



Obesity

Key Terms

- **Body mass index (BMI):** A person's weight in kilograms (kg) is divided by the square of their height in metres (m).
- **Obese:** Having a BMI greater than or equal to 30kg/m².
- **Overweight:** Having a BMI greater than or equal to 25kg/m².
- **Visceral fat:** Fat stored around organs of the body, like the liver, kidneys or heart. This fat is associated with diabetes, high levels of cholesterol and greater risk of heart disease and stroke.
- **Basal metabolic rate (BMR):** The energy our bodies use every day to maintain normal bodily functions.

What's all the fuss about?

Obesity is on the increase around the world. Worried about the long-term threat to health from obesity, doctors and researchers are trying to understand what makes people become obese so that they can design more effective treatments and prevention strategies.

Statistics

Key facts from the UN ([fact sheet number 311, March 2011](#)):

- Worldwide obesity has more than doubled since 1980.
- In 2008, 1.5 billion adults, 20 years and older, were overweight. Of these, over 200 million men and nearly 300 million women were obese.
- 65% of the world's population lives in countries where overweight and obesity kills more people than underweight.
- Nearly 43 million children under the age of five were overweight in 2010.
- These problems start in childhood. In England, 23% of boys and 27% of girls are overweight and obese. Data from countries with fast-growing populations and economies, such as India and China, show overweight and obesity affects 10-15% of children.

Science Q&A

What are the different types of body fat?

All fat that is stored on the body can contribute to obesity. But some fat stores can have more worrying consequences than others.

Fat stored under the skin is called **subcutaneous fat**, and this is the type of fat which can often accumulate in the thighs and buttocks, giving a “pear-shaped” appearance. Women tend to have more of this type of fat than men.

Fat stored around organs of the body, such as the liver, kidneys or heart, is called **visceral fat**. Large amounts of this type of fat give people an “apple-shaped” appearance. Men usually have more visceral fat than women. Visceral fat is associated with diabetes, high levels of cholesterol and an increased risk of heart disease and stroke.

How do we know genetics play a role in obesity?

Many different types of research show that a person’s genetic make-up, among other factors, can affect their risk of becoming obese.

Doctors often see that obese patients tend to have obese or overweight family members. This indicates a genetic link, but it is difficult to know whether the same genes are playing a role in the obesity, or whether it is the fact of growing up in the same environment.

To clarify this, researchers have studied **twins**. Identical twins share the same genes but non-identical twins do not. Research shows that if you are obese, and have a twin, your twin is more likely to be obese as well if you are identical twins. If your twin is non-identical, and doesn’t share exactly the same genes as you, they are less likely to also be obese.

Congenital leptin deficiency is a medical condition caused by a rare gene defect. Its most visible symptom is morbid obesity. Leptin is a hormone which suppresses appetite and improves energy consumption in muscles. A patient diagnosed with this deficiency can be treated with leptin, and will soon lose weight.

How are researchers looking for genes linked to obesity?

There are two main approaches to finding genes linked to the risk of obesity.

One is through **genome-wide association studies**. This means looking at the genetic make-up of many individuals to see if there are **common genetic variants** which could be linked to a trait like obesity. Finding common genetic variants helps researchers to understand the risk of obesity to large numbers of people, but these variants are only associated with small increases in risk of obesity.

Another approach is to look for **rare gene defects**, for example where genes have been mutated or deleted, in what are called **candidate gene studies**. Finding gene defects can help researchers identify causes of significantly increased risk of obesity, but only in very rare cases.

Why is it helpful to identify genes linked to obesity?

If we understand the common genetic variants associated with obesity, doctors can inform patients more accurately about their risk of becoming obese, and help them to focus on changes in their lifestyle to reduce their risk.

If research identifies the rare gene defects that are linked to obesity, in the future people with rare forms of the disease may be able to use **prenatal screening** during pregnancy to reduce the risk of their children developing the same condition. Some gene defects may also be targeted with gene therapies or specific tailored treatments.

