



The global obesity rate has nearly tripled since 1995, with an estimated 650M people classified as obese in 2016.

***Oils & Fats International* takes a look at what obesity is, what are its causes, and which oils and fats are the good, the bad and the worst for managing weight gain**

Historically, gaining weight has been far from an easy task. For most of human history, food has been a relatively scarce commodity. Whatever calories our ancestors managed to scrape up, they quickly burned off in heavy manual labour in order to secure their next meal.

In an environment like this, being able to build a large stomach was in many places considered a status symbol. It signified the individual had the means to acquire large amounts of food, even more than they needed, and that they could pay others to do their hard labour for them. During the Renaissance, for example, the mighty and powerful flaunted their weight, making sure that their portraits showed off their robust physiques.

Attitudes began to change in the 19th century and since then, a slim figure has become the new beauty standard. While some argue that we have now gone too far in the opposite direction and promote unrealistic standards of thinness, few would deny that obesity is unhealthy. Such conclusions were reached as far back as in the Egypt of the Pharaohs and modern medicine certainly does not disagree.

Prevalence of obesity

Obesity is defined by the United Nations' World Health Organization (WHO) as a condition where abnormal or excessive fat accumulation may impair health. The simplest way to determine whether an individual is obese, according to WHO, is

using the body mass index (BMI). The BMI score is determined by dividing a person's weight by a square of their height.

A BMI score equal to or greater than 25 is defined as overweight, while the threshold for obesity runs at BMI 30, according to WHO guidelines. The BMI is a rather inaccurate calculation method as it does not account for fluctuations in body structure and other differences between individuals. As such, fat distribution tests and other examinations need to be conducted to actually diagnose obesity. However, the BMI score gives a rough guideline that can establish whether a person is too fat.

While rampant obesity used to be considered an ailment of the developed nations – and perhaps there was a time when it was – it has become a global issue. WHO data shows that worldwide obesity has nearly tripled since 1975 with an estimate of more than 650M people being obese in 2016. If the number of those who are “merely” overweight is added to the figure, the total increases to a whopping 1.9bn people – a full quarter of the entire world population.

The list of the most obese countries in the world provides further proof that obesity is not just found in rich western countries any more. The *CIA World Factbook's* 'Top 20' list of the most obese places in the world includes only one such nation, the USA, which shares the 18th place with Saudi Arabia.

The top 10 features countries almost exclusively from the Pacific islands, with American Samoa (74.6% of population overweight), Nauru

(71.1%) and the Cook Islands (63.7%) having the questionable honour of being the leading three.

All in all, the WHO says most of the world's population lives in countries where being overweight and obese kills more people than malnutrition. Looking at these statistics, it comes as no surprise that the organisation declared obesity a global health epidemic in 1997.

Obesity and health

Hippocrates, an ancient Greek philosopher who is often called the father of medicine, wrote of obesity: "Corpulence is not only a disease itself, but a harbinger of others." His evaluation from over 2,000 years ago still holds, according to the WHO.

Obesity has been linked to a slew of noncommunicable diseases. Among them are musculoskeletal disorders – particularly osteoarthritis, a degenerative joint disease stemming from excessive body weight – certain types of cancer, such as breast, ovarian, kidney and colon, and diabetes.

Additionally, obesity significantly increases the risk of developing cardiovascular diseases such as heart disease and stroke, which in 2012 became the leading cause of death worldwide.

Obesity is also often accompanied with high cholesterol and consequently high blood pressure, which again increases strain on the heart. Mental health can be impacted as well and several studies have linked obesity to depression due to possible chemical imbalances in the brain, a negative self-image and society's attitude to the overweight.

General quality of life can be severely impacted due to amassing difficulties in performing every day tasks, including work. According to a review by the Department of Public Health Sciences of the Karolinska Institutet in Sweden, overweight employees took more sick days than those with a normal body weight.

