both these changes can be either due to physiological or pathological causes

## What is the Difference Between Hypertrophy and Atrophy?

| Hypertrophy vs Atrophy  |  |
|---|--|
| An increase in the size of the cells that results in an increase in the size of the affected organ is defined as hypertrophy. | The reduction of the size of an organ or a tissue due to a decrease in the size and number of cells is defined as atrophy. |
| Size of the Organ   |  |
| Size of the organ increases in hypertrophy.   | In atrophy, the size of the organ decreases.   |
| Number of Cells   |  |
| There is no change in the number of cells.  | The number of cells is reduced in atrophy.   |

## Summary – Hypertrophy vs Atrophy

An increase in the size of the cells that results in an increase in the size of the affected organ is defined as hypertrophy, and the reduction of the size of an organ or a tissue due to a decrease in the size and number of cells is defined as atrophy. In hypertrophy, the cell number remains the same, but in atrophy, the cell number is reduced. This can be considered as the major difference between hypertrophy and atrophy.

## Reference:

1. Kumar, Vinay, Stanley Leonard Robbins, Ramzi S. Cotran, Abul K. Abbas, and Nelson Fausto. Robbins and Cotran pathologic basis of disease. 9th ed. Philadelphia, Pa: Elsevier Saunders, 2010. Print.

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