

An evaluation of the evidence of physical activity as a treatment for anxiety

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"I found that I worked better and thought more clearly when I was in good physical condition". (Mandela 1994)

This traditional review evaluates and elucidates the role of physical activity as a form of treatment intervention for anxiety. By critically appraising the latest and most robust literature, the review identified that physical activity has an acute anxiolytic effect (small effect size) on individuals, a moderate effect size on chronic anxiety and with a some longevity effect (reported through longitudinal follow up studies). It was reported that the best 'feel good' effect from exercise resulted from moderate intensity exercise of 30 to 45 minutes duration, 3 to 5 times a week for more than 12 weeks, in adults and 60 minutes of daily exercise for children. There is some evidence to support the prescribing of physical activity as an adjunct therapy to treat generalised anxiety disorders and social anxiety, however the efficacy of physical activity is less effective than pharmacotherapy and cognitive behaviour therapy.

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INTRODUCTION

The World Health Organisation (WHO) recommended physical activity of moderate intensity three or more times per week, being one of the five key ingredients for a person to maintain overall good mental health, the others are; good nutrition, adequate sleep, having a supportive relationship, doing something to help others.¹ However, the WHO also reported that one quarter of the world's population will suffer from a mental disorder at any one point in their lives.¹

During the last century, WHO recognised that physical activity levels the world over were falling as a result of industrialisation, urbanisation and economic development.² Humans were less active than they have been for 99 per cent of their existence.³ The US National Health and Nutrition Examination survey reported that children and adults who spent more than 7.7 hours per day seated were considered sedentary. In the meantime, diets have increased in fat content.⁴ Although the concept of healthy mind and health body has been discussed for centuries, research into the field of sports psychology only started in the late 1960s and until the mid 1980s there were only tentative associations considered between sports and good mental health. A seminal systematic review of 43 studies was the first to describe a causal strong link between physical activity and preventing a coronary heart disease.⁵

With the onset of mass sport events in the 80s such as; big city marathons, the development of school education programs and introduction of weekly timed park runs for both children and adults alike, the proportion of persons carrying out regular physical activity has increased. However, until the 1990s at least 60 per cent of the global population failed to carry regular physical activity. Inactivity contributes to an estimated 75 billion in medical

costs on the USA alone. The initiative in England, titled 'Health of the Nation' in 1993 (Department of Health 1993), aimed to increase the proportion of active adults to 60% of the population within 20 years.⁶

In the past decade clear associations have been identified between regular physical activity and good mental health. The NICE guidelines depression 2009, recommended physical activity, three sessions a week (45 to 60 minutes) over 10 to 14 weeks for mild to moderate depression.⁷ However, there is published literature reporting the negative effects of too much sports and associations between elite level sports and mental disorders such as depression, anxiety, eating disorders and substance misuse, which needs to be kept in mind.⁸ Overall research reports that moderate to vigorous physical activity appear to reduce the risk of all causes. Moderate, but not high intensity exercise, has mood enhancing effects.⁹ An 'inverted-U' relationship between exercise intensity and affect is described.¹⁰ The chief medical officer report stated that both physical inactivity and good mental health are a public health priority.¹¹

METHODOLOGY

This literature review aimed to report a short synthesis on the published literature between physical activity and anxiety. The literature search strings were conducted using Medline and PsychINFO databases, end search 10th October 2020. These included; 'mental disorder*', 'anxiety*', 'generalised anxiety disorder*', 'social anxiety*', 'adults' or 'adolescents*', 'physical activity*' or 'exercise*'.

LITERATURE FINDINGS

The adolescent period is considered to be one of high risk.¹² Mental disorders are reported to be the

number one cause of ill health in YP aged 15 to 25 years.¹³ 75% of mental disorders emerge before the age of 25.¹⁴ Mental disorders in young people, are often persistent and have the capacity to 'inflict tremendous morbidity, mortality, and impairment'. Severe mental disorders, are referred to as 'the chronic disease of the younger'.¹⁵ Globally, depressive disorders are ranked as the single largest contributor to non-fatal health loss. Suicide was the second leading cause of death among 15-29 year old globally in 2015. Department of Health estimated that 80 million days were lost due to anxiety and depression, at a cost of 5.3 billion pounds.¹⁶ Anxiety disorders are the most prevalent mental disorder, with a lifetime prevalence of 31% in women and 19% in men. The estimated annual costs of treating anxiety and its indirect costs, is around \$44 billion, equivalent to 22% spent on any DSM 5 disorder.¹⁷