The study also found that when obese subjects lost weight, they took fewer sick days, suggesting an improved general health condition. In addition, all the combined health effects of obesity resulted in a significantly heightened risk of death. A BMI of more than 30 can reduce life expectancy by anywhere between two to 10 years.

Causes of obesity

What makes obesity a difficult problem to tackle is that it is not caused by any single factor that can be easily pinpointed and eliminated. There are cases where obesity is present as a major feature of certain syndromes or medical conditions (so called syndromic obesity). These instances, however, only account for a very small fraction of the global obesity epidemic.

In most cases, obesity stems from lifestyle. Increasing automation and mechanisation has led to a significant shift towards less physically demanding work.

As a result, the WHO estimates that at least 30% of the world's population are not getting enough exercise, although the rate at which people engage in physical activity varies heavily from country to country. All in all, however, a sedentary lifestyle greatly increases the risk of developing obesity.

A more significant reason, and a more relevant one for the oils and fats industry, however, is the impact of diet.

A 2016 study by researchers from the Medical University of Lodz, Poland, highlighted excess food as the primary factor in obesity.

The average daily caloric intake has increased significantly over the past two centuries. From 1970 to 2000, the average food energy available per person grew everywhere in the world apart from Eastern Europe.

Combined with the increased availability of food, more efficient agricultural practices have pushed global food prices down, while industrialisation in developing countries is lifting living standards for an increasing number of people. As people can afford more food, they also start eating more.

While most of the extra energy from food is consumed as carbohydrates – in the forms of sugary drinks, potato chips and other starchy foods – fats and oils are far from blameless. Martin Grootvelt, professor of bioanalytical chemistry and chemical pathology at the UK's De Montfort University, who has studied fats and their health effects for more than 20 years, sees high fat consumption as a definite culprit in the obesity epidemic.

"When it comes to obesity, obviously people are eating more fat. There's a general limit of less than, or equal to, two fried meals a week that is fine, while others talk about a maximum of four meals. But your average person [in western countries] is having more than that, certainly more than four," Grootvelt tells *Oils and Fats International*.

