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The Relation of Physical Activity and Exercise to Mental Health

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Synopsis

Mental disorders are of major public health significance. It has been claimed that vigorous physi-

cal activity has positive effects on mental health in both clinical and nonclinical populations. This paper reviews the evidence for this claim and provides recommendations for future studies.

The strongest evidence suggests that physical activity and exercise probably alleviate some symptoms associated with mild to moderate depression. The evidence also suggests that physical activity and exercise might provide a beneficial adjunct for alcoholism and substance abuse programs; improve self-image, social skills, and cognitive functioning; reduce the symptoms of anxiety; and alter aspects of coronary-prone (Type A) behavior and physiological response to stressors. The effects of physical activity and exercise on mental disorders, such as schizophrenia, and other aspects of mental health are not known. Negative psychological effects from exercise have also been reported. Recommendations for further research on the effects of physical activity and exercise on mental health are made.

MENTAL DISORDERS are of major public health significance, affecting, by one conservative estimate, 15 percent of the population during any 1 year (1). In 1975, they led the list of causes for days of hospitalization, accounting for 260 million days, or 30 percent of the total. That same year, they cost about \$19.3 million, about 8 percent of all health costs. They ranked 3rd as the reason for Social Security disability, 9th as a cause of office visits to physicians, 9th as a cause of limitation of activity, and 10th in days of work lost (2). The human costs of these disorders are inestimable.

It has been claimed that mental health in both clinical and nonclinical populations is positively affected by vigorous physical activity (see box below). Some of these proposed psychological benefits are improved confidence, well-being, sexual satisfaction, anxiety reduction, and positive effects on depressed mood and intellectual functioning (3). Such effects of vigorous physical activity could have important primary preventive benefits by making people less susceptible to other factors that might produce mental illness and could also have secondary preventive effects in improving functioning in people with mental illness.

Altogether, more than 1,000 articles addressing the psychological effects of sport and exercise have been identified (4). Most of these articles are anecdotal or editorial or have methodological problems that limit the usefulness of the data. Nevertheless, for some illnesses and psychological functions, sufficient data are present on the subjects, the exer-

Some proposed psychological benefits of exercise in clinical and nonclinical populations

<i>Increases</i>	<i>Decreases</i>
Academic performance	Absenteeism at work
Assertiveness	Alcohol abuse
Confidence	Anger
Emotional stability	Anxiety
Independence	Confusion
Intellectual functioning	Depression
Internal locus of control	Dysmenorrhea
Memory	Headaches
Mood	Hostility
Perception	Phobias
Popularity	Psychotic behavior
Positive body image	Stress response
Self-control	Tension
Sexual satisfaction	Type A behavior
Well-being	Work errors
Work efficiency	

cise procedures, the measures, and the outcomes to merit consideration and to provide encouragement as to the usefulness of physical activity and exercise for reducing symptoms associated with mental illness and increasing mental health and functioning. Such articles serve as the basis for this review.

The discussion has been restricted to those conditions justified by the quality of existing information. The emphasis of the discussion is on conditions that are included in the American Psychiatric Association's "Diagnostic and Statistical Manual of Mental Disorders" (DSM-III) (5) or on psychological functions that might have primary or secondary preventive effects. The effects of physical activity and exercise on organic brain syndrome, personality disorders, perception, social behavior, and family life, for example, are not discussed. The psychology of sport and exercise and the effects of dance, movement, and other such activities used for "recreational therapy," although relevant for mental health, were excluded from the review. This paper has been aided by several recent excellent reviews (3,6-8) and by the unpublished papers from the National Institute of Mental Health-sponsored workshop, April 26-27, 1984, on "Coping with Stress: The Potential and Limits of Exercise Intervention."

Favorable Effects of Exercise

Depression. Clinical depression is a major public health problem, affecting 5 to 10 percent of the American population (9). About 15 percent of depressed patients will die from suicide. While the antidepressant effects of exercise are widely accepted, only a few studies have shown a benefit in populations with a primary problem of depression (10-13), and only two of these studies were controlled (10,13). Some studies have shown a relation between fitness and depression (14) while others have not (15).