Published literature reported a causal link between exercise and improving one's mood, of moderate effect. However, to date less is known about how physical activity and exercise relate to clinical anxiety conditions at a population level. Possibly there is a bidirectional relationship between physical activity and anxiety. A Scandinavian study $n=20,207$ used the HADS scale for depression and anxiety. When multivariate analysis was used to confirm associations depicting a reduction in anxiety and depression, only the link with depression remained significant (adjusted OR = 0.58).¹⁸ It has also been reported that elevated symptoms of anxiety or the fear of anxiety-related sensations may reduce not only physical activity levels but also the desire to exercise. On the other hand, a prospective cohort meta-analysis reported an overall small but significant reduction in anxiety in persons who exercise.¹⁹ The Physical Guidelines for Americans reported that moderate to vigorous physical activity reduces feelings of anxiety, improves sleep and aspects of cognitive function.²⁰

A number of large scale population epidemiological studies have shown that exercise improves one's self-esteem, and a sense of wellbeing. Some postulated psychology theories for a reduction in anxiety are; sensitivity, the more one is exposed to a raised heart rate the less one fears these somatic symptoms. Another is the self-efficacy, the ability for a person to effect control over their surroundings, which lead to developing a sense of mastery.²¹ Another theory postulated is 'distraction' or 'time out' from the stressful environment, in the similar way meditation helps reduce anxiety and also gives the person a sense of achievement and mastery.²² Crew and Landers 1987 conducted a meta-analysis and found that people who exercised regularly presented with reduced reactivity to stressors, such as sympathetic physiological changes to stress and recovered faster following a stressor. The endorphin hypothesis posits that mood elevations and reduced anxiety following acute exercise are due to the release and binding of endogenous opioids to their receptor sites in the brain.

Enjoyment is an important element for motivation, particularly when physical effort might be required. Kimiecik (2001) adopted Csikzentmihalyi's approach and defined enjoyment in terms of 'flow'. Wankel discussed the importance of enjoyment during exercise as a determinant of changes in mental health outcomes. Studies have consistently shown that a period of training can reduce trait anxiety in a wide subgroups of the population. Greatest benefits are reported when training is longer than 15 weeks.²³

The study of the anxiolytic effects of exercise, has a long history in sport and exercise psychology and has remained an area of considerable interest to researchers. In a review of exercise and anxiety, Leith (1994) identified twenty experimental studies.

Of these, fourteen (70 per cent) showed reduced anxiety from exercise, with the rest showing no change. Taylor (2000) concluded that 'single sessions of moderate exercise can reduce short-term physiological reactivity to and enhance recovery from brief psycho-social stressors'.²⁴

There is quite a few good quality published papers within reporting a small but significant effect of exercise on anxiety. One of the first seminal and most cited papers in sports and anxiety was a meta-analysis which reviewed more than 100 selected articles. The pooled results reported a small but significant effect size (ES) low 0.24 to moderate/high 0.65, higher on self reported measures, and greater effects on psychophysiological measures from acute exercise. A number of moderators were identified, these included; subject, exercise, methodological characteristics that influenced the strength of relationships. ES improved with exercise duration over 40 minutes and for more than 15 weeks. Most studies focused on aerobic exercise, few on non-aerobic exercise and found no differences. Reported no additional benefits from exercise compared to other alternative therapies. Lastly the authors reported an ES 0.21 from pre-post following a single exercise session.²²