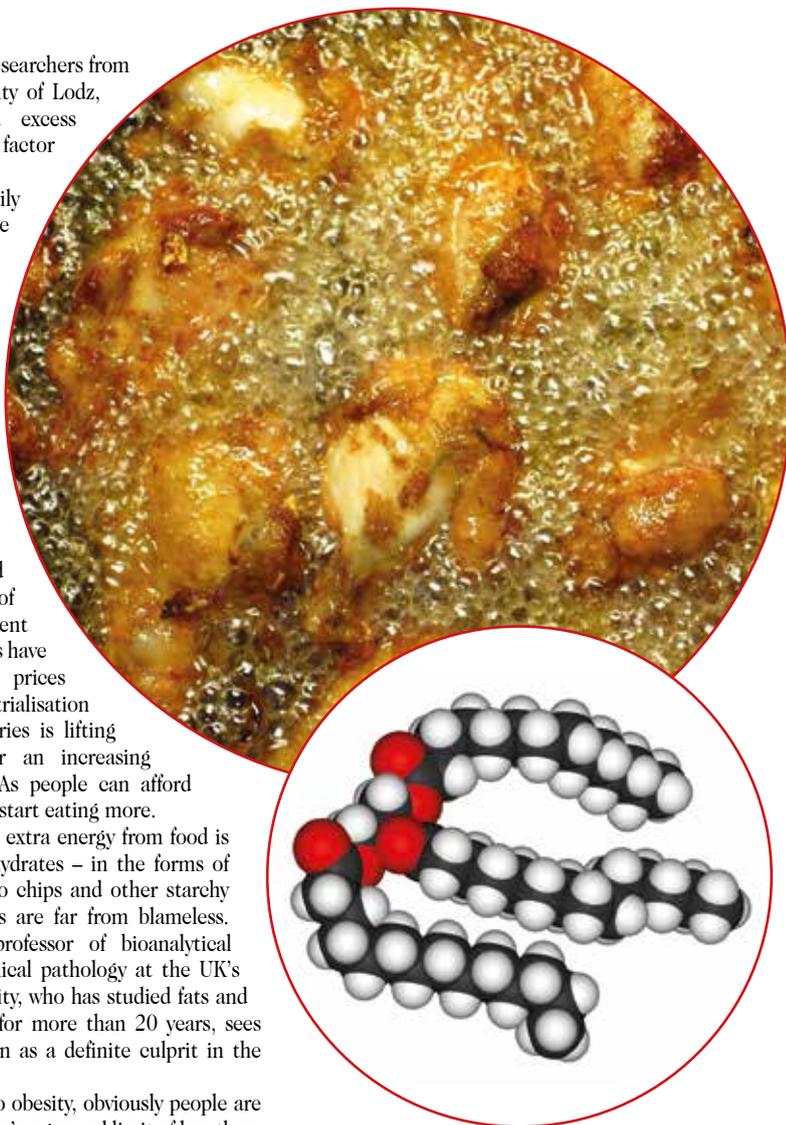
The mechanics of fat

Before attempting a further evaluation of the contribution fats and oils make towards obesity, it is necessary to briefly look at what science says about the structure of fat and what our bodies do with it. Our caloric intake composes mostly of three macronutrients – protein, carbohydrate and fat.

While carbohydrates might make up most of the extra energy we get, fat is by far the most energy-packed of these three nutrients. Proteins and carbohydrates both contain approximately four calories/gram, while fat has more than double that at nine calories/gram. Considering this significant difference, perhaps it is a silver lining that we use more carbohydrates than fats.

Our bodies, however, need fats, as they are essential for maintaining the basic operations of the human body. Some essential nutrients, such as vitamins A, D, E and K, are fat-soluble and therefore cannot be transported around or absorbed into the body through water. Fats help cells maintain their structure, supply energy and form the backbone in the production of many hormones.

In addition, they maintain skin and hair health,



FAT MOLECULES IN FRIED FOODS, WHICH ARE ALREADY FATTENING, UNDERGO HEAT-INDUCED CHANGES THAT PRODUCE TOXIC COMPOUNDS KNOWN AS ALDEHYDES

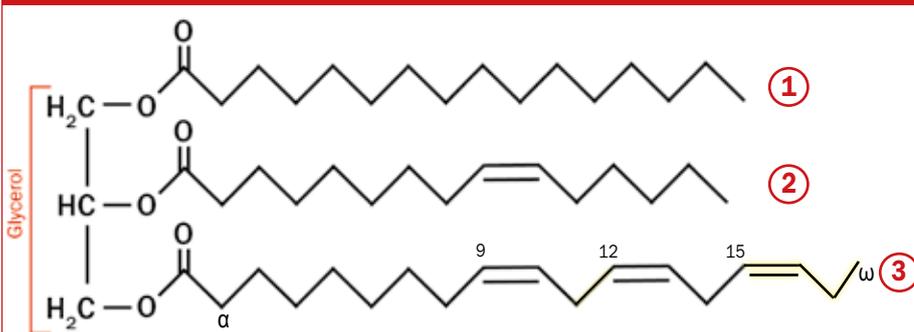
insulate organs against shock, maintain body temperature and can bind certain substances if their levels in the bloodstream get dangerously high. In a nutshell, without any fat in our bodies, we would most likely perish, or at least be extremely unhealthy.

Out of all of fat's functions, energy supply and storage is the one that's immediately most apparent when talking about obesity. Forming fatty tissue, or adipose tissue, is the body's method to store metabolic energy for extended periods of time. Fat cells called adipocytes store fat molecules derived from the diet and from liver metabolism. When the body faces a lack of energy, this stored fat can be metabolised to fulfil the body's energy needs.