How can a person's environment increase their risk of obesity?

Type 2 diabetes is a long-term condition caused by too much glucose, a type of sugar, in the blood. In people with Type 2 diabetes, the body is not producing enough of a hormone called insulin, which would normally control glucose levels, or the body's cells are not reacting to insulin. If you have Type 2 diabetes, you may be able to control your symptoms simply by eating a healthy diet and monitoring your blood glucose level. However, as it gets worse, you may need to take insulin medication. Type 2 diabetes is often associated with obesity.

Research shows that a person's environment can contribute significantly to their weight, whatever their genetic make-up.

A person's environment includes many factors which affect their **energy intake**. How much food is available, what type, and at what cost? How do people behave when it comes to food?

Their environment also includes factors related to **energy expenditure**. How much physical activity do they do? What are their patterns of activity and rest?

If energy intake is greater than energy expenditure, there will be net weight gain. For an "average" person, as little as 100 calories per day excess energy intake could cause a 5kg weight gain over a one-year period.

How does the economy affect people's risk of obesity?

In developed countries, cheap, high-energy food is produced that can be transported around the world. Easy access to high-calorie food, and the way it is promoted by the food industry, are thought to be some of the reasons for the world's rapid increase in obesity levels over the last few decades. In the world's

poorest countries, many populations do not suffer from obesity as they do not have access to enough food. However, many developing countries are facing problems of both obesity and malnutrition.

Why do obese people find it more difficult to lose weight?

60-75% of the energy our bodies use every day is purely to maintain normal bodily functions. This is known as our **basal metabolic rate** (BMR). These normal bodily functions are carried out at a high rate in organs like the heart, liver, kidneys and brain. Fat, or adipose tissue, does not use up much energy in this way. It usually contributes 20-30% of body weight, but only 3-5% of resting metabolic rate. People with excessive body fat content are therefore relatively "inefficient" in their overall basal metabolic efficiency. This inefficiency is one reason overweight and obese people find it difficult to lose weight, as they have to use up a lot more energy to overcome this net energy surplus.

What problems can obesity cause?

Obese or overweight people are at greater risk of a number of illnesses, of which the most life-threatening are cardiovascular disease and cancer. Statistically, people die younger if they are obese.

Type of disorder	How does the disorder occur?	What are the risks?
<p>Metabolic disorders</p> <ul style="list-style-type: none"> • Type 2 diabetes • High cholesterol and triglycerides (dyslipidaemia) • Fatty liver disease • Polycystic ovarian syndrome 	<p>Too much visceral fat can result in the body developing a resistance to insulin, which is one of the main features of type 2 diabetes.</p> <p>An increase in free fatty acids in the blood also results in excessive production of certain lipid particles that further increases the production of insulin, making insulin resistance worse.</p> <p>Chronically high levels of insulin and changes to sex hormone metabolism can result in polycystic ovarian syndrome, a condition that affects how women's ovaries work.</p>	<p>People with a BMI of 30 have six times the risk of developing type 2 diabetes.</p>
<p>Cardiovascular disease</p> <ul style="list-style-type: none"> • High blood pressure • Coronary heart disease • Stroke 	<p>Excess visceral fat produces hormones that can increase blood pressure.</p> <p>Obese people also have a greater total volume of circulating blood. This increases the blood's thickness and ability to clot.</p>	<p>The risk of high blood pressure is 5 times greater in people who are obese.</p>

