- Mental health / Brain / Anxiety

SPECIAL

Understanding MENTAL HEALTH

Take a tour of the brain to discover the origins of anxiety and how to tackle it

WORDS SCOTT DUTFIELD

The term 'mental health' is used to encompass a person's emotional and psychological wellbeing, which is experienced differently from one person to the next and includes a spectrum of mental health conditions. One of the most prevalent mental health concerns today centres around people's levels of anxiety and depression. In the US alone, 6.8 million adults are affected by generalised anxiety disorder (GAD), which is a feeling of unease and worry to a variety of degrees, from manageable fear to debilitating panic. Common mental health issues such as GAD can also have knock-on effects on our physical health: depression and anxiety can lead to increases in blood pressure, reduce the amount of blood that flows through the heart and increase the release of a stress hormone called cortisol, all of which can contribute to the development of heart disease.

Did you know?
Half of lifetime mental illnesses begin by the age of 14

Mental health is often intertwined with a concept known as neurodiversity. This term is used to describe the breadth of ways the human brain operates and how it interprets and processes information. A neurotypical person is someone whose brain functions in a typical way – similar to the majority of their peers. The brain of a neurodivergent person, however, deviates from the typical. For example, someone on the autism spectrum or with attention deficit hyperactivity disorder (ADHD) might consider themselves to be neurodivergent.

While many neurodivergent conditions, such as ADHD, can be treated as a mental health disorder, being neurodivergent is more about recognising different cognitive



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qualities. "Neurodivergence is something that people identify with, so it's part of their identity as much as their personality and is part of who they are, but mental health issues are seen as separate and something that will need to be addressed," says Dr Giorgia Michelini, an assistant professor in psychology at Queen Mary University of London. "Mental health is something that characterises everyone; mental health problems are experienced by some people or at some point in someone's life."

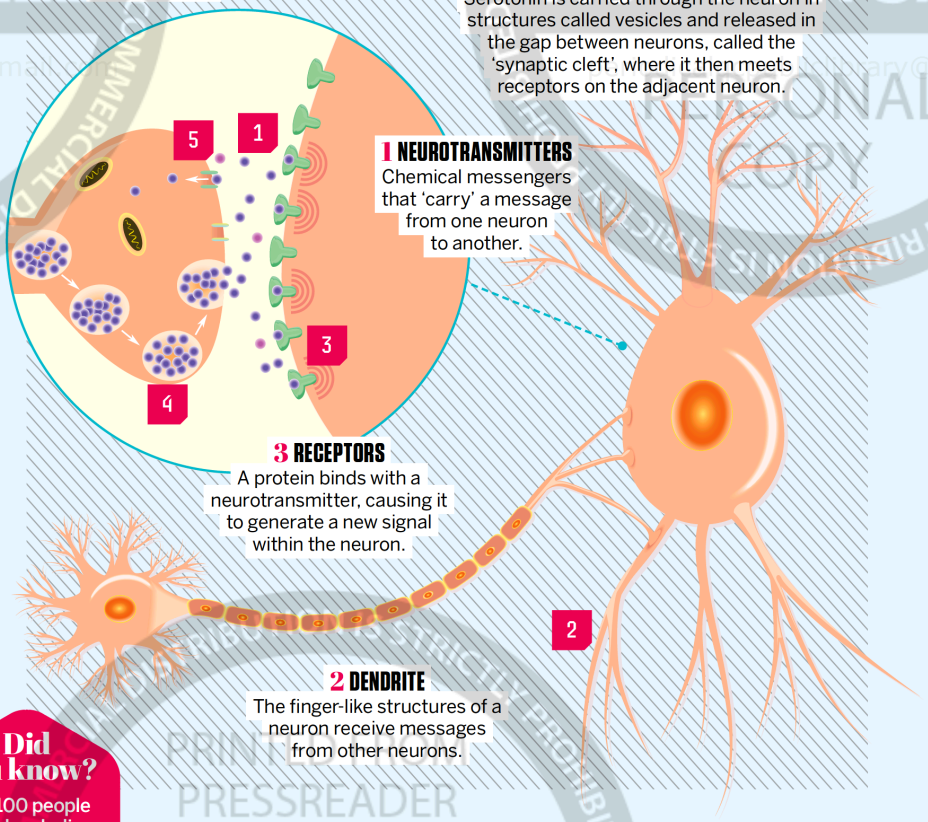
Within the brain is a complex network of structures called the limbic system that controls our emotions, memories and behaviours. One of the main functions of this system is to warn us of danger and trigger a fear response, known as the fight-or-flight reaction. This also translates into how the brain experiences anxiety and its associated conditions, such as phobias and PTSD. One structure, the amygdala, is responsible for assessing the emotional significance of information and whether or not the fight-or-flight response should be triggered. When the amygdala is too easily triggered or is 'turned on' when a threat isn't evident, this can lead to the development of anxiety disorders.

