Integrating Physical Activity Into Mental Health Services for Persons With Serious Mental Illness

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This article reviews evidence supporting the need for interventions to promote physical activity among persons with serious mental illness. Principles of designing effective physical activity interventions are discussed along with ways to adapt such interventions for this population. Individuals with serious mental illness are at high risk of chronic diseases associated with sedentary behavior, including diabetes and cardiovascular disease. The effects of lifestyle modification on chronic disease outcomes are large and consistent across multiple studies. Evidence for the psychological benefits for clinical populations comes from two meta-analyses of outcomes of depressed patients that showed that effects of exercise were similar to those of psychotherapeutic interventions. Exercise can also alleviate secondary symptoms such as low self-esteem and social withdrawal. Although structured group programs can be effective for persons with serious mental illness, especially walking programs, lifestyle changes that focus on accumulation of moderate-intensity activity throughout the day may be most appropriate. Research suggests that exercise is well accepted by people with serious mental illness and is often considered one of the most valued components of treatment. Adherence to physical activity interventions appears comparable to that in the general population. Mental health service providers can provide effective, evidence-based physical activity interventions for individuals with serious mental illness. (*Psychiatric Services* 56: 324–331, 2005)

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Even though the psychological benefits from regular exercise are well known, researchers have only recently begun to examine the impact of physical activity on the mental and physical health of individuals with serious mental illness. The use of physical activity to promote both mental and physical health among individuals with serious mental illness has a sound rationale. In the general population, a strong relationship has been found between physical activity and mental health (1,2) as well as between physical activity and physical health (3). People who have serious mental illness, including major depression, schizophrenia, and bipolar disorder, often have poor physical health and experience significant psychiatric, social, and cognitive disability (4,5). Physical activity has the potential to improve the quality of life of people with serious mental illness through two routes—by improving physical health and by alleviating psychiatric and social disability.

In this article, we first review the evidence for the benefits of physical activity in the general population and more specifically among individuals with serious mental illness. We then summarize what is currently known about the epidemiology of physical activity in the population of persons with serious mental illness. We also present an overview of the principles of designing effective physical activity

interventions. Finally, we argue that such interventions should become a routine component of comprehensive psychiatric care for individuals with serious mental illness.

Physical health benefits of physical activity

Physical inactivity (sedentary behavior) is a major cause of morbidity and mortality (3). Compared with those who are physically active, sedentary people have a substantially increased risk of developing diabetes (6–8), heart disease (9–12), high blood pressure (13–17), and a number of other prevalent and disabling chronic conditions (3). The effects of lifestyle modification, including diet and exercise, on chronic disease outcomes are large and consistent across multiple studies. For example, the Diabetes Prevention Program study (6), a large multicenter randomized controlled trial with more than 3,000 participants, compared an intensive diet-and-exercise intervention with two other treatment arms, a usual-care control group and a medical management group that received metformin. The incidence of diabetes among participants who were randomly assigned to the intensive lifestyle intervention was 14 percent, compared with 29 percent in the control group. This outcome represents an almost 60 percent reduction in risk, and the effect was twice as large as the effect of the medication. The effect of the diet-and-exercise intervention was so impressive that a data-monitoring board stopped the trial early.

The results for cardiovascular disease prevention are similarly impressive, and benefits are seen even among people who already have documented disease. In one randomized controlled trial of people with a history of congestive heart failure, risks of heart attacks, hospitalizations, and death among those randomly assigned to an exercise intervention were all reduced by approximately 60 percent compared with the usual-care group (18). Physical activity also plays a critical role in weight loss and in reducing the risk of weight gain in the general population (19–24). Even in the absence of weight loss, physical activity can result in substantial health benefits, and individuals who are obese but active are on average healthier than those who are sedentary but not obese (25).

People with serious mental illness are at higher risk of premature mortality than the general population (26–28). On average, people with severe mental illness die ten to 15 years earlier than the general population. Although some of the excess mortality is due to suicide and accidental death, ischemic heart disease is a common cause of excess mortality in this population (29). In a study of all users of psychiatric services in Australia between 1980 and 1998, age-adjusted ischemic heart disease mortality ratios were 1.9 (95 percent confidence interval, 1.8 to 2) for those who used psychiatric services compared with the general population (29). Rates of comorbid illnesses, such as hypertension, diabetes, respiratory disease, and cardiovascular disease, are as high as 60 percent among people with serious mental illness (30–32). In a study of more than 38,000 persons who received care in the Department of Veterans Affairs health system, of those with schizophrenia, 19 percent, or almost one in five, also had a diagnosis of diabetes (33). This finding may be due partly to the association between atypical narcoleptics and diabetes (33,34). However, individuals with schizophrenia are not the only persons with serious mental illness who are at increased risk of diabetes. Depression is roughly twice as common among patients with diabetes as in the general population, with a prevalence of between 15 and 30 percent depending on whether estimates are based on *DSM* criteria or elevated levels of depressive symptoms measured with standardized scales (35–37).

