

Clinical chemistry
Fats and its Importance

Fats are compound that do not dissolve in water. It is include saturated fatty acids , monosaturated fatty acids ,polyunsaturated fatty acids(omega-3 fatty acids) ,trans fatty acids , triglycerides and cholesterol.

The three basic kind are : saturated , monosaturated and unsaturated.

The level of fat intake recommended by experts is 35% or less of the total calories consumed daily .this mean that a person eating 2,000 calories a day should eat on more than 700 of those calories as fat which is equal to a bout 6.5 table spoon of fat.

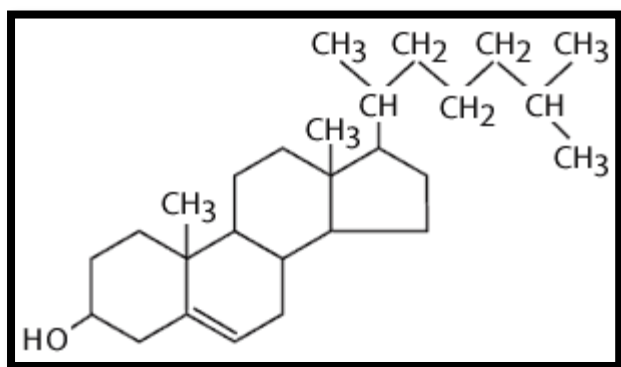
The chemical structure:

Fats and oils belong to a group of biological substances called lipids. Lipids are biological chemicals that do not dissolve in water.

They serve a variety of functions in organisms, such as regulatory messengers (hormones), structural components of membranes, and as energy storehouses. Fats and oils generally function in the latter capacity.

Cholesterol:

Is a steroid compound containing a storied nucleus (the ring A,B,C,D). chole means "bile" and sterol means "solid alcohol". the structural formula is:



Occurrence : The largest amount is present in most brain , nerve tissue, bile , human tissue , blood and liver.

In blood the cholesterol is present in two forms;

- a. Free cholesterol which present 1/3 of the total
- b. Cholesterol ester which present 2/3 of the total.

Normal value: 140 – 280 mg/100ml

Clinical signification :

increased cholesterol levels cause:

1. Bile canacculi and duets obstruction(انسداد المرارة الصفراء) due to reduction of extraction into the intestine.
2. Nephritic syndrome:(التهاب الكلية المزمن)due to rise of protein in the plasma and lipids.
3. Diabetes mellitus(البول السكري): due to malabsorption(سوء الامتصاص) of protein and lipids.
4. Atherosclerosis(تصلب الشرايين): duo to cholesterol deposits in the athermatous lesions of the blood vessels.(افة تعصد الشرايين).
5. Heart diseases: due to cholesterol deposits in blood vessels.

Decreasing cholesterol levels cause:

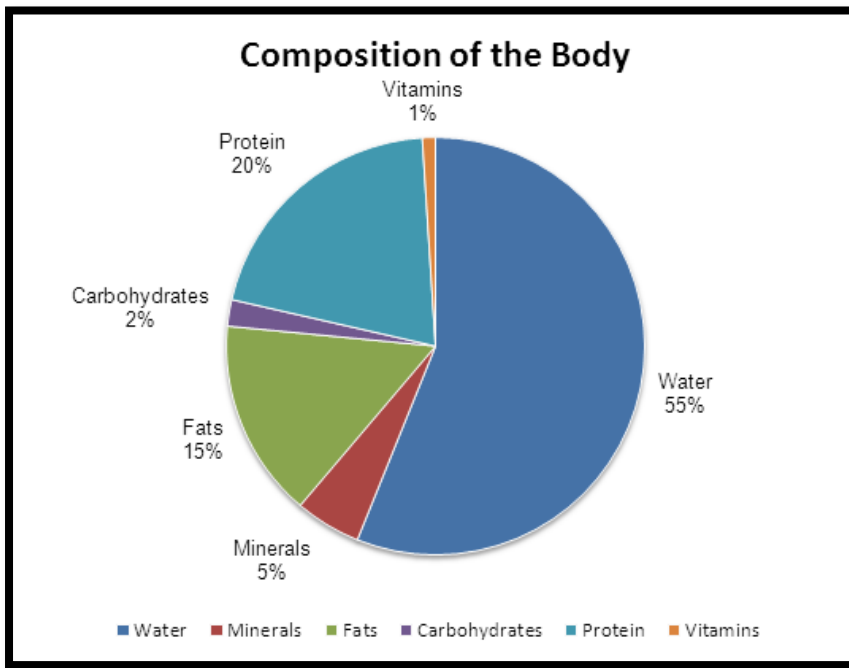
1. Sever hepatitis.(التهاب الكبدالشديد):duo to low synthesis of cholesterol by the liver and in liver cirrhosis (تليف الكبد)duo to large area of damaged cells.
2. Hyperthyroidism(افراز الغدة الدرقية):duo to the inverse nature of thyroxin.