A robust review of prospective cohort study with at least one year follow up, reported a significant reduction in anxiety with OR=0.54. This study elucidates the longevity of the anxiolytic effect by exercise on anxiety. Searches were carried out by two independent reviewers, using three databases ($n=2,1818$), the quality of selected papers was assessed using Q-Coh (moderate quality was the least accepted), data were analysed using a random-effects meta-analysis. A small but significant reduction in generalised anxiety disorder with

exercise was found and this persisted through to follow up.¹⁹

Over the past 30 years there has been an increasing number of good quality literature on the acute effect of exercise and anxiety. One of the first studies to report a positive relationship between adherence and anxiety reduction said this effect was just time-limited.²⁵ A recently published meta-analysis which summarised the findings from 25 years of RCTs ($n=36$) reported the weighted mean ES to be 0.17 (small) yet statistically significant. The methodology followed the MOOSE framework, identified studies from five databases, search strings documented and independent reviewers mentioned. Data analysis employed the Cohen's *d* to calculate ES. Once again most included studies had methodological limitations and there was large heterogeneity between the studies. Limitations were accounted using fixed and mixed effects models to examine moderators which may have effected the outcomes. Only three studies reported findings from persons with clinical anxiety, therefore the results are not generalisable to people with severe anxiety. The authors concluded that this study replicated similar results found by Petruzzo et al in 1991, this therefore substantiates the evidence that exercise can reduce anxiety.²⁵

A recent systematic review compared the treatment effects of exercise with pharmacotherapy and psychotherapy. 4134 studies were identified, the CCDAN quality assessment tool was used to ascertain the quality of the studies, eight RCTs met the study's inclusion criteria from the electronic/manual searches through six databases. These studies assessed the effect of exercise in clinically anxious adults and a significant reduction in anxiety symptoms were reported for persons' with panic disorder but exercise was less effective than SSRI treatment. Better results were found when

combining the two. Added benefits were also reported for social anxiety being treated with CBT and exercise. Causal links between exercise and a reduction in anxiety were proposed such as running being a form of graded exposure to the outdoors and to the somatic symptoms of anxiety. Only articles published in English were considered, too few studies to analyse using a funnel plot, the RCTs identified had methodological limitations.²⁶

Another systematic review assessed high intensity against low intensity exercise versus waiting list in the treatment of anxiety. All participants had a diagnosis of anxiety and the exercise program had to be at least two weeks long. Three databases were searched, RCT studies only included, quality of studies assessed using Cochrane's risk of bias tools, clear data analysis plan documented. PRISMA guidelines used for selection of the papers. 15 studies met inclusion criteria ($n=675$), ten studies which assessed aerobic exercise found a low to moderate ES 0.41 between exercise and the controls. However, sample size of every study was low, and studies failed to defined the exercise intervention. High intensity exercise was shown to have better outcomes than low on anxiety, but had higher dropout rates. A key finding were the follow up results, ES of 0.33, on exercise for having an anxiolytic effect months after exercise stopped. The authors conclude, exercise can be prescribed at by general practitioners.²⁷ On the other hand an older meta-analysis investigating the efficacy of exercise as a treatment for clinically anxious individuals, excluded people with PTSD, reported in the sub group analysis no effect anxiety by on aerobic or non-aerobic exercise. They concluded that exercise cannot be prescribed as an adjunct treatment, furthermore, pharmacology and CBT were clinically superior to exercise.²⁸

There are only a handful of studies which attempted to answer the question; whether exercise could be used to treat a particular anxiety disorder. One of the most optimistic studies recruited 56 unmedicated persons with social anxiety, randomly assigned to an eight week exercise program and they reported ES=0.51 to 0.70, and after 4 months the ES= 0.49-0.54 persisted.²⁹

A small RCT who recruited 30 sedentary women, 100% completion rate, reported an improvement (NNT=3), following 6 weeks of exercise for generalised anxiety disorder. They concluded the response rate was similar to other treatments such as pharmacology and CBT for GAD.³⁰ A year later this same author carried out a comprehensive systematic review on the effects of exercise and anxiety, pertaining to specific disorders. Preliminary data suggested that exercise training can serve as an alternative therapy for patients with social anxiety disorder, generalised anxiety disorder, and obsessive-compulsive disorder. Anxiety reductions appear to be comparable to empirically supported treatments for panic and generalised anxiety disorders. Moderator analyses showed larger ES for participants 31 to 45 years of age compared to older participants and for an exercise frequency of 3 to 4 times per week. There exists less conclusive evidence to support the effects of exercise on CBT and PTSD.³¹

CONCLUSIONS

There are even fewer studies comparing the effect of exercise on anxiety to other alternative therapies such as yoga, ti chi, and relaxation. The results from these studies report comparable effectiveness. More studies are needed to compare the effects of exercise on treating anxiety if it is going to be made a recommendation in general practitioner clinics.