Adipose tissue is present in all animals and it is a perfectly natural way for the body to have a bit of extra in reserve for a rainy day. However, when our energy intake becomes much higher than what we need, the only response our body has is to keep storing this extra energy by creating more and more adipose tissue. As the fatty tissue accumulates, problems begin to pile on as well.

The stored fat is generally present as two different types – visceral fat, which is packed in the abdominal cavity and around organs, and subcutaneous fat, which build up under the skin. ▶

FIGURE 1: STRUCTURE OF A TRIGLYCERIDE WITH SATURATED, MONOUNSATURATED AND POLYUNSATURATED FATTY ACIDS



1. Palmitic acid – Saturated fatty acid with no double bonds
 2. Oleic acid – Monounsaturated fatty acid with one double bond
 3. Alpha-linolenic acid – Triunsaturated (omega-3) fatty acid, an example of a polyunsaturated fatty acid (PUFA) with three double bonds.
- Note: Linoleic (omega-6) fatty acid is a PUFA with two carbon-carbon double bonds (rather than 3 in alpha-linolenic acid), and the great majority of edible oils have a higher content of this fatty acid over that of alpha-linolenic acid

► Out of the two, excess visceral fat is more dangerous, as studies have linked it to type 2 diabetes, insulin resistance, inflammatory diseases and other obesity-related diseases.

Classification of fats

The fats we get from food come in the form of triglycerides, esters with three fatty acid chains attached to an alcohol glycerol. Simplified, a fat molecule resembles the capital letter 'E', with the vertical 'backbone' being the glycerol. The three horizontal lines trailing off are fatty acid chains consisting of carbon atoms linked by a chemical bond. In addition, each carbon atom is linked to two hydrogen atoms.

Fats are classified as saturated, monounsaturated or polyunsaturated based on the number of double bonds between the carbon atoms in the fatty acid chains (see Figure 1, above). This molecular structure is important in determining the physical qualities and health effect of different fats and oils.

In saturated fats, there are no double bonds between the carbon atoms. These kinds of fats are generally solid at room temperature, turning into a liquid when heated. They are found in meat, eggs

and dairy, but also in some plant-based fat products, such as coconut, cocoa butter and palm oil.

Monounsaturated fats have one set of carbon atoms that are linked to each other by a double bond. This structure gives them their name – 'mono' meaning 'one'. These kinds of fats tend to be solid when refrigerated and turn into a liquid at room temperature. Monounsaturated oils include canola, olive and peanut oils.

Finally, polyunsaturated fats have more than one set of carbon atoms bonded to each other with a double bond, leading to the term 'poly' meaning 'many'. Primarily vegetable and fish oils, polyunsaturated fats stay liquid at both room temperature and in the refrigerator. Oils in the polyunsaturated category include corn, cottonseed, safflower and sunflower.

In addition to these 'big three', there are essential fatty acids (EFAs). This group includes two fatty acids – omega 6 or linoleic acid, and omega 3 or alpha linoleic acid. From these two fats, the body can process four other essential fatty acids.

"This group of fats are a requirement for normal health and cellular function," says Jacqueline Jacques, a neuropathic doctor and chief science officer at Catalina Lifesciences, USA. "The body

cannot make these fats itself, so it must obtain them from an outside source such as a food or a dietary supplement."

There are also hydrogenated and partially hydrogenated fats, which are artificially created saturated fats formed through an industrial process that adds hydrogen to normally unsaturated fats. The process makes them more solid and prolongs their shelf life, which is desirable in many industries, such as margarine and baked goods production.

However, partial hydrogenation has the side effect of producing *trans* fatty acids. The name stems from the hydrogen atoms being attached on opposite sides of the carbon molecules instead of the same side as in regular – or *cis* – fats.

Artificial *trans* fats have been linked to several negative health effects, including cardiovascular disease, and it is believed, according to Jacques, that they function in the body more like saturated than unsaturated fats.

Natural *trans* fats are created in the stomachs of ruminant animals, such as cattle, sheep and goats, and can be found in their milk and fat.