The association between the limbic system and anxiety means that by monitoring the electrical activity in these regions of the brain, researchers can study it in more detail. In 2021 researchers at the University of Rochester in New York used virtual reality to test how the brain responded to anxiety-inducing scenarios. Patients were exposed to a VR meadow filled with flowers – either safe or concealing a bee that could virtually 'sting' with minor electrical stimulation to the hand. Half of the meadow was filled with beeless flowers. While using functional magnetic resonance imaging (fMRI) to study the patients' brain activity, the researchers found that patients who suffered from anxiety had increased activation in some of the limbic system's regions when viewing both 'safe' and 'unsafe' areas of the meadow. This suggests that despite recognising the safe areas of the meadow, the brain still associated them with danger and perpetuated feelings of anxiety.



CHANGES IN SIGNALS

How the cells in the brain talk to each other



Did you know?

1 in 100 people have borderline personality disorder

Another tool researchers can utilise in researching mental health and neurodivergence are electroencephalograms (EEG). Created to study the brains of those with epilepsy, EEGs use small electrodes placed around the head to measure the electrical activity of neurons within the brain. The activity is amplified, recorded and displayed as different brain wave patterns at different locations around the head, indicating which parts of the brain are active and to what degree. While the technology isn't strong enough to be used to diagnose different mental health conditions, researchers like Michelini can use it as a tool to study them in more depth. "A lot of the work I've done is on EEG studies of people with ADHD. We would take a group of people with ADHD and a group of people that don't have ADHD then record EEG activity when they're at rest or get them to do something that would challenge their attention, such as complete a computer task. Then we could see the EEG markers that are different between people with ADHD and people that don't have ADHD."

The known causes of many mental health conditions vary, and many causes remain largely unknown. Some of the environmental factors that have been identified as detrimental to mental health involve harmful social interactions, economic issues and substance abuse. Even pollution might have a role to play in contributing to negative

"Mental health problems are experienced by some people or at some point in someone's life"

DID YOU KNOW? The term 'neurodiversity' was coined by Australian sociologist Judy Singer in 1997

