The Effect of Exercise on Mental Health

Andrea L. Dunn[1] *and Jennifer S. Jewell*[2]

[1]Senior Scientist, Klein Buendel, Inc., Golden, CO; [2]Project Coordinator, Klein Buendel, Inc., Golden, CO

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Including exercise for the prevention and treatment of mental disorders is a promising area of research for exercise scientists since data indicate that many of these disorders are not treated at all, and there is a significant delay in treatment. This review provides an appraisal of the recent use of exercise to prevent and treat specific mental disorders and provides a recommended framework for future progress of this research. More research is needed to overcome methodological issues to demonstrate the efficacy and effectiveness of exercise and to integrate mental and physical healthcare for widespread dissemination.

INTRODUCTION

A recent Institute of Medicine (IOM) report provides a useful and distinct framework for interventions of mental health disorders that includes mental health promotion, prevention, treatment, and maintenance (33). Mental disorders include emotional and behavioral symptoms defined by *The Diagnostic and Statistical Manual of Mental Disorders* (DSM) and the International Classification of Disease (ICD). These include schizophrenia, depression, anxiety disorders, attention deficit hyperactivity disorder (ADHD), conduct disorder, and substance abuse and dependence. The IOM framework provides a useful organizational scheme to discuss recent exercise and physical activity interventions and to determine priorities for future study (44). First, it is important to gain an understanding of the magnitude of the problem to understand how widely exercise interventions might be implemented.

The World Health Organization (WHO) now has published several studies on the prevalence, severity, and treatment of mental disorders using a structured diagnostic interview, thus allowing for cross-national comparisons (24,39,41,47). These studies report that the 12-month prevalence of any mental disorder is highly variable. Low prevalence rates for any mental disorders are 4.3% in Shanghai China, 4.7% in Nigeria, and 8.2% in Italy. The highest yearly prevalence rates are 26.3% in the U.S., 20.4% in the Ukraine, and 18.4% in France. Differences in prevalence rates may be due to the cultural stigma of mental disorders and to the availability of mental health services. Of importance for exercise to prevent and to treat mental disorders are data indicating that the majority of these illnesses would be classified as moderate or mild and that most individuals do not receive any health care treatment regardless of severity (41).

In addition to the failure to receive any treatment, there is also a substantial delay in seeking treatment for mental disorders that is highly dependent on each country's mental health delivery system, financing, type of disorder (48), and the stigma associated with seeking treatment (2). For example, the median delay for seeking treatment for an anxiety disorder is 3 yr in Israel and 30 yr in Mexico (48). Furthermore, seeking treatment for a mental disorder does not mean individuals are provided with optimal treatment, and individuals struggling with chronic or recurring mental disorders have higher rates of mortality (3) and elevated morbidity outcomes when depression occurs alongside physical diseases such as diabetes or cardiovascular disease (17). Data show that those who have mental disorders die 10 to 15 yr earlier than the general population, and major contributing factors include preventable cardiovascular diseases resulting from poor lifestyle choices like physical inactivity (34). Given the lack of treatment, the delay in seeking treatment, and the high morbidity and mortality due to mental illness, physical activity and exercise likely could play a substantial role in the prevention and treatment of mental disorders in addition to standard evidence-based treatments that includes pharmacotherapy and cognitive behavioral therapy (CBT). In other words, exercise could be medicine for mental disorders, but there are insufficient data to demonstrate that exercise could prevent or treat mental disorders. Despite this lack of evidence for the integration of physical activity or exercise, consensus recommendations do promote its use, and in some countries like Great Britain, it has become more integrated

Address for correspondence: Andrea L. Dunn, Ph.D., FACSM, Senior Scientist, Klein Buendel, Inc., 1667 Cole Blvd, Suite 225, Golden, CO 80403-3313 (E-mail: adunn@kleinbuendel.com).

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into treatment of select mental disorders, like depression (29,30).

