



## The Role of Physical Activity and Exercise in the Prevention and Treatment of Depression

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### Abstract:

Depression is a term that refers to a clinical syndrome or disorder characterised by a feeling of hopelessness or unhappiness. Symptoms include weight loss with loss of pleasure, sleep changes (i.e. insomnia or hypersomnia), psychomotor agitation or regression, fatigue or loss of energy, feelings of worthlessness or excessive guilt, reduced ability to think or concentrate, and recurrent thoughts of death. Basically, treatment consists of pharmacological and psychological interventions. Although these treatments are effective, not all patients achieve the same results. In this case, alternative approaches are needed to prevent and treat depression. Our literature review shows that high levels of physical activity and exercise have protective effects on depression cases. In combination with other treatment modalities, exercise and physical activity may lead to a more rapid improvement of the clinical picture. In this article, we reviewed the current literature on the use of physical activity and exercise for the prevention and treatment of depression.

## 1. Introduction

Depression is a serious mental health disorder that seems to be increasing in prevalence in modern society. Identifying effective preventative measures and available treatment options is important, considering the disorder's high levels of chronicity and associated disability and suffering [1,2]. This essay briefly describes some of the main causes of depression before arguing that physical activity and exercise can play a significant part in both prevention and treatment of the disorder. A brief overview of how neuroscience explains the effects of exercise on mental health is provided, followed by a discussion of the potential impact on society and government policy necessitated by more holistic approaches to health [3,4]. Depression is a significant cause of disability worldwide. Rising incidence and high chronicity rates indicate that depression is not being effectively treated either by medication or existing psychological therapies. Given the difficulty associated with large-scale preventative measures and the social context of mental illness, some researchers are proposing a greater focus on various lifestyle factors and preventative measures [5]. As such, those experiencing depression need a wide range of

treatments to help manage their condition, including psychotherapies, medications, and preventative measures. Depression is a real brain disorder caused by a variety of both genetic and environmental factors. There are many reasons people get depression, including childhood factors, and it is suggested that the initial cause is a consequence of various genetically determined and environmental vulnerabilities accruing over time [6-9].

## 2. Understanding Depression

Depression is a common disorder. It is not something that one can control, and it is not a matter of "snapping out of it." Depression is different from an occasional feeling of sadness or being "down." It is a serious and, contrary to popular myths, a real illness with symptoms that include a persistent sad mood and a loss of interest or pleasure. It also includes physical symptoms such as changes in appetite, weight, and sleeping patterns, a decrease in energy, tiredness, headache, and cramps. It has cognitive symptoms, such as thoughts of worthlessness and guilt, diminished ability to concentrate, think, or make decisions, and has direct consequences on behaviour, for example, physical slowing or agitation, restlessness, frequent weeping

spells, and social withdrawal. The specific combination of these symptoms and their severity is used to diagnose the disease [10, 11]. Depression is a leading cause of disability worldwide and is a major contributor to the overall global burden of disease. The lifetime prevalence rates in the general population range between 8% and 12%. Further, by the year 2020, depression is expected to become the second leading cause of disease burden worldwide, second only to ischemic heart disease. Estimates of the worldwide economic burden of depression are not yet available. There are some data, however, from the developed world, which suggest that the cost of untreated depression can add up to billions of dollars per year. Awareness of depression is low. Stigma is a major barrier to the treatment of the disorder, since many people would rather suffer in silence because they are afraid of feeling isolated and rejected by others. It is often easier to say, "I have pneumonia" than "I am depressed." Moreover, when people think of depression, they think of an illness of the mind, which can be easily shaken off if an effort is made. This can further result in individuals feeling guilt and "blame," on top of the severity of their disorder. Given the potential impact of stigma, it is important to consider that physical activity might be viewed differently. We know it is important to engage in physical activity to maintain our physical health. Further, individuals feel that they are making "an effort" to combat something (depression) through "activity" [6, 8].