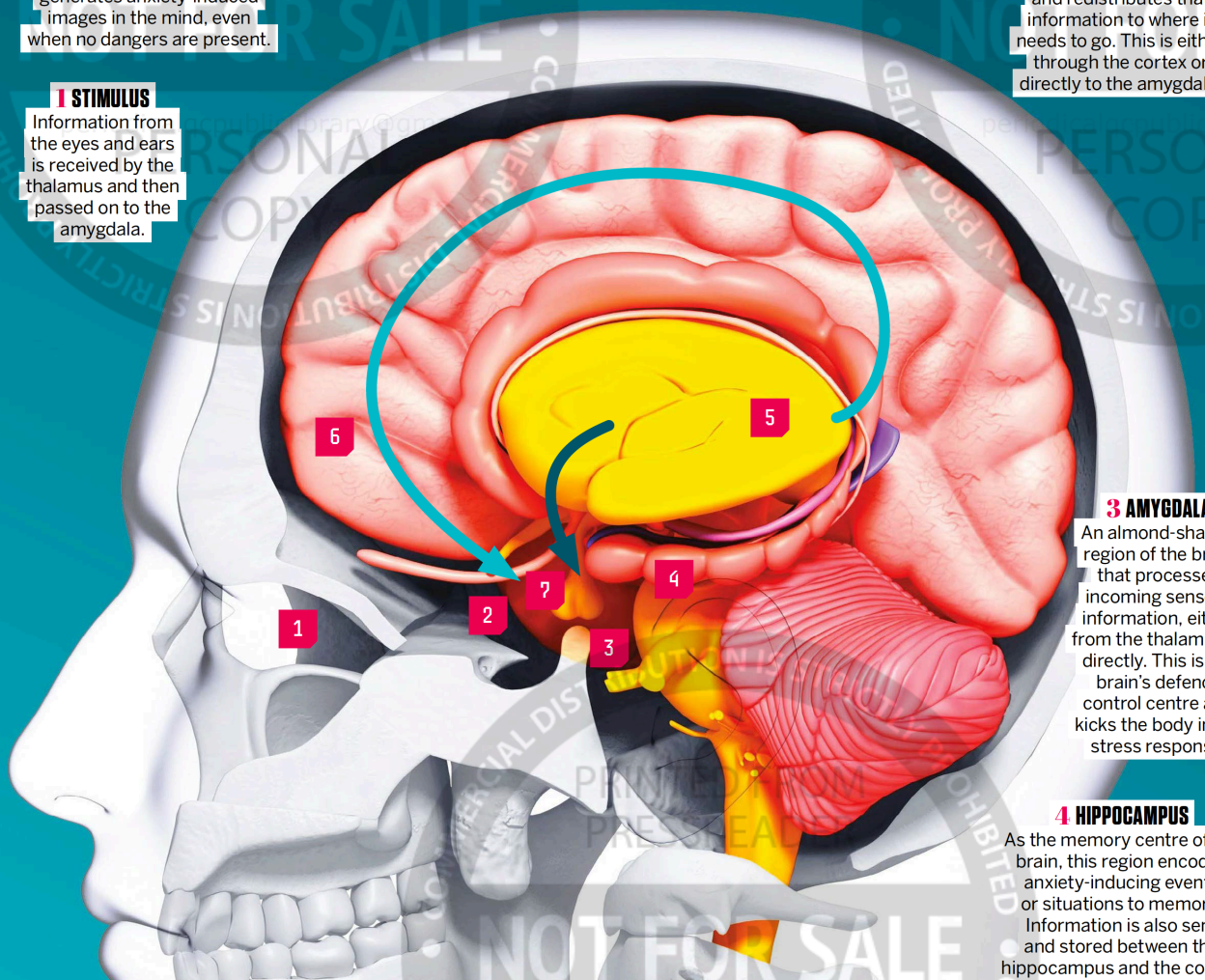
THE ANATOMY OF ANXIETY

These parts of the brain are involved in making us anxious

6 PREFRONTAL CORTEX
Often referred to as the 'thinking part' of the brain, the cortex attaches meaning to sensory stimulus and generates anxiety-induced images in the mind, even when no dangers are present.

1 STIMULUS
Information from the eyes and ears is received by the thalamus and then passed on to the amygdala.

5 THALAMUS
A cognitive router, the thalamus receives information from sensory organs, such as sight and sound, processes and redistributes that information to where it needs to go. This is either through the cortex or directly to the amygdala.

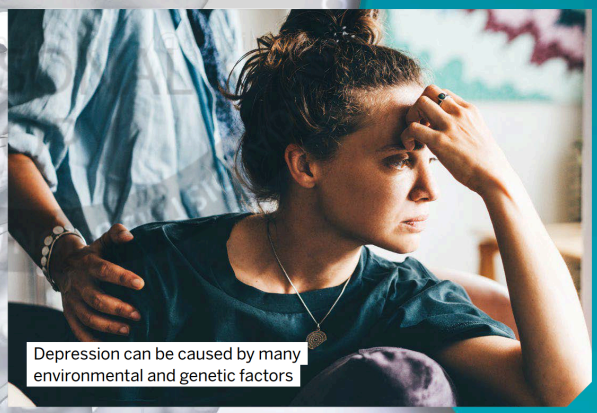


3 AMYGDALA
An almond-shaped region of the brain that processes incoming sensory information, either from the thalamus or directly. This is the brain's defence control centre and kicks the body into a stress response.

4 HIPPOCAMPUS
As the memory centre of the brain, this region encodes anxiety-inducing events or situations to memory. Information is also sent and stored between the hippocampus and the cortex.

2 SHORTCUT
Sensory information such as smell and touch reach the amygdala without passing through the thalamus.

7 HYPOTHALAMUS
Typically responsible for maintaining harmony in the body, known as homeostasis, when triggered by the amygdala it signals to glands around the body to release stress hormones during anxious moments.