The effects of exercise in alleviating depression in postmyocardial infarction (post-MI) patients are less certain. While at least one uncontrolled study has shown significant improvement in depression in post-MI patients participating in an exercise program (16), four other studies have not found a significant effect of exercise when compared with other interventions or control (17-20). On the other hand, a strong antidepressant effect of exercise in post-MI patients would be difficult to show in populations that do not have high levels of depression, as was the case in these studies.

In nonclinical populations, a few studies have reported decreased depressed mood or improved mood associated with exercise (21,22), a few reported no change overall (23-25), and one study found an effect of exercise on women but not on men (26). Low initial levels of depression may make it difficult to detect exercise-induced mood shifts.

The changes in depression have been attributed to diversion, social reinforcement, improved self-efficacy, and increased neurotransmission of catecholamines or endogenous opiates or both (3).

Anxiety. Physical activity and exercise are also purported to alleviate anxiety. Surprisingly, there have been no controlled studies of subjects who meet the DSM-III criteria for an anxiety disorder (the effects of exercise on self-reported anxiety are discussed in the following paragraph). A few case reports have reported positive benefit from exercise in reducing symptoms in patients with situational phobias and patients who suffer from panic attacks (27-29).

Previous reviewers have been rather positive about the effects of exercise on anxiety signs and symptoms (7,30). Experimental studies of both acute and chronic exercise of vigorous intensities have consistently shown a reduction in state (temporary or transient) anxiety (30-35). Effects of acute exercise are more pronounced in patients who have clinical elevations in state anxiety (7,30). Changes in trait anxiety following chronic exercise training have been less consistent: some studies have shown decreases (32,36,37), one study has shown an increase (16), and some studies have shown no change (17,18). In several studies, acute exercise was as effective in reducing anxiety as meditation (31,37) or a cognitive-behavioral method (35). The need for careful controls in anxiety studies is illustrated by a study in which state anxiety decreased equally as a result of running, attending an exercise class, or eating lunch (38). Physiological studies have consistently found that exercising has relaxation effects (39,40).

The effects of exercise on anxiety have been attributed to diversion; social reinforcement; experience of mastery; and improved response to stress through reduced muscle tension, heart rate, skin conductance, and catecholamine, glucocorticoid, or lactate production (3).

Psychoses. A few case reports, anecdotes, and small group studies with heterogeneous populations suggest that physical activity and exercise can be beneficial for schizophrenic patients. No controlled studies have been undertaken to determine if physical activ-

'While the antidepressant effects of exercise are widely accepted, only a few studies have shown a benefit in populations with a primary problem of depression, and only two of these studies were controlled.'

ity or exercise would alleviate symptoms of schizophrenia or even if the apparent benefits of exercise (such as improved self-image) seen in nonclinical populations occur in schizophrenic patients.

Alcoholism and substance abuse. Uncontrolled studies of alcoholics have had mixed results: one study found little correlation between fitness improvement and changes in self-concept (41); two others found positive changes in depression and other subscales of the Minnesota Multiphasic Personality Inventory (see table) (42,43). Fifty-eight alcoholics participating in a fitness program exhibited significantly higher abstinence rates 3 months after treatment than did comparison populations (44). Although exercise has been employed in many programs treating patients for substance abuse, the importance of exercise per se has not been demonstrated.

Mental retardation. The effects of physical exercise in improving self-concept and even IQ (or behaviors associated with IQ measurement) in mentally retarded persons are encouraging. Several studies have demonstrated that a comprehensive conditioning program can produce significant gains in IQ (45-47). Factors other than improved physical conditioning may account for these changes, but these tantalizing findings have received surprisingly little followup. Physical development programs for retarded children result in more positive body image (48,49). This improvement appears to remain stable over time (49). Exercise may also improve the social skills of retarded children (45,50).

Other psychological effects. Exercise and physical activity may help improve mental health and even prevent mental disorders by improving self-confidence, self-concept, cognition, or other psychological variables.

In controlled studies, children and adolescents improved *self-confidence* after exercise (51,52).

