Chapter

Mental Health Conditions and Exercise

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Abstract

Mental health conditions are a major public health issue affecting many people worldwide. Evidence suggests that physical activity and exercise can prevent and treat mental health conditions, especially depression and anxiety. Several mechanisms are involved in the relationship between mental health conditions and exercise, from neurobiological to behavioural mechanisms. This chapter intends to explain the main mechanisms that explain that interaction and present recent evidence from studies that analyse the effects of exercise on mental health outcomes. It also highlights the principles of physical exercise (frequency, intensity, volume, and type) and how they can influence the main outcomes of mental health. Engaging in regular physical activity may prevent the onset of different mental health disorders. Also, evidence shows that exercise diminishes depressive symptoms. This chapter is indicated for health professionals who wish to have a broad view of the relationship between exercise and mental health. This knowledge can be valuable in designing public interventions that aim to treat mental disorders and optimise mental health.

Keywords: depression, anxiety, lifestyle, physical activity

1. Introduction

Mental health is a multidimensional construct comprising emotional, psychological, and social dimensions of well-being [1]. In 1948, the World Health Organization stated that health is a complete physical, mental, and social well-being and not merely the absence of disease or infirmity. Although so many years have passed, many sectors of society continue to neglect mental health. There is still a stigma about mental health, which causes prejudice about the person suffering from a mental health disorder. Mental health disorders affect relationships with others, education, and work opportunities [2]. People with severe mental disorders are at the most risk of poverty and unemployment [3].

Mental health conditions are a global issue that increasingly affects people worldwide. It is estimated that one in every eight people in the world lives with a mental disorder [4]. Mental health conditions impact other health outcomes,

including cardiovascular disease [5], premature death, and all-cause mortality [6]. Mental disorders account for 32.4% of years lived with disability (YLDs) and 13% of disability-adjusted life-years (DALYs) [7]. Major depressive disorder explained 16 million suicide DALYs and almost 4 million ischemic heart disease DALYs [2]. Also, mental health causes global and national economic loss, and depression and anxiety disorders cost the global economy US$ 1 trillion annually. More than half of the global economic burden attributable to non-communicable disease are from mental ill-health [8].

2. Deal with mental health conditions

In response to the impact caused by mental health conditions, the World Health Organization Mental Health Action Plan (2013–2030) aims to focus on four major objectives "more effective leadership and governance for mental health; the provision of comprehensive, integrated mental health and social care services in community-based settings; implementation of strategies for promotion and prevention; and strengthened information systems, evidence and research". This is a great effort to improve mental health, but much more needs to be done, especially considering low- and middle-income countries [9]. In general, mental health conditions can be treated at a relatively low cost; however, the gap between people needing care and those with access to care remains substantial.

Each mental health condition needs special attention to choose the best available treatment. Evidence has shown that lifestyle factors (physical activity, diet, tobacco smoking, and sleep) influence different psychiatric conditions. A meta-review concerning the role of modifiable lifestyle factors in preventing and treating mental disorders confirms that physical activity has a protective role in reducing the risk for certain mental disorders [10]. Physical activity provides effective adjunctive treatment for depression, anxiety and stress-related disorders, psychotic disorders, and attention-deficit/hyperactivity disorder (ADHD) [10]. Poor sleep has a causal role in bipolar disorder, and sleep disturbances have been found to significantly heighten the risk of suicidal behaviour in people with mental illness [10]. Smoking is associated with a heightened prospective risk of mental disorders, earlier age of onset, and adverse outcomes in those living with mental illness [10]. The causal effects of diet on common and severe mental conditions are less clear.

It is well recognised the effects of physical activity and exercise (structured physical activity) on several health outcomes, such as improvements in longevity, bone mineral density, cardiovascular risk factor, aerobic fitness, muscular strength and endurance, diabetes mellitus, obesity, some types of cancers, osteoporosis, and mental health [11]. Therefore, it is important to understand the association between physical activity and mental health conditions.

3. Mechanism that explains the association between exercise and mental health

Several mechanisms are involved in the association between exercise and mental health, from neurobiological to behavioural mechanisms and the integration of inter-related behavioural and neurobehavioral domains [12].

