

## The Mood-Muscle Meta Bridge (Brain Muscle Axis)

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### Abstract

Psychological well-being is essential for the maintenance of good metabolic health. Modern management of most chronic metabolic disorders rightly focusses on improving the health-related quality of life of persons living with disease. In this brief communication we describe the bidirectional association between muscle function and mood (psychological health), explore the various pathways that link these aspects of health, and underscore their clinical implications. This paper emphasizes the importance of maintaining good mental health through exercise and vice a versa.

**Keywords:** Muscle function, muscle strength, sarcopenia, dysthymia, depression, physical activity

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### Introduction

The mood (brain) and muscle may be seemingly distant and disparate organs, but are connected by various communication mechanisms. We term these the mood-muscle meta bridge (MMM). This terminology includes not only the brain-gut-muscle axis, but other means of mood and muscle interaction. In this brief communication, we list the various components and clinical features of the MMM, and posit ways in which these can be harnessed for clinical use.

### The bidirectional association between Mood and Muscle

There are several ways in which the mental state of an individual influences the muscle health. It is unlikely for a patient living with depression and dysthymia to plan regular physical activity in their daily schedule. This may further be worsened in individuals with concurrent dementia. Moreover, low mood is known to reduce the threshold of pain in individuals with fibromyalgia or other similar pain syndromes. Patients with low mood are also

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**Table 1:** The Mood Muscle Meta Bridge

#### MOOD INFLUENCES MUSCLE

- Mood influences motivation for muscle exercise
- Mood impacts muscle tension and pain
- Mood disorders are linked with substance abuse, which can detrimental to muscle health
- Mood influences recovery from muscular fatigue and injury
- Dementia is associated with lack of muscular exercise

#### MUSCLE INFLUENCES MOOD

- Muscle mass and strength are associated with good mood and sense of self-esteem
- Muscle exercise leads to mood elevation (runner's high)
- Muscle pain and injury, along with lack of exercise, can negatively influence mood
- Muscle exercise (resistance training) help prevent neuro degenerative disease
- Muscle exercise improves insulin sensitivity, glucose and blood pressure control, which reduces the risk of cerebro vascular events

more likely to consume substances of abuse and this may worsen the muscle injury in already weak muscles.<sup>1</sup>

Furthermore, good physical exercise is also known to elevate the mood of a given individual (called the runners high). Good muscle exercise would improves the metabolic functions of the patient, which in turn will help to prevent deterioration of mood due to physical problems.<sup>2</sup> More recent evidence also suggests that regular exercise can retard the progression of neurodegenerative disorders. (Table 1)

**Table 2:** Pathways of The Mood Muscle Meta Bridge

#### ENDOCRINE PATHWAYS

##### Hypothalamo-pituitary-adrenal axis

- Stress increases cortisol which reduces muscle mass

##### Hypothalamo-pituitary-gonadal axis

- Low testosterone in functional hypogonadism impacts mood and muscle negatively
- Alterations in cortisol: testosterone ratio are used to monitor elite athletes' performance and anxiety

##### Maintenance of optimal thyroid function

#### NERVOUS PATHWAYS

##### Neuroendocrine transmitters (Runner's high)

- Endocannabinoids
- Endogenous opioids
- Serotonin

##### Mitochondrial pathways

- Myokines released from muscle influence cerebral angiogenesis and mood

##### Autonomic nervous system

- Muscle tension/pain leads to release of adrenaline/noradrenaline, which influence mood

#### INTESTINAL PATHWAYS

- Microbiome metabolites-short chain fatty acids bile acids, tryptophan metabolites-act on receptors in muscle and brain (brain-gut-muscle axis)

#### IMMUNE PATHWAYS

- Muscle exercise releases immunoglobulins, which increase immunity and enhance mood

