Cross-sectional associations between regular physical activity engagement and domains of mental health in a global sample of ~~43,227 young adults~~

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Estimating the treatment effect of exercise exposure with propensity score weighting using generalized boosted models

Mental health conditions have proven to be a significant burden on the global population. Approximately 29% of individuals have experienced a common mental disorder during their lifetime, with a 9.6%, 12.9%, and 10.7% lifetime prevalence for mood, anxiety, and substance-use disorders, respectively (Steel 2014). Global burden of mental disorders in 2019 is estimated at 125.3 million disability-adjusted life-years (DALY) – an increase from 80.8 million DALYs in 1990 (Lancet 2022). Moreover, lost productivity due to poor mental health is estimated to cost the global economy $2.5T annually and is projected to more than double over the next decade, reaching $6T by 2030 (Health, 2020).

Recent epidemiological reviews of global samples indicates stagnation in the overall prevalence of mental disorders (Ritcher 2019), despite an increase in the prevalence of depression (Moreno-Agostino 2021). (\*\*\*\*\*\*\*incidence rates evidence?\*\*\*\*\*\*\*) Together, these studies suggest that current strategies which seek to prevent and/or reduce mental problems are ineffective (Jorm 2017). The COVID-19 pandemic has also conferred a considerable toll on population mental health and wellbeing worldwide. Specifically, meta-analytic evidence from three studies suggests there has been a small increase in mental health problems, with even larger effects observed for depressive and anxiety symptoms, although it should be noted that findings for general mental health and wellbeing are mixed (Patel et al., 2022; Prati & Mancini, 2021; Robinson et al., 2022).

Emerging evidence suggests certain age cohorts across the adult lifespan may be at greater risk for poor mental health and wellbeing than others. For example, a recent report showed that younger adults living in the US consistently report the lowest scores on all six domains of well-being, including happiness, health, meaning and purpose, character, social relationships, and financial stability, with a linear pattern of improvements in wellbeing observed with increased age (Chen et al., 2022). These findings are in contrast to previous work that had demonstrated an inverted-U relationship between age and mental wellbeing in which mental wellbeing was lowest in middle adulthood (Blanchflower & Oswald 2008). Evidently, more research is needed to better understand these trends from a global perspective, including a focus on protective factors that may moderate the relationship between age and mental health and wellbeing.

An emerging body of literature continues to establish effects of physical activity on mental health as well. Observational and experimental evidence consistently shows a relationship between higher levels of physical activity and benefits across various mental health outcomes (Creese 2020, Rodriguez-Ayllon 2019, McDowell 2019, Firth 2020, Schuch 2017, Pearce 2022, Brosse et al., 2002; Kvam et al., 2016; Pearce et al., 2022; Schuch et al., 2016; Stathopoulou et al., 2006) For example, in a large cross-sectional dataset of 1,237,194 US respondents, Chekroud et al. (2018) demonstrated optimal amounts of exercise frequency associated with reduce mental health burden in that more is not always better. A recent meta-analysis of prospective cohort studies showed a similar pattern of results for the relationship between physical activity and depression – higher volumes of physical activity were associated with diminishing additional benefits (Pearce et al., 2022). While this evidence further supports the importance of physical activity for preventing and/or reducing a range of mental health problems and improving overall wellbeing, certain mental health disorders and symptoms have received limited attention to date. For some other mental disorders and symptoms, the evidence is less suggestive of benefits, or remains unclear (Firth 2015; Dauwan 2016; Brokmeier 2020; Brondino 2017; Ashdown-Franks 2019; Melo 2016).