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Mental health benefits of physical activity

Although the physical health benefits of physical activity for people with serious mental illness are dramatic, exercise may also confer other important benefits in this population. The most convincing evidence for the psychological benefits of exercise for clinical populations comes from research examining clinical depression. Two recent meta-analyses reported average effect sizes of .72 (38) and 1.1 (39) for exercise compared with no treatment for depression, and both meta-analyses showed effects for exercise that were similar to those found from other psychotherapeutic interventions. Craft and Landers (38) reported a greater effect on moderately to severely depressed individuals than on those who were initially classified as mildly to moderately depressed. More modest but positive effects of physical activity have been noted for generalized anxiety disorder, phobias, panic attacks, and stress disorders (40).

Regular physical activity can improve mental health among people with serious mental illness. Improvements in quality of life and emotional well-being due to physical activity have been reported even in the absence of objective diagnostic improvement (41–43). A 1999 review of exercise interventions for people with schizophrenia identified eight preexperimental, three quasi-experimental, and only one experimental study (41). The authors concluded that exercise could alleviate secondary symptoms of schizophrenia, such as depression, low self-esteem, and social withdrawal. For some people, exercise also can be a useful coping strategy for the positive symptoms of schizophrenia, such as auditory hallu-

cinations (41). Physical activity may also play a role in reducing social isolation for people with serious mental illness. This aspect of physical activity remains an underresearched area, although case studies suggest that participation in physical activity can engage individuals in mental health services, promote a sense of normalization, and offer safe opportunities for social interaction (44,45). In addition, mental health service users have a right to participate in recreational and leisure pursuits, such as physical activity, which are enjoyed by the community at large.

Epidemiology of physical activity and serious mental illness

Individuals with serious mental illness are significantly less active than the general population (46–48). In one study of 140 individuals with schizophrenia, none of the respondents reported any vigorous exercise during the previous week, and only 19 percent of men and 15 percent of women reported participating in at least one session of moderate-intensity physical activity (46). These physical activity levels are lower than levels reported in the general population. In a cohort of 234 people with serious mental illness, 12 percent reported vigorous exercise during the previous two weeks, compared with 35 percent in the general population, and participation in light exercise was significantly decreased as well (47). In a cohort of 89 people with bipolar disorder, only 39 percent reported engaging in physical activity of any intensity at least a few times a week during the previous four weeks, compared with 70 percent of age- and sex-matched controls (48).

Because of the combination of a sedentary lifestyle, poor diet (46,48), and medication-induced weight gain (34,49–52), one would expect individuals with serious mental illness to be significantly more likely to be obese than those in the general population. However, studies examining the prevalence of obesity in this population report mixed results, with some studies showing significantly increased incidence of obesity (47) and others showing no significant difference (46,53). Despite these conflicting results, it is clear that the high prevalence of obesity is at least as alarming for individuals with serious mental illness as it is for the general population, and individuals who take antipsychotic medication may be at particularly high risk of obesity-related morbidity (34,49,54). In addition, concerns about obesity may contribute to noncompliance with antipsychotic medication, which jeopardizes the potential for recovery and reintegration (55).

A national consensus panel found strong evidence that second-generation antipsychotic medications increase weight gain and the risk of diabetes (56). The panel recommended physical activity and nutritional counseling for all overweight and obese patients taking antipsychotic medication. Although no randomized controlled trials have been reported, preliminary results suggest that such lifestyle interventions can reduce weight gain in this population (57,58).

Designing effective physical activity programs

Recommended levels of physical activity

The American College of Sports Medicine (ACSM), a national organization interested in promoting the health of all Americans, has published a position statement that recommends appropriate amounts of exercise needed to attain minimal levels of physical fitness (59). Although not specific to various disabilities, these guidelines describe the frequency, duration, and intensity of exercise needed to develop and maintain cardiovascular fitness and reduce body fat. According to ACSM guidelines, a minimal exercise program should consist of at least three 20- to 60-minute exercise sessions each week.

An alternative to this structured exercise approach is lifestyle recommendations that focus on the accumulation of moderate-intensity physical activity throughout the day. A Surgeon General's report (3) recommended that "people of all ages accumulate a minimum of 30 minutes of physical activity of moderate intensity (such as brisk walking) on most, if not all, days of the week."

Structured versus lifestyle activity

Both structured, supervised, facility-based exercise programs and lifestyle physical activity interventions that encourage participants to incorporate physical activity in their daily lives may be effective for people with serious mental illness. Structured exercise programs are appealing because it is easier to ensure safe and appropriate levels of physical activity in a supervised setting and because adherence can be more easily verified than with a lifestyle intervention. However, there are some disadvantages, including potentially costly space, equipment, and staffing. Lifestyle interventions improve cardiorespiratory fitness and have a positive effect on risk factors for cardiovascular disease, and they may be more effective than structured exercise interventions in increasing levels of physical activity (17,60–65). Their flexibility, lower cost, and easy integration into daily schedules might be particularly appealing to individuals with serious mental illness. Also, some individuals may prefer a home-based program rather than traveling to an exercise facility three or more times a week, particularly if transportation to and from the facility is inconvenient.

