

ADIPOSE TISSUE: **FRIEND OR ENEMY?**

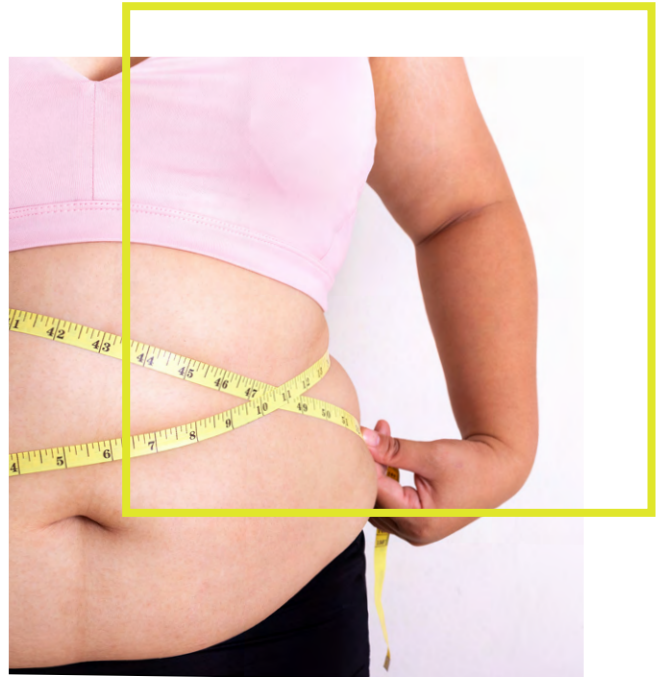
FROM THE EXPERT :

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Humanity has to face a **global obesity "epidemic"**. The causes of this epidemic are multifactorial and particularly complex to define. Tackling obesity requires to take into consideration biology, physiology, ecology and societal environment.

Humanity is confronted with a particularly deleterious telescoping between our genetic heritage and the recent irruption of a particularly aggressive post-industrial environment.

One thing is certain, the increased prevalence of obesity contributes very directly to the appearance of **chronic diseases**, including type 2 diabetes and various cardiovascular diseases.

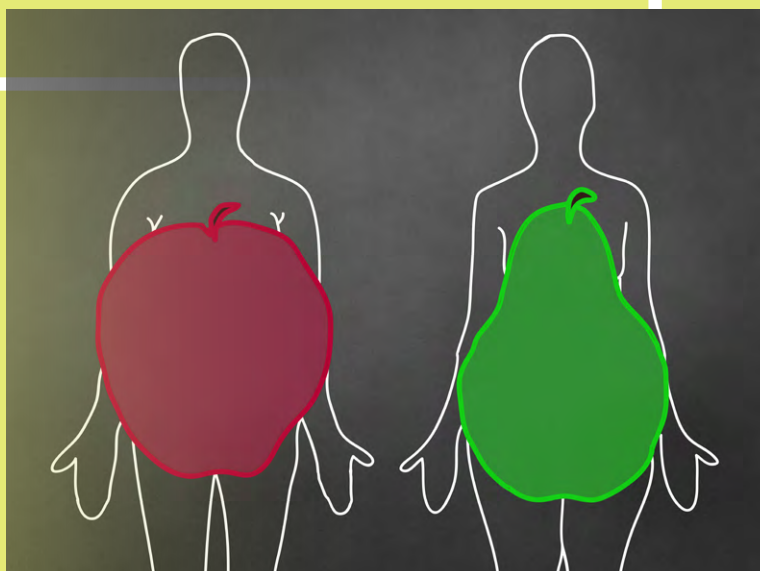


An obese person is characterized by an excess of adipose tissue (AT) and **obesity is a disorder of the 'fat organ'** affecting many functions.