Depression can be caused by many environmental and genetic factors

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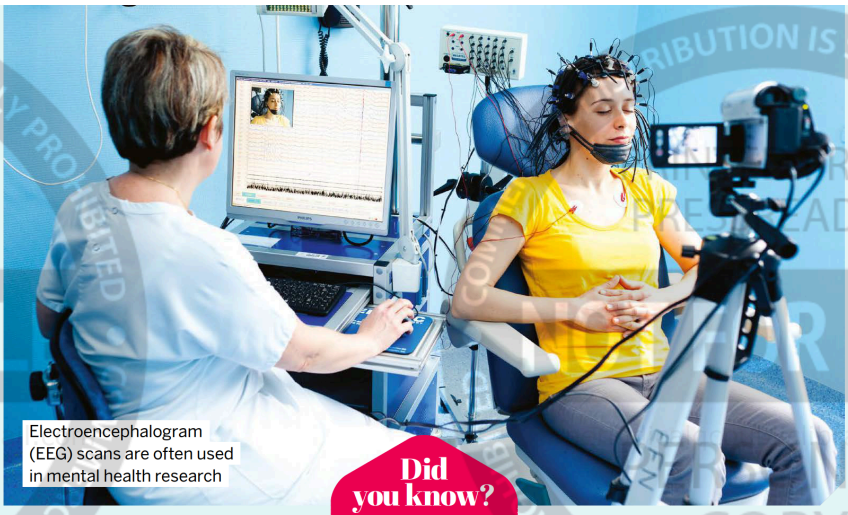
mental health. In 2019, research published in the *British Journal of Psychiatry* revealed a link between air pollution and the use of mental healthcare services. Using anonymous data from South London and Maudsley NHS Foundation Trust combined with data on quarterly average concentrations of air pollutants, such as nitrogen dioxide and particulate matter, researchers found that people exposed to higher residential levels of air pollutants used the mental healthcare services more frequently when compared to those exposed to lower air pollution.

The COVID-19 pandemic also has a lot to answer for as a source of isolation, which is thought to have caused a decline in mental health. Surveys conducted by the Office for National Statistics revealed that before UK lockdown began in March 2020, the prevalence of depression among the UK's population was around ten per cent. That figure rose to 19 per cent in June of the same year and then jumped again to 21 per cent by January 2021. However, by October 2022, following the removal of many lockdown measures, depression levels dropped to 16 per cent.

One of the biological explanations for declining mental health relates to our brain chemistry. In the 1960s it was believed that a decline in the production of a neurotransmitter called serotonin was the leading biological cause of some mental health conditions, such as depression. Often referred to as a 'chemical imbalance' in the brain, the serotonin theory has come under fire in recent years as an out-of-date explanation and being oversimplistic. However, the topic remains largely debated in the scientific community.



Electroencephalogram (EEG) scans are often used in mental health research

Did you know?

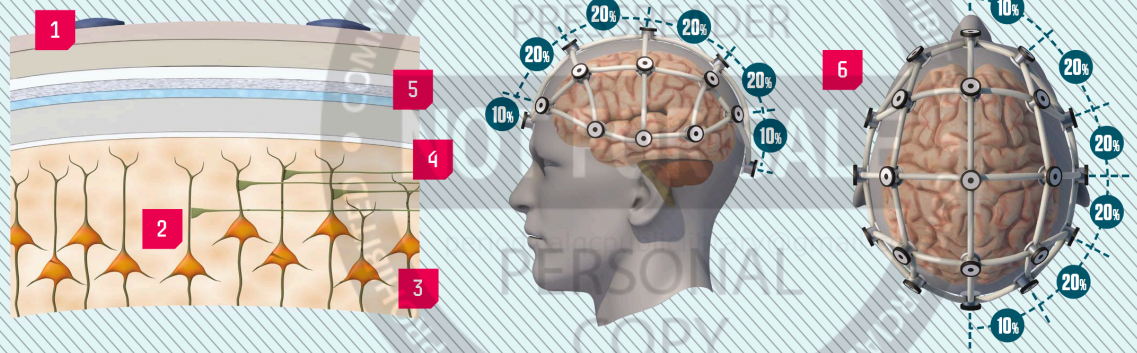
OCD affects around two per cent of people

There's also genetics at play: the blueprints for our bodies not only determine most of our physical characteristics, but also how our brains function. According to Michelini, the role of genetics in the development of mental health conditions differs. With anxiety and depression, "we see that the role of genetics is 30 to 40 per cent and the rest is down to a person's environment and their experiences. But for disorders such as psychosis and bipolar disorder, and all forms of neurodivergence, such as autism and ADHD, we find that the genetic component is higher at around 80 per cent, with around 20 per cent down to their environment."