Walking, either in the form of supervised group walks or unsupervised home-based walking, is one of the easiest, safest, and most inexpensive types of exercise to promote, and it is also one of the most popular forms of exercise among those with and without chronic illness. For example, a majority of people with type 2 diabetes who are active choose walking as their primary form of exercise (66). Walking is an activity that almost everyone can do almost anywhere. However, even low-cost walking programs require planning, supervision, and evaluation and entail administrative time. Other forms of physical activity that may be low cost and popular include low-impact exercise videos and group aerobics classes.

Individually tailored interventions

Physical activity interventions are complex in that there are many design components that may contribute

to their effectiveness. Interventions that target specific groups or that are tailored to the individual, taking into account the participant's age, gender, socioeconomic status, cultural background, health status, barriers to activity, and fitness level, are more effective in increasing levels of physical activity than more generic interventions (67–70). Similarly, programs that deliver exercise prescriptions or motivational messages in printed form or by computer are more effective than face-to-face counseling alone (71–73). Interventions that focus on vigorous physical activity, such as running, soccer, or aerobics classes, tend to be less successful than interventions that focus on more moderate-intensity activities, such as walking (71). Although more vigorous activities do improve cardiorespiratory fitness and speed weight loss, the dropout rate from such programs may be higher than with less intensive interventions. Programs that employ principles of behavior modification, including goal setting, self-monitoring, social support, and shaping (that is, changing behavior in small steps) rather than simple educational programs are more effective. Programs that encourage physical activity during leisure time or unsupervised home-based activities have better long-term adherence rates (71).

Self-monitoring

Participants need to set goals and self-monitor achievement in order to successfully change their behavior (74,75). Unfortunately, self-monitoring of physical activity, particularly lifestyle physical activity, is difficult. For example, most people are unable to accurately report how much walking they have done (76,77). Participation in a structured exercise program, such as a regularly scheduled group class, may be easier to recall but is still subject to recall bias. Fortunately, there are several inexpensive and effective ways to help participants self-monitor their physical activity. These methods include daily paper logs, Web-based logging systems, and objective monitoring devices, including pedometers and heart rate monitors.

Pedometers are inexpensive, reliable, and easy-to-use devices that can be worn throughout the day (78). They count each step taken by the wearer and report accumulated step-count on a small built-in display (79,80). Heart rate monitors are also relatively inexpensive, reliable, and easy to use (81,82). They consist of an elastic band worn on the chest and a watch that displays the wearer's current heart rate. Heart rate monitors provide the wearer with feedback about exercise intensity during an exercise session. For more structured programs, session attendance can be tracked. Interventions that incorporate objective physical activity assessment are more effective than interventions that rely on participants' self-report alone (71).

Feedback is a critical component of self-monitoring and self-regulation in behavior change to increase physical activity (74,75). Unlike highly trained athletes who are able to accurately assess and regulate their level of exertion, sedentary and deconditioned individuals frequently overexert themselves, which leads to discouragement and dropout. Feedback that is fine grained enough to clearly document gradual incremental improvement can be a powerful motivator. Pedometers and heart rate monitors are not too complex for everyday use by most individuals with serious mental illness.

Group versus one-on-one sessions

Group interventions are generally less expensive than one-on-one interventions. However, individualized attention and tailored goal setting play an important role in behavior change among people with serious mental illness. Providing individualized attention for participants is a challenge in a group intervention. Even if feedback devices such as pedometers are used, participants still need personal acknowledgment of their efforts and oversight of their progress. Brief periodic individual conferences, log reviews, and group leaders' participation in the exercise sessions can build in opportunities for individualized attention. Providing certificates of participation and holding social sessions to mark milestones can help to recognize participants' efforts.

Self-efficacy

Lack of knowledge and experience, lack of confidence, tenuous motivation, and unrealistic expectations can all hinder successful participation in physical activity. Successful achievement of and recognition for small incremental increases in physical activity gradually build self-efficacy, and self-efficacy is one of the most important predictors of adherence in a physical activity program (83). The "no-pain, no-gain" philosophy is of no benefit in encouraging continued participation in an active lifestyle for people with severe mental illness. Enthusiastic, knowledgeable, and supportive exercise leaders are as important as the actual exercise prescription itself. Because of a number of psychological issues, including hypersensitivity about their bodies, which may be due to weight gain and life experiences with trauma, it is very important to have skilled exercise leaders who are willing to provide support to help participants overcome a number of self-esteem barriers. Instilling confidence in participants' ability to recover their wellness and develop greater resiliency is also an essential task for any exercise leader of groups of persons with psychiatric disability.

