1 The Importance of Exercise

Exercise is an 'all-rounder' as it improves our brain, cognition, mood, and physical health. Engaging in regular exercise is crucial for physical fitness. It helps in weight management by burning calories and increasing metabolism, and by reducing the risk of obesity and related health issues such as heart disease, Type 2 diabetes, and high blood pressure. Exercise also enhances cardiovascular health by strengthening the heart, improving blood circulation, and lowering the risk of stroke. It is also a great way to de-stress, relax, and improve sleep and a sense of wellbeing. Exercise significantly influences mental health and cognitive function. Regular physical activity releases endorphins, neurotransmitters that elevate mood and reduce stress, anxiety, and depression. It enhances cognitive abilities, including better memory, sharper focus, and increased productivity. Another wonderful aspect of exercise is that we can walk, run, or cycle on our own, or we can do so with friends, which makes it a nice way to interact socially. Participating in group workouts, sports, or fitness classes can create opportunities to meet new people, build friendships, and strengthen existing relationships. This social interaction contributes to emotional wellbeing, reducing feelings of isolation and loneliness. Team sports, such as football, have also been shown to be an excellent way to obtain the benefits of exercise. Golf, for example, is also a great social activity, and is a wonderful way to

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interact socially with different generations. In fact, many golfers continue into their 70s and beyond; remarkably, Phil Mickelson won the PGA tour at 51 years of age. Embracing exercise as a lifestyle choice improves our physical health, brain health, cognition, and wellbeing, and can foster vital social connections. The importance of exercise extends far beyond physical fitness. Making exercise a regular part of our routines can lead to a healthier, happier, and more fulfilling life. Whether through structured workouts, recreational activities, or simply staying active in daily life, prioritising exercise is essential for overall health and wellbeing.

There are two main types of exercise, aerobic and anaerobic exercise. Aerobic exercise, also known as cardiovascular exercise, is physical exercise of low to high intensity which depends mostly on the use of oxygen to meet energy demands. Examples of cardiovascular or aerobic exercise are medium- to long-distance running or jogging, swimming, cycling, stair climbing, and walking. Anaerobic exercise is a type of exercise that breaks down glucose in the body without oxygen. These types of exercise are often more intense, but of shorter duration than aerobic exercise, for example weightlifting or high-intensity interval training (HIIT). Anaerobic exercise may be used to help build endurance and muscle strength. As much of the exercise we do throughout the day is low-intensity aerobic activity, we therefore know more about the effects of aerobic exercise and many of the research studies have also focused on the effects of aerobic exercise. With any form of exercise, for better effects, it is important to raise your heart rate. However, if you have health concerns, you should consult your doctor prior to undertaking vigorous forms of exercise.

How do you know what intensity exercise you are engaging in? The intensity of exercise can often be measured through heart rate. For example, you can determine your maximum heart rate by subtracting your age from 220 (for a 40-year-old this would be 180 beats per minute). The target heart rate for moderate intensity exercise is 65–75% of your maximum heart rate and 77–93% for vigorous intensity exercise. So, for a 40-year-old, this would be 117–135 beats per minute for moderate and 139–167 beats per minute for vigorous intensity exercise (15).

Another way to measure the intensity of exercise is through metabolic equivalents of tasks (METs), where one MET is the amount of energy used while sitting quietly. Below are some examples of exercise of varying intensities as classified by METs (15).

- **Light intensity** – Uses 1.6–3.0 METs. Examples include walking at a leisurely pace.
- **Moderate intensity** – Uses 3.0–6.0 METs. Examples are walking briskly or cycling.
- **Vigorous intensity** – Uses 6.0+ METs. Examples are walking very quickly, running, or taking an aerobics class.

Staying Alive, Physical Health, and Exercise

Is exercise really that important for our health? In short, yes, exercise can be seen as an 'all-rounder' in the sense that it is good for our mood, our brain and cognition, and our mental and physical health. People have tried to determine how much exercise is required to provide benefits for physical

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health and longevity. Recently, there have been several studies that have determined that as little as 11 minutes per day of vigorous physical activity is associated with lower mortality, cardiovascular disease, and cancer risk (16–19). One study using a US cohort of 40- to 85-year-olds found that increasing their physical activity by 10 minutes per day could prevent 110,000 deaths per year (18). Interestingly, Garcia and colleagues (17) showed that the greatest risk reduction for mortality, cardiovascular disease, and cancers was associated with 150 minutes per week (21 minutes per day) of moderate-to-vigorous physical activity; however, physical activity greater than this duration had only minimal further benefits. But even half this amount, approximately 11 minutes per day, was associated with a 23% lower risk of early death. For those of you who are very keen on exercise, a study showed that the lowest rates of mortality were associated with 150–300 minutes per week (21–42 minutes a day) of vigorous physical activity, or 300 to 600 minutes per week of moderate physical activity (16). Overall, these findings suggest that even small amounts of physical activity on a daily basis can be greatly beneficial to physical health and longevity. While physical health is very important, the aim of this book is to focus on and highlight the importance of brain health, cognition, and wellbeing.

