Methods to improve our well-being

The relationship between brain chemicals, known as neurotransmitters, and our well-being is a fascinating topic that has gained significant attention in recent years. Neurotransmitters are crucial for the communication between neurons and are fundamentally involved in regulating numerous bodily processes such as mood and emotions. Imbalances in these neurotransmitters can cause serious problems such as depression, anxiety and even addiction, therefore understanding how to manipulate the levels of these brain chemicals will be beneficial to our overall well-being.

Understanding neurotransmitters

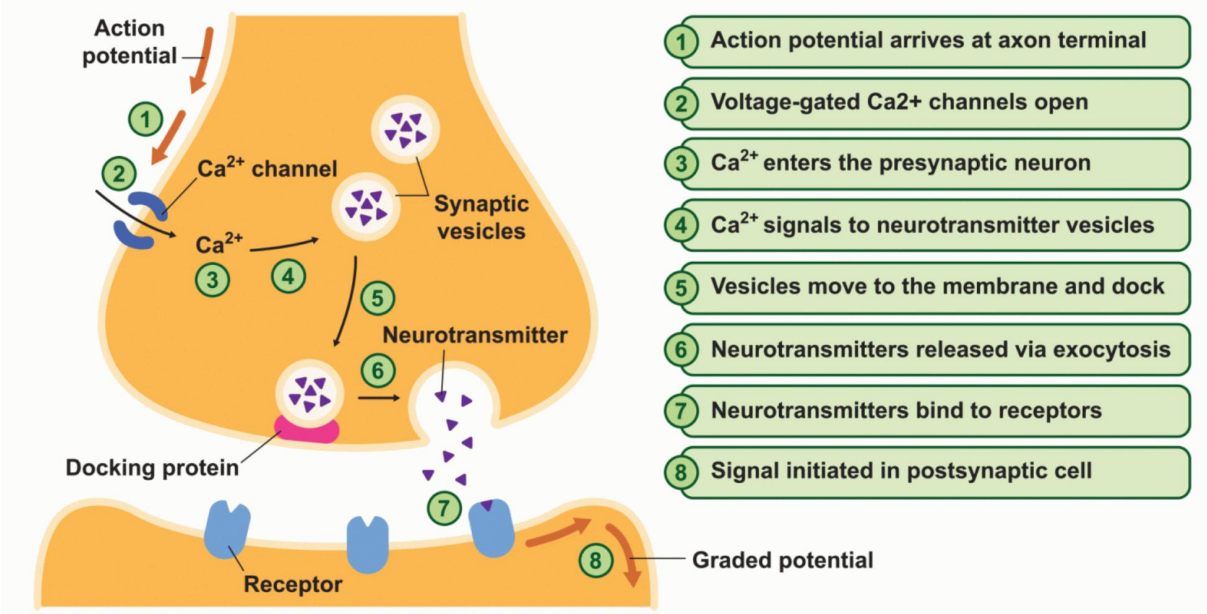
Whilst many neurotransmitters are responsible for enhancing our feelings of positivity, there are 4 main neurotransmitters which are directly related to our well-being: dopamine, serotonin, oxytocin and endorphins (Raypole, 2019). First of all, dopamine has a vital role in motivation, pleasure and reward (Julson, 2022), whilst serotonin is an excitatory monoamine (composed of one amino acid) neurotransmitter which is associated with regulating mood, appetite and sleep patterns. It is frequently referred to as the “feel-good” neurotransmitter (Raypole et al, n.d)

Oxytocin is a hormone and a neurotransmitter which aids in the function of the reproductive systems, and also in facilitating childbirth. It is known as the “love hormone” (Raypole,2020). Finally, endorphins are neurotransmitters which inhibit pain receptors. They are associated with feelings of euphoria, reduced stress and an increased tolerance to pain. Other neurotransmitters which contribute to our well-being include adrenaline, noradrenaline, and gamma-aminobutyric acid.