This review will provide recently published data on the use of exercise to prevent depression using the IOM guidelines. These have advanced how prevention studies are conceptualized from health promotion, through universal, selective, and indicated prevention studies and whose major aim is to prevent the onset of mental disorders, particularly depression and anxiety disorders. Similarly, this review will update treatment studies of exercise and physical activity to treat mental disorders, focusing first on the mental disorders' outcome, such as depression disorders or anxiety disorders, and also classifying exercise treatments as a monotherapy, an augmentation, or add-on treatment (*e.g.,* Does adding exercise improve symptoms, or as an adjunct or combination? Does adding exercise improve other outcomes, *e.g.,* blood glucose in depressed patients with diabetes or quality of life in all age groups?). In the discussions of prevention and treatment, recommendations will be made for additional research, with special attention paid to careful diagnosis of the mental disorder, descriptions of the types of exercise treatments, and length of treatment. Finally, how exercise research has progressed from epidemiology to efficacy and effectiveness, with the need to advance to dissemination and integration into physical and mental health care will be discussed briefly. This appraisal of recent studies will not cover psychological or biological mechanisms that might underlie effects. Readers are referred to recent reviews that can provide more complete information (12,13,21,46).

EXERCISE AND PHYSICAL ACTIVITY TO PREVENT MENTAL DISORDERS

The most comprehensive recent review about the ability of physical activity to prevent mental disorders comes from Section 8 of the Physical Activity Guidelines Advisory report published in 2008 (35). The conclusions of this report, based on cross-sectional and prospective epidemiological data, are that physical activity can protect against feelings of distress, enhance psychological well-being, protect against symptoms of anxiety and development of anxiety disorders, protect against depressive symptoms and development of major depressive disorder, and delay the effects of dementia and the cognitive decline associated with aging. This report also concludes that there is little evidence about whether physical activity can prevent other mood disorders like bipolar disorder or postpartum depression; evidence for the role of exercise to prevent other mental disorders like ADHD and substance abuse is not included.

Prevention studies conceptualized by the IOM include *universal* preventive interventions aimed at a broad part of the population; *selective* preventive interventions are targeted to at-risk groups based on environmental, genetic, or situational risk factors; and *indicated* preventive interventions are directed to high-risk, subsyndromal individuals who are at an increased risk of developing a mental health disorder. The main outcome of all of these types of interventions is to prevent the onset of the disorder. Despite a 2006 Cochrane Review on the prevention and treatment of anxiety and depression disorders (26), there are no published studies of exercise treatment that might be classified as prevention interventions using the IOM categorization scheme with the aim of preventing the onset of the disorder. Furthermore, this review has been criticized for inadequately describing the study sample, incomplete descriptions of the type, duration, intensity, and frequency of exercise, and lack of reporting of adherence to the treatments under investigation (15).

Prevention studies using the IOM scheme of mental disorders in children and teens are greatly needed since retrospective data from the National Cormorbidity Survey (NCS) indicates that one half of all mental disorders begin by the mid-teen years, and this increases to nearly 75% by the time by the time adults reach their mid-20s (33). An example of *universal* prevention programs for children and teens would be to require physical activity as part of all school days from elementary schools through high school. Such physical activity programs could be combined with resilience training or evidence-based coping skills training programs. *Selective* interventions might target children and teens whose parents have a mental illness, and once again exercise or physical activity might be combined with evidence-based coping skills or other evidence-based prevention programs. Finally, *indicated* prevention interventions might use exercise or physical activity interventions with children or teens with symptoms of a mood or anxiety disorder or who might be displaying aggressive or hyperactive behaviors.

Prevention researchers also should develop a better understanding of whether any type of prevention program would be acceptable to the target audience. A recent study in Germany focusing on depression illness found that individuals had favorable perceptions of prevention programs in much the same way as they positively regard cancer or diabetes prevention programs. This study found that certain subgroups were more open-minded to prevention programs, including those who had contact with someone who was depressed or those with family members with the disorder. They also felt that lifestyle programs would be most acceptable (38). Surveys such as this point to the importance of understanding what is feasible and acceptable for the development of each type of prevention program. This survey is an example of the type of accretion of studies that led to large-scale prevention interventions such as the Diabetes Prevention Project (DPP). It will be important to compile data from such studies with the aim of conducting large-scale trials to prevent mental disorders like anxiety and depression. Building this scientific foundation for a large-scale depression and/or anxiety prevention project will be necessary if progress is to be made to understand what role exercise can play in the prevention of many types of mental disorders.

In addition, the conduct of these types of prevention programs will require a shift in thinking that moves beyond the traditional disease model, an integration of physical and mental health within and outside of the current health care systems, and better communication among a variety of disciplines that includes an understanding of various developmental stages and respect for research and practice in multiple disciplines (33). For example, in the United States, payment is made for disease treatment and some types of physical illness prevention interventions by insurance and government funded programs, but these same programs generally will not pay for lower cost

interventions that might prevent the onset of mental disorders. Furthermore, pediatricians often are the first health care professionals to see the onset of mental disorders in children and teens, but they often lack the training or tools to treat children and adolescents with these symptoms. It is estimated that nearly 24% of visits to pediatricians are for behavioral and mental health problems (10). Challenges and opportunities for future research exist within this larger infrastructure and will require a great deal of cross-collaboration between behavioral, medical, exercise scientists, community researchers, and practitioners as well as cost-effectiveness, implementation, and dissemination, and policy experts.