3.1 Inflammation

Exploring the neurobiological pathway through which exercise impacts mental health is needed. One potential biological mechanism is inflammation-related factors (IRFs), which have been linked with a broad range of psychiatric disorders [13]. The immune system moderates inflammation through several signalling pathways, particularly proteins like pro- and anti-inflammatory factors. Changes in some IRFs have been intensively studied and reviewed with psychiatric disorders, such as post-traumatic stress disorder (PTSD) [14], anxiety-based disorders [15], and autism spectrum disorder [16].

One possible explanation of increased inflammation is via activation of the stress response and central and peripheral immune cells to release cytokines [15]. Another explanation is that dysregulation of the stress axis in the face of increased sympathetic tone and decreased parasympathetic activity could further augment inflammation and consequently increase anxiety symptoms, affecting brain regions such as the prefrontal cortex, insula, amygdala, and hippocampus [15]. Also, some studies have shown an association between inflammatory markers and depressive symptoms, including fatigue, impaired sleep, and cognitive dysfunction [17].

Inflammation and neuropsychiatric disorders are possibly bidirectional, as occurs with depression. Depression facilitates inflammatory reactions, and inflammation promotes depression and other neuropsychiatric disorders [18]. A pharmacological meta-analysis study involving 2370 participants aimed to examine the potential role of cytokines in the treatment of depression showed a significant antidepressant effect of anti-cytokine treatment compared with placebo. The anti-TNF drug was the most commonly studied [19]. Some studies explained the pathways by which cytokines contribute to mental disorders: cytokines access the brain and interact with virtually every pathophysiologic domain relevant to mental illness, such as neurotransmitter metabolism, neuroendocrine function, and neural plasticity [20]. Exercise could create an anti-inflammatory environment and reduce the serum level of leptin and fibroblast growth factors (FGF) [21]. IL-10, produced by exercise, acts as an anti-inflammatory cytokine and is stimulated by the release of adrenaline and cortisol from the adrenal gland, reducing the release of proinflammatory cytokines in the hippocampus [22]. Therefore, inflammation could be a suitable biomarker for psychiatric disorders and help improve the accuracy of diagnosis and treatment of several psychiatric disorders.

3.2 Neuroplasticity

Neuroplasticity is the brain's ability to modify, change and adapt structure and function throughout life in response to experience. It is highly influenced by physical activity [12]. The increased neuroplastic capacity explains the mental health benefits of various somatic psychiatric treatments, such as selective serotonin reuptake inhibitors and trans-magnetic stimulation [12].

Several systemic factors, modifiable through exercise training, must be present to facilitate neuroplastic changes. Two essential factors include neurotrophins and low neuroinflammation. Neurotrophic growth factors increase with exercise and are linked to neuroplasticity, including modulation of brain-derived neurotrophic factor (BDNF), vascular endothelial growth factor (VEGF), and insulin-like growth factor 1 (IGF-1) [12]. Studies have shown that exercise increases BDNF production

in the population with and without depression [23]. BDNF plays an important role in regulating synapse plasticity, affecting serotonin production in the hippocampus [23], and consequently impacts depressive symptoms. Also, exercise-enhancing VEGF and changing the vascular microenvironment were conducive to delivering oxygen-optimising neurogenesis [24].

3.3 Monoamines neurotransmitters (serotonin, norepinephrine, and dopamine)

Serotonin, norepinephrine, and dopamine are all monoamine neurotransmitters that modulate our mood. Depression has been consistently associated with impaired monoaminergic neurotransmission [25].

The cytokines can influence the synthesis, release, and reuptake of neurotransmitters [26]. Exercise may also influence depression by elevating the levels of endorphins and monoamines and regulating the hypothalamic-pituitary-adrenal axis.

3.4 Behavioural mechanism: the role of self-esteem and self-efficacy

Several aspects of the physical activity experience should be considered, such as enjoyment, mastery of skills/goals, autonomous motivation, social interaction, self-efficacy, self-esteem, and sense of belonging.

Exercise can promote several behavioural changes and may lead to a sense of mastery [27]. The activity-based perception of physical strength and flexibility is associated with increased physical self-esteem and, consequently, global self-esteem [28].