Effects of exercise on depression and alcoholism

Study	Population	Design	Measures	Outcome
<i>Clinical depression</i>				
Greist and coworkers, 1979 (10)	23 depressed outpatients	Running; time-unlimited psychotherapy; time-limited psychotherapy, 12 weeks	SCL-90	Significant improvement for all groups; no among-group differences
Doyne and coworkers, 1983 (11)	4 depressed females	Stationary bicycle, 4 times a week for 6 weeks, using A-B multiple baseline	Adjective Checklist, BECK Depression Inventory	Significant improvement over baseline
Klein and coworkers (13)	42 depressed outpatients	Walking and jogging, meditation, group psychotherapy, 23 sessions each	SCL-90, Zung Depression Scale, POMS	Significant improvement for all groups; no difference among groups
Kavanagh and coworkers, 1977 (12)	44 depressed post-MI patients	4-year participation in a rehabilitation program	MMPI (depression scale)	Slight improvement
<i>Depression in postmyocardial infarction patients</i>				
Naughton and coworkers 1968 (17)	14 post-MI	Exercise, matched sedentary cardiac patients and controls	MMPI	No significant difference between groups
Stern and coworkers, 1981 (16)	122 post-MI	Low-level exercise, 6 weeks	MMPI (depression scale)	Significant improvement
Stern and coworkers, 1982 (18)	651 post-MI	Exercise or no training, 2 years	MMPI (depression scale)	No significant difference between groups
Stern and coworkers, 1983 (19)	106 post-MI	3 groups: exercise, group counseling, control; 12 weeks	Taylor Anxiety, Zung Depression, NIMH Mood scales	At 12 weeks, exercise or counseling significantly better than control; no difference at 1 year
Mayou, 1983 (20)	129 post-MI	Usual care, exercise training, and exercise training and extra advice, 23 weeks	Various depression measures	No difference among groups
<i>Alcoholism</i>				
Frankel and Murphy, 1974 (43)	24 male alcoholics	Exercise 5 days a week for 12 weeks	MMPI	Improved
Gary and Guthrie, 1972 (41)	20 chronic alcoholics	Jogging for 20 days, control group	Self-concept scales	Increased self-esteem
Murphy and coworkers, 1972 (42)	93 male alcoholics	23-month physical fitness combined with hospitalization	MMPI (anxiety and depression scales)	Improved
Sinyor and coworkers, 1983 (44)	46 male and 12 female alcoholics	Exercise 5 days a week, with hospital program for 6 weeks	Abstinence from alcohol	Greater abstinence, compared with other groups

NOTE: SCL-90 = Symptom Checklist 90; POMS = Profile of Mood States; MMPI = Minnesota Multiphasic Personality Inventory.

Women in an exercise group reported large increases in self-confidence that were correlated with changes in fitness (33). However, in a study conducted in the workplace, changes in self-concept were not related to fitness changes (36). In a well-designed study, running by itself did not improve self-concept, but running plus group discussion did

(53). Thus, specific effects of fitness on self-concept have been found in children but not in adults.

Some studies of children have shown that enhanced *cognitive functioning* is associated with physical activity (7) while others have shown no relationship (54,55). Studies of adults have had the same mixed results: some have shown positive rela-

tionships (56–58) and others no relationship (59,60). Two studies have found that exhaustive exercise caused a decrement in cognitive performance (61,62). Folkins and Sime (7) concluded that cognitive functioning of geriatric mental patients is improved by fitness training. In an experimental study of elderly persons in a nonclinical setting, improvements in two of seven cognitive tests were noted for the experimental group (63). Thus, with all age groups there are mixed results.

Exercise has been associated with improved sense of *well-being*. Two major Canadian population surveys (64,65) report positive associations between exercise and psychological well-being as measured by Bradburn's index. Two U.S. fitness surveys (66,67) contain data on exercise and general well-being that, if analyzed, would provide additional cross-sectional data on this issue. Physical activity and exercise might have different psychological benefits in different age or population groups. For example, elderly patients might show greater benefit than younger patients, or persons with chronic illness might show greater benefit than able-bodied persons.

Reductions in the physiological and psychometric estimates of coronary-prone (Type A) behavior have accompanied exercise (35,68,69); however, a randomized 4-year trial with post-MI patients showed no change in Type A-Type B characteristics as diagnosed by the Jenkins Activity Survey (70). A decrease in Type A behavior was related to improved fitness in men (68), but no effect was seen in women in another study (71). Exercise has been associated with acute reductions in anger (22), an important characteristic of Type A behavior, and longer-term increases in tolerance of frustration (72).

A number of cross-sectional studies (73–75) and two randomized trials (76,77) showed that acute and chronic exercise reduce physiological responses to stress. These studies suggest that physical fitness training may produce improvements in physiological responses to stress comparable to or greater than those produced by some relaxation techniques.