How Does Exercise Affect Our Mood and Wellbeing?

As you may have experienced for yourself, exercise boosts your mood, wellbeing, and outlook on life. In addition, people have more energy and motivation following exercise.

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Indeed, a large study of 31,000 people showed that physically active individuals reported lower depression levels than physically inactive peers (20). Similarly, a large study of 5,877 individuals aged 15–54 years showed that the levels of depression reported were directly related to the amount of physical activity people were doing. In other words, there was lower depression in physically active people than those who were non-active (21). But how does exercise enhance our mood and wellbeing?

You may have heard of a 'runners' high'; this is where endorphins are released and give you a sense of pleasure and happiness following intense exercise. Endorphins help relieve pain, reduce stress, and improve your sense of wellbeing (22). One study used a neuroimaging technique called positron emission tomography (PET), which measures chemicals in the brain. They showed that following 2 hours of running, participants reported an increased level of euphoria, which was associated with endorphin changes in the brain in regions involved in the processing of emotional states and mood (23). It has been suggested that other forms of less vigorous exercise can also release endorphins; however, there has been less direct evidence of this (24). While the 'runners' high' is generally thought to be due to a release of endorphins, this may not be the whole story and the exact cause of the 'high' is still not fully understood (25). We also still do not know the exact intensity of exercise required to experience the 'runners' high'.

It seems that both vigorous exercise, such as running, and more gentle forms of exercise, such as going for a walk, are able to reduce stress. But how exactly does this

work? When we're stressed, our body releases cortisol, a hormone involved in the stress response through our stress system called the hypothalamus–pituitary–adrenal (HPA) axis in the brain. Recent research shows that the intensity of exercise impacts how our body responds to stress. The more physically active we are, the less our stress system reacts to stressors (26). This may explain why exercise helps us feel less stressed. Even gentle exercise like walking can reduce stress. It might work by distracting us from whatever is stressing us; for example, some people practise mindfulness while walking. Exercise may also improve our sleep, or change other chemicals in the brain like serotonin (27). So, whether it's running or walking, exercise is a great way to beat stress!

It is well known that the neurochemical serotonin is involved in mood and emotion regulation and selective serotonin reuptake inhibitors (SSRIs) are often the first-line drug treatment for depression. Depending on the severity of depression, many people will need treatment with SSRIs, and evidence shows they are effective in many people. However, those with milder symptoms may prefer not to take drug treatments if that is possible and, unfortunately, some people experience unwanted side-effects with SSRIs, such as blunted or dulled emotions (28). Importantly, it has been suggested that serotonin can also be altered in ways other than through drugs, with exercise being one potential way (29). Indeed, the National Institute for Health and Care Excellence (NICE) includes exercise as a treatment for mild depression. There is a large amount of evidence for exercise being important for improving mood and wellbeing. One study conducted a 7-week exercise intervention and showed

that the exercise group had a greater change in serotonin and that this also improved wellbeing (30). These findings suggest that exercise improves mood and wellbeing. A further recent study (31) examined the effectiveness of a 16-week group-based running therapy for out-patients with mild to moderate depression and/or anxiety. They showed that the running therapy was equally effective as SSRI medication for reducing the mental health symptoms. However, the benefits to physical health were significantly better in those who participated in the running therapy. Interestingly, the study was designed so that participants could choose which intervention they wanted to be assigned to, and 68% chose to participate in the running therapy. These findings provide evidence that running exercise can improve our mental health and wellbeing, perhaps through changes in the brain. So, to keep our mood and wellbeing optimal, exercise is important. It is worth noting that many of the studies have focused on running, and more studies need to be conducted on other forms of exercise. In addition, studies comparing different forms of exercise are needed. However, while the available studies suggest that running does seem to be an effective exercise to positively affect our brains, other forms of more gentle exercise are still beneficial and may be more suitable for many of us.

The Importance of Exercise for Brain Health and Cognition

Exercise is not only beneficial for our mood and wellbeing, but has also been shown to boost brain health and cognition.

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An article (32) examined data from 98 studies with 11,061 participants, and included older healthy adults, patients with mild cognitive impairment (MCI), and patients with dementia. Their results showed that the duration of exercise was associated with better cognitive outcomes, specifically that an average of 52 hours of exercise over a mean duration of 6 months (120 minutes per week) was required for improved cognitive outcomes. A 2023 study using accelerometer-measured data, through a wearable activity monitor, in over 91,000 participants aged 40 to 69 years from the UK BioBank, showed that both moderate and vigorous physical activity led to increased cognitive functioning (33). These studies further show that physical exercise is vital for good cognition and improving our lives. Exercising consistently is important, but it may not be practical to do on a daily basis, particularly if you are stuck travelling long distances; the important thing is that you fit regular exercise into a schedule that works for you.

