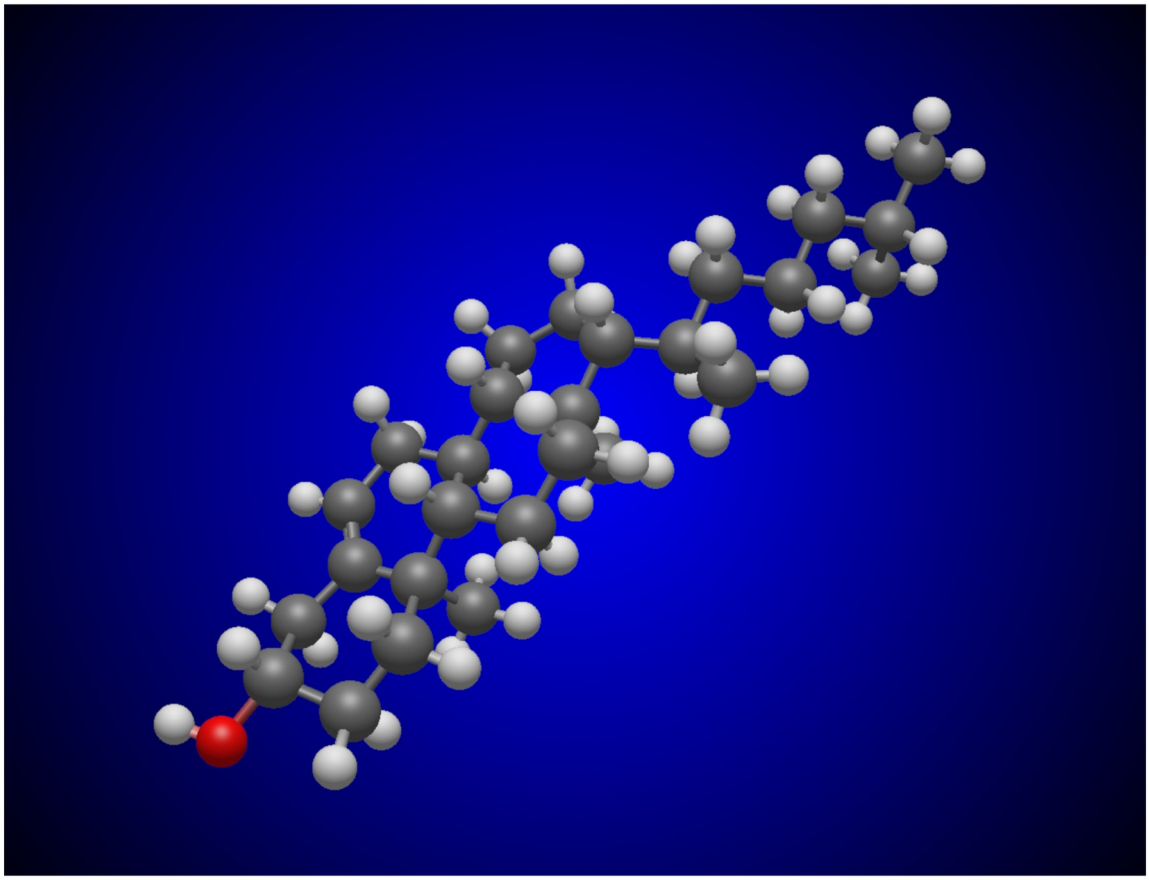
THE TOTAL CHOLESTEROL DOGMA



MARINUS VAN DER WEL

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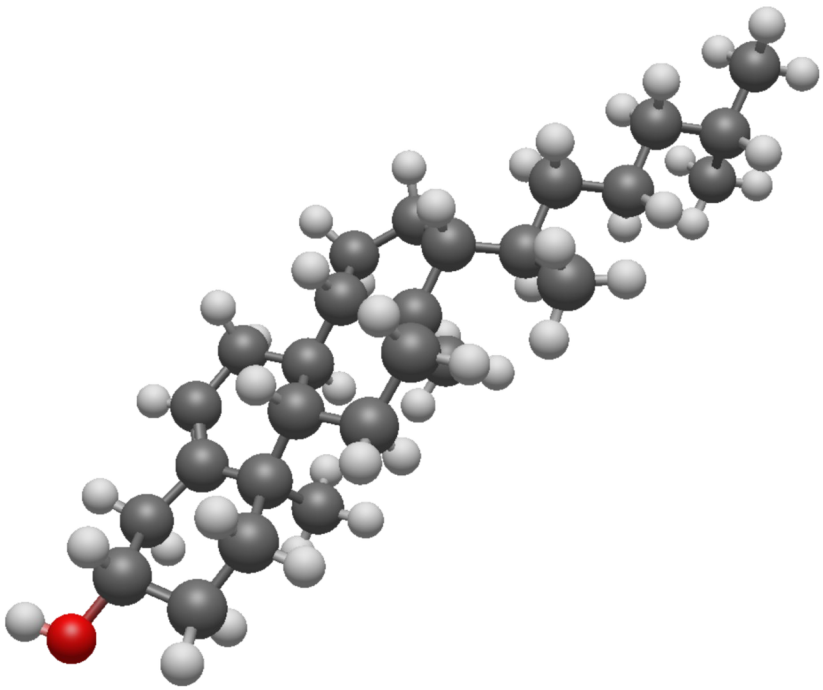

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About the book

About the contents

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Intended audience

This book is intended to be read by everyone who wants to know more about the very important concept of cholesterol and the central role it plays in modern healthcare and how this influences how we are treated by the medical sector if we experience health issues and also how it influences guidelines covering food and health.

Why has this book been written?

In 2019 the author experienced metabolic health issues. These issues could not be addressed by the medical sector in a way that the author considers satisfactory. This has led him to embark on a private study of physiology. He looked primarily at metabolism, endocrinology (most important hormones) and the function of lipoproteins. During this study the author also looked into how guidelines about food and health are established and how they influence the functioning of the medical sector and with that the lives of everyone. He discovered that there are areas of concern. Especially dogmatic thinking in science and healthcare, problematic communication/explanation of science and the immense influence of large economic stakeholders seem to throw a shadow over society. The author came to the conclusion that because of these concerns many people may not be informed properly about what is going on and may therefore not be sufficiently equipped to effectively make informed decisions about how to address issues regarding their medical situation. With this book the author wants to make a humble contribution to chance this.

About the author

Marinus van der Wel has over 35 years of professional experience. During that time, he has worked in the private sector and within public and semi-public organisation. In the early years of his career, the focus was on technical IT roles (System Engineer, Software Engineer, Solution Architect), but this gradually shifted towards roles related to business operations, such as Project Leader, Manager and Business Analyst. In these latter roles Marinus has now built up years of experience in analysing and tackling issues in the field of business operations and beyond. Apart from his professional experience Marinus has interest in subjects such as physiology, astronomy, philosophy and photography. The author is not affiliated with any corporation, political, ideological and/or religious organisation.