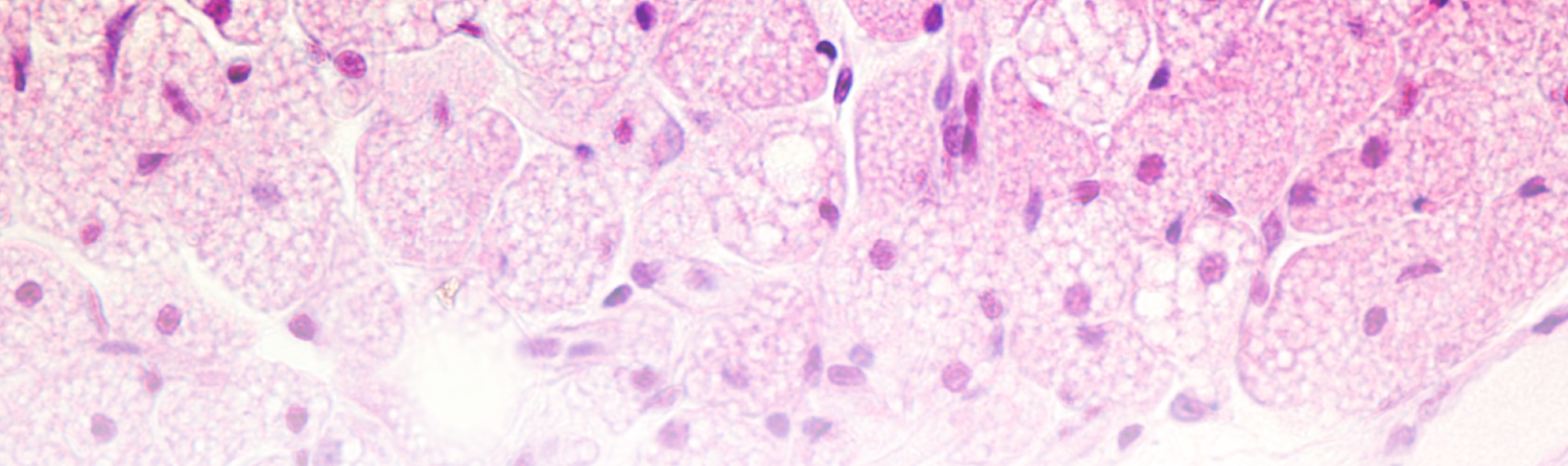
The adipose cell (adipocyte) is one of the important building blocks of our AT. We have from 40 to over 100 billion of them depending on the level of TA expansion. Recent data has drawn attention to the precocity of adipocyte developmental abnormalities in childhood and adolescence. Another important point to note is the significant sexual disparities in the distribution of fat mass as well as the functional heterogeneity of adipocytes according to their anatomical location.

AN ANDROID DISTRIBUTION OF ADIPOSE DEPOSITS ('APPLE' PHENOTYPE), IS KNOWN TO HAVE MORE DELETERIOUS ENDOCRINE AND METABOLIC IMPACTS THAN A GYNOID DISTRIBUTION (PEAR» PHENOTYPE / WOMEN CHARACTERISTIC)

The AT is not limited to adipocytes exclusively. It is a complex tissue in which mature adipocytes involved in the regulation of lipid metabolism and the production of some hormones can be distinguished. In addition, a heterogeneous cell population constitutes the vascular stromal fraction (VSF).



It contains adipocyte progenitor cells, preadipocytes and various **vascular and immune system** cells. The study of AT vascularisation and innervation has revealed that fat deposits are not homogeneously irrigated and innervated. The extra-cellular matrix (ECM) that provides the structure, let's say the architecture, of the AT contains a complex set of constituents (i.e. various types of collagens, fibronectin, laminin, elastins and proteoglycans). There will be significant remodeling during the development of fat mass. The phenomenon can go as far as the appearance **of fibrotic areas** in the AT of obese people. The most recent studies underline a major role of the ECM in the possibilities of fat mass expansion and on adipocytes metabolism.