**Table 3:** Clinical implications of mood muscle metabridge

- Regular muscle exercise improves mood
  - Directly
  - By improving cognitive health
  - By improving overall health
- Mood management improves muscle health
  - By improving adherence to exercise regimens
  - By improving overall self-care
  - By minimizing harmful substance abuse
- Regular exercise should be incorporated in management regimens for psychological, psychiatric and substance abuse disorders.
- Regular exercise should be incorporated in the lifestyle of all healthy individuals, as well as those with clinical metabolic, vascular and neurodegenerative disease
- Mood modulation therapy, whether non pharmacological, or pharmacological (if needed) may be used to enhance acceptance of, and adherence to, prescribed exercise regimens
- Mood-matched muscular exercise regimens may be used to optimize short-term satisfaction and long-term benefits
  - To enhance calmness: yoga, stretching, deep breathing
  - To overcome sadness: running, speed walking, cycling
  - To promote good sleep: lying down yoga, Pilates
  - To improve social skills: team sports

### The pathophysiological links between mood and muscle interactions

The bidirectional effects of muscle and mood interactions can be linked through several pathophysiological pathways. These could involve pathways through the endocrine system but also through neuro, immune and through the GUT related pathways.<sup>3</sup> These have been summarized in Table 2. However, the most important pathways here are those linked through the endocrine system especially the hypothalamo-pituitary-adrenal axis.<sup>4</sup>

### Clinical implications

The understanding of this mood muscle metabridge will help physicians incorporate physical exercise regularly in their prescription with the aim of improving psychological health of their patients.<sup>5</sup> In addition to provide metabolic benefits in terms of reducing the incidence of diabetes, hypertension and dyslipidaemia, regular exercise has been shown to improve overall health related quality of life and

cognition.<sup>6</sup> Another very important dimension of improving physical activity is that helps to enhance sleep, which in turn has multiple metabolic and psychological benefits.<sup>7</sup> (Table 3)

### Summary

In this manuscript the authors have described the overall impact, pathophysiological links and the clinical impact of enhancing exercise and its impact on the emotional status of a given individual. Moreover, the impact of mood on regular physical activity has also been highlighted in this paper. This brief manuscript undermines the use of physical activity beyond the realms of just metabolic benefit. Several practical and clinical methods of improving physical activity have been described in the latter half of the article.

### References

1. Sane RM, Jadhav PR, Subhedar SN. The acute effects of decaffeinated versus caffeinated coffee on reaction time, mood and skeletal muscle strength. *J Basic Clin Physiol Pharmacol.* 2019;30: Sane RM, Jadhav PR, Subhedar SN. The acute effects of decaffeinated versus caffeinated coffee on reaction time, mood and skeletal muscle strength. *J Basic Clin Physiol Pharmacol.* 2019;30: doi: 10.1515/jbcp-2018-0119.
2. Stoesslein BAC, Kuypers KPC. Self-Rated Recovery and Mood Before and After Resistance Training and Muscle Microcurrent Application. *Front Psychol.* 2022;13:836695.
3. Kalra S, Kumar V, Kapoor N. The MOAN (Musculo-Osteo-Arthro-Neuropathic) syndrome. *J Pak Med Assoc.* 2022;72:373-4.
4. Kalra S, Kapoor N, Bhattacharya S, Aydin H, Coetzee A. Barocrinology: The Endocrinology of Obesity from Bench to Bedside. *Med Sci (Basel).* 2020;8:51 doi: 10.3390/medsci8040051
5. Kalra S, Mandlekar A, Kapoor N. Exercise therapy for the exercise naïve: The first step in obesity management. *J Pak Med Assoc.* 2021;71:2828-30.
6. Memory and mood may depend on muscle strength and diet choices. Research continues to solidify the link between physical fitness and cognitive health. *Duke Med Health News.* 2010;16:3-4.
7. Jiwanmall SA, Kattula D, Nandyal MB, Parvathareddy S, Kirubakaran R, Jebasingh F, et al. Weight Stigma in Patients With Obesity and Its Clinical Correlates: A Perspective From an Indian Bariatric Clinic. *Cureus.* 2022;14:e26837.