In table below the nutrition fact show the % daily values

Fat	Calories
Total fat	Less than 65g
Sat. fat	Less than 20g
Cholestrol	Less than 300mg
Total carbohydrate	300 gm

Fat as a Source of Energy:

The body uses two main fuels for energy: carbohydrates and fats. The energy is obtained by changing carbohydrates to sugar (called blood sugar or glucose) and fats to fatty acids. However, **fats can provide more than twice the energy of sugar.**



Measurement of fats :Body fat percentage:

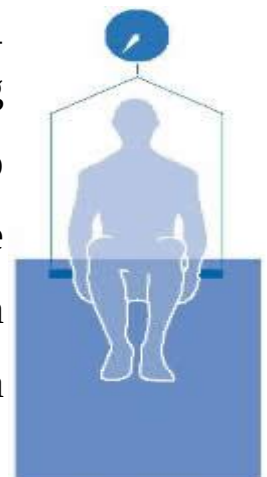
Is the total weight of person fat divided by the persons weight and consists of essential body fat . Essential body fat is necessary to maintenance life and re production functions. Essential fat is 3-5% in men and 8- 12% in women .

Measurement techniques:

There are several techniques can be used to estimate fat percentage accurately:

1. Hydro densitometry Weighing (Underwater Weighing) –

This method measures whole body density by determining body volume. There is a variety of equipment available to do underwater weighing ranging in sophistication from the standard stainless steel tank with a chair or cot mounted on underwater scales, to a chair and scale suspended from a



diving board over a pool or hot tub.

This technique first requires weighing a person outside the tank, then immersing them totally in water and weighing them again, the difference between these weighing in specific volume of water in liter will determine the density of person (ρ).

The densities of bone and muscles are higher than water, and fat is less dense than water. So a person with more bone and muscle will weight more in water than a person with less bone and muscle, meaning they have a higher body density and lower percentage of body fat. For example, athletes tend to have denser bones and muscles than non-athletes. The body fat percentage is calculated from body density using standard equations (either *Siri* or *Brozek*).

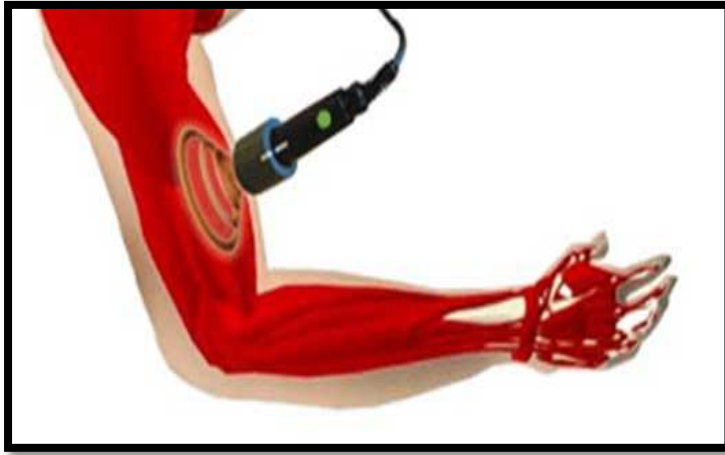
a. Brozek formula: $BF = (4.57/\rho - 4.142) \times 100$

b. Siri formula is: $BF = (4.95/\rho - 4.50) \times 100$

2. Near –infrared interaction (NIR) : The biceps(عضلات الذراع الاعلى) is the most often used single site for estimating body fat using the NIR method.

A fiber optic probe is connected to a digital analyzer that indirectly measures the tissue composition (fat and water) at various sites on the body. The NIR light penetrates the tissues and is reflected off the bone back to the detector. The NIR data is entered into a prediction equation with the person's height, weight, and level of activity to estimate the percent body fat. This method has become popular outside of the laboratory because it is simple, fast, noninvasive, and the equipment is relatively inexpensive. However, the amount of pressure applied to the fiber optic probe during measurement may affect the values of optical densities, and skin color and

hydration level may be potential sources of error. The validity of a single-site measurement at the biceps is questionable. Numerous sources report that more research is needed to substantiate the validity, accuracy and applicability of this method.