So, how is it that physical exercise can improve brain function and cognition? There may be a number of mechanisms involved. Studies have shown that exercise may increase brain plasticity. Brain plasticity has been defined as the brain's ability to change – for example, when we learn. Brain plasticity is also how the brain reorganises after brain damage to help us recover. One way in which we can measure brain plasticity is through proteins known as brain-derived neurotrophic factors (BDNF) that stimulate and control new brain cells. BDNF is involved in brain plasticity by increasing the number of synapses, as well as the branches and growth of developing neurons. Synapses are

particularly important in brain functioning as they allow transmission of chemical and electrical signals from one neuron to another. Essentially, synapses and neurons are how our brain communicates. Neuroplasticity is important for cognition, mental health, and wellbeing, and may be one possible mechanism by which exercise is beneficial for these domains. Research has shown that brain plasticity increases with exercise, specifically in the hippocampus, which is a brain region that is essential for learning and memory (34). One study using a randomised control design in 120 older adults also showed that the group who engaged in exercise had higher levels of serum BDNF and improvements in spatial memory (35). Spatial memory is our ability to remember where objects and places are located in the space around us, but it is also very important for navigating and finding our way around. The brain region called the hippocampus is essential for spatial memory. For example, Eleanor Maguire and colleagues (36) did a brain imaging study on taxi drivers in London, who have to remember the location of places, and navigate the best route, therefore using spatial memory a lot. They showed that the greater the time spent in their occupation, the larger their posterior hippocampus was. This demonstrates the importance of the hippocampus for spatial memory.

Exercise, specifically cardiovascular exercise, affects the way that blood flows in the brain (37). With cardiovascular exercise, there is an increase in heart rate, which results in greater blood flow, and this increases oxygen and nutrient supply to the brain. One study examined healthy older men who were relatively sedentary. Participants

were randomly assigned to a fully supervised aerobic exercise training programme or a no-exercise control for 8 weeks. The results showed increased blood flow in the brain following exercise training, which was associated with increased executive function performance, specifically cognitive flexibility, as measured by the CANTAB multi-tasking test (38). This physiological response may be another potential mechanism for how cognition is improved by exercise.

Aerobic exercise has also been shown to affect brain volume, or the size of the brain. For example, one study examined older adults aged between 59 and 81 years and showed that their heart and lung fitness was associated with the size of the hippocampus (39). This increased hippocampus size was in turn associated with better performance on a spatial memory task (40). The finding that exercise can increase hippocampal volume is important considering that the hippocampus is especially affected by the ageing process, particularly in Alzheimer's disease; as such, these findings suggest that exercise may be a good way to prevent age-related brain and cognition changes. It has been suggested that increased BDNF is related to hippocampal volume, and aerobic exercise is related to the levels of BDNF and larger hippocampal volumes, and ultimately impacts learning and memory (35, 40). Similar research has been conducted in younger populations and has also found that aerobic fitness is related to larger hippocampal volumes (41) and better memory performance (42) in pre-adolescent children. Again, this finding is important as it may suggest

that exercise is able to help build cognitive reserve (3), which is important for good brain health and wellbeing, but is also protective against age-related cognitive decline. No matter your age, to be able to continue to learn we need brain plasticity, so keep up the exercise because it is a great all-rounder that affects not only your physical health, but also your brain, cognition, and wellbeing.

Keeping Our Body Fit Will Keep Our Mind Fit Too

In summary, doing some exercise is much better than being sedentary. If you can exercise and raise your heart rate, then that is even better. When selecting exercise, choose something that you enjoy, so that you will continue to do it on a daily or weekly basis. Try to build it into your work schedule so that it becomes a routine or good habit. Doing exercise with a friend or family member tends to make it more fun and helps to ensure your commitment. There are several fun runs and half marathons hosted in a number of locations worldwide, so why not find a friend and set yourselves a goal to take part? Many of these are used as an opportunity to raise money for charities, so this is also a great way to give back to the community. Also, consider in your daily life where you can increase your exercise – for example, by walking or cycling to the train station or to work. Exercise tends to give you greater energy for achieving your goals at work and at home and also makes you feel more positive about your life and the world around you, which means you will enjoy life more.

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- Find an exercise that you enjoy and can fit into your schedule.
- If you are not sure what exercise is right for you, try a few different ones, such as cycling, running, swimming, or golfing, perhaps with friends, and find the one you like the best.
- If you don't currently exercise, build up slowly and try to exercise every day. If you already exercise, maintain that level and try to build on it. Some people like to monitor their exercise with apps or technology, so this may help to keep track of your exercise.

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