Participants' safety

Concerns about safety, particularly with respect to adverse cardiovascular events, can be a barrier to the implementation of physical activity programs in high-risk populations. Moderate-intensity activities, including walking, are relatively safe, but some preexisting conditions may be exacerbated by moderate exercise, even walking. The Physical Activity Readiness Questionnaire (PAR-Q) (84) is a simple tool that is commonly used in preparticipation screening for moderate-intensity physical activity programs (85–87). Individuals who have risk factors identified by the PAR-Q should get medical clearance before they participate in a physical activity program.

Exercise is associated with other potential risks besides cardiovascular risk, the most common being musculoskeletal injury. Risk of musculoskeletal injury can be minimized by

Physical activity resources for mental health service providers

Books

Marcus BH, Forsyth LH: Motivating People to be Physically Active. Champaign, Ill, Human Kinetics, 2003

American College of Sports Medicine: ASCM's Exercise Management for Persons With Chronic Diseases and Disabilities, 2nd ed. Champaign, Ill, Human Kinetics, 2003

US Department of Health and Human Services: Physical Activity and Health: A Report of the Surgeon General. Atlanta, Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996

National organizations

American College of Sports Medicine, PO Box 1440, Indianapolis, Indiana 46206-1440; telephone, 317-637-9200; Web site, www.acsm.org/index.asp

Division of Nutrition and Physical Activity, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 4770 Buford Highway, NE, MS/K-24, Atlanta, Georgia 30341-3717; telephone, 770-488-5820; Web site www.cdc.gov/nccdphp/dnpa/index.htm

Local resources

Hospital-linked fitness centers

YMCA

University kinesiology, movement sciences, or physical education departments

Web sites

Information about pedometers, www.new-lifestyles.com

National Center on Physical Activity and Disability, University of Illinois at Chicago, www.ncpad.org/about

Resources for promoting health through physical activity, Arnold School of Public Health, University of South Carolina, http://prevention.sph.sc.edu/index.htm

Center for Psychiatric Rehabilitation, National Research and Training Center in Psychiatric Rehabilitation and Recovery, www.bu.edu/cpr/rc (provides program consultation, training, and evaluation nationally and internationally)

gradually increasing the intensity and duration of activity, adding warm-up and cool-down periods to a session, and wearing proper footwear (88). Good shoes are particularly important for individuals with diabetes because of the risk of foot ulcers from peripheral neuropathy. Although the side effects of various psychiatric medications do bother some individuals, people using these medications can still continue to exercise. There are no known serious complications to the combination of physical exercise and psychotropic medication (89). Given that many individuals in the population have low initial fitness levels and that drowsiness and fatigue may be side effects of some medications, a very gradual approach to increasing physical activity may be necessary (90).

Adherence

In the general population, adherence to physical activity programs drops off sharply after six months, with less than half the participants able to stick with the program (71). It is unrealistic to expect adherence rates to be any better for individuals with serious mental illness. In fact, individuals with serious mental illness often face substantial illness-related barriers to physical activity that healthier individuals do not face. However, our experience and existing research suggest that exercise is well accepted by people with serious mental illness (91) and is often considered one of the most valued components of treatment (92). If programs are made available as part of psychiatric services, individuals will choose to enroll, and adherence appears comparable to that in the general population (93). Longitudinal program designs that require participants to attend sessions regularly in order to keep up may pose a problem for individuals who frequently but intermittently face exacerbations in their illness, transportation problems, and other barriers that prevent regular attendance. Such individuals, if encouraged to attend a regularly scheduled session whenever possible, may benefit even from the intermittent program. Evaluations that account for frequent "drop out" and "drop in" of participants may more accurately capture the impact of such programs.

The Frontline Reports column in this issue of *Psychiatric Services* describes four innovative physical activity programs implemented in mental health treatment settings (94). Dropout rates in these programs are similar to dropout rates for interventions in the general population. Perceived and real barriers to participation and adherence may differ for individuals with serious mental illness, but the desire to increase or maintain activity levels probably does not (95). For more information on intervention design and guidelines, see the box on this page.

Integrating activity interventions into psychiatric services

One of the most challenging aspects of assisting people with serious mental illness to manage their care is ensuring effective coordination across their many service providers. We believe that physical activity programs for individuals with serious mental illness should be integrated into mental health services. An alternative but less desirable approach would be to refer these individuals to a primary care physician or other health care provider for management of cardiovascular disease risk factors, including promotion of physical activity.

There are three important reasons for integrating the promotion of physical activity into mental health services. First, individuals with serious mental illness have frequent contact with their mental health service providers. Changing health behaviors can be difficult, and frequent reinforcement can play a critical role in successful long-term adoption of regular physical activity. Second, barriers specific to mental illness can be more appropriately addressed by individuals who have been trained to be sensi-

tive and supportive around these issues. Finally, physical activity may play a role in successful mental health recovery.