Recent work has suggested that mental health is a complex and heterogenous construct in which there is considerable overlap in symptomology across the most common disorders (Newson et al., 2020). Novel measures such as the Mental Health Quotient (MHQ) have been developed to address these considerations, but due to their recency, have received limited attention. There is also a paucity of literature on the ~~specific symptoms that~~ specific aspects of mental health that physical activity may especially favor, which only one previous study to our knowledge investigating symptom-level effects (Murri 2018). Improved precision in the treatment target may have important implications for clinical outcomes (User 2012; Iniesta 2016). Varying amounts of physical activity may be associated with differential effects across the lifespan, particularly as it relates to certain aspects of mental wellbeing.

The purpose of the present study was to examine the relationship between frequency of physical activity and various aspects of mental health and wellbeing, and comparing across age groups while statistically accounting for a wide range of observed covariates in a large global sample.

Steel, Z., Marnane, C., Iranpour, C., Chey, T., Jackson, J. W., Patel, V., & Silove, D. (2014). The global prevalence of common mental disorders: a systematic review and meta-analysis 1980–2013. International journal of epidemiology, 43(2), 476-493.

GBD 2019 Mental Disorders Collaborators. (2022). Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet Psychiatry, 9(2), 137-150.

Health, T. L. G. (2020). Mental health matters. The Lancet. Global Health, 8(11), e1352.

Richter, D., Wall, A., Bruen, A., & Whittington, R. (2019). Is the global prevalence rate of adult mental illness increasing? Systematic review and meta‐analysis. Acta Psychiatrica Scandinavica, 140(5), 393-407.

Moreno-Agostino, D., Wu, Y. T., Daskalopoulou, C., Hasan, M. T., Huisman, M., & Prina, M. (2021). Global trends in the prevalence and incidence of depression: a systematic review and meta-analysis. Journal of Affective Disorders, 281, 235-243.

Jorm, A. F., Patten, S. B., Brugha, T. S., & Mojtabai, R. (2017). Has increased provision of treatment reduced the prevalence of common mental disorders? Review of the evidence from four countries. World Psychiatry, 16(1), 90-99.

Panchal, U., Salazar de Pablo, G., Franco, M., Moreno, C., Parellada, M., Arango, C., & Fusar-Poli, P. (2021). The impact of COVID-19 lockdown on child and adolescent mental health: systematic review. European child & adolescent psychiatry, 1-27.

Aknin, L. B., De Neve, J. E., Dunn, E. W., Fancourt, D. E., Goldberg, E., Helliwell, J. F., ... & Ben Amor, Y. (2022). Mental health during the first year of the COVID-19 pandemic: A review and recommendations for moving forward. Perspectives on psychological science, 17(4), 915-936.

Serafini, G., Parmigiani, B., Amerio, A., Aguglia, A., Sher, L., & Amore, M. (2020). The psychological impact of COVID-19 on the mental health in the general population.

Samji, H., Wu, J., Ladak, A., Vossen, C., Stewart, E., Dove, N., ... & Snell, G. (2022). Mental health impacts of the COVID‐19 pandemic on children and youth–a systematic review. Child and adolescent mental health, 27(2), 173-189.

Pierce, M., Hope, H., Ford, T., Hatch, S., Hotopf, M., John, A., ... & Abel, K. M. (2020). Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. The Lancet Psychiatry, 7(10), 883-892.

Robinson, E., Sutin, A. R., Daly, M., & Jones, A. (2022). A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. Journal of affective disorders, 296, 567-576.

Oswalt, S. B., Lederer, A. M., Chestnut-Steich, K., Day, C., Halbritter, A., & Ortiz, D. (2020). Trends in college students’ mental health diagnoses and utilization of services, 2009–2015. Journal of American college health, 68(1), 41-51.

Chen, Y., Cowden, R. G., Fulks, J., Plake, J. F., & VanderWeele, T. J. (2022). National Data on Age Gradients in Well-being Among US Adults. JAMA psychiatry.

Blanchflower, D. G., & Oswald, A. J. (2008). Is well-being U-shaped over the life cycle?. Social science & medicine, 66(8), 1733-1749.