## 2.1. Definition and Symptoms

### Depression

Depression is classified as one of the mood disorders and is the leading cause of disability worldwide. People who experience depression feel down and have a decreased interest or pleasure in almost all activities. Throughout the day, they may feel fatigued, tired, lose their motivation to engage in physical activities, feel worthless or guilty, and may have recurrent thoughts of death. Many symptoms typically characterize depression, as well as having the characteristic of a heterogeneous clinical presentation, contributing obstacles to the diagnostic action. Moreover, a subdivision of "major depression" and "minor depression" is required, even in general population studies [12, 13]. The different levels of severity and duration of major and minor depression require a more suitable adjustment of the diagnostic frames, which extend the concept of single, typical depressive episodes to that of recurrent chronic moderate depression, typical in cases of medical special care outside a psychiatrist. Patients who meet the diagnostic criteria for major depression syndrome, in parallel with their psychological symptoms, may develop multiple

clinically significant physical symptoms, such as sleep disorders and changes in eating habits, with consequent reduction in body weight, but also moderate anorexia. This can lead to a loss of social relationships and impairment of work performance [14, 15]. In the clinical field, major depression is often difficult to diagnose because patients may disclose the symptoms, they experience differently from what is described in diagnostic manuals or provide a subjective account differing from the actual condition. A consequence is that some of the symptoms, at first apparent within the clinic, can be inadequately diagnosed or neglected. The attention paid by general practitioners to physical health and the co-occurrence of somatic disease between physically ill individuals and depressed patients is ubiquitous in medical settings, yet few are acquainted with the diagnostic criteria and symptomatology typical of severe depression or its minor form [16]. Depressive disorder is mainly characterized by cognitive symptoms (persistent sadness, decrease in the ability for formal and informal thought, perception of being strong or ill, poor ability to sleep), emotional symptoms (decreased interest in pleasurable activities, poor motivation, lowered energy level, decreased attention, disinterest, perceived uselessness), and physical symptoms (fatigue, restlessness, slowed movements, memory degradation, sadness, material disorder, and loss of vitality). People with depression show not only cognitive symptoms but also many physical symptoms [17]. These symptoms can be reported in all types of depression. Clinical depression and ordinary emotional vulnerability are not the same. People with depression do more than feel sad. Along with the characteristic mood problems of depression, it can induce physical signs, such as a sensation of chronic tiredness, that can impair overall health. Whether you're sad, these symptoms might persist, signifying that the dips of daily life are typical and not indicative of a clinical ailment [18-21].

### 2.2. Prevalence and Impact

Depression is a major public health problem, disproportionately affecting certain demographic groups such as women, people in lower socioeconomic groups, unemployed people, and those with fewer family and social contacts. In 2019, 6.1% of Americans had at least one major depressive episode each year, with 17.1% of people experiencing depression during their lifetime [22]. Women are 1.5 to 3 times more likely to develop major depressive disorder than men. Major depressive disorder often begins between the ages of 20 and 30, though it affects all ages. The risk of having major depressive disorder is twice as high in

adults aged 18-24 as in those aged 55 and older [23]. Depression affects more than 264 million people globally. It is the leading cause of disease burden worldwide and one of the leading causes of disease burden in developing countries. It is the leading cause of disability for people aged 5 years and older. Depression is the leading cause of disability among non-fatal diseases. Moreover, major depressive disorder is a significant cause of suicide. Unipolar depression is the most significant contributor to corporate productivity losses of all diseases [8, 24-26]. Research suggests that depression has serious consequences if it is left untreated. It can lead to the development of other psychiatric illnesses and chronic diseases such as diabetes and heart disease. Depression may make symptoms of these comorbidities worse [27]. The incidence and impact of depressive illness underline the importance of treating and preventing it. Because current treatments are not completely effective, prevention is a priority in reducing its incidence and overall impact. The risk of developing depression is increased by cognitive risk factors [28, 29]. Cognitive restructuring is a common part of therapy for depression. Models of the aetiology of major depressive disorder will not succeed in treating and preventing major depressive disorder completely if they stop short of addressing some aspect of the defence program or adaptive profile that interacts with the environment. This is where health behaviours, especially mental health behaviours, come in. Given the potential pressures on health services, the consequences of mental health issues, and the large numbers of depressed individuals in the population, it could be argued that depression is the single most important mental health issue for public health to address at any one time because of the sheer scale of the problem [30-32].