The physical activity programs that are available through medical health providers are often fragmented and inadequate (96). Such low-intensity, unsupportive, and fragmented physical activity programs are even less likely to be successful in this high-risk population than in the general population. However, primary care physicians can play an important role in collaboratively identifying behavioral goals, reinforcing efforts to reach behavioral targets, and addressing barriers to physical activity. Particularly when people with serious mental illness have comorbid physical health problems, the involvement of medical staff can ensure that the promotion of physical activity reinforces other efforts to improve an individual's overall health and well-being (35). The support of medical care providers can legitimize the inclusion of exercise within an individual's care plan and can also enhance adherence to physical activity programs.

Limitations of current research and future directions

Research on the effects of physical activity on the physical and mental health of individuals with serious mental illness is limited. Intervention research in this population is even scarcer. In the studies that have been published, small samples, lack of control groups, or inadequate selection of control groups are recurring problems. Neither randomized controlled trials of physical activity interventions nor cost-effectiveness studies have been conducted to evaluate such interventions for people with serious mental illness. Further research of both a quantitative and qualitative nature is urgently needed to examine how we can help individuals with severe mental illness become more active. Interventions should be guided by an evidence-based model that incorporates a process of evaluation and review. Mental health professionals who are interested in creating physical activity programs could collaborate with organizations such as academic institutions to gain access not only to expertise and resources in exercise programming but also to research and evaluation skills. There is clearly a need to examine how to best deliver physical activity as an adjunctive treatment for individuals with serious mental illness (97).

Conclusions

Strategies to change physical activity behavior that have been successful in healthier populations can be adopted for those with serious mental illness. These interventions are feasible and popular and can result in clinically significant behavior change in a mental health services setting. Physical activity has an important role to play in the lives of individuals with serious mental illness. By integrating physical activity programs into psychiatric services, we can substantially improve the physical health outcomes of people with serious mental illness, and we may also see improvements in psychological and social outcomes. Thus physical activity interventions are a critical component of a biopsychosocial approach in recovery-oriented mental health services (98). ♦

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References

1. Biddle SJ, Fox KR, Boutcher SH: Physical Activity and Psychological Well-Being. London, Routledge, 2000
2. Morgan WP: Physical activity and mental health. Washington, DC, Taylor and Francis, 1997
3. US Department of Health and Human Services: Physical Activity and Health: A Report of the Surgeon General. Atlanta, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996
4. Childs S, Griffiths C: Severe and enduring mental illness, in Physiotherapy and Occupational Therapy in Mental Health: An Evidence Based Approach. Edited by Everett T, Donaghy M, Fever S. Oxford, Butterworth Heinemann, 2003
5. Goldberg D, Huxley P: Common Mental Disorders: A Biosocial Model. London, Routledge, 1992
6. Knowler WC, Barrett-Connor E, Fowler SE, et al: Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. New England Journal of Medicine 346:393–403, 2002
7. Pan XR, Li GW, Hu YH, et al: Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: the Da Qing IGT and Diabetes Study. Diabetes Care 20:537–544, 1997
8. Tuomilehto J, Lindstrom J, Eriksson JG, et al: Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. New England Journal of Medicine 344:1343–1350, 2001
9. Hu FB, Stampfer MJ, Solomon C, et al: Physical activity and risk for cardiovascular events in diabetic women. Annals of Internal Medicine 134:96–105, 2001
10. Manson JE, Greenland P, LaCroix AZ, et al: Walking compared with vigorous exercise for the prevention of cardiovascular events in women. New England Journal of Medicine 347:716–725, 2002
11. Owens JF, Matthews KA, Raikkonen K, et al: It is never too late: change in physical activity fosters change in cardiovascular risk factors in middle-aged women. Preventive Cardiology 6:22–28, 2003
12. Williams PT: Physical fitness and activity as separate heart disease risk factors: a meta-analysis. Medicine and Science in Sports and Exercise 33:754–761, 2001
13. Haapanen N, Miilunpalo S, Vuori I, et al: Association of leisure time physical activity with the risk of coronary heart disease, hypertension, and diabetes in middle-aged men and women. International Journal of Epidemiology 26:739–747, 1997
14. Hayashi T, Tsumura K, Suematsu C, et al: Walking to work and the risk for hypertension in men: the Osaka Health Survey. Annals of Internal Medicine 131:21–26, 1999
15. Iwane M, Arita M, Tomimoto S, et al: Walking 10,000 steps/day or more reduces blood pressure and sympathetic nerve activity in mild essential hypertension. Hypertension Research 23:573–580, 2000
16. Kokkinos PF, Narayan P, Colleran JA, et al: Effects of regular exercise on blood pressure and left ventricular hypertrophy in African-American men with severe hypertension. New England Journal of Medicine 333:1462–1467, 1995
17. Moreau KL, Degarmo R, Langley J, et al: Increasing daily walking lowers blood pressure in postmenopausal women. Medicine and Science in Sports and Exercise 33: 1825–1831, 2001
18. Belardinelli R, Georgiou D, Cianci G, et al: Randomized, controlled trial of long-term moderate exercise training in chronic heart failure: effects on functional capacity, quality of life, and clinical outcome. Circulation 99:1173–1182, 1999
19. Blair SN: Evidence for success of exercise in weight loss and control. Annals of Internal Medicine 119:702–706, 1993
20. Colditz GA, Coakley E: Weight, weight gain, activity, and major illnesses: the Nurses' Health Study. International Journal of Sports Medicine 18(suppl 3):S162–S170, 1997