One of the ways that scientists have made these genetic connections is by studying both identical and fraternal twins. Genetically identical twins share almost 100 per cent of their genetic information, whereas fraternal twins – those born from separate eggs – only share around half of their genes. This fact allows researchers to compare the prevalence of different mental health conditions between people with similar or near-similar genetics. Some studies have shown that incidences of obsessive-compulsive disorder (OCD) developing in both twins is higher in identical twins than fraternal twins, pointing to genetic origins.

SEEING PAST THE SKULL

How electroencephalograms peer into the brain and monitor activity



1 EEG ELECTRODE
Electrodes are placed around the head. The electrical energy released by brain activity can 'push' or 'pull' on the electrode, which is recorded and measured.

2 ACTIVE SYNAPSE
When many neurons fire at the same time, they generate enough energy for the EEG electrodes to detect.

3 EFFERENT NEURONS
These neurons carry signals from the brain to various parts of the body to carry out an action, such as movement.

4 AFFERENT NEURONS
Represented by the horizontal lines in the illustration, these neurons transmit information between sensory organs, such as the eyes and ears, and the central nervous system.

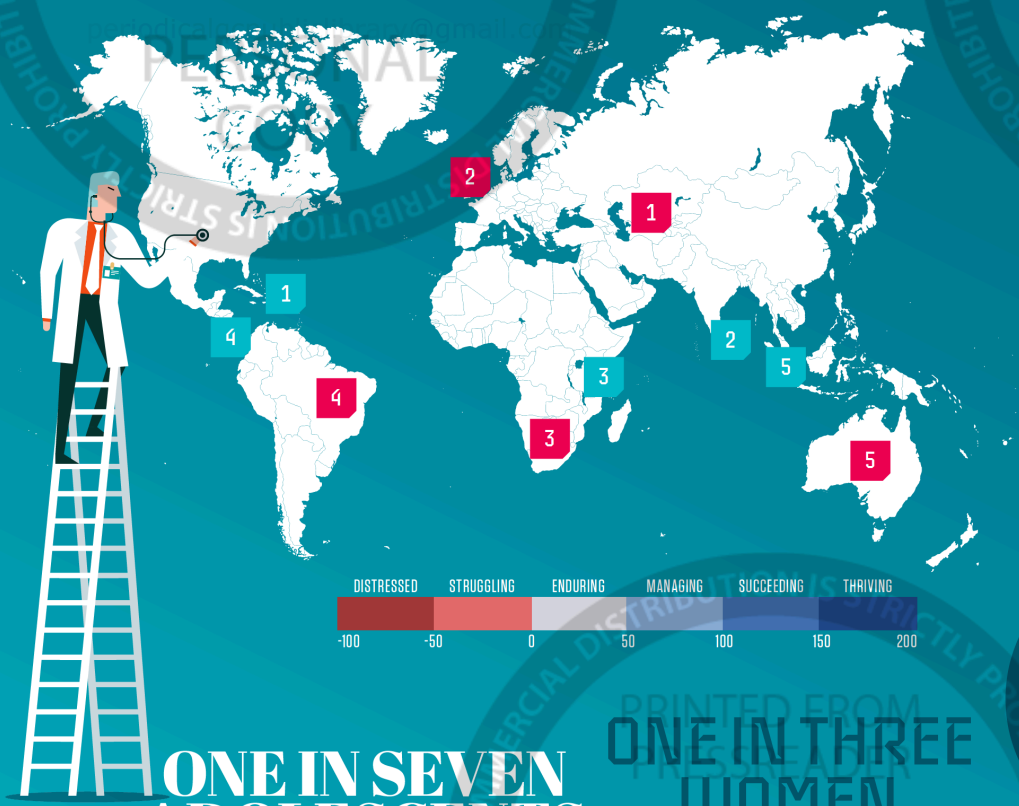
5 PROTECTIVE LAYERS
The energy of brain activity moves through the protective layers around the brain, allowing it to be measured on the surface.

6 ELECTRODE LOCATIONS
Electrodes are placed on the head using the '10-20 system', whereby each electrode is positioned at 10 or 20 per cent of the skull's total distance either from front to back or from left to right.