### 3. Physical Activity and Exercise: An Overview

Physical activity and exercise are often used interchangeably in the literature, but they are conceptually related yet distinct. Cardiovascular exercise, stiffness exercises, flexibility exercises, recreational activities, leisure activities, physical activities of daily living, occupational or work activities, and unstructured physical activity are all technically included as methods of physical activity [33, 34]. Physical activities become "exercises" when characterized as a "structured" activity. In other words, exercise involves regular participation in physical activity, with the explicit goal of:

- 1) reducing symptoms of disease or pathology.
- 2) enhancing and/or optimizing health status.

Engaging in non-exercise physical activities is recommended in addition to a structured exercise program and is not intended or optimal to achieve the safety and health benefits strictly related to exercise [34, 35-38]. Even the nutrition guidelines now include a suggestion for a regular physical activity program. The inclusion of exercise as an essential dietary component contributes significantly to disease prevention, healthier aging, optimal weight management, alleviating stress and anxiety, accommodating normative life events, reducing symptoms of chronic conditions and diseases, and is linked with pain management. From the aspect of psychology, "aerobic" exercise has been eagerly endorsed as a panacea for depression, anxiety, and tension [39]. It is believed that regular participation in physical activity and/or exercise, fitness or performance contributes to improvements in psychological well-being, effectual reductions in stress, and enhancements in cognitive functioning. Nonetheless, the extant empirical evidence has tended to be less robust and has generally shown only modest effects. Determining the true psychological effect of exercise is limited by the many confounding variables [40]. We need to continue to delve deeper into unravelling the complex synthesis of psychology and the physiology of the effects of habitual exercise and physical activity. We also need to disseminate more realistic information, consistent with modern scientific mechanisms, to the public because most people have been provided erroneous information about the effect of the level of exercise and characteristics related to the anti-depressive effects of varying exercise intensities [41-43].

#### 3.1. Definitions and Types

Physical activity, also referred to as movement, is a universal human behaviour that is typically reliant on one's physiological state, requirements, and barriers of daily life, and is influenced by the sociocultural norms of each country [44]. Exercise is a subcategory of physical activity that is planned, structured, repetitive, and purposive in the sense that the improvement or maintenance of one or more components of physical or psychosocial health is the objective. This contrasts with structured activities, which are generally performed during a specific period, require a group of people to play against or with, and have specific sets of rules. From intensity and duration perspectives, physical activities can be categorized as low, moderate, and vigorous, as well as light versus heavy and short versus long. In terms of the modality of movements, the activities can be divided into aerobic, anaerobic, and therapeutic and recreational activities [45, 46]. Moderate exercise is defined as a level at which physical fatigue can be

felt, the heart beats faster, and the body perspires, and one can still engage in a conversation, while engaging in vigorous exercise, which is difficult to continue for a long time without cessation [47]. Moderate to vigorous exercise improves health at the following levels: moderate intensity is 40–60% HRR or VO<sub>2</sub>R, while vigorous intensity is 60–80% HRR or VO<sub>2</sub>R. Clinical studies have demonstrated that different forms of exercise can lead to a decrease in scores on the Montgomery-Asberg Depression Rating Scale or Hamilton Rating Scale for Depression in patients with clinical depression [48]. Because of the wide variety of physical activity, it is important to select one's preferred mode, intensity, frequency, and duration to achieve long-term adherence to the final program. Any form of motion is better than just being sedentary [49, 50].

### 3.2. Benefits for Physical Health

Regular exercise and physical activity lead to a wide range of health benefits as far as physical health is concerned. For example, regular exercise can help to reduce the risk of developing cardiovascular diseases. Over time, exercise and physical activity training can increase the size of the heart and lower resting heart rate. It has also been observed that both body fat and muscle mass can improve, with fat tissue decreasing while muscle mass increases, especially with strength training. In addition, regular exercise is important when one is looking to improve their flexibility [51-53]. Another advantage of regularly engaging in exercise and physical activity is that it can help with weight management. Not only will an exercise regime help prevent obesity, but it can also help individuals reduce body weight, body fat, and for those who have lost weight, stabilize body weight. Moreover, regular physical activity helps develop a state of hyperinsulinemia, increasing the excretion of insulin and having greater and prolonged control over blood glucose levels [54]. When this is done, one can reduce the risk of suffering from type II diabetes. Improvements in cardiorespiratory function are critical because they reduce the risk of developing non-communicable metabolic diseases such as hypertension and diabetes. Moreover, the muscular system plays a key role when it comes to preventing and treating metabolic diseases because muscles function as a sink for glucose.