EXERCISE AND PHYSICAL ACTIVITY TO TREAT MENTAL DISORDERS

In the current treatment guidelines for depression from the National Guideline Clearinghouse, exercise is recommended only as an adjunctive self-management treatment based on consensus rather than evidence (32). This means the evidence for exercise as a treatment for depression is insufficient to recommend it as a front-line treatment for this disorder. This also is true for other mental disorders.

For progress to be made, exercise scientists should consider organizing physical activity or exercise treatments for mental health disorders such as depression or anxiety into three distinct categories. These include use of exercise treatment as a monotherapy, augmentation therapy, or adjunct therapy, an organizational scheme promulgated by the mental health treatment community. Also, within each of these categories, the treatment process should be characterized clearly as having three successive states: 1) acute phase treatment that lasts for 8 to 12 wk with the goal to achieve a response to treatment (30%–50% reduction in symptoms) or remission (very much improved or symptom level in the normal range on a standardized assessment); 2) continuation phase treatment that lasts for 4 to 12 months with the major goals of preventing relapse and to further improve functioning; and 3) maintenance phase treatment that can last beyond 1 yr to ensure that the disorder does not recur (25). Severity of the disorder also should be taken into account to ensure safety and appropriateness of treatment for patients.

In addition to characteristics of the mental health treatment, exercise studies should carefully describe the exercise type (*e.g.*, resistance, aerobic, yoga); the exercise or physical activity amount, intensity, frequency, and duration; adherence to each condition and overall; and a clear description of the comparator condition (*e.g.*, wait list, psychotherapy, and pharmacotherapy). Finally, exercise treatment studies should follow methodological guidelines developed for the conduct of randomized controlled clinical trials as described by the 22-item checklist of the Consort Statement (31).

Recent Meta-Analyses of Exercise to Treat Depression and Anxiety

To overcome some of these weaknesses, several comprehensive reviews and meta-analyses have recently been published on exercise to treat depression (27,37) and on exercise treatment for anxiety in patients with chronic illnesses (19). First, in the Cochrane review conducted by Mead and colleagues, exercise was compared with standard treatment, no treatment or placebo treatment in adults with depression as defined by the authors. A total of 28 trials met the inclusion criteria for this review, and of these, 23 provided adequate data for a meta-analysis. These 23 trials compared exercise with no treatment or a control intervention, and the pooled effect size was −0.82 (95% confidence interval [CI] −1.12, −0.51), which indicates a large effect. However, of these 28 studies, only three had adequate concealment of randomization to treatment, used intention to treat analysis, and had a blinded outcome assessment. The pooled effect size was attenuated to −0.42 (95% CI −0.88, 0.03), considered a moderate effect size.

A meta-analysis published in the same year and using different inclusion criteria used 75 studies, and of these, adequate information was included in 58 to calculate an effect size of −0.80 (95% CI −0.92, −0.67). Despite similar findings to the Cochrane review, a key difference is that this meta-analysis included nonclinical samples, and participants were not defined as clinically depressed. If one compares effect sizes of those that included only clinical samples, meaning individuals with symptoms or a diagnosis of depression, the sample was reduced to 17 studies and had a somewhat larger effect size (ES = −1.03) compared with 40 studies of nonclinical participants (ES = −0.59). It is possible that the reason for the larger effect sizes in this meta-analysis is because of the more limited selection of groups considered for comparison. This meta-analysis stated they used only a no-treatment control or a wait-list control and did not include psychotherapy or pharmacological treatment as the Cochrane review did.

This meta-analysis also examined moderating effects of the exercise characteristics, methodological characteristics, and comparisons with standard treatments such as psychotherapy and pharmacotherapy. For example, in clinically depressed populations, effect sizes were significantly larger in interventions that were 10 to 16 wk in length compared with those that were only 4 to 9 wk in length. Studies of continuation or maintenance-phase treatments were not reported. Bouts of 45 to 59 min in length appeared to be more efficacious that those lasting fewer than 44 min or more than 60 min, and there did not appear to be an effect of type of exercise in these analyses. Analyses of methodological variables found larger effect sizes in studies that used intent to treat analysis and concealment of treatment, and conducting a clinical interview to confirm diagnosis did not appear to make a difference. In the small number of studies that compared exercise with psychotherapy or with pharmacotherapy, no differences were found.