21. Jakicic JM, Marcus BH, Gallagher KI, et al: Effect of exercise duration and intensity on weight loss in overweight, sedentary women: a randomized trial. JAMA 290: 1323–1330, 2003

22. Ross R, Freeman JA, Janssen I: Exercise alone is an effective strategy for reducing obesity and related comorbidities. Exercise and Sport Sciences Reviews 28:165–170, 2000

23. Schoeller DA, Shay K, Kushner RF: How much physical activity is needed to minimize weight gain in previously obese women? American Journal of Clinical Nutrition 66:551–556, 1997

24. Jebb SA, Moore MS: Contribution of a sedentary lifestyle and inactivity to the etiology of overweight and obesity: current evidence and research issues. Medicine and Science in Sports and Exercise 31:S534–S541, 1999

25. Blair SN, Brodney S: Effects of physical inactivity and obesity on morbidity and mortality: current evidence and research issues. Medicine and Science in Sports and Exercise 31:S646–662, 1999

26. Harris EC, Barraclough B: Excess mortality of mental disorder. British Journal of Psychiatry 173:11–53, 1998

27. Brown S, Inskip H, Barraclough B: Causes of the excess mortality of schizophrenia. British Journal of Psychiatry 177:212–217, 2000

28. Joukamaa M, Heliovaara M, Knekt P, et al: Mental disorders and cause-specific mortality. British Journal of Psychiatry 179: 498–502, 2001

29. Lawrence DM, Holman CD, Jablensky AV, et al: Death rate from ischaemic heart disease in Western Australian psychiatric patients 1980–1998. British Journal of Psychiatry 182:31–36, 2003

30. Koran LM, Sox HC, Morton KI, et al: Medical evaluation of psychiatric patients. Archives of General Psychiatry 36:414–447, 1989

31. Bartsch DA, Shern DL, Feinberg LE, et al: Screening CMHC outpatients for physical illness. Hospital and Community Psychiatry 41:786–790, 1990

32. Berren MR, Hill KR, Merikle E, et al: Serious mental illness and mortality rates. Hospital and Community Psychiatry 45:604–605, 1994

33. Sernyak MJ, Leslie DL, Alarcon RD, et al: Association of diabetes mellitus with use of atypical neuroleptics in the treatment of schizophrenia. American Journal of Psychiatry 159:561–566, 2002

34. Lean ME, Pajonk FG: Patients on atypical antipsychotic drugs: another high-risk group for type 2 diabetes. Diabetes Care 26:1597–1605, 2003

35. Piette J, Richardson C, Valenstein M: Addressing the needs of patients with multiple chronic illnesses: the case of diabetes and depression. American Journal of Managed Care 10:41–51, 2004

36. Anderson RJ, Freedland KE, Clouse RE, et al: The prevalence of comorbid depression in adults with diabetes: a meta-analysis. Diabetes Care 24:1069–1078, 2001

37. Peyrot M, Rubin RR: Levels and risks of depression and anxiety symptomatology among diabetic adults. Diabetes Care 20:585–590, 1997

38. Craft LL, Landers DM: The effect of exercise on clinical depression and depression resulting from mental illness: a meta-analysis. Journal of Sport and Exercise Psychology 20:339–357, 1998

39. Lawlor DA, Hopker SW: The effectiveness of exercise as an intervention in the management of depression: systematic review and meta-regression analysis of randomised controlled trials. British Medical Journal 322:763–767, 2001

40. O'Conner PJ, Raglin JS, Martinsen EW: Physical activity, anxiety, and anxiety disorders. International Journal of Sport Psychology 31:136–155, 2000

41. Faulkner G, Biddle S: Exercise as an adjunct treatment for schizophrenia: a review of the literature. Journal of Mental Health 8:441–457, 1999

42. Hutchinson DS, Skrinar GS, Cross C: The role of improved physical fitness in rehabilitation and recovery. Psychiatric Rehabilitation Journal 22:355–359, 1999

43. Skrinar GS, Unger KV, Hutchinson DS, et al: Effects of exercise training in young adults with psychiatric disabilities. Canadian Journal of Rehabilitation 5:151–157, 1992