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Introduction

When we look at how science has shaped modern healthcare especially in the realm of cardiovascular health there are two hypothesis that have had an enormous influence. These are the lipid hypothesis and the diet heart hypothesis. The diet heart hypothesis has had an enormous influence on dietary guidelines especially in the western world. Apart from that it has influenced scientific research especially in the realm of further development of the lipid hypothesis (see further). The food industry had been structurally changed by this hypothesis in that we have seen a very large expansion of low (saturated) fat and cholesterol free products. This expansion has been supported by food guidelines endorsed by governments all over the world that state we should avoid saturated fats and cholesterol. One could say that because of the diet heart hypothesis and the aforementioned food guidelines that are based on it we have seen a strong shift in society with regard to food habits and perception of what constitutes healthy and unhealthy foods. The lipid hypothesis that states that lowering cholesterol in the blood prevents cardiovascular disease plays a very important role in establishing guidelines aimed at prevention of heart disease worldwide and is regarded by many professionals in the health care space as to be 'settled science'. The lipid hypothesis specifically focusses on LDL cholesterol which is considered to be 'bad' whereby high levels of LDL are seen as causative to heart disease. The typical treatment of people with high levels of LDL cholesterol is prescribing statin medications that interfere with the creation of cholesterol and therefore lowers LDL. This book intends to look at both hypothesis in a constructive critical way meaning it investigates whether or not these hypothesis are really as sturdy as claimed by many scientists and health professionals and if they have actually contributed to improvement of cardiovascular and metabolic health in societies.