DID YOU KNOW? 63 per cent of Britons agree that when others are kind, it has a positive impact on their mental health

GLOBAL MENTAL HEALTH

Every year, a nonprofit organisation called Sapien Labs releases its Mental State of the World Report, which outlines what it calls a mental health quotient (MHQ) score across 71 countries. More than 400,000 people across these countries took part in the 2023 survey. Patients filled out a questionnaire to assess their mental wellbeing on a MHQ point scale that starts at -100 (distressed) and goes up to 200 (thriving). Here are the average MHQ scores for the highest and lowest scoring countries for positive mental wellbeing.



BEST AVERAGE MHQ SCORE

1 DOMINICAN REPUBLIC 91
2 SRI LANKA 89
3 TANZANIA 88
4 PANAMA 85
5 MALAYSIA 85

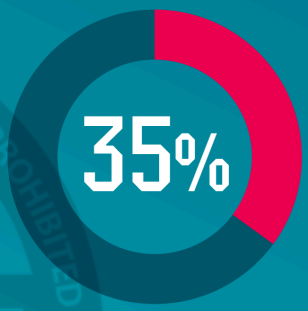
WORST AVERAGE MHQ SCORE

1 UZBEKISTAN 48
2 UNITED KINGDOM 49
3 SOUTH AFRICA 50
4 BRAZIL 53
5 AUSTRALIA 54

ONE IN SEVEN ADOLESCENTS HAVE A MENTAL DISORDER

ONE IN THREE WOMEN

Women are more likely than men to experience major depression in their lives



35 PER CENT OF PEOPLE WITH SEVERE MENTAL HEALTH PROBLEMS ALSO HAVE LONG-TERM PHYSICAL CONDITIONS

ONE IN FOUR

Only 27.6 per cent of the people that require treatment for anxiety disorders receive it

301 MILLION PEOPLE

Anxiety disorders are the world's most common mental illnesses



14 PER CENT OF ADULTS AGED 60 AND ABOVE LIVE WITH A MENTAL DISORDER

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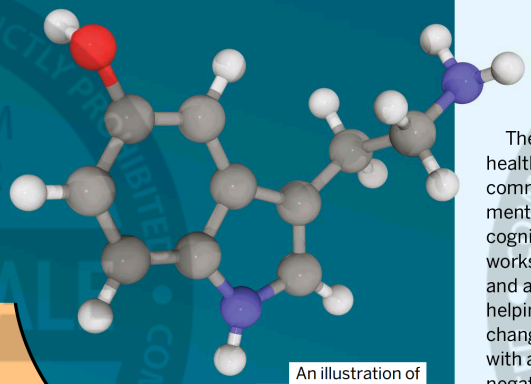
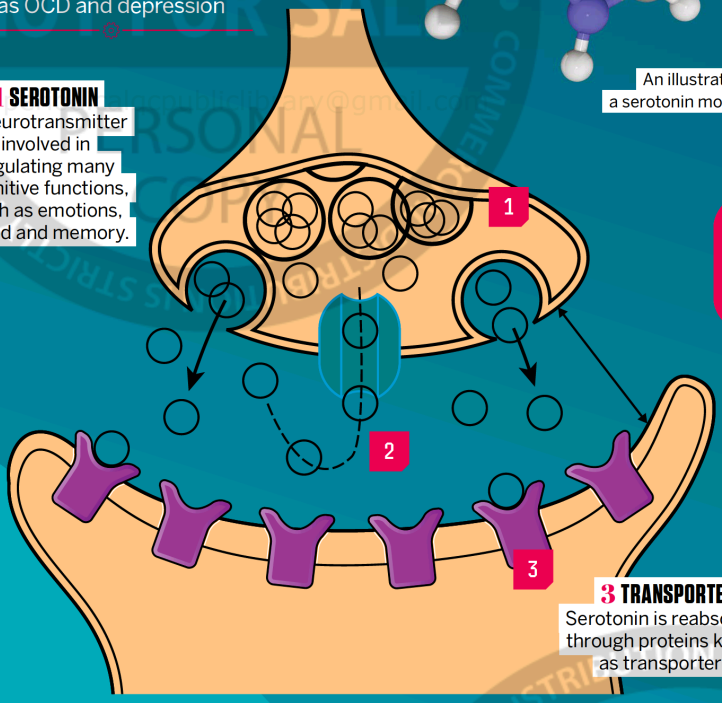
SPECIAL

