

## **The Effect of Movement on Cognition**

*Compiled for the Learning Center at Washington University in St. Louis by Matthew Serafini-Lamanna*

Throughout time, humans have evolved increased metabolic demands in response to our need to hunt and forage for food. During the hunter-gatherer era, food was plentiful and our ability to absorb and store sugar and fats enabled us to survive during periods of famine or drought. These periods where food was abundant were balanced by times where food was scarce, and therefore humans have evolved to adapt to a constant demand for movement and bursts of physical activity when needed to survive<sup>1</sup>. The need for movement has been deeply encoded in our lives, whether we are aware of it or not.

In recent times, where food is abundant, easy to access, and requires little movement to obtain as compared to the hunter-gatherer era, the disruption of this evolved metabolic homeostasis contributes to the increased prevalence of metabolic diseases today<sup>1</sup>. In addition to the overall decreased need for movement in our daily lives to survive, the majority of adults in the U.S do not obtain the recommended level of physical activity per week (150 minutes of moderately vigorous activity)<sup>2</sup>.

A contributor to this lack of movement in recent history is the COVID-19 pandemic<sup>3</sup>. During the last year in the United States, a significant reduction in physical activity and an increase in sedentary behaviour was observed in adults<sup>3-5</sup>. Importantly, COVID-19-related (both the disease itself and societal manifestations to curb its progression) increases in sedentary behaviors and decreases in physical activity are correlated with increased prevalence of mental illness in adults (primarily anxiety and depression)<sup>5,6</sup>.

Each factor mentioned above, the COVID-19 pandemic, mental illness, sedentary behaviour, and physical activity has a significant impact on academic achievement for children and adults. Below is a composite of research which describes the effect physical activity can have on cognition and its relation to academic achievement.

- ❖ Children and adults who walked for 10 minutes prior to a test with emphasis on the application of information performed significantly better than those who did not<sup>8</sup>. The effect was most prominent with students who had GPA's below 60%.<sup>8</sup>
- ❖ Low and/or moderate physical activity completed at least 2 times weekly was found to improve working memory and cognitive ability in both children and adults.<sup>9</sup>
- ❖ Individuals who were physically fit (engaging in regular physical activity) had overall higher academic achievement than those who did not. <sup>9,10</sup>

- ❖ Students who participated in after-school sports or fitness programs had significantly higher GPAs than those who did not.
- ❖ Symptoms of anxiety and depression negatively impact academic achievement;<sup>12</sup> however, a small amount of daily physical activity was found to reduce symptoms of anxiety and depression as well as improve academic achievement.<sup>13-15</sup>
- ❖ Engaging in periods of mindfulness when participating in physical activity was found to be more significant in improving cognitive function in children and adults than the length of time spent participating in physical activity.<sup>16</sup>
- ❖ Individuals remaining in isolation during the COVID-19 were more likely to experience the onset of mental illness; however, participating in moderate to vigorous activity (15-30 minutes daily) reduced the individual's symptoms of depression and anxiety.<sup>17</sup>
- ❖ Adolescents who participated in physical activity regularly had improved cognitive flexibility (ability to adapt to varying situations) than did their peers who did not engage in physical activity.<sup>18</sup>

**In summary:** Engaging in a mindful exercise session (where your sole focus is the exercise session) for 10+ minutes a few times weekly can improve symptoms of mental health, academic performance, and overall quality of life.