Exercise

Exercise is widely known for its health benefits, but one lesser known advantage is that it can increase the levels of neurotransmitters (dopamine, serotonin, endorphins, adrenaline and noradrenaline). A study by Robertson et al (2016) showed one group of former methamphetamine addicts had increased dopamine levels after exercise when compared to a control group (who were also methamphetamine addicts). The use of methamphetamine

increases dopamine receptors in the brain, therefore, the study was investigating if exercise had the same effect.



Neurotransmitters are sent across the synapse to their complementary receptors, in order to send a message. After they are sent to their receptors, reuptake occurs. Reuptake is when neurotransmitters get reabsorbed back to the presynaptic neuron (neuron in which they came from) (Guy-Evans, 2023).

During exercise, dopamine and endorphin levels increase, and the rate at which they are sent across the synapse is accelerated. This will lead to higher circulating levels of dopamine and endorphins, leading to the formation of their complementary receptors, which will increase levels (Reboud, 2023). Enhanced concentrations of dopamine makes one feel more motivated and pleasant, and the heightened endorphin concentration leads to feelings of euphoria. Exercise is also linked to increased serotonin levels (Young, 2007). Another study by Kocahan et al (2021) shows how serotonin levels in adolescent basketball players increased after they exercised. Exercise triggers the release of an amino acid named tryptophan, which is the crucial amino acid for serotonin synthesis (Raypole et al, n.d). This promotes the release of serotonin, contributing to an improved sense of well-being and reducing symptoms of depression and anxiety. Lastly, exercise promotes the release of the neurotransmitter adrenaline from the adrenal glands. The elevated levels of adrenaline raises your heart rate, allowing more oxygen into your body, leading to one's organs functioning better (MedlinePlus, n.d)

Exercising has a wide range of health benefits, such as improving your sleep quality, and decreasing the risks of diseases. Exercising aids in the regulation of the stress hormone levels (Basso et al, 2017) leading to decreased stress and improved feelings of tranquillity. Exercising promotes the production of BDNF, a protein which is fundamental for neuron growth (Sleiman et al, 2016), by increasing blood flow and oxygen to the brain. This allows neurons to obtain a higher capacity to store and send neurotransmitters to their receptors.

Meditation

Meditation is one of the most powerful mindfulness methods that has been recognized for its impact on overall health. One intriguing aspect is its ability to influence neurotransmitter levels. While the relationship between meditation and dopamine levels is still being researched, a study by the NIH (Kjaer et al, 2002) proves that meditation could increase dopamine levels. This is due to a 7.9% decrease in 11C- raclopride (an antipsychotic which acts as a selective antagonist, which inhibits dopamine receptors) binding in the ventral striatum, a part of the brain. When a subject is placed under an EEG (electroencephalogram), the decreased 11C-raclopride binding correlates to an increase in theta waves, which enhances dopamine release by 65%, correlating to feelings of satisfaction. Meditation not only increases theta waves in an EEG, but also alpha waves. This will then correlate to increased serotonin levels, which positively affects your mood, making you happier (Howard, 2022). Regular meditation can increase blood flow to the prefrontal cortex, which aids in stimulating the region in the brain that produces GABA, a neurotransmitter which aids in producing feelings of peace (Gugletti et al, 2013). Meditation also activates the hypothalamic-pituitary-adrenal axis (HPA-axis) in the amygdala and the paraventricular nucleus (which are both parts of the brain), leading to the increase in oxytocin levels in the brain, developing a sense of bonding and trust (Ito et al, 2019).

Meditation positively affects cognition. By regularly practising mindfulness, people can experience heightened concentration and attention (Columbia School of Professional Studies, 2021), as well as improving memory and decision making. This will correspond to improved productivity and efficiency in tasks. It can also diminish stress, by reducing the production of the stress hormone cortisol (Alhawatmeh et al, 2022). As a result, people obtain a greater

sense of peace and will be able to have more awareness of their emotions. This will then contribute to greater well-being and happiness.
As much as meditation can positively impact mental and emotional health, it can also contribute to physical health. Studies have shown that meditation can help lower blood pressure - leading to a lesser risk of cardiovascular diseases (Harvard Health, 2020)

Meditation, as mentioned previously, stimulates the prefrontal cortex, which produces GABA, a neurotransmitter associated with feelings of tranquillity. However, stimulation of the prefrontal cortex also promotes the release of glutamate, a neurotransmitter. Increased levels of glutamate has multiple symptoms such as hyperalgesia (unusually severe pain when the feeling pain is normal), anxiety and restlessness (Dellwo, 2022).