REDIRECTING SEROTONIN

How SSRIs can help combat mental health conditions such as OCD and depression



An illustration of a serotonin molecule



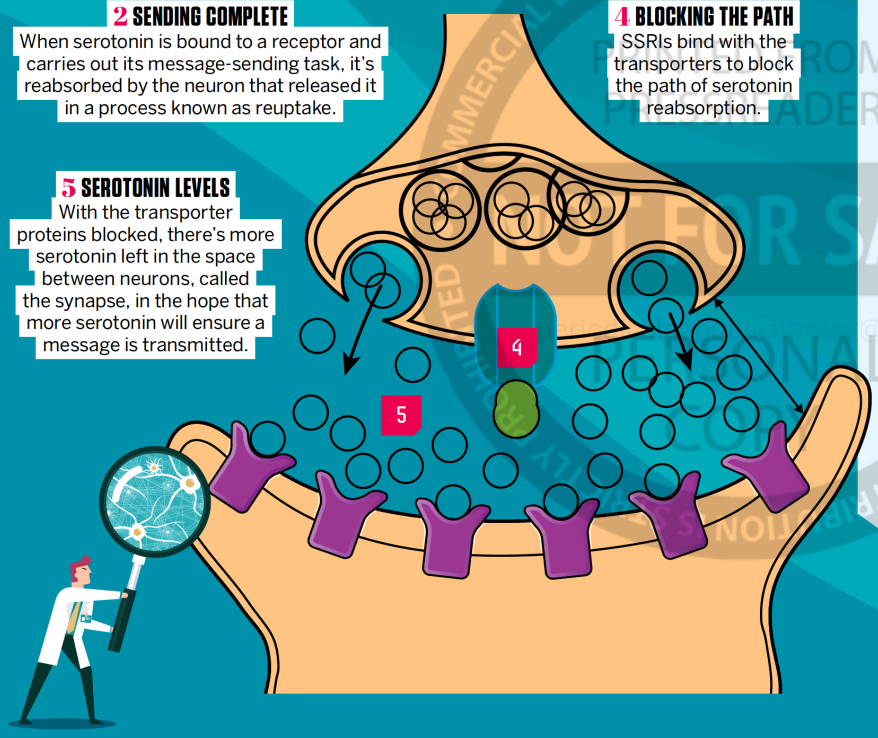
1 SEROTONIN
A neurotransmitter involved in regulating many cognitive functions, such as emotions, mood and memory.

3 TRANSPORTER
Serotonin is reabsorbed through proteins known as transporters.

2 SENDING COMPLETE
When serotonin is bound to a receptor and carries out its message-sending task, it's reabsorbed by the neuron that released it in a process known as reuptake.

4 BLOCKING THE PATH
SSRIs bind with the transporters to block the path of serotonin reabsorption.

5 SERONTONIN LEVELS
With the transporter proteins blocked, there's more serotonin left in the space between neurons, called the synapse, in the hope that more serotonin will ensure a message is transmitted.



Did you know?
1 in 25 adults in the US live with serious mental illness

There are numerous ways that mental health conditions are tackled. One of the most commonly used forms of treatment for many mental health conditions, such as anxiety, is cognitive behavioural therapy (CBT). CBT works on the basis that our thoughts, feelings and actions are all interconnected and that helping change one of these elements may change the others. Through repeated sessions with a therapist, CBT identifies patterns of negative thoughts, behaviours and actions and helps someone develop the skills to break these patterns. Conditions such as eating disorders, psychosis and bipolar disorder have been successfully treated using CBT. However, when talking therapies such as CBT aren't effective alone, pharmaceutical interventions may also be required. For example, to treat conditions such as PTSD, OCD and depression, a group of drugs called selective serotonin reuptake inhibitors (SSRIs) are often used. These inhibitors increase the amount of the neurotransmitter serotonin, which moves around the gaps between brain neurons, called the synaptic cleft or junction. Although the relationship between serotonin and mental health needs further investigation and clarification, studies have shown that an increase in its levels can improve the symptoms of many different mental health conditions.

Some uncommon alternative treatments are being used to alleviate certain mental health conditions. Transcranial magnetic stimulation (TMS) uses magnetic fields to stimulate nerve cells to treat depression and OCD. The treatment uses a coil, placed on the head, to emit magnetic pulses through the skull and into the brain. Although it remains unclear exactly why TMS can help alleviate symptoms after lengthy periods of treatment, it's been suggested that the magnetic fields change the firing patterns of neurons. Some studies have shown that around 50 to 60 per cent of people with depression who have not responded to other treatments have a 'meaningful response' to TMS. Of course, the treatment isn't without its side effects, which can include headaches, spasms in facial muscles and lightheadedness.