While these reviews and meta-analysis provide some intriguing data, they are based on small numbers of studies with generally small and often underpowered sample sizes. In contrast to the 23 studies of the Cochrane Review with a total of 907 participants, there have been 74 phase 2 and 3 clinical trials with antidepressant medications with a total of 12,564 patients (43). With more than three times the numbers of studies and well over 10 times the number of patients, it becomes evident why pharmacotherapy is an accepted evidence-based treatment compared with exercise or physical activity.

Effect sizes reported in this study likely are to be of interest to exercise scientists and clinicians. The effect size for the entire combined sample was 32% overall for both published and unpublished studies, with greater effect sizes reported for published studies (0.37, 95% CI 0.33–0.41) compared with unpublished studies (0.15, 95% CI 0.08–0.22). These effect sizes are comparable with the attenuated effects from the three studies that did not have methodological problems cited in the Cochrane review, but with so few studies, more research needs to be conducted, and reviewers should avoid publication bias issues that have been demonstrated in this recent study of antidepressant medications (43).

The consistency of effect sizes of exercise training to reduce anxiety symptoms in sedentary patients with chronic illnesses such as cardiovascular disease, fibromyalgia, multiple sclerosis (MS), cancer, chronic obstructive pulmonary disease (COPD), chronic pain, and other chronic diseases was recently reported in a study by Herring and colleagues (19). In this study, the mean effect size was 0.29 (CI 0.23–0.36) an effect comparable to the depression studies previously cited (27,37). This review also examined moderators of the effect sizes and found that exercise training, with a duration of 3 to 12 wk (0.39, 95% CI 0.28–0.49), was more effective compared with longer training durations of more than 12 wk (0.23, 95% CI 0.15–0.31). Exercise bouts of 30 min or more had greater effect sizes than shorter durations or unspecified session durations. Methodological issues related to how anxiety was measured also appeared to have an impact on the size of the effects reported. As in the reviews and meta-analysis of exercise to treat depression, the number of studies are relatively small (N = 40), but nevertheless exercise does appear to reduce anxiety in patients with chronic disease, and these results will help to justify larger trials in patient populations with chronic illness.

Exercise Augmentation or Adjunct Treatments for Mental Disorders

Combining exercise with other treatments for mental disorders has been increasingly emphasized by government commissions, advocacy groups for the mentally ill, and mental health associations calling for integrated health care services within mental health care settings (3,20,34,40). A recent report identified health promotion efforts to be an important component of mental health care, yet few states actually offer health promotions programs that can help those with mental illness stop smoking, improve diet, or increase physical activity. Nearly 70% of states score a D or F in this area. Suggestions that programs integrate physical activity and other lifestyle behaviors into mental health care likely will fill an important gap (3). A review by Callaghan suggests that exercise seldom is recognized as an effective intervention because of the lack of knowledge of the role of exercise in the treatment of mental disorders (5). This lack of knowledge likely plays some role for nonimplementation of exercise as a potential treatment, but there is very little basic information about physical activity habits in these populations, and there are even fewer studies on the effects of augmentation or adjunct interventions for populations with any mental disorder.

There are some estimates of physical activity in patients with mental illnesses that indicate these patients are less physically active than the general population (11), but a recent study of objective measure by accelerometers found study participants (N = 55) with mental illness averaged 120 $min \cdot wk^{-1}$ of moderate to vigorous physical activity (MVPA) (22). Of the sample, 35% accumulated at least 150 $min \cdot wk^{-1}$ of MVPA; however, only 4% of the participants accumulated 150 $min \cdot wk^{-1}$ of MVPA in bouts that were at least 10 min in length, indicating this population did not perform sustained physical activity. These objective physical activity measures are similar to findings by Troiano and colleagues using National Health and Nutrition Examination Survey data in a representative U.S. sample (42). Further, these data are consistent with a study examining objective and self-report measures of physical activity in a small sample of participants with severe mental illness (14). An important secondary finding of the study by Jerome and colleagues was that symptoms of mental illness were not associated with physical activity and that there was high compliance with the accelerometer protocol (22). Being able to measure physical activity in individuals with severe mental illness helps to demonstrate that physical activity programs in these populations are feasible.