1. Terminology

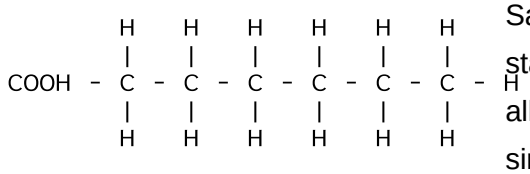
In order to understand the contents of this book it is of importance to get familiar with the terminology used. The following terms will be explained in this section:

- Fats
- Triglycerides
- Cholesterol
- Total cholesterol
- Lipoproteins
- ApoB
- LDL Oxidation
- Sugars
- Endothelial cells
- Macrophages
- Arteriosclerosis
- Atherosclerosis

Fats

Fats, more formally called fatty acids are molecules that can serve as energy carriers and also as building blocks for cells in the body. They consist of multiple atoms of type oxygen, hydrogen and carbon. There are three main types of fats: saturated, monounsaturated and polyunsaturated. On the atomic level these three types differ in how the atoms are arranged in the respective molecules. Especially the way the carbon atoms are being connected with each other is very important. These bonds can be of type single or double whereby a single bond is chemically more stable than a double bond. Apart from the type of bonds the three types are characterised as follows:

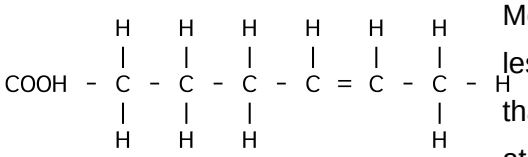
Saturated fatty acids



Saturated fats (abbreviated as SFA) are the most stable of the three types of fats. This is because all bonds between the carbon atoms are of type single. SFAs can be sub divided into short chain (2-6), medium chain (6-12) and long chain (12 or more) fatty acids. SFAs are present primarily in animal based foods such as dairy, beef, pork and eggs and also in some plant based foods such as coconut and palm oil. Saturated fats have the following functions in the body:

- Storage of energy
- Provision of energy
- Absorption of vitamins (A, D, E and K)
- Building block for cell membrane structure (especially nerve cells)
- Important in cholesterol production
- Insulation and protection
- Contribute to brain structure (neuronal membranes)

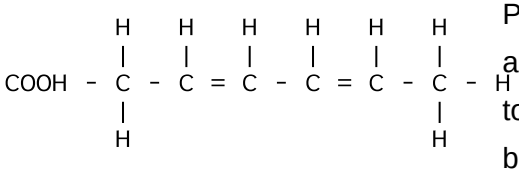
Monounsaturated fatty acids



Monounsaturated fats (abbreviated as MUFA) are less stable than saturated fats because of the fact that they contain one bond between carbon atoms that is of type double. They are however much more stable than polyunsaturated fatty acids (see further). They can be found in animal based foods such as red meat, dairy and eggs and also in plant based foods such as olives and avocados. Monounsaturated fats have the following functions in the body:

- Storage of energy
- Provision of energy
- Absorption of vitamins (A, D, E and K)
- Cell membrane structural fluidity

Polyunsaturated fatty acids



Polyunsaturated fatty acids (abreviated as PUFA) are the least stable of the three types of fats due to the fact that there are multiple double bonds between carbon atoms within its molecular structure. PUFA's are important for humans in relatively small amounts and can be sub-divided into omega-3 and omega-6 fatty acids. Omega-3 fatty acids cannot be produced by the body and are therefore essential. They can be obtained from marine (especially fatty fish such as mackerel, salmon, sardines, herring and anchovies) and plant based sources such as flaxseed, chia seeds, walnuts, canola oil and soybean oil. Just as omega-3 also omega-6 fatty acids are essential and have to be obtained from animal based foods such as red meat (moderate amounts), eggs and poultry and plant based foods such as safflower oil, walnuts, sunflower seeds, canola oil, tofu and almonds. Polyunsaturated fatty acids of type omega-3 have the following functions in the body:

- Cell membrane structure and function

- Important for brain development and cognitive function
- Help resolve inflammation
- Improve eye health
- Help regulate immune responses
- Support neurotransmitter function
- Regulation of inflammation (they are anti inflammatory)