44. Carter-Morris P, Faulkner G: A football project for service users: the role of football in reducing social exclusion. Journal of Mental Health Promotion 2:24–30, 2003

45. Faulkner G, Sparkes A: Exercise as therapy for schizophrenia: an ethnographic study. Journal of Sport and Exercise Psychology 21:52–69, 1999

46. Brown S, Birtwistle J, Roe L, et al: The unhealthy lifestyle of people with schizophrenia. Psychological Medicine 29:697–701, 1999

47. Davidson S, Judd F, Jolley D, et al: Cardiovascular risk factors for people with mental illness. Australian and New Zealand Journal of Psychiatry 35:196–202, 2001

48. Elmslie JL, Mann JI, Silverstone JT, et al: Determinants of overweight and obesity in patients with bipolar disorder. Journal of Clinical Psychiatry 62:486–491, 2001

49. Allison DB, Mentore JL, Heo M, et al: Antipsychotic-induced weight gain: a comprehensive research synthesis. American Journal of Psychiatry 156:1686–1696, 1999

50. Fontaine KR, Heo M, Harrigan EP, et al: Estimating the consequences of anti-psychotic induced weight gain on health and mortality rate. Psychiatry Research 101: 277–288, 2001

51. Green AI, Patel JK, Goisman RM, et al: Weight gain from novel antipsychotic drugs: need for action. General Hospital Psychiatry 22:224–235, 2000

52. McIntyre RS, Mancini DA, Basile VS: Mechanisms of antipsychotic-induced weight gain. Journal of Clinical Psychiatry 62(suppl 23):23–29, 2001

53. Allison DB, Fontaine KR, Heo M, et al: The distribution of body mass index among individuals with and without schizophrenia. Journal of Clinical Psychiatry 60:215–220, 1999

54. Kurzthaler I, Fleischhacker WW: The clinical implications of weight gain in schizophrenia. Journal of Clinical Psychiatry 62(suppl 7):32–37, 2001

55. Weiden PJ, Mackell JA, McDonnell DD: Obesity as a risk factor for antipsychotic noncompliance. Schizophrenia Research 66:51–57, 2004

56. Consensus development conference on antipsychotic drugs and obesity and diabetes. Diabetes Care 27:596–601, 2004

57. Faulkner G, Soundy AA, Lloyd K: Schizophrenia and weight management: a systematic review of interventions to control weight. Acta Psychiatrica Scandinavica 108:324–332, 2003

58. Menza M, Vreeland B, Minsky S, et al: Managing atypical antipsychotic-associated weight gain: 12-month data on a multimodal weight control program. Journal of Clinical Psychiatry 65:471–477, 2004

59. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults: American College of Sports Medicine position stand. Medicine and Science in Sports and Exercise 30:975–991, 1998

60. Dunn AL, Garcia ME, Marcus BH, et al: Six-month physical activity and fitness changes in Project Active, a randomized trial. Medicine and Science in Sports and Exercise 30:1076–1083, 1998

61. Andersen RE, Wadden TA, Bartlett SJ, et al: Effects of lifestyle activity vs structured aerobic exercise in obese women: a randomized trial. JAMA 281:335–340, 1999

62. Dunn AL, Marcus BH, Kampert JB, et al: Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: a randomized trial. JAMA 281:327–334, 1999

63. Smolander J, Blair SN, Kohl HW, 3rd: Work ability, physical activity, and cardiorespiratory fitness: 2-year results from Project Active. Journal of Occupational and Environmental Medicine 42:906–910, 2000

64. Writing Group of the Premier Collaborative Research Group: effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA 289:2083–2093, 2003

65. Hagiwara A, Hayashi Y, Nakamura Y, et al: Effects of group- versus home-based walking intervention on lifestyle activity. Japanese Journal of Physical Fitness and Sports

Medicine 49:571–579, 2000

66. Krug LM, Haire-Joshu D, Heady SA: Exercise habits and exercise relapse in persons with non-insulin-dependent diabetes mellitus. Diabetes Educator 17:185–188, 1991

67. Marcus BH, Bock BC, Pinto BM, et al: Efficacy of an individualized, motivationally-tailored physical activity intervention. Annals of Behavioral Medicine 20:174–180, 1998

68. Marcus BH, Forsyth LH: Tailoring interventions to promote physically active lifestyles in women. Women's Health Issues 8:104–111, 1998

69. Strecher V, Wang C, Derry H, et al: Tailored interventions for multiple risk behaviors. Health Education Research 17:619–626, 2002

70. Segar M, Hanlon J, Jayaratne T, et al: Fitting fitness into women's lives: effects of a gender-tailored physical activity intervention. Women's Health Issues 12:338–347, 2002

71. Dishman RK, Buckworth J: Increasing physical activity: a quantitative synthesis. Medicine and Science in Sports and Exercise 28:706–719, 1996