	<p>These factors all increase the risk of high blood pressure, but also play a role in the development of atherosclerosis, a potentially serious condition where arteries become clogged up by fatty substances.</p> <p>When atherosclerosis affects arteries of the heart, it can result in angina and heart attacks. In the brain, it can cause a stroke.</p>	
<p>Cancer</p> <ul style="list-style-type: none"> • e.g. breast cancer, colon cancer, kidney cancer, prostate cancer 	<p>Excess fat in the body causes inflammation when the body's immune system starts to attack fat cells. This inflammation, along with changes in metabolism of sex hormones, and insulin resistance, are thought to increase obese people's risk of cancer.</p>	<p>At least 10% of cancer deaths are thought to be due to obesity.</p>
<p>Bone and joint disease</p> <ul style="list-style-type: none"> • arthritis • osteoporosis • disability 	<p>Excessive body weight increases the stress on joints in the body, which can cause arthritis. Arthritis is common in obesity, and can bring with it back pain, knee and hip problems, and chronic disability.</p> <p>Reduced bone density can also occur, due to a lack of vitamin D. Reduced bone density, or osteoporosis, can lead to fractures and further disability.</p>	
<p>Respiratory disease</p> <ul style="list-style-type: none"> • obstructive sleep apnoea • obesity hypoventilation syndrome 	<p>Excessive body fat can restrict people's breathing, from too much fatty tissue around the neck and nose, or irregular breathing patterns.</p>	
<p>Psychological problems</p> <ul style="list-style-type: none"> • depression • anxiety 	<p>Mood disturbances, such as depression and anxiety, are more common in people with obesity. This is thought to be due to a range of factors, including behavioural disturbances associated with trying to lose weight, dissatisfaction with body image, and social stigma.</p>	<p>Women in the US who are obese have a 37% increased risk of depression.</p>
<p>Pregnancy complications</p>	<p>Obesity in pregnancy puts both mother and baby at risk, due to higher rates of diabetes of the mother, pre-eclampsia (high blood pressure and fluid retention) and fetal macrosomia ("big baby syndrome").</p>	

How can we treat obesity?

It is important for obese people to lose weight in order to avoid health complications. The question is: how can people best achieve this weight loss? It is true that **eating less and exercising more** is the best method, but in reality this is overly simplistic. We know that the processes behind energy regulation in the body are very complex and therefore other methods are more successful in achieving weight loss. Ways to treat obesity include: **lifestyle change, drugs, surgery and psychological therapies.**

How can lifestyle change help to treat obesity?

Many studies show that lifestyle interventions can be a successful way to prevent and treat obesity. The key element is to ensure individuals eat less and exercise more. People who manage to adopt these changes in the long term may see positive results. Crash diets, on the other hand, rarely produce positive long-term results.

How can drugs help to treat obesity?

Several different drug therapies have been tested and used in the treatment of obesity. Clinical trials showed that two drugs, sibutramine and rimonabant, that work on **appetite** and **energy regulation** can have beneficial effects on weight loss. However, with increasing use, researchers noticed side-effects, including increases in cardiovascular risk, or mood disturbance and suicide. Both these drugs have now been withdrawn.

Pharmaceutical companies are continuing to work on this type of drug, to reduce the side effects. One promising drug is orlistat, which stops the release of enzymes which break down fats during digestion. The fats are therefore absorbed less into the body. This drug shows modest benefits, achieving on average 2-3kg of weight loss over a 1 year period. However, it causes side effects of flatulence and diarrhoea. These side effects stop many people from taking the drug.

Newer drug therapies available to treat obesity and type 2 diabetes include drugs called GLP-1 agonists. These drugs work on hormones in the gut which are released after eating to **suppress appetite** and make people feel full – hormones which often don't work as well in people with obesity or Type 2 diabetes. These drugs copy the body's natural response in normal individuals. They are relatively new, and not fully understood, but they seem to be effective in weight loss and diabetes control. Future studies will tell us more.

How can surgery help to treat obesity?

At the moment, surgery is the **most successful** way to help obese people to lose significant weight in the long term, and to prevent or treat any complications. Surgery can mean a **gastric band** being fitted around the stomach, or a **bypass operation**. These operations are thought to induce weight loss by stopping food getting into the stomach, promoting a feeling of fullness and reduced appetite, and allowing less absorption in the gut, reducing energy intake. Large studies show that these operations, especially a stomach bypass, can achieve significant weight loss of 10-30%, and reduce the risk of death from obesity by up to 40% in some cases.