## References

1. Ratey JJ, Loehr JE. The positive impact of physical activity on cognition during adulthood: a review of underlying mechanisms, evidence and recommendations. *Rev Neurosci*. 2011;22(2):171-85. doi: 10.1515/RNS.2011.017. PMID: 21417955.
2. Troiano, R.P., Berrigan, D., Dodd, K.W., Mâsse, L.C., Tilert, T., and McDowell, M. (2008). Physical activity cognition States measured by accelerometer. *Med. Sci. Sports Exerc.* 40,181 – 188
3. Meyer J, McDowell C, Lansing J, Brower C, Smith L, Tully M, Herring M. Changes in Physical Activity and Sedentary Behavior in Response to COVID-19 and Their Associations with Mental Health in 3052 US Adults. *Int J Environ Res Public Health*. 2020 Sep 5;17(18):6469. doi: 10.3390/ijerph17186469. Erratum in: *Int J Environ Res Public Health*. 2020 Sep 23;17(19): PMID: 32899495; PMCID: PMC7559240.
4. Vindegaard N, Benros ME. COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain Behav Immun*. 2020;89:531-542. doi:10.1016/j.bbi.2020.05.048
5. Dunton, G.F., Do, B. & Wang, S.D. Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the U.S.. *BMC Public Health* 20, 1351 (2020). <https://doi.org/10.1186/s12889-020-09429-3>
6. Nguyen H.C., Nguyen M.H., Do B.N., Tran C.Q., Nguyen T.T., Pham K.M., Pham L.V., Tran K.V., Duong T.T., Tran T.V., et al. People with Suspected COVID-19 Symptoms Were More Likely Depressed and Had Lower Health-Related Quality of Life: The Potential Benefit of Health Literacy. *J. Clin. Med.* 2020;9:965. doi: 10.3390/jcm9040965
7. Zheng C, Huang WY, Sheridan S, Sit CH, Chen XK, Wong SH. COVID-19 Pandemic Brings a Sedentary Lifestyle in Young Adults: A Cross-Sectional and Longitudinal Study. *Int J Environ Res Public Health*. 2020 Aug 19;17(17):6035. doi: 10.3390/ijerph17176035. PMID: 32825092; PMCID: PMC7503726.
8. Mualem R, Leisman G, Zbedat Y, et al. The Effect of Movement on Cognitive Performance. *Front Public Health*. 2018;6:100. Published 2018 Apr 20. doi:10.3389/fpubh.2018.00100
9. Chaddock-Heyman L, Erickson KI, Voss MW, et al. The effects of physical activity on functional MRI activation associated with cognitive control in children: a randomized controlled intervention. *Frontiers in human neuroscience*. 2013;7:72
10. Donnelly JE, Hillman CH, Castelli D, Etnier JL, Lee S, Tomporowski P, Lambourne K, Szabo-Reed AN. Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. *Med Sci Sports Exerc*. 2016 Jun;48(6):1197-222. doi: 10.1249/MSS.0000000000000901. PMID: 27182986; PMCID: PMC4874515.

11. Fox CK, Barr-Anderson D, Neumark-Sztainer D, Wall M. Physical activity and sports team participation: associations with academic outcomes in middle school and high school students. *J Sch Health*. 2010 Jan;80(1):31-7. doi: 10.1111/j.1746-1561.2009.00454.x. PMID: 20051088.
12. Murphy JM, Guzmán J, McCarthy AE, et al. Mental health predicts better academic outcomes: a longitudinal study of elementary school students in Chile. *Child Psychiatry Hum Dev*. 2015;46(2):245-256. doi:10.1007/s10578-014-0464-4
13. Antunes R, Frontini R. Physical activity and mental health in Covid-19 times: an editorial. *Sleep Med*. 2020 Oct 15:S1389-9457(20)30448-2. doi: 10.1016/j.sleep.2020.10.007. Epub ahead of print. PMID: 33109448; PMCID: PMC7560384.
14. Anderson E., Shivakumar G. Effects of exercise and physical activity on anxiety. *Front Psychiatr*. 2013;4:10–13
15. Tamminen N., Reinikainen J., Appelqvist-Schmidlechner K., Borodulin K., Mäki-Opas T., Solin P. Associations of physical activity with positive mental health: A population-based study. *Ment. Health Phys*. 2020;18:100319. doi: 10.1016/j.mhpa.2020.100319.
16. Moore, A. and Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Conscious Cogn*. 18 , 176 – 186
17. Schuch FB, Bulzing RA, Meyer J, et al. Associations of moderate to vigorous physical activity and sedentary behavior with depressive and anxiety symptoms in self-isolating people during the COVID-19 pandemic: A cross-sectional survey in Brazil. *Psychiatry Res*. 2020;292:113339. doi:10.1016/j.psychres.2020.113339
18. Themanson, J.R., Pontifex, M.B., and Hillman, C.H. (2008). Fitness and action monitoring: evidence for improved cognitive flexibility in young adults. *Neuroscience* 157 , 319 – 328.