Diet

Altering your diet is one of the methods that is known to have a significant impact on the levels of neurotransmitters. Foods such as chicken, cheese, and avocados are known to increase dopamine levels as they are excellent sources of the amino acid tyrosine (Julson, 2022). Neurotransmitters are small polypeptide chains made from amino acids. For dopamine, the precursor (a substance in which another is formed during a reaction) is tyrosine. The food is broken down in the digestive system, releasing tyrosine, which then goes through a series of enzymatic reactions to produce dopamine (Bloemendaal et al 2018). The increased levels of dopamine promote positive feelings of motivation and satisfaction.

Similar to dopamine synthesis is the process of serotonin synthesis. A fundamental amino acid needed for serotonin production is named tryptophan. Foods such as fish, chicken and tofu are all rich in tryptophan (Raypole et al, n.d). Therefore, by eating tryptophan rich foods, serotonin levels will increase making you feel more happier. Dark chocolate is reputed for increasing endorphin production as it activates the pituitary gland, releasing beta-endorphins, hence, it fosters feelings of euphoria (Cafasso, 2017).

Tyrosine rich foods not only promote dopamine production, but also significantly enhance noradrenaline levels. The precursor for noradrenaline, is similar to dopamine’s precursor,

which is tyrosine. Increased levels of noradrenaline contribute to increased alertness and attention. Ingesting tyrosine-rich foods can provide the necessary precursor to maintain optimal adrenaline levels as well as noradrenaline levels (Van de Walle, 2018). Hence, optimal adrenaline levels can aid in improving cognition.

Tryptophan is the amino acid which is the precursor to serotonin, but also to melatonin. This means that tryptophan can also increase melatonin production as well as serotonin production (Levy, 2022). Enhanced melatonin levels can positively affect the sleep-wake cycle (Link, 2018). Eating foods rich in tryptophan will make you feel more calm, as it increases serotonin levels.

Eating dark chocolate has a beneficial impact on physical health: as it contains copper and potassium, which potentially prevents atherosclerosis (hardening of the arteries). Dark chocolate also contains flavonoids, which reduces the risk of a stroke (Callingham, 2023).

Socialisation

One of the main neurotransmitters which contribute to well-being during socialisation is oxytocin, also known as the “love” hormone. A study by Feldman et al.(2007) demonstrated how mothers and children that have engaged in positive social interactions had enhanced oxytocin levels. Oxytocin is released by the paraventricular nucleus during socialisation, therefore, this leads to improved feelings of trust, bonding and social connection. Endorphins also play a crucial role in socialisation. A study by Dunbar et al. (2012) found that partaking in laughter had enhanced endorphin levels. Similarly, taking part in interactive social activities such as team sports or dancing triggers the release of endorphins, profoundly impacting mood and well-being (University of Oxford, 2016). Socialisation also stimulates the ventral tegmental area in the brain, by activation of oxytocin receptors (Borland et al, 2018). The ventral tegmental area is well known to secrete dopamine (Cai et al, 2022), hence, making one feel like socialisation is a rewarding experience.

Socialization also plays a significant role in cognitive stimulation, fostering neuroplasticity - the brain's ability to form new connections and adapt to new experiences (Davidson et al, 2012). Regular social interactions require us to engage in conversation, problem solving and emotional recognition. These relationships stimulate the brain, leading to enhanced neural

plasticity and cognitive function. Socialisation also provides a sense of belonging and affection, due to the risen oxytocin levels. Social isolation gives rise to disorders such as depression and anxiety, therefore, by frequently socialising, the symptoms of depression and anxiety are greatly reduced, as oxytocin triggers the release of serotonin (Lefevre et al, 2017).