Pedersen, B. K., & Saltin, B. (2015). Exercise as medicine–evidence for prescribing exercise as therapy in 26 different chronic diseases. Scandinavian journal of medicine & science in sports, 25, 1-72.

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. The lancet, 380(9838), 219-229.

Creese, B., Khan, Z., Henley, W., O’Dwyer, S., Corbett, A., Da Silva, M. V., ... & Ballard, C. (2021). Loneliness, physical activity, and mental health during COVID-19: a longitudinal analysis of depression and anxiety in adults over the age of 50 between 2015 and 2020. International Psychogeriatrics, 33(5), 505-514.

Rodriguez-Ayllon, M., Cadenas-Sánchez, C., Estévez-López, F., Muñoz, N. E., Mora-Gonzalez, J., Migueles, J. H., ... & Esteban-Cornejo, I. (2019). Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. Sports medicine, 49(9), 1383-1410.

McDowell, C. P., Dishman, R. K., Gordon, B. R., & Herring, M. P. (2019). Physical activity and anxiety: a systematic review and meta-analysis of prospective cohort studies. American journal of preventive medicine, 57(4), 545-556.

Firth, J., Solmi, M., Wootton, R. E., Vancampfort, D., Schuch, F. B., Hoare, E., ... & Stubbs, B. (2020). A meta‐review of “lifestyle psychiatry”: the role of exercise, smoking, diet and sleep in the prevention and treatment of mental disorders. World Psychiatry, 19(3), 360-380.

Schuch, F., Vancampfort, D., Firth, J., Rosenbaum, S., Ward, P., Reichert, T., ... & Stubbs, B. (2017). Physical activity and sedentary behavior in people with major depressive disorder: a systematic review and meta-analysis. Journal of affective disorders, 210, 139-150.

Pearce, M., Garcia, L., Abbas, A., Strain, T., Schuch, F. B., Golubic, R., ... & Woodcock, J. (2022). Association Between Physical Activity and Risk of Depression: A Systematic Review and Meta-analysis. JAMA psychiatry.

Chekroud, S. R., Gueorguieva, R., Zheutlin, A. B., Paulus, M., Krumholz, H. M., Krystal, J. H., & Chekroud, A. M. (2018). Association between physical exercise and mental health in 1· 2 million individuals in the USA between 2011 and 2015: a cross-sectional study. The Lancet Psychiatry, 5(9), 739-746.

Biddle, S. J., Ciaccioni, S., Thomas, G., & Vergeer, I. (2019). Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. Psychology of Sport and Exercise, 42, 146-155.

Josefsson, T., Lindwall, M., & Archer, T. (2014). Physical exercise intervention in depressive disorders: Meta‐analysis and systematic review. Scandinavian journal of medicine & science in sports, 24(2), 259-272.

Schuch, F. B., Vancampfort, D., Richards, J., Rosenbaum, S., Ward, P. B., & Stubbs, B. (2016). Exercise as a treatment for depression: a meta-analysis adjusting for publication bias. Journal of psychiatric research, 77, 42-51.

Gordon, B. R., McDowell, C. P., Hallgren, M., Meyer, J. D., Lyons, M., & Herring, M. P. (2018). Association of efficacy of resistance exercise training with depressive symptoms: meta-analysis and meta-regression analysis of randomized clinical trials. JAMA psychiatry, 75(6), 566-576.

Marquez, D. X., Aguiñaga, S., Vásquez, P. M., Conroy, D. E., Erickson, K. I., Hillman, C., ... & Powell, K. E. (2020). A systematic review of physical activity and quality of life and well-being. Translational behavioral medicine, 10(5), 1098-1109.

Schuch, F. B., Vancampfort, D., Rosenbaum, S., Richards, J., Ward, P. B., & Stubbs, B. (2016). Exercise improves physical and psychological quality of life in people with depression: A meta-analysis including the evaluation of control group response. Psychiatry research, 241, 47-54.