3- Skin Fold Caliper

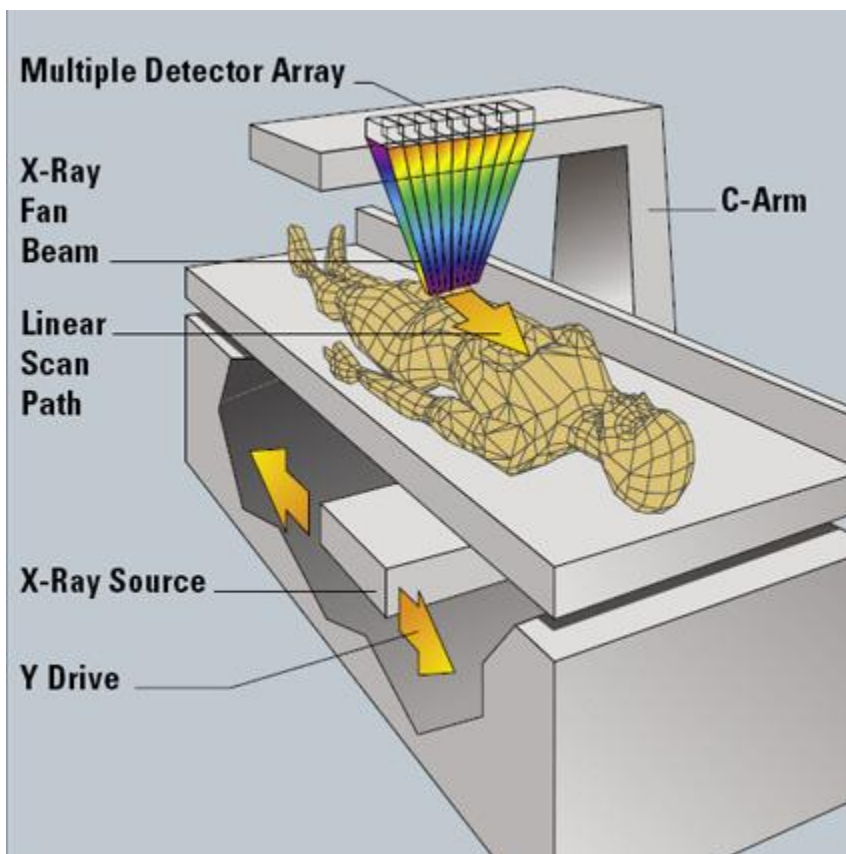
The “skin fold” method measures your body fat percentage by pinching your fat with your fingers then measuring the thickness with a body fat caliper. The reading is given in millimeters, which you compare to a chart with age and gender to arrive at your body fat percentage.



4- Dual energy X-ray absorptiometry (DEXA):

A relatively new technology that is very accurate. DEXA scan is fast becoming the “new” gold standard of body fat measurement because it’s based on a three-compartment model that divides the body into ***total body mineral, fat-free soft (lean) mass, and fat tissue mass***. Hydrostatic Weighing on the other hand only uses a 2 compartment model (***fat free mass and fat mass***).

In this technique the patient is placed between two sources of x-ray and a detector. The two sources of X-ray of different energy levels penetrate depending on body tissue i.e. denser tissue to pass through. The x-ray transmitted side is detected by an electronic calculator that calculates the density of entire between the x-ray source and the not allow to x-ray to out on the other detector which then tissue region detector. A scan takes between 10-20 minutes. This method is safe, although this method is not as accurate in measuring the extremely obese and the cost of equipment is high.



5- BMI (Body mass impedance):

Bioelectrical impedance method is used to calculate the body fat percentage. The muscle, blood vessels and bones are body tissue having a high water content that conduct electrically easily. But body fat is tissue that has a little electric current conductivity. The body fat analyzer sends an extremely weak electrical current of 50 kHz and 500μA through your body to determine the amount of fat tissue. Then uses information on the person's weight, height, age, and sex, to calculate an approximate value for the person's body fat percentage. The calculation measures the total volume of water in the body (lean tissue and muscle contain a higher percentage of water than fat), and estimates the percentage of fat based on this information.