72. Smith BJ, Bauman AE, Bull FC, et al: Promoting physical activity in general practice: a controlled trial of written advice and information materials. British Journal of Sports Medicine 34:262–267, 2000

73. Swinburn BA, Walter LG, Arroll B, et al: The green prescription study: a randomized controlled trial of written exercise advice provided by general practitioners. American Journal of Public Health 88:288–291, 1998

74. Cameron LD, Leventhal H: The Self-Regulation of Health And Illness Behavior. London, Routledge, 2003

75. Boekaerts M, Pintrich PR, Zeidner M: Handbook of Self-Regulation. San Diego, Academic Press, 2000

76. Bassett DR Jr, Cureton AL, Ainsworth BE: Measurement of daily walking distance: questionnaire versus pedometer. Medicine and Science in Sports and Exercise 32:1018–1023, 2000

77. Welk GJ: Physical Activity Assessments for Health-Related Research. Stanningley, United Kingdom, Human Kinetics, 2002

78. Schneider PL, Crouter SE, Bassett DR: pedometer measures of free-living physical activity: comparison of 13 models. Medicine and Science in Sports and Exercise 36:331–335, 2004

79. Tudor-Locke C, Bell RC, Myers AM, et al: Controlled outcome evaluation of the First Step Program: a daily physical activity intervention for individuals with type II diabetes. International Journal of Obesity and Related Metabolic Disorders 28:113–119, 2004

80. Tudor-Locke CE, Myers AM: Methodological considerations for researchers and practitioners using pedometers to measure physical (ambulatory) activity. Research Quarterly for Exercise and Sport 72:1–12, 2001

81. Strath SJ, Swartz AM, Bassett DR Jr, et al: Evaluation of heart rate as a method for assessing moderate intensity physical activity. Medicine and Science in Sports and Exercise 32(suppl 9):S465–S470, 2000

82. Seaward BL, Sleamaker RH, McAuliffe T, et al: The precision and accuracy of a portable heart rate monitor. Biomedical Instrumentation and Technology 24:37–41, 1990

83. McAuley E, Blissmer B: Self-efficacy determinants and consequences of physical activity. Exercise and Sport Sciences Reviews 28:85–88, 2000

84. Canadian Society for Exercise Physiology: Physical Activity Readiness Questionnaire, revised 2002. Available at www.csep.ca/pdfs/par-q.pdf

85. American College of Sports Medicine: ACSM's Guidelines for Exercise Testing and Prescription. Baltimore, Lippincott, Williams and Wilkins, 2000

86. Thomas S, Reading J, Shephard RJ: Revision of the Physical Activity Readiness Questionnaire (PAR-Q). Canadian Journal of Sport Sciences 17:338–345, 1992

87. Arraiz GA, Wigle DT, Mao Y: Risk assessment of physical activity and physical fitness in the Canada Health Survey mortality follow-up study. Journal of Clinical Epidemiology 45:419–428, 1992

88. Centers of Disease Control and Prevention: Exercise-related injuries among women: strategies for prevention from civilian and military studies. Morbidity and Mortality Weekly Report 49:13–33, 2000

89. Martinsen EW, Stanghelle JK: Drug therapy and physical activity, in Physical Activity and Mental Health. Edited by Morgan WP. Washington, DC, Taylor and Francis, 1997

90. Mutrie N, Faulkner G: Physical activity and mental health, in Physiotherapy and Occupational Therapy in Mental Health: An Evidence Based Approach. Edited by Everett T, Donaghy M, Fever S. Oxford, Butterworth Heinemann, 2003

91. Martinsen E: The effects of exercise on mental health in clinical populations, in European Perspectives on Exercise and Sport Psychology. Edited by Biddle S. Stanningley, United Kingdom, Human Kinetics, 1995

92. O'Kelly JG, Piper WE, Kerber R, et al: Exercise groups in an insight-oriented, evening treatment program. International Journal of Group Psychotherapy 48:85–98, 1998

93. Martinsen EG: Therapeutic implications of exercise for clinically anxious and depressed patients. International Journal of Sport Psychology 24:185–199, 1993

94. Frontline Reports. Psychiatric Services 56: 353–355, 2005

95. Faulkner G, Biddle S: Physical activity and depression: considering contextuality and variability. Journal of Sport and Exercise Psychology 26:3–18, 2004

96. Eden KB, Orleans CT, Mulrow CD, et al: Does counseling by clinicians improve physical activity? A summary of the evidence for the US Preventive Services Task Force. Annals of Internal Medicine 137: 208–215, 2002

97. Faulkner G, Biddle S: Exercise and mental health: it's just not psychology! Journal of Sports Sciences 19:433–444, 2001

98. Anthony W, Cohen M, Farkas M, et al: Psychiatric rehabilitation. Boston, Boston University, Center for Psychiatric Rehabilitation, 2002