Actually an original study published in the journal «*Obesity Facts*» has shown that mechanical stimuli applied with a mechano-stimulation device (endermologie®) on female femoral TA were able to have an impact on **adipocyte reactivity**. Mechanical massage of the TA promotes a better lipolytic reactivity of adipocytes and vascular vasodilatory responses. Recovery of a higher lipolytic efficiency in an AT known for its reaction inertia could be of an important benefit if combined with physical activity training programs, known to enhance mobilization of non-esterified fatty acids from adipocytes and their oxidation by active skeletal muscle¹.

Intensely studied in all its aspects over the last 40 years, the AT has turned out to have very diverse properties, which we will summarize in an attempt to answer the question asked at the outset :

IS **ADIPOSE TISSUE** A FRIEND OR AN ENEMY?

An important issue to be reminded is that **the mature adipocyte does not divide**. Appearance of new adipocytes, their differentiation, occurs from the pre-adipocytes. It contributes to the expansion of AT in obesity; hypertrophy (increase in size) and hyperplasia (increase in number) regulate the expansion of fat mass. The turnover rate of adipocytes in human subcutaneous AT is about 10% per year. The regeneration or renewal rate of adipocytes will depend on the renewal capacities of a pool of adipocyte progenitors from mesenchymal stem cells.

increased adipocyte size and expansion of fat mass. These adipocyte lipid reserves can be mobilized as needed through **lipolysis**, a complex process ensuring the hydrolysis of triglycerides stored in the lipid droplet of the white adipocyte. It induces the release of non-esterified fatty acids (NEFA) and glycerol by that cell. Lipolysis is a very specific function of white adipocytes, activated by prolonged fasting and especially by physical activity.

Adipocytes play an essential role **in storing energy** from nutrients such as glucose and fatty acids (from ingested food) in the form of triglycerides; this is **lipogenesis**. Excessive storage leads to



One of the major characteristics of the adipocyte is its ability to accumulate a large amount of lipids, mainly in triglycerides form, without toxic effects manifestation usually induced by lipid accumulation in many other cell types. This is a beneficial effect that should not be overlooked.

By storing lipids, the adipocyte limits the circulation of lipids and their toxicity when circulating. A limitation of AT expansion capacities can have deleterious effects and lead to significant dysfunctions of adipocyte functions. Numerous functional disturbances of adipocytes concomitant with their hypertrophy have been observed. It is difficult to decide between benefits and risks.

AT has a beneficial buffering effect on lipids, but only if it does not exceed its potential in certain plethoric situations.

OTHER ACTIVITIES OF ADIPOSE TISSUE

Apart from the management of lipids storage, adipocytes are endowed with **notable secretory activities**. AT synthesizes and secretes circulating hormones that act as signaling molecules and/or mediators of inflammatory processes.

Conceptual revolution: the adipocyte has an endocrine activity due to its ability to produce hormones!

- The discovery of **leptin** has established the secretory capacities of the adipocyte and revealed the pleiotropic effects of that satiety hormone.

Very quickly the list of secreted factors was extended:

- **Adiponectin** and **apelin** have been shown to improve insulin sensitivity in various tissues. In addition adiponectin may work in the central nervous system to stimulate appetite, reduce energy expenditure and affect blood vessel formation.

Finally, AT is able to capture many Persistent Organic Pollutants (POPs). It is therefore likely to play a buffering effect when exposed to such environmental agents. The adipocyte, with its reserves of triglycerides, constitutes a privileged reservoir for many liposoluble, potentially toxic pollutants, grouped together under the term of POPs, such as organochlorines and various polycyclic aromatic compounds.



IN CONCLUSION...

That quick overview of knowledge of the biology and physiology of AT highlights the spectacular growth of that field and reveal the structural complexity of this tissue. No brief conclusion to the question asked: is the adipose tissue friend or enemy? Everything will depend on its level of expansion and the anatomical distribution of fat deposits.

SOURCES :

- Marques M-A et al., Obesity Facts, 2011, 4 : 121-129.
- Lafontan M. Adipose tissue, organ with unsuspected resources. Nutrition and dietetics notebooks (2015) 50, 5S1-5S7.



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