Self-efficacy is another important construct to better understand the relationship between exercise and mental health. Self-efficacy is an "individual's confidence in their ability to achieve specific, personally significant goals" [29]. Greater engagement in an exercise program has been shown to increase exercise self-efficacy [30] and improve self-image [31]. Self-esteem and self-efficacy mechanisms may explain the association between physical activity and depressive symptomatology [28].

Another important factor is the social interaction that the exercise can provide when performed as a group or just outdoors and is an important mediator of the association between exercise and depression, especially among older adults [32].

4. Physical activity guidelines for mental health conditions

The most recent physical activity guidelines from World Health Organization, in 2020, highlight the positive effects of physical activity on mental health, specifically reducing symptoms of anxiety and depression [33]. These recommendation covers subgroups, such as children and adolescents, adults, older adults, pregnant and postpartum women, adults and older adults with chronic conditions, children and adolescent, and adults living with disability, but did not include a specific recommendation to common mental illness, such as anxiety and depression.

The global recommendations suggest that adults should participate in at least 150–300 min of moderate-intensity aerobic physical activity or at least 75–150 min of vigorous-intensity aerobic physical activity per week and for additional health benefits on at least 2 days a week of muscle-strengthening activities at the moderate or greater intensity that involver all major muscle groups [33].

5. Physical activity and exercise for mental benefits

Several meta-analytic studies have investigated the association and the impact of physical activity on mental health outcomes. The results vary in efficacy degrees depending on methodological considerations, including study quality and duration [34].

Meta-analyses of prospective cohort studies have found that physical activity had a protective effect against the emergence of depression [35]. Also, physical activity protects against anxiety symptoms [36]. The association seems to be proportional since a higher level of physical fitness was associated with a lower onset of mental health problems [35]. In addition, sedentary behaviour is associated with an increased risk of depression [37] and anxiety [38].

Exercise exerts a causal influence on mental health disorders since exercise has a significant antidepressant effect in people with depression (including major depressive disorder) [39] and could improve anxiety symptoms in people with a current diagnosis of anxiety or stress-related disorders [40]. The antidepressant effect of aerobic exercise interventions was examined in a meta-analysis study and showed a significantly large effect [41]. The analysis revealed comparable effects across various settings and delivery formats, regardless of symptom severity in both outpatients and inpatients.

Furthermore, we can look forward and analyse the association between cardiorespiratory fitness (CRF) and common mental disorders. CRF captures broad physical activity trends with one discrete test using objective, clearly defined markers, such as oxygen consumption. The studies found that low and medium CRF is associated with an increased risk of common mental health disorders, namely depression [42] and anxiety [43].

Beyond cardiorespiratory fitness, muscle strength has also been associated with mental disorders. Increased hand grip strength may be associated with lower odds of developing generalised anxiety disorder [44]. Hand grip strength has been considered an important predictor of depressive symptoms in middle-aged and older adults [45].

Although several studies have demonstrated that physical activity can be used to prevent and treat common mental health disorders, most of the evidence assessed physical activity in general without analysing a dose-response of exercise, neither intensity, type, or other important aspects of exercise prescription.

5.1 Dose-response of the association between exercise and mental health functioning

Incremental increases in cardiorespiratory fitness are associated with proportional decreases in the risk of new-onset common mental health disorders, indicating a dose-response relationship between exercise and mental health disorders [43]. A national population-based study reveals that a minimal level of at least 20 min per week of physical activity guarantees mental health benefits. However, dose-response patterns demonstrated greater risk reduction for activity at a higher volume and intensity [46].

Meta-analyses of prospective cohort studies reveal that completing 150 min/week of moderate-vigorous physical activity reduces the risk of developing depression by about 22% [35]. However, low levels of physical activity (e.g., walking <150 min/week) can prevent future depression [47].

Exercise duration significantly moderates the effect of endurance intervention on depressive symptoms, and an extended exercise duration strengthens the antidepressant effect of endurance exercise interventions [48].

Regarding the bouts of exercise, a systematic review showed that short bouts (10–15 min) of physical activity had a significant effect on reducing stress and depressive symptoms and improving self-esteem among adults without mental health conditions [49].