These benefits are thought to outweigh the risks of performing surgery in obese individuals. Studies also show that these operations are highly cost-effective as they are much cheaper than the cost of treating long-term complications such as disability and Type 2 diabetes.

At the present time, surgery is an option open to individuals with a BMI greater than 35-40 in the UK, for example.

How can psychological therapies help to treat obesity?

There are often complex processes behind obesity, such as behavioural systems that promote “reward” and “motivation” from eating. Psychological techniques such as cognitive-behavioural therapy can address these processes. This type of treatment can also be useful as obesity is associated with high rates of psychological problems, such as depression and anxiety. Most specialist obesity services offer psychological support and treatment for patients. In children with obesity, treatment often involves the whole family, as doctors understand obesity can be linked to eating patterns and behaviours at home.

Discussion Continuum

This activity is designed to facilitate dialogue about the ethical, legal and social aspects of research into obesity. Groups of 4-12 students discuss the issues raised by each statement and choose where each card should go between 'agree' and 'disagree'.

Contents:

- An AGREE and a DISAGREE card
- 8 Discussion Cards, which include a statement on some aspect of obesity

Gameplay:

1. Players form small groups, between 4 and 12 per group. Each group is given an AGREE and DISAGREE card and 8 discussion cards.
2. Within each group, the AGREE card and DISAGREE card are placed on the floor/table about one metre apart, to represent the two extremes of the continuum. The space in between is where the discussion cards will be placed.
3. The first player reads the first discussion card to the rest of the group. The player should check everyone understands the card, and use information from the introduction where necessary to ensure the group understands the statement.
4. The first player then decides to what extent they agree with the first card. They place the card face up, anywhere on the discussion continuum, closer to AGREE or DISAGREE as they choose. This is entirely the choice of the individual player, and is not discussed by the group. The player can give a reason, if they wish.
5. Each player in turn then reads a card, checks that everyone understands, and chooses individually where to place it on the continuum in a similar way.
6. When all the cards have been read, understood and placed on the continuum, the discussion begins. The aim is to place the cards between AGREE and DISAGREE in an order that most of the players agree on. Players should pick a card for discussion, and discuss whether to move it.
7. At the end of the discussion, each group should have a continuum which they mostly agree with.
8. If several groups are playing at the same time, the facilitator may wish to bring the different groups' results together. Are they similar? Can someone from each group explain their choices on particular cards?

Adapting the game:

Time limitations? Don't hesitate to reduce the number of cards, or simply use the cards as starting points for discussion.

Discussion continuum developed by Ecsite, in collaboration with Barcelona Science Park, in the context of the Xplore Health project. Thanks to At-Bristol for the development of the discussion continuum format: www.at-bristol.org.uk

Agree

Disagree

Discussion Card 1

“If I don’t see myself as **obese**, and I have no immediate health problems, I should not feel any obligation to have my obesity **treated.**”

Discussion Card 2

“The government should spend less money **educating people about obesity** and more money making our cities easier places to **keep fit**, with cycle lanes and open spaces to **exercise.**”

Discussion Card 3

“Patients who are obese from **genetic causes** should have their treatment prioritised over those who are obese because of their **behaviour.**”

Discussion Card 4

“Much more funding should go into research into **common causes** of obesity, because this affects many more people than the **rare causes** of obesity, and can therefore save a lot more lives.”

Discussion Card 5

“It should be illegal to **advertise snack food** during **children’s** television.”

Discussion Card 6

“**Surgery to tackle obesity** can be a good use of public money.”

Discussion Card 7

“Any treatment that allows an **obese** person to continue to **overeat** is immoral.”

Discussion Card 8

“It makes no difference if obese people lose weight by **eating more healthily** and **getting exercise**, or by taking **prescription drugs**. The important thing is for them to lose weight in the long term.”