Oils, fats and health

The current consensus among the nutritional science community is that saturated fats are generally the ones that have the largest negative impact on health. According to Jacques, they are known to contribute to elevated cholesterol and are associated with heart disease risk when consumed in excess.

The modern western meat-heavy diet contains plenty of saturated fats and, as such, health authorities recommend limiting daily intake of saturated fats. For example, the US Department of Agriculture (USDA) dietary guidelines recommend consuming less than 10% of daily calories from saturated fats and keeping total fat intake to between 20-35% of daily calories.

Instead of using saturated fats, the WHO and the European Food Safety Authority (EFSA) recommend replacing them with unsaturated oils, such as those contained in vegetable oils. According to the EFSA, unsaturated fatty acids lower the 'bad' LDL cholesterol and increase the levels of 'good' HDL cholesterol, leading to increased heart health.

However, Jacques points out that within unsaturated fats, the choice between monounsaturated and polyunsaturated can



TABLE 1: FATTY ACID, CHOLESTEROL AND VITAMIN E CONTENT IN OILS AND FATS					
	SATURATED	MONOUNSATURATED	POLYUNSATURATED	CHOLESTEROL	VITAMIN E
	g/100g	g/100g	g/100g	mg/100g	mg/100g
ANIMAL FATS					
Lard	40.8	43.8	9.6	93	0.6
Duck fat	33.2	49.3	12.9	100	2.7
Butter	54	19.8	2.6	230	2
VEGETABLE FATS					
Coconut oil	85.2	6.6	1.7	0	0.66
Cocoa butter	60	32.9	3	0	1.8
Palm kernel oil	81.5	11.4	1.6	0	3.8
Palm oil	45.3	41.6	8.3	0	33.12
Cottonseed oil	25.5	21.3	48.1	0	42.77
Wheat germ oil	18.8	15.9	60.7	0	136.65
Soybean oil	14.5	23.2	56.5	0	16.29
Olive oil	14	69.7	11.2	0	5.1
Corn oil	12.7	24.7	57.8	0	17.24
Sunflower oil	11.9	20.2	63	0	49
Safflower oil	10.2	12.6	72.1	0	40.68
Hemp oil	10	15	75	0	12.34
Rapeseed oil	5.3	64.3	24.8	0	22.21

▶ make all the difference.

“Though this sounds like a small change, the difference is quite large when it comes to health. Monounsaturated fats are known to be some of the healthiest around. They are much more stable than other oils and are not prone to being damaged by heat,” says Jacques. “Polyunsaturated fats are delicate and can be damaged by light and heat. They should be kept refrigerated to prevent rancidity and are not the best choice for sautéing and frying.”

Opposing opinions

However, new evidence and research is surfacing that shows that unsaturated fats and oils are perhaps not the solution to obesity and health problems they've been made out to be. Grootveld's research has shown, as Jacques suggests, that many of the 'healthy' vegetable oils become highly unhealthy when they are exposed to heat, degrading into compounds known as aldehydes.

“Unsaturated fats degrade at high temperatures, generally at 180°C. There are different types of aldehydes – unsaturated aldehydes that are more toxic and saturated aldehydes that are less toxic. But the ballpark really is that they're all toxic,” Grootveld says.

The polyunsaturated fats' tendency to degrade is an issue due to modern populations' penchant for fried foods. Frying in oil greatly increases the fat content in foods, consequently making them more energy-rich, which adds to obesity. It is also these high frying temperatures that Grootveld talks about when he warns about using polyunsaturated oils in cooking.

“The basic line is, anything that's rich in monounsaturates is better for frying because they're more resistant to oxidation,” says Grootveld. “People should avoid anything with more than 20% of polyunsaturates. Health authorities recommend that we use polyunsaturates, but they don't consider

the fact that they are used for frying.”

For frying purposes, Grootveld recommends processed coconut oil. It has been panned historically as being unhealthy due to its high saturated fat content and many health organisations – among them the WHO and USDA – advise against its food use. However, it is precisely the saturated fats that make coconut oil more stable during heating, causing it to form less aldehydes than the recommended polyunsaturated oils.