Considering multiple dose-response curves of exercise regarding different health outcomes [50], no consensus about the optimal dose of physical activity to prevent or treat mental health was founded. For an increment of physical activity for the general population with mental health conditions, the World Health Organization policy seems to be a good way when proclaiming that "any movement counts" [33]. However, considering exercise prescriptions for each mental health condition, more systematic reviews of randomised controlled trials are needed to clarify the optimal dose response.

5.2 Intensity

A meta-analytical review concluded that increased exercise intensity of neuromuscular exercise strengthened the antidepressant effect among depressed adults [48]. Among older people with depression, moderate-intensity physical activity significantly affected depression [39]. Cross-sectional and prospective studies have demonstrated that moderate and vigorous physical activity intensity is associated with lower odds of depressive symptoms [51]. The best intensity to deal with depressive symptoms still needs more investigation.

A scoping review showed that there is not always a direct association between mental health and exercise duration/intensity [52]. In a study carried out with retired older adults, it was found that high-intensity physical activities had a negative impact on the perception of well-being [53]. A systematic review with meta-analysis of randomised controlled trials on sleep quality and insomnia in middle-aged women concluded that moderate levels of programmed exercise (aerobic exercise) indicated a positive effect on sleep quality. In contrast, low-intensity exercises did not reveal a significant effect [54]. These findings suggest that high-intensity exercise may not be the best strategy for well-being in the middle-aged and older adult population. A possible explanation is that this population tends to exercise to maintain physical fitness and also seek prosocial benefits, such as minimising isolation [55]. Consequently, practising exercises associated with social contact reflects positively on mental health [56]. Thus, moderate intensity seems to be the most useful measure of mental well-being.

5.3 Type of exercise

A meta-analysis including 1877 participants found that resistance exercise training was associated with a significant reduction in depressive symptoms, with a moderate-sized mean effect. However, a smaller reduction was observed when considering only trials with blinded allocation and assessment [57]. Similar anxiety results were found in another meta-analysis involving 922 participants, where resistance exercise training improves anxiety symptoms among healthy participants and participants with physical or mental disorders [58]. Combined aerobic moderate-vigorous physical activity and muscle-strengthening exercise were associated with the lowest likelihood of reporting depressive symptoms, analysed in a large population-based sample of adults (17,839 participants) [59].

Thus, when comparing aerobic exercise only and muscle-strengthening exercise only, no difference between modalities in reducing depressive symptoms was founded [42].

But adults who practice aerobic and muscle-strengthening physical activity combined had the lowest likelihood of depressive symptoms compared to those who adhere only to one exercise modality [59].

Other meta-analytical reviews revealed a moderate to large effect in favour of endurance exercise and a large effect in favour of neuromuscular exercise, compared to control conditions, to reduce depressive symptoms among depressed adults [48].

Among older adults with depression, a meta-analysis of randomised controlled trials found that mixed aerobic and anaerobic interventions significantly affected depression compared with the control group [39].

6. Conclusions

Mental health conditions represent a major impact on public health globally. People with mental conditions may be affected by several determinants related to physical, emotional, and social domains. This chapter aimed to elucidate alternatives to deal with mental conditions, highlighting the importance of physical activity and exercise. This underscores the importance of a multi-disciplinary approach to improve mental health that incorporates exercise as an essential part of treatment and prevention strategies. We present several mechanisms (neurobiological and behavioural) that are involved in the association between exercise and mental conditions. In line with the most recent guidelines, we expose the World Health Organization's general physical activity recommendation. Despite several evidence demonstrating the association between exercise and improvement in mental health outcomes, there is still a lack of clear guidelines on how to prescribe exercise based on the specific mental health condition and the principles of exercise (frequency, intensity, type, and duration). To finish this chapter, we present several pieces of evidence demonstrating the impact of exercise on mental health outcomes and explore the difference in dose response, intensity, and type of exercise.

The positive effects of physical activity and exercise on mental health are particularly relevant for public health interventions aimed at preventing and treating mental health disorders. We expected that this chapter would help future studies to fill some gaps in the literature and help health professionals to have a better understanding of the relationship between exercise and mental health outcomes.

Conflict of interest

The authors declare no conflict of interest.

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