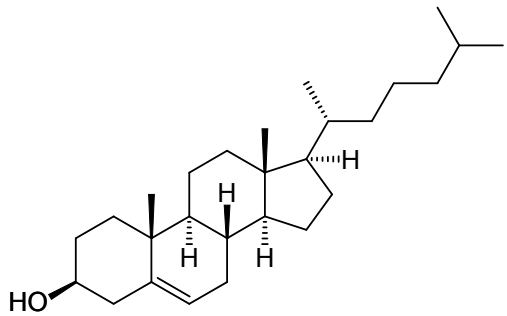
Polyunsaturated fatty acids of type omega-6 have the following functions in the body:

- Balance membrane flexibility and stability
- Regulation of inflammation (they are pro inflammatory which is useful in the case of injuries but problematic in access)
- Aid in skin health
- Influence cholesterol metabolism and lipid transport

Triglycerides

Triglycerides is the type of fat that is stored in the human body. They are made by the body from dietary fats, excess carbohydrates and alcohol.

Cholesterol



Cholesterol is a fat like substance that is responsible for various functions in the human body. Cholesterol is produced by the liver whereby the liver can provide up to 80% of human requirements. Cholesterol can also be obtained from animal based foods such as meat, poultry, eggs, fish and dairy products. Cholesterol has the following functions in the body:

- Cell membrane structure and function
- Precursor of steroid hormones (testosterone, oestrogen, progesterone)
- Constituent of bile (required for fat metabolism)
- Important in vitamin D synthesis
- Important for neurological function (building block of the insulation of neurons and supports synapse formation in the brain)
- Cell signalling and repair

Total cholesterol

If in the medical realm one speaks of total cholesterol what is actually meant is the measurement of the total amount of cholesterol being carried by all the particles present in the blood that are capable of carrying cholesterol so essentially all lipoproteins (see further).

Lipoproteins

Most fats cannot be transported in the blood because they are hydrophobic meaning they repel water and can therefore not be dissolved in blood which consists primarily out of water. This means that in order for the body to be able to transports fats and cholesterol to the places where they are needed we need a structure that can contain fats and transport them in the blood. This structure needs to be lipophilic (fat loving) on the inside and hydrophilic (water loving) on the outside. The lipophilic inside makes sure that the fats can be stored in the structure, the hydrophilic outside makes sure the structure can be disolved in water (so also in the blood). The following types of lipoproteins exist:

- Chylomicron
- VLDL (very large density lipoprotein)
- HDL (high density lipoprotein)
- IDL (intermediate density lipoprotein)
- LDL (low density lipoprotein)

The purpose of chylomicrons is to transport dietary fats to storage in the fat cells. So they package fats that have been consumed and transport them via the lymphatic system and the blood stream to the fat cells. After they deliver the fats they are recycled in the liver. VLDL is used for transporting fats made in the liver to tissues in the body such as muscles and adipose tissue for storage and use of energy. During the delivery of their contents to cells VLDL particles convert into IDL and eventually into LDL particles. So the more contents they lose the lower in density they become. Eventually LDL is absorbed by the liver and recycled. LDL sometimes is deposited in artery walls as plaque because of which it is called 'bad' cholesterol. HDL is used for collecting access cholesterol from the body tissues and carry those to the liver for recycling. This means that HDL collects cholesterol from artery walls (where cholesterol could be present) and also from LDL (if there is any cholesterol left in an LDL the HDL will collect it) after which it deposits its contents in the liver for recycling. HDL is often called the 'good' cholesterol becaus of its role.

ApoB

Lipoproteins all incorporate a structure called ApoB. The function of ApoB is to enable the lipoprotein to dock with tissues in the human body in order to start exchanging the

contents of the lipoprotein with the tissue (or vice-versa). One could draw the analogy with a postal code (ApoB) that states where a package (the lipoprotein) needs to be delivered with the exception that there can be multiple sites that have ApoB receptors and so can exchange cholesterol, fats and other particles with lipoproteins.

LDL Oxidation

This concerns the chemical modification of LDL into a pro-inflammatory substance (ox-LDL).