One can easily relate physical health to mental health. When one's physical well-being is guaranteed, chances are that their mental and social well-being will be guaranteed as well. In addition, people who are physically fit because of physical activity and exercise are usually emotionally stable [55-59].

### 3.3. Benefits of Physical Activity for Mental Health

Regular physical activity and exercise have also shown a favourable effect on self-reported symptoms of anxiety and depression, as well as promising signs for the prevention of developing a subsequent depressive episode [60]. Evidence is overwhelmingly consistent across a vast majority of studies, demonstrating exercise-related reductions in symptoms of depression in a diverse range of cancer and various disease/pathological conditions, including multiple sclerosis. Multiple mechanisms for the protective role of physical activity on depression have been suggested and investigated, including the endorphin hypothesis and the possible consequences of increased self-esteem due to the satisfaction of being able to manage change and physical improvements such as weight reduction and enhanced body image [61, 62]. One of the most popular suggestions is known as the 'Endorphin Hypothesis.' According to this hypothesis, exercise contributes to and stimulates the release of endorphins or 'feel-good' neurotransmitters, producing an increase in positive mood and a decrease in painful symptoms. While some endorphins are not able to cross the blood-brain barrier, allowing free circulating plasma endorphins, levels of blood plasma show a high positive correlation with the release of beta-endorphin from neurons of the anterior lobe of the pituitary gland [63]. Additionally, engagement in regular physical activities and exercise can improve daily symptoms related to depression. Patients with intense depression, especially during the Covid-19 lockdown, treated their depression by exercising at home [64]. Participants are encouraged to combat loneliness by participating in concerts or joining weekend hiking groups. Participation leads to new friendships, a sense of community, fun, and laughter, helping individuals return to a normal social life after years of living in seclusion [65, 66].

### 4. The Link Between Physical Activity and Depression

There are both biological and psychological ways in which doing physical activities can directly benefit depression. Firstly, physical activities—specifically exercise—have biological effects on the brain and neuron systems. That means that going for a run, working out at the gym, or simply walking around the block can change brain chemistry and neurotransmitter activity in a way that almost instantly enhances mood and reduces depressive symptoms. Exercise has been shown to increase the production of endorphins, natural substances in the

body that reduce pain and discomfort while increasing emotions and pleasure. This effect is thought to help counteract depressive symptoms and to be helpful for treating depression. Doing exercises such as yoga or tai chi can help people stay active, and it has been reported to benefit their mental health. Serotonin, another substance in the brain that has a biological link to depression, also plays a role in mood improvements with physical activities. Changes to serotonin in the brain occur from physical activities, particularly with increasing the amount of exercise. There are many theories of how exercise can help regulate improperly released chemicals and other substances in the brain, and changes to blood flow to the brain [63, 67, 68]. Besides biological effects, physical activities could improve how people feel inside, to think about themselves, and to reduce stress. This mental impact of physical activities on depression is particularly important because people who are affected by depression may lose a sense of who they are and what is happening in their lives. Feeling a sense of worth and achievement and feeling like they have some control over their future, can be a big challenge for people with depression. Physical activities help to achieve these goals because they generally involve maintaining set aims and reaching goals step by step [69]. On the most elementary level, depression is typically linked to feeling beaten down and as though people have lost all hope. Exercise, and its positive effects on the body, can be a powerful distraction from these negative thought patterns. Shaking off a negative cascade of stressful thoughts, engaging in a single act such as exercise may provide the benefit of enhancing self-efficacy, after which improvements in depression start occurring. There is a correlation that exists in the relationship between regular physical activities and less severe cases of depression. Severe depression occurs more frequently in those who do not exercise regularly as opposed to someone who exercises regularly [60].