Even if the evidence for a causal relationship between physical activity and anxiety in the general population remains unclear, it would not necessarily mean that exercise training is unable to reduce at least certain symptoms of anxiety for some people. Individuals may find it harder to exercise during times of stress, such as before exams, so this is the

time when counsellors could encourage people to keep up exercising. Fitness changes are not directly linked to a reduction in anxiety, but improved physical health may result in enhanced quality of life therefore indirectly reduce the anxiety associated with ageing.³²

REFERENCES

1. World Health Organisation (2008) Global burden of disease report
http://www.who.int/healthinfo/global_burden_disease/estimates_country/en/index.htmlhttp://www.who.int/healthinfo/global_burden_disease/estimates_country/en/index.html
2. World Health Organization (2004) Global strategy on diet physical activity and health: World Health Organization
3. Astrand, P.-O. (1994) Physical activity and fitness: Evolutionary perspective and trends for the future. In C. Bouchard, R. J. Shephard and T. Stephens (eds), *Physical activity, fitness, and health* (pp. 98–105). Champaign, IL: Human Kinetics.
4. Hobbs, M., Pearson, N., Foster, P. J., & Biddle, S. J. (2015). Sedentary behaviour and diet across the lifespan: an updated systematic review. *British Journal of Sports Medicine*, 49(18), 1179-1188. 10.1136/bjsports-2014-093754 [doi]
5. Powell, K. E., Thompson, P. D., Caspersen, C. J., & Kendrick, J. S. (1987). Physical activity and the incidence of coronary heart disease. *Annual Review of Public Health*, 8, 253-287. 10.1146/annurev.pu.08.050187.001345 [doi]
6. Department for Culture, Media and Sport (2002) *Game Plan: A strategy for delivering Government's sport and physical activity objectives*. London: Cabinet Office.
7. NICE guidelines, *Depression in adults: recognition and management*. Clinical guideline [CG90] 2009.
8. Castaldelli-Maia, J. M., Gallinaro, J G M E, Falcao, R. S., Gouttebarga, V., Hitchcock, M. E., Hainline, B., Reardon, C. L., & Stull, T. (2019). Mental health symptoms and disorders in elite athletes: a systematic review on cultural influencers and barriers to athletes seeking treatment. *British Journal of Sports Medicine*, 53(11), 707-721. 10.1136/bjsports-2019-100710 [doi]
9. Knox, E. C., Taylor, I. M., Biddle, S. J., & Sherar, L. B. (2015). Awareness of moderate-to-vigorous physical activity: can information on guidelines prevent overestimation? *BMC Public Health*, 15, 392-6. 10.1186/s12889-015-1705-6 [doi]
10. Ekkekakis, P., & Brand, R. (2019). Affective responses to and automatic affective valuations of physical activity: Fifty years of progress on the seminal question in exercise psychology. *Psychology of Sport and Exercise*, 42, 130-137. 10.1016/j.psychsport.2018.12.018
11. Davies DSC. *Annual Report of the Chief Medical Officer*. Department of Health, UK: 2013.
12. Camilleri, N., Newbury-Birch, D., McArdle, P., Stocken, D. D., Thick, T., & Le Couteur, A. (2017). Innovations in Practice: A case control and follow-up study of 'hard to reach' young people who suffered from multiple complex mental disorders. *Child and Adolescent Mental Health*, 22(1), 49-57. 10.1111/camh.12202 [doi]
13. Gore, F. M., Bloem, P. J., Patton, G. C., Ferguson, J., Joseph, V., Coffey, C., Sawyer, S. M., & Mathers, C. D. (2011). Global burden of disease in young people aged 10-24 years: a systematic analysis. *Lancet (London, England)*, 377(9783), 2093-2102. 10.1016/S0140-6736(11)60512-6 [doi]
14. Royal College of Paediatrics and Child Health, *Bridging the gaps: healthcare for adolescents 2003*. Available from: www.rcpsych.ac.uk