In recent years it appears the world has felt the impact of mental health, and awareness of its complexities and conditions has rapidly grown. Hundreds of millions of people around the world have been affected by a mental health condition and have sought treatment. However, there's still so much that's yet to be discovered about what goes on in our brains and how it impacts our health.

DID YOU KNOW? 20 per cent of people who experience a traumatic event will develop PTSD

DR GIORGIA MICHELINI

Following her research into neurodevelopmental and mental health conditions, Michelini tells us about mental health conditions and the future of mental health research


© Giorgia Michelini

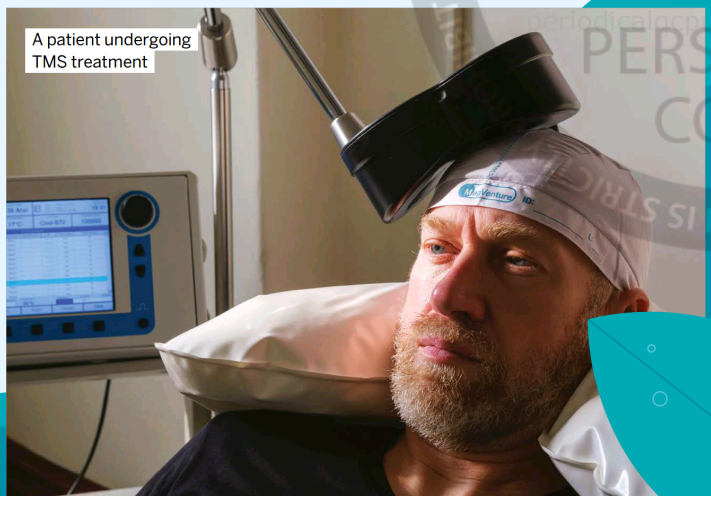
Has there been a rise in mental health conditions in recent years?
It's helpful to distinguish between different groups of mental health. There's a lot of talk about an increase in rates of autism, ADHD and neurodivergence in general. The consensus is more that there is an increase in recognition and awareness of these conditions, rather than them being more prevalent.

Studies that actually look at the prevalence of these conditions see that they're not actually increasing. When there are increases, they are more due to the changes in the way these conditions are defined. For example, about ten years ago there was a change in the way autism is described in diagnostic manuals – before there was a narrower group of people that were identified as autistic, and then we started talking about the autism spectrum, which encompasses a broader group of presentations. That's where we see that there's an increase in the number of people that will meet criteria, but in general if you apply the new criteria to the people before you would have seen roughly the same number. Similarly, with ADHD and autism it's really a matter of increase in the number of self referrals.

Another interesting trend is among other forms of mental health problems that are more related to anxiety and depression. I think there is more of a true increase there, and especially in the aftermath of COVID and during the pandemic. Many people have faced mental health challenges, and these have been triggered by isolation.

What emerging mental health treatments are there?
One area which is very interesting is trying to find better mental health treatment for neurodivergent people. Very often when somebody who's autistic or somebody with ADHD also experiences anxiety and depression, those concerns will be brushed under the carpet.

A very important matter is to first identify these additional mental health conditions in people who are neurodivergent, and secondly offer evidence-based treatments and intervention for them. The reason for this is that CBT or medications that are given to the general population don't seem to work well in neurodivergent people, which speaks to the potential different mechanisms that drive anxiety and depression in neurodivergent people.


A patient undergoing TMS treatment

HOW TO IMPROVE YOUR MENTAL WELLBEING AT HOME

GET INTO A SLEEP ROUTINE
During those precious hours of sleep, the brain is forming new neurological pathways to help your brain function optimally. Studies have shown sleep deprivation can increase the risk of some mental health conditions.

ADDRESS YOUR DIET
Food can play a key role in improving mental health. While there's no specific diet to help boost your mental health, studies have shown that diets that contain high refined sugars can worsen symptoms.

EXERCISE
Along with providing an alternative focus, exercise can help release hormones called endorphins. Endorphins can reduce stress and help relieve pain, which may be contributing to negative mental health.

CONNECTIONS
Several studies have found that maintaining positive relationships and 'social connectedness' can improve your mental wellbeing, whereas loneliness increases the risk of developing anxiety and even antisocial behaviour.

CHOOSE KINDNESS
Acts of kindness, especially to ourselves, can be beneficial to positive mental health, along with reducing stress and boosting self-esteem.

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