“Interestingly, coconut oil is the staple oil used for cooking and frying in Sri Lanka and according to a 1978 demographic handbook, the occurrence of cardiovascular disease was the lowest there. It does not prove cause and effect, but it's a recorded fact,” muses Grootveld.

A 2015 study by researchers from the University of California looks at coconut oil from the angle of obesogenic properties. According to the study, the use of polyunsaturated soyabean oil in the USA has increased by astronomical amounts since the trend against saturated fats began in the 1950s, while the US obesity rating has also skyrocketed.

Tests carried out on mice – which were fed soyabean and coconut oil at a ratio corresponding to US food use – showed that soyabean oil increased negative metabolic effects, inducing more weight gain and adiposity. Coconut oil, while increasing the mice's weight due to a high-fat diet, did not cause weight gain at such a high rate.

“[This study] suggests that this dietary shift [to soya oil], while perhaps beneficial for cardiac health, may have aggravated other problems, such as obesity, diabetes, glucose intolerance and fatty liver,” the researchers say.

Of course, people are not mice, and the study's results are not directly applicable to humans. However, Norway's National Institute of Nutrition and Seafood Research in 2012 released a study that claimed that vegetable oils promote obesity due to their high omega 6 fatty acid content.

Anita Røyneberg Alveim, lead researcher of the study, says people in the western world are eating less and less fat, but at the same time our body weight is increasing, so the type of fats we eat – not just how much fat we consume – would seem to be significant in the development of obesity.

According to Alveim, the omega 6 – found in soya and sunflower oils, for example – forms part of the system controlling appetite, the feeling of hunger and energy and fat storage. When the body receives too much omega 6, our brains refuse to send a signal that our need for food is satiated.

Omega 6 also competes with omega 3 for space in cellular tissue and a high intake of omega 6 replaces omega 3. As a result, our own brains are fooling us into overeating, says Alveim, who recommends switching to a more omega 3-rich diet.

No simple solution

As stated above, obesity is not easily tackled, not even when the question only concerns oils and fats. The opinion of global health authorities is that we eat too much fat, so cutting back on fat consumption at least should not hurt. However, evidence also suggests that we should keep an eye on what kind of fat we consume.

While organisations such as the WHO and EFSA swear by polyunsaturated oils, they have been proven to lose their health edge when they're used in cooking at high temperatures. There are also the rogue cases where consumption and general health consensus just do not add up. Grootveld brings up what he calls 'the French paradox'.

“This was noticed a long time ago when researchers were looking at saturated fat intakes. The French have lower instance of cardiovascular and other diseases related to diet, yet they have a greater intake of saturated fat and meat. It doesn't agree with what popular science says,” he explains.

Oxidation is also an issue, as many vegetable oils sold in stores are stored for long periods. Switching to oils such as coconut oil, which are high in saturates, can on the other hand be prohibitively costly, and with our current high fat consumption, it might make the situation worse. So what is a consumer to do in this crossfire of conflicting recommendation? Experts such as Grootveld suggest using the right oil in the right place.

“If they're not used for frying purposes, then polyunsaturates are great. I recommend oils like sunflower oil, when they haven't been stored for a long time, as a salad dressing,” Grootveld says. “If it's for frying, go for oils rich in monounsaturates, like olive oil. Canola oil is an intermediate between olive and sunflower because it contains high levels of both mono- and polyunsaturates.”

But even if the perfect fat was found, it alone will not be enough to eradicate obesity if we keep eating too much of it. Additionally, since most of our everyday calories come from carbohydrates, cutting back on overconsumption and becoming more physically active are essential for losing our collective weight.

And that is just in the West. In developing countries – where food may have been very scarce until the last few decades – it might be a whole other task altogether to explain to people why they should watch what they eat, now that they can finally have their fill. ●

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