Negative Psychological Effects of Exercise

Little is known about the etiology, diagnosis, treatment, prevalence, or incidence of negative effects of running or other exercises. A number of negative psychological effects have been attributed to exercise (3) (see box). For instance, Morgan (78)

Proposed psychological harms of exercise

- Addiction to exercise
- Compulsiveness
- Decreased involvement in job, marriage, and so on
- Escape or avoidance of problems
- Exacerbation of anorexia nervosa
- Exercise deprivation effects
- Fatigue
- Overcompetitiveness
- Overexertion
- Poor eating habits
- Preoccupation with fitness, diet, and body image
- Self-centeredness

described eight persons with "running addiction," in whom commitment to running assumed a higher priority than commitments to work, family, interpersonal relationships, and medical advice. This "obligatory running" has been characterized as neurotic (79) and akin to the excessive running evident in many anorectic patients (80,81). It is not clear if the running causes the negative behavior or if certain personalities are predisposed to abuse running as a way of avoiding or perhaps even coping with other problems. Excessive running is characteristic of many patients with anorexia nervosa (82), but again it is not clear whether the exercise is a result of the anorexia or helps produce the syndrome. The apparent increase in the prevalence of anorexia makes this an important public health question.

Summary

For both psychiatric and nonclinical populations, physical activity and exercise would seem to offer some benefit. Yet despite the great public health importance of this potential benefit, surprisingly few studies meeting acceptable standards of methodology have been reported to help explain how physical activity and exercise might be useful (a) to reduce morbidity in psychiatric populations and (b) to prevent psychological problems and even improve mental health in nonclinical populations. Even the controlled studies have been short term, involving small samples, and few studies have addressed possible mechanisms. Our knowledge in the area can best be advanced through a variety of studies that both address a variety of populations and combine excellent psychological and physiological methodology with equally careful description and assessment of physical activity and exercise.

What is known:

1. Physical activity and exercise appear to alleviate symptoms associated with mild-to-moderate depression.
2. Physical activity and exercise are associated with such mental health benefits as improved self-concept and confidence (at least in children and adolescents) and social skills (at least in mentally retarded individuals).
3. Physical activity and exercise are associated with reduction of symptoms of anxiety and perhaps improved mood.
4. Physical activity and exercise may alter some aspects of the stress response and coronary-prone (Type A) behavior.
5. Negative psychological side effects can occur from exercising or stopping exercise and may interact with personality disorders and other personal problems in negative ways.
6. Physical activity and exercise *might* provide a beneficial adjunct to alcohol and other substance abuse programs.

Recommendations:

1. Determine the form, frequency, duration, and intensity of exercise most beneficial for subgroups of depression and for long-term effect on depression.
2. Determine the effectiveness of exercise in reducing stress (including perception of stress and stress responses) and aspects of coronary-prone (Type A) behavior.
3. Determine the positive mental health effects of exercise (for example, coping, self-confidence, self-concept, and mood) in nonpsychiatric populations, including people without apparent disease and those with chronic illness. Secondary analysis of some of the existing large data sets, which include measures of well-being, is encouraged.
4. Include mental health outcomes as variables in population studies of the effects of exercise. Standardized instruments with reliability and validity data should be used.
5. Establish the effects of physical activity and exercise in reducing behaviors associated with alcohol and substance abuse and the role of exercise in alcohol and substance abuse programs.
6. Determine if there are beneficial effects of physical activity and exercise on patients with anxiety disorders or psychoses. Studies with psychiatric populations should use standard psychiatric diagnostic systems.

7. Determine the frequency, type, and duration of negative psychological effects of exercise and the negative interaction of exercise with other problems and with personality disorders.
8. Determine the biopsychosocial mechanisms by which exercise affects various mental health problems.

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Physical Activity and Exercise To Achieve Health-Related Physical Fitness Components

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Synopsis

To improve health and fitness effectively through physical activity or exercise, we need to understand how this comes about. For many of these changes, the stimulus has been grossly defined in terms of type, intensity, duration, and frequency of exercise, but for others a dose-response relationship has not been determined.

Physical activity that appears to provide the most diverse health benefits consists of dynamic, rhythmic contractions of large muscles that transport