Socialisation has its own shares of drawbacks. In situations such as peer pressure and social anxiety causes stress (Cleveland Clinic, 2021), therefore, stressors in the brain are affected, triggering the release of the hormone cortisol. This will cause imbalances in the neurotransmitters dopamine, and noradrenaline (Dalvi-Garcia et al, 2021, and Cameron, 1995), giving rise to feelings of anxiety and restlessness.

Supplements

Dopamine

While there are many supplements to increase dopamine levels, the most popular supplement is a herbal supplement called Mucuna pruriens (Berkheiser, 2018). Derived from velvet beans, it contains a compound named levodopa, the precursor to dopamine. The levodopa is converted to dopamine by an enzyme named aromatic l-amino acid decarboxylase (Aldred, 2007).
In addition to increasing dopamine production, Mucuna pruriens impacts dopamine receptors. Studies suggest that the compounds in Mucuna pruriens act as dopamine receptor agonists. This means that they have the potential to bind and activate these receptors (Katzenshlager et al, 2004). These interactions enhance the feelings linked to improved dopamine levels, making one feel like they have achieved something.

Serotonin

One of the most common supplements which increase serotonin levels are known as SSRIs. SSRIs, or Selective Serotonin Reuptake Inhibitors, are a class of medications widely prescribed to treat various mental health conditions, most commonly depression and anxiety disorders. Examples of SSRIs include citalopram and fluoxetine.

SSRIs work by inhibiting the reuptake of serotonin by the neurons that released it. They bind to the serotonin transporter proteins present on the neuron's surface, blocking their ability to reabsorb serotonin back into the cell. As a result, more serotonin molecules remain in the synapse, enabling increased binding to the receptors on the adjacent neurons, creating feelings of positivity and alleviating symptoms of depression and anxiety (Chu et al, 2022)

Dopamine plays a crucial role in cognitive processes such as memory, attention and problem solving, as well as regulating mood. Therefore, consuming Mucuna pruriens serves a potential advantage as the increased dopamine availability can enhance cognitive performance, such as memory consolidation (EndurElite, n.d.). Mucuna pruriens helps the brain, but so does SSRIs. Research suggests that SSRIs can positively influence neuroplasticity (Andrade et al, 2010). By facilitating neuroplasticity, SSRIs can aid in the production of new neurons, promoting overall brain health. SSRIs have been proven beneficial in reducing symptoms associated with obsessive compulsive disorder, such as disturbing thoughts and compulsive behaviours (Himani, 2022).

Risks for all

As spoken with Dr Reboud, Leader of Biomedical Engineering at the University of Glasgow, a major disadvantage for all of these methods is that prolonged and intensive regimes of the activity can overstimulate the systems of the neurotransmitters, causing an overproduction of neurotransmitters, especially when taking supplements. An overproduction of neurotransmitters, especially of dopamine and serotonin can have adverse effects. An excess of dopamine contributes to aggressive behaviour and poor impulse control, similar to the symptoms of schizophrenia, while an excess of serotonin leads to a drug reaction named serotonin syndrome. It is life threatening with symptoms varying from mild (shivering, vomiting, diarrhoea) to severe (fever, muscle rigidity, seizures and even death, if not treated). Overstimulation can leave one with an increased tolerance to them. This will leave them with a desire for more intensive stimuli. While this adversely impacts one’s physical and mental health, this also contributes to the development of addictive behaviours (Reboud, 2023).

Conclusion

Neurotransmitters are chemical messengers which are essential for the control of our bodily processes. Manipulating the levels of the neurotransmitters by diet, exercise, meditation, social interaction and even supplements have shown a positive impact on our overall well-being, however, it is important that one does not do the methods intensively or for a long time, otherwise it can have a serious effect on both physical and mental health. A wide variety of neurotransmitters are responsible for making us feel better, but the 4 main neurotransmitters are dopamine, serotonin, oxytocin and endorphins. This further emphasises their important role in our well being.

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