Aylett, E., Small, N., & Bower, P. (2018). Exercise in the treatment of clinical anxiety in general practice–a systematic review and meta-analysis. BMC health services research, 18(1), 1-18.

Firth, J., Cotter, J., Elliott, R., French, P., & Yung, A. R. (2015). A systematic review and meta-analysis of exercise interventions in schizophrenia patients. Psychological medicine, 45(7), 1343-1361.

Dauwan, M., Begemann, M. J., Heringa, S. M., & Sommer, I. E. (2016). Exercise improves clinical symptoms, quality of life, global functioning, and depression in schizophrenia: a systematic review and meta-analysis. Schizophrenia bulletin, 42(3), 588-599.

Brokmeier, L. L., Firth, J., Vancampfort, D., Smith, L., Deenik, J., Rosenbaum, S., ... & Schuch, F. B. (2020). Does physical activity reduce the risk of psychosis? A systematic review and meta-analysis of prospective studies. Psychiatry research, 284, 112675.

Brondino, N., Rocchetti, M., Fusar‐Poli, L., Codrons, E., Correale, L., Vandoni, M., ... & Politi, P. (2017). A systematic review of cognitive effects of exercise in depression. Acta Psychiatrica Scandinavica, 135(4), 285-295.

Ashdown-Franks, G., Firth, J., Carney, R., Carvalho, A. F., Hallgren, M., Koyanagi, A., ... & Stubbs, B. (2020). Exercise as medicine for mental and substance use disorders: a meta-review of the benefits for neuropsychiatric and cognitive outcomes. Sports Medicine, 50(1), 151-170.

Melo, M. C. A., Daher, E. D. F., Albuquerque, S. G. C., & de Bruin, V. M. S. (2016). Exercise in bipolar patients: a systematic review. Journal of affective disorders, 198, 32-38.

Recchia, F., Leung, C. K., Chin, E. C., Fong, D. Y., Montero, D., Cheng, C. P., ... & Siu, P. M. (2022). Comparative effectiveness of exercise, antidepressants and their combination in treating non-severe depression: a systematic review and network meta-analysis of randomised controlled trials. British Journal of Sports Medicine.

Ekkekakis, P. (2015). Honey, I shrunk the pooled SMD! Guide to critical appraisal of systematic reviews and meta-analyses using the Cochrane review on exercise for depression as example. Mental health and physical activity, 8, 21-36.

Ekkekakis, P., Hartman, M. E., & Ladwig, M. A. (2018). Mass media representations of the evidence as a possible deterrent to recommending exercise for the treatment of depression: Lessons five years after the extraordinary case of TREAD-UK. Journal of sports sciences, 36(16), 1860-1871.

Ekkekakis, P. (2020). Why Is Exercise Underutilized in Clinical Practice Despite Evidence It Is Effective? Lessons in Pragmatism From the Inclusion of Exercise in Guidelines for the Treatment of Depression in the British National Health Service. Kinesiology Review, 10(1), 29-50.

Murri, M. B., Ekkekakis, P., Menchetti, M., Neviani, F., Trevisani, F., Tedeschi, S., ... & Amore, M. (2018). Physical exercise for late-life depression: effects on symptom dimensions and time course. Journal of affective disorders, 230, 65-70.

Uher, R., Perlis, R. H., Henigsberg, N., Zobel, A., Rietschel, M., Mors, O., ... & McGuffin, P. (2012). Depression symptom dimensions as predictors of antidepressant treatment outcome: replicable evidence for interest-activity symptoms. Psychological medicine, 42(5), 967-980.

Iniesta, R., Malki, K., Maier, W., Rietschel, M., Mors, O., Hauser, J., ... & Uher, R. (2016). Combining clinical variables to optimize prediction of antidepressant treatment outcomes. Journal of psychiatric research, 78, 94-102.

Newson, J. J., Hunter, D., & Thiagarajan, T. C. (2020). The heterogeneity of mental health assessment. Frontiers in psychiatry, 11, 76.