#### 4.1. Biological Mechanisms

Increased physical activity changes the body and its functions. On the systemic level, exercise improves vascular function, and therefore the function of the brain, by increasing the total blood flow to the brain. Physical activity, continued a regular basis, is one of the most efficient ways of increasing new brain cells, a process also called neurogenesis. The associated molecular mechanisms seem to overlap significantly with those involved in the development of depressive symptoms, such as decreasing brain-derived neurotrophic factor or the induction of tryptophan-kynurenine metabolism, resulting in the production of immune-reactive metabolites when

microglia are involved. Furthermore, physical exercise has a direct impact on some neuromodulator systems in the brain. Neurons that are excited by the neurotransmitter norepinephrine are part of the central regulation of emotions and are involved in the stress system [70, 71]. Furthermore, regular and moderate physical activity results in an increased production and liberation of endorphins. On this basis, in conjunction with the monoamine hypothesis, the same group postulates the endorphin hypothesis [72]. Endorphins have an analgesic effect, but also function as tranquilizers and happiness hormones, responsible for physical constitution as well as the elevation of mood in humans. The idea of endorphin release as an antidepressant effect has been confirmed by a study of untrained patients with major depressive disorder, which revealed a significant reduction in the HDRS total score after a one-week moderate endurance intervention. Physical exercise triggers the production of various proteins, which lead to immune processes and decrease the risk of developing infections and diseases through their anti-inflammatory effect. Inflammatory processes can coincide with depressive symptoms. For example, pro-inflammatory cytokines appear to be able to positively influence neurotransmitter levels, such as decreased serotonin. Regular physical activity stimulates overall brain health and builds the capacity of individuals to withstand stress more effectively [73-76].

#### 4.2. Psychological Mechanisms

Exercise is also thought to boost emotional health through a few psychological mechanisms. First, it is proposed that exercise contributes to enhanced mental health by serving as a powerful stress reliever. A significant positive relationship also exists between exercise levels and subjective well-being, and research has indicated that those who regularly engage in vigorous exercise have less vulnerability to anxiety or depressive symptoms. Second, physical activities fill up time and give a sense of achievement, raising the individual's self-efficacy. Interventions that focus on increasing valued activities and achievement levels may produce greater therapeutic benefit, particularly for those who are depressed [77]. A third psychological mechanism centres on the positive outcomes of social support. Physical activities can be group-based, and this exposure to different social contexts has also been associated with individual well-being. Participants who actively engage in clubs, including sports clubs, are found to have a higher life satisfaction than those who are not involved in clubs. Exercise can also reduce social isolation and loneliness, commonly experienced by depressed

persons, thus preventing increases in core depressive symptomatology [78, 79]. Fourth, regular physical activities can also involve doing something that demands attention or effort, breaking the depressive cycle of negative rumination. Some people use exercise to take time out—I go into a vegetative state, feeling tremendous effort. I just push myself 100 percent, then just collapse or push my body to the limit.' Also, by engaging in a physical activity, individuals may encounter pleasant sensory experiences, such as the smell of flowers in a garden or the beautiful scene in a park [60]. In this way, participants may engage in the activity for the unexpected positive experiences that happen during the activity. Finally, scheduling the exercise can give the participants a structure to their day, leading to mood-stabilizing routines for people whose depressions are related to boredom or erratic daily routines. Given these psychological factors, it is proposed that engaging in regular physical activity is an enduring adjunct to established psychological therapies. They do not fare well as a sole treatment, though [80-82].

## 5. Evidence-Based Strategies for Incorporating Physical Activity and Exercise in Depression Management

With a growing body of evidence establishing physical inactivity and sedentary behaviour as risk factors for developing depression, researchers, clinicians, professional organizations, and community and country-level agencies have recommended strategies for integrating physical activity and exercise in prevention, treatment, and maintenance protocols for depression [83]. This section summarizes four evidence-based strategies developed to assist a variety of practicing health professionals in integrating regular physical activity into evidence-based depression management protocols.