15. McGorry, P. (2017). Youth mental health and mental wealth: reaping the rewards. *Australasian Psychiatry : Bulletin of Royal Australian and New Zealand College of Psychiatrists*, 25(2), 101-103. 10.1177/1039856217694768 [doi]
16. Department of Health (2004) At least five a week: Evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer. London: Author.
17. Kessler RC, Petukhova M, Sampson NA, Zaslavsky AM, Wittchen HU. Twelvemonth and lifetime prevalence and lifetime morbid risk of anxiety and mood disorders in the United States. *Int J Methods Psychiatry Res*. 2012;21(3):169–184. <https://doi.org/10.1002/mpr.1359>.
18. Thorsen, L., Nystad, W., Stigum, H., Dahl, O., Klepp, O., Bremnes, R. M., . . . Fosså, S.,D. (2005). The association between self-reported physical activity and prevalence of depression and anxiety disorder in long-term survivors of testicular cancer and men in a general population sample. *Supportive Care in Cancer*, 13(8), 637-46. doi:<http://dx.doi.org.ezproxy.staffs.ac.uk/10.1007/s00520-004-0769-0>
19. McDowell, C. P., Dishman, R. K., Hallgren, M., MacDonncha, C., & Herring, M. P. (2018). Associations of physical activity and depression: Results from the Irish Longitudinal Study on Ageing. *Experimental gerontology*
20. U.S. Department of Health and Human Services. *Physical Activity Guidelines for Americans 2nd edition*. Washington, DC: U.S. Department of Health and Human Services; 2018.
21. Anderson, E & Shivakumar, G. (2013). Effects of Physical Activity on Anxiety. *Frontiers in Psychiatry*: 4: 27.
22. Petruzzello, S. J., Landers, D. M., Hatfield, B. D., Kubitz, K. A., & Salazar, W. (1991). A meta-analysis on the anxiety-reducing effects of acute and chronic exercise. *Outcomes and mechanisms. Sports Medicine (Auckland, N.Z.)*, 11(3), 143-182. 10.2165/00007256-199111030-00002 [doi]
23. Kimiecik, J. C., Kimiecik, J. C., & Harris, A. T. (1). What Is Enjoyment? A Conceptual/Definitional Analysis with Implications for Sport and Exercise Psychology. *Journal of Sport & Exercise Psychology*, 18(3), 247-263.
24. Biddle, S. (2015). *The psychology of physical activity: determinants, well-being and interventions (3rd ed.)*. Routledge.
25. Ensari, I., Greenlee, T.A., Motl, R.W. & Petruzzello, S.J. (2015). Meta-analysis of acute exercise effects and state anxiety: an update of randomised control trials over the past 25 years. *Depression and Anxiety*, 32:624–634.
26. Jayakody, K., Gunadasa, S. & Hosker, C. (2014). Exercise for anxiety disorders: systematic review : *Br. J Sports Med*. 48:187–196.
27. 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), 559-5. 10.1186/s12913-018-3313-5 [doi]
28. Bartley B, Hay M, Bloch M. Meta-analysis: aerobic exercise for the treatment of anxiety disorders. *Prog Neuro-Psychopharmacol Biol Psychiatry*. 2013;45:34–9.
29. Jazaieri H, Goldin PR, Werner K, Ziv M, Gross J. A Randomized trial of MBSR versus aerobic exercise for social anxiety disorder. *J Clin Psychol*. 2012;68(7): 715–31.
30. Herring MP, Jacob ML, Suveg C, Dishman RK, O'Connor PJ. Feasibility of exercise training for the short-term treatment of generalized anxiety disorder: a randomized controlled trial. *Psychother Psychosom*. 2012;81:21-28
31. Herring, M. P., Lindheimer, M.A., & O'Connor, P. J. (2013). The effect of exercise training on anxiety. *American Journal of Lifestyle Medicine*.
32. Rejeski, W.J., Marsh, A.P., Chmelo, E. and Rejeski, J.J. (2010), Obesity, intentional weight loss and physical disability in older adults. *Obesity Reviews*, 11: 671-685. doi:10.1111/j.1467-789X.2009.00679.x