**The Importance of Incorporating Physical Activity for Ongoing Mental Health**

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While the importance of exercise is often stressed in relation to physical health, there are also notable benefits for mental health. Indeed, a large body of literature has shown consistent positive effects of various exercise modalities on mood-related disorders such as anxiety, stress, and major depressive disorder (Mikkelsen et al., 2017). Much of this research has linked these benefits to attenuation of certain neurotransmitters, increased hippocampal function, and reduction of hyperactive responses of the hypothalamic pituitary-adrenal (HPA) axis (Mikkelsen et al., 2017; Nabkasorn et al., 2006; Voss et al., 2013; Helgadottir et al., 2016; Lin & Kuo, 2013; Anderson & Shivakumar, 2013). Further, there are prominent psychological effects of exercise, namely distraction from negative thoughts and improved self-efficacy through goal-setting (Danielsson et al., 2016; Chen et al., 2015). In this essay, I will discuss evidence for the benefits of various modalities of exercise on mental health, and elaborate on physiological and psychological mechanisms that may cause these benefits.

 Aerobic and anaerobic (ie. resistance training) exercise modalities have both been shown to improve aspects of mental health. In fact, neural benefits are apparent even after single bouts of aerobic activity, indicating short-term exercise prescriptions can still have a remedial effect for mood-related disorders (Voss et al., 2013; Chapman et al., 2013). However, habitual physical activity will facilitate any acute physiological changes seen immediately after activity (Pesce et al., 2011). In other words, adherence to long-term exercise programs will enhance the associated benefits to mental health, which is why regular aerobic exercise for youth may be recommended as a preventative measure for mood-related disorders and neurodegeneration (Ploughman, 2008). Interestingly, it has been shown that varying intensities of aerobic exercise are equally beneficial for reduction of depressive symptoms, allowing for some individual agency when prescribing an activity program (Helgadottir et al., 2016). Further, when paired with aerobic training, resistance training has proven to be beneficial for co-occurring depression and anxiety (Oftedal et al., 2019). While there is little evidence for mental health benefits from this modality alone, there is literature supporting other cognitive benefits, namely executive function, that may extend to depression and stress (Liu-Ambrose et al., 2010). Improvements to psychological health caused by physical exercise have largely been attributed to physiological changes in certain brain areas.

 There are numerous neural changes in the brain associated with exercise. Perhaps the most well-described effect is increased hippocampal function via increased volumes of brain-derived neurotrophic factor (BDNF; Voss et al., 2013). While much of the current literature has focused on hippocampal BDNF’s role in learning and memory formation, some have also described a link to depression (Voss et al., 2013; Gourgouvelis et al., 2018). Considering the potential relationship between antidepressant treatment and increased BDNF levels, this is a tempting connection to make (Zhou et al., 2017). Further, there is an established link between hippocampal neurogenesis caused by BDNF and counteracting stress (Yau et al., 2011). However, due to contradicting evidence and limited sample sizes, the link between BDNF and depression is inconclusive (Szhuany and Otto, 2020). One more promising line of research is on the upregulation of monoamine neurotransmitters following exercise (Lin & Kuo, 2013). Increased levels of circulating dopamine, norepinephrine, and serotonin following physical activity have been linked to decreased symptoms of depression, stress, and anxiety, respectively. Finally, hyperactivity of the HPA axis, a hormone system responsible for adaptation to psychological stressors, has been implicated in cases of depression and anxiety (Mikkelsen et al., 2017). Voluntary aerobic exercise has been shown to have a hypoactive response on this system, potentially attenuating symptoms of stressors associated with these disorders (Anderson & Shivakumar, 2013). In addition to these physiological benefits, there are some psychological effects of exercise that may alleviate symptoms of mental health disorders.

 It is important to consider the potential psychosocial benefits of exercise on mental health. When prescribed in a therapeutic context, exercise can improve a depressed individuals’ perception of their physical ability, and consequently improve their depressed state (Danielsson et al., 2016). Indeed, perceived self-efficacy is a determinant of susceptibility to depressive behaviour (Chen et al., 2015). Further, while patients with major depressive disorder are largely interesting in exercise as a treatment, they view their symptoms as a barrier to this method, and as such self-efficacy could be important in helping these individuals overcome their reluctance (Busch et al., 2016). Another hypothesized benefit of exercise is distraction from negative thoughts, where exercise acts an avenue for those with mood-related disorders to devote attention away from depressive or anxious ruminations (Motta, 2018). However, there is limited evidence for a direct link between distraction and mediation of mental health disorders (Mikkelsen et al., 2017).

 In summary, exercise has been proven to be a valuable tool in the treatment of depression. While the clinical benefits of resistance training for mood-related disorders are uncertain, aerobic exercise of any intensity have been proven in multiple settings (Voss et al., 2013; Chapman et al., 2013; Helgadottir, et al., 2016; Liu-Ambrose et al., 2010). At a physiological level, these changes are likely due to increased neurotransmitter levels and decreased activity of the HPA axis, with enhance hippocampal function being another potential yet controversial explanation (Voss et al., 2013; Lin & Kuo, 2013; Mikkelsen et al., 2017). From a behavioural view, exercise increase a depressed individual’s self-esteem through increased self-efficacy, thus counteracting depressive symptoms and increasing the likelihood they continue exercising (Chen et al., 2013; Busch et al., 2016). A second, controversial psychological explanation is that exercise improves mood by acting as a distraction from negative thoughts (Motta, 2018). Overall, the evidence presented here supports the notion that physical activity is an important component for the treatment of various mood-related mental health disorders.

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