A recent review by Allison and colleagues provides a summary of a very small number of studies of lifestyle modification in people with severe mental illness who have high rates of morbidity due to obesity, diabetes, and cardiovascular disease (1). This summary finds the evidence for exercise or physical activity in patients with severe mental illness and chronic disease is somewhat mixed. More recent studies indicate that exercise added to pharmacotherapy in patients with treatment-resistant depression showed improvement in depressive symptoms and physical health after long-term (32 wk) exercise. However, the sample size in this study was very small, with only 10 participants each randomized to exercise or control (7). Similarly, recent studies of adjunctive exercise treatment for adolescents, adults, and older adults with Alzheimer's disease have found improvements in mental disorder symptoms and other secondary measures of health and functioning (28,36,45,50). Again, these studies have methodological issues, but they do provide preliminary data that exercise can be added to traditional treatments and provide further benefits in terms of symptom reduction and improvement in secondary outcomes such as improved functioning and quality of life. A key question now is how researchers can build on the small number of studies, improve methodological problems, and progress toward better understanding of the effects of exercise to prevent and treat mental disorders and to disseminate programs found to be effective.

BUILDING THE SCIENCE OF PHYSICAL ACTIVITY AND EXERCISE TO PREVENT AND TREAT MENTAL DISORDERS

Although it long has been recognized that individuals with good health habits, including regular exercise, also have good mental health, the science of using exercise to prevent and treat mental disorders is relatively new (33). There are

numerous reasons for this, but one primary reason has to do with the interdisciplinary nature of these studies, which in turn, has implications for funding and policy. Within the field of exercise science, there seems to be interest in the effects of exercise on mental health outcomes, but like many disciplines, the prevention or treatment of mental disorders is not a primary goal within this field. Therefore, it is important to collaborate with experts where mental disorders are the primary interest of the discipline. These collaborations are of key importance and likely would help improve many of the methodological problems that have plagued previous studies (27,35,37). Experts in mental health could provide proficiency in the prevention and treatment paradigms of specific disorders; knowledge of measurement including how to diagnose and measure various mental disorders; and capabilities to ensure safety of participants. Experts in exercise science could provide proficiency in the types of exercise that might be used; training paradigms including the intensity, frequency, duration, and total energy expenditure and best methods of measurement; and experience in how to monitor adherence to exercise. These cross-collaborations have increased in recent years (4,16), but they have not been the norm as borne out by recent reviews (15,27,37). It will be necessary for these cross-collaborations to become the norm to determine whether exercise can prevent and treat a wide variety of mental disorders.

This cross-collaboration likely will not be sufficient for using exercise or physical activity to prevent or manage mental disorders, even if interventions demonstrate efficacy and effectiveness. There is increasing interest to include allied health professionals within mental health treatment to improve translation and widespread dissemination. For example, physicians in Great Britain have referred patients with depression to exercise specialists (29), and primary care physicians in Australia have referred patients with depression and anxiety to dietitians and exercise scientists (18). The Australian study, in particular, demonstrates that it is feasible to incorporate these professionals into primary care. Wider dissemination might be accomplished through the use of computerized, tailored Web sites within primary care or mental health counseling centers, but this remains to be demonstrated (6,23). The increased use of technology to deliver mental health interventions has been shown to be feasible with CBT therapy for depression (8,9) and for other health behaviors (49), so it is possible that it also might be used to facilitate treatment of tailored physical activity interventions in some populations with mental health issues in a variety of settings.

CONCLUSION

Based on recent evidence to demonstrate efficacy to treat some mental disorders like depression and anxiety, there is increasing support that exercise could be medicine for these disorders. Currently, Section 8 of the Physical Activity Guidelines recommends that clinicians should advise some exercise for their patients with mental disorders, and physicians should take into account comorbid disease and the patient's capabilities. In the future, greater interdisciplinary collaboration is needed to overcome numerous methodological problems and to demonstrate the effectiveness of exercise at comparable levels to standard treatments. There is little evidence for the use of exercise as an augmentation or adjunct treatment, and this is an area where more research is needed, particularly when one considers the undertreatment of mental disorders. Very little evidence exists that physical activity can prevent mental disorders using the IOM framework. Despite pioneering efforts to integrate activity into mental health care, there are many studies that remain to be performed. This area of study holds a great deal of promise to improve mental disorders worldwide.

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