The goal of this section is to ensure that the evidence is translated into practical guidelines for individuals with depression, behavioural change approaches, and psychotherapeutic and physician counselling guidance. It is our hope that these strategies will motivate sedentary individuals experiencing depression to act and will offer a range of evidence-based strategies for practicing healthcare professionals to consider when working with their clients. The four strategies in this section are as follows:

1. Agreed Antidepressant Prescription Brainstorming Activity
2. Freestyle Physical Activity Planning
3. Activity Jobs Activity

4. Physical Activity Report from a Psychiatrist [84-86].

### 5.1. Guidelines and Recommendations

If you or a loved one are considering using physical activity as part of the ongoing management of low mood and depression in the short or long term, keep the following in mind: Consistency is more important than intensity; start with manageable amounts of exercise in your training zone and increase your activity gradually when you feel ready. Choose something you enjoy; combining something fun is likely to make you feel better, as well as keep you more motivated to keep practicing [87]. Some people really enjoy house cleaning and happily incorporate this into their exercise plan. Set realistic and achievable goals; find time to do your chosen activity most days of the week for 20-30 minutes. You are even able to take a 10-minute walk in the morning, as this will increase your weekly exercise time considerably [88, 89]. Frequency of exercise: at least three times per week has been associated with a low risk of depressive symptoms in individuals who have never been diagnosed with a mental health issue. However, the literature does suggest that daily physical activity is associated with less risk for depressive issues. Duration of exercise: over several decades of research, 60 minutes of moderate intensity physical activity for those without depressive symptoms has been associated with a low risk of symptoms of poor mental health. However, beginners to physical activity can still gain benefits from exercising at levels which may seem easier. Monitoring progress: as well as benefits to physical health, some individuals indicate that they prefer to use a pedometer to monitor their walking activity. The pedometer helps to sustain motivation to achieve daily step goals and provides a sense of accomplishment [90, 91].

### 5.2. Barriers and Solutions

Among the most common barriers cited by people affected by mental health challenges are not feeling motivated to be physically active, feeling like physical limitations make it impossible to stick to a routine, finding it close to impossible to initiate an exercise regime, and not having the support to live a healthier life, which includes activity. Identifying these potential barriers is a good first step; however, it's only the first of many steps to creating possible solutions. One possible solution to lack of motivation is to work out with a buddy or in a group. This increases the likelihood that people will engage in regular physical activity. If you can organize social exercise, the best chances for success rest in setting a regular time and place, creating conditions that people find fun and enjoyable. Training

regimens such as boot camps reinforce the value of mutual support and are rapidly growing in popularity. Some people dislike the environment in which we expect them to exercise. It might be the gym itself, or it might be the long drive that it takes to get there. The prevalence of various forms of exercise devices in a commercial gym includes enough variety to serve the needs of most people, but it is overwhelmingly not their trainer's priority. It is recognized that not everyone can afford to join a gym or have the expertise to know what to do on their own, which is fine [92]. Plus, there are many other strategies that can be employed without a gym, like climbing the stairs or taking the dog for a walk. The best exercise regimens for maintaining adherence of muscle-specific efforts are cost-free; if you want, you can incorporate a small financial investment as you become more fit. Lots can be achieved to help you move more in either familiar or new environments at no cost. Finally, given the polished place that your device holds on the counter or in your bag or pocket, the availability of apps and the potential for building in different kinds of physical activities make this a resource that can't be overlooked. There are all kinds of ways to be resilient and exercise our creativity [93, 94].

## 6. Conclusion and Future Directions

In conclusion, it is evident that physical activity has a crucial role in the prevention and treatment of depression. Current evidence points towards both biological and psychological explanations for the relationship between physical activity and mental health, including reduced inflammation, increased neurogenesis, increased endogenous neurorestorative functions, and improved self-efficacy. The optimal intervention duration and intensity are yet to be determined, and future studies should explore the long-term and sustained effects of exercise on depressive symptoms [95]. Despite the challenges ahead, evidence highlights that healthcare professionals should place physical activity in a more central role in integrated, holistic approaches to the treatment and management of depression [46, 60, 96]. Exercise is an effective method for the prevention of depression, and there is evidence to suggest that physical activity is an effective additional treatment to traditional treatment methods for the prevention of depression. Further longitudinal research should examine the sustained effects of physical activity on preventative measures in individuals not meeting the clinical threshold for depression. Future research should also explore the potential benefits of individualized exercise programs compared to standard community physical activity referral schemes, particularly for

those in the population with increased risk. Finally, the benefits of physical activity for individuals with severe depression and those requiring more intensive care to reduce symptoms and aid recovery is an area that needs further research to explore if and how this could occur safely and effectively [44, 97, 98, 99].

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