Sugars

Sugar is classified as sweet-tasting water soluble carbohydrates. They can be subdivided into monosaccharides, disaccharides and polysaccharides whereby the first mentioned type constitutes the least, and the last mentioned type the most complex form of sugar. Monosaccharides include glucose, fructose and galactose. Disaccharides or double sugars are two bonded monosaccharides. Examples of these are sucrose (glucose + fructose), lactose (glucose + galactose) and maltose (two glucose molecules). White sugar is almost pure sucrose. During digestion disaccharides are hydrolysed into simple sugars. Polysaccharides contain more than two bonded monosaccharides and are not regarded as sugars (because they don't taste sweet), however - just like disaccharides - they are converted into monosaccharides during digestion and can then be taken into the blood stream. Because of this for the purpose of the discussion in this book they will be seen as sugars. Sugars can be made by the body (from fats and/or protein) or can be obtained from plant based foods such as fruits (sucrose), vegetables (sucrose), honey (sucrose), grains (maltose) and also from animal based foods such as dairy products (lactose). Polysaccharides can be had from rice, potatoes, beans, oats and corn. Sugars have the following function in the body:

- Energy source for all cells
- Only energy source for cells that do not have mitochondria (e.g. red blood cells)
- Short term energy storage (after conversion to glycogen)
- Long term energy storage (after conversion to triglycerides by the liver)
- Structural and functional roles (e.g. in DNA formation)

Endothelial cells

Endothelial cells make up the endothelium. This is a layer that lines the interior surface of blood and lymphatic vessels. The endothelium works as an interface between blood (or lymph) and the rest of the vessel wall. The endothelium is the place where plaque formation could take place.

Macrophages

Macrophages are white blood cells in the blood stream. Their function is to neutralize inflamed substances in order to prevent disease. So they are part of the bodies immune system..

Arteriosclerosis

The literal meaning of arteriosclerosis is "hardening of the arteries". It is a general term for a spectrum of vascular disorders that are characterised by abnormal thickening, hardening, and loss of elasticity of the walls of arteries. When this happens restriction of blood flow to tissues could be impaired resulting in severe health risks.

Atherosclerosis

This is a specific form of arteriosclerosis that results in lesions in the walls of arteries. This inflammatory condition is generally considered to be chronic and to be caused by high blood levels of cholesterol, primarily LDL.

2. The lipid hypothesis

The lipid hypothesis states that increased levels of plasma cholesterol, particularly LDL cholesterol are causative to coronary heart disease and other cardiovascular conditions. This has been discussed since the 18th century. Cholesterol was first identified as a substance within bile and gallstones by François Poulletier de la Salle in 1769. In 1815 this was rediscovered by Michel Eugène Chevreul who subsequently introduced the term “cholesterine". In 1856 Rudolf Virchof introduced the term "endo-arteritis chronica deformans" to identify inflammatory changes linked to the growth of atherosclerotic plaques within the arterial wall. In 1910 cholesterol was investigated further by Adolph Windaus whereby he identified its presence in bile and other tissues. He noticed that cholesterol levels rise during pregnancy and fall in certain states of disease. Windaus received the Nobel prize in chemistry in 1928 for his work called “constitution of sterols and their connection with other substances occurring in nature.”. The now considered accurate formula for cholesterol was published in 1928 by Wieland and Bain in 1932. The Russian scientist Nikolai Anichkov demonstrated in 1913 that cholesterol builds up near arterial lesions. He correlated this to intake of high levels of cholesterol. Anichkov also made a description of the foam cell (a lipid-laden macrophage in arterial tissue) which he referred to as “cholesterinesterphagozyten". The first description of lipoproteins as complexes of lipids and proteins circulating the blood was produced by the French scientist Michel Macheboeuf in the 1920s. Later a Nobel Prize was awarded to Konrad Block and Feodor Lynen for explaining how cholesterol is created in the body. In 1938 high levels of cholesterol in relation to the occurrence of xanthomas (fatty deposits that accumulate in the skin, tendons, or other tissues) and the occurrence of artery disease providing for the first time evidence linking elevated cholesterol levels with cardiovascular disease. In 1949 types of lipoproteins found in the blood were separated from one another by means of a centrifuge by John Gofman of the University of California in Bekeley (US). He also showed that in patients with a genetic condition that leads to high levels of cholesterol the elevated cholesterol was concentrated in the IDL and LDL particles.