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January 2003

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Recommended Citation
Bopp, C., Phillips, K. D., Fulk, L., & Hand, G. A. (2003). Clinical implications of therapeutic exercise in HIV/AIDS. *Journal of the Association of Nurses in AIDS Care*, 14(1), 73-78.

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Clinical Implications of Therapeutic Exercise in HIV/AIDS

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HIV/AIDS poses serious risks to the health of millions around the globe. Despite decades of research, no cure or vaccine has been found to prevent this disease and the resultant morbidity and mortality. New antiretroviral drug regimens, such as highly active antiretroviral therapy (HAART), offer benefits at the cost of debilitating side effects. Other therapies, such as steroid and growth hormone administration, are also effective in treating HIV-related symptoms, but with serious side effects and increased cost (Basaria, Wahlstrom, & Dobs, 2001; Schambelan et al., 1996). Alternative therapies, the most commonly used of which is therapeutic exercise, are currently being explored to deal with symptoms and complications of chronic HIV infection without the unwanted side effects (Standish et al., 2001).

Therapeutic exercise has been used successfully in the treatment of diabetes (Albright et al., 2000), dyslipidemias (Durstine & Haskell, 1994), hypertension (JNC VI, 1997), cardiovascular disease (American College of Sports Medicine, 1994) and certain types of cancer (Winningham, MacVicar, Bondoc, Anderson, & Minton, 1989). The benefits of regular exercise also extend to the population infected with HIV. Chronic HIV infection is associated with muscle wasting, muscle weakness, fatigue, impaired functional work capacity, depression, and decreased quality of life, which lead to disability and mortality. Exercise can positively affect many aspects of the physical and mental health of HIV-infected patients.

The effects of prolonged, high-intensity exercise, or overtraining, have been well documented to increase the severity of infections and to negatively affect immune function in humans and increase mortality in animal models. It is for these reasons that many physicians still instruct their HIV-infected clients to avoid physical exertion, despite evidence that moderate-intensity exercise can decrease symptoms of HIV infection and positively affect immune measures.

Effects of Exercise on Immunological Measures

In apparently healthy individuals free of HIV infection, acute, moderate-intensity exercise will cause

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JOURNAL OF THE ASSOCIATION OF NURSES IN AIDS CARE, Vol. 14, No. 1, January/February 2003, 73-78
DOI: 10.1177/1055329002239192
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neutrophil proliferation, epinephrine and cortisol secretion, a temporary decline in lymphocyte levels, and an elevated number of natural killer cells and increased cytokine levels (IL-1, TNF-α, IL-6). This response is blunted in HIV-infected individuals following a single exercise session (Roubenoff et al., 1999a). Higher intensity exercise sessions decrease the effectiveness of the immune system, leading to more opportunistic infections among HIV-free individuals (Nieman, Johanssen, Lee, & Arabatzis, 1990). For this reason, high-intensity exercise has been avoided, and moderate-intensity exercise has been most often recommended for HIV-infected individuals.

Several immunological variables are of significance to HIV-infected patients, including HIV-1 ribonucleic acid viral load and CD4 cell count. Unfortunately, the data available in the literature describing the relationship of these markers and exercise are ambiguous. Studies by Smith et al. (2001) and Rigsby, Dishman, Jackson, Maclean, and Raven (1992) found that 12 weeks of aerobic exercise and 12 weeks of combined resistance and aerobic training, respectively, had no effect on viral load or CD4 count. Roubenoff and colleagues (1999c) found similar results after 8 weeks of progressive resistance training. In unpublished data from a recent study, Bopp, Phillips, Fulk, and Hand observed an inverse correlation between physical activity levels and viral load ($r = -.42$, $p = .0061$). LaPerriere and colleagues (1991) reported that aerobic conditioning increased CD4 cell counts. Mustafa and colleagues (1999) found that HIV-infected individuals self-reporting exercise participation had 107.5% higher CD4 counts when compared to HIV-infected individuals who denied exercise participation. Exercisers also displayed slower disease progression to AIDS, less symptomology, and decreased rates of mortality compared to nonexercisers. Finally, MacArthur, Levine, and Birk (1993) linked lower CD4 cell count levels with noncompliance to prescribed exercise.

Effects of Exercise on Functional Work Capacity

Maximal oxygen consumption, $\dot{V}O_2max$ (mL/kg/min), is a common measure of functional work capacity. As physical fitness increases, so too does $\dot{V}O_2max$ in healthy adults free of HIV infection (Brooks, Fahey, & White, 1996). A study by Keyser, Peralta, Cade, Miller, and Anixt (2000) found that adolescents seropositive for the HIV virus had average $\dot{V}O_2max$ values in the upper 20s, placing them in the "well below average" group compared to age-matched, uninfected controls (American College of Sports Medicine, 2000). Pothoff, Wassermann, and Ostmann (1994) found that $\dot{V}O_2max$ values both at the anaerobic threshold and at maximal exercise were reduced in HIV-infected individuals compared to a control group of uninfected individuals.

Therapeutic exercise has been found to increase functional capacity in HIV-infected individuals. Significant increases in functional capacity were seen following 12 weeks (LaPerriere et al., 1991; Smith et al., 2001) and 24 weeks of aerobic endurance activity (MacArthur et al., 1993). The effects of this increase in functional capacity have not been evaluated in an HIV-infected population, but similar findings in a population undergoing cardiac rehabilitation resulted in a 40% improvement in the ability of the participants to perform activities of daily living (Parker et al., 1996). If this relationship exists in an HIV-infected population, increased functional capacity may decrease HIV-related disability and allow for longer independent living.

Effects of Exercise on Muscular Strength

Adaptations to exercise are dependent on the specific type of exercise stress applied to the body. Progressive resistance training causes increases in muscular strength and muscular hypertrophy. Little has been published regarding the effects of resistance training on HIV-infected individuals. A study by Roubenoff and colleagues (1999b) found that three weekly strength-training workouts increased one repetition maximum by 31% to 50% in 8 weeks. More important, increases in muscular strength were largely maintained following 8 additional weeks of self-selected activity. A study by Rigsby et al. (1992) looked at the combined effects of both resistance and aerobic training. Because the response to exercise is specific to the applied stimulus, the increases in muscular strength observed by Rigsby and colleagues were not as

Table 1. Changes in Exercise Parameters With Varying Stages of HIV Infection

Parameter	Asymptomatic	Early Symptomatic	AIDS
Exercise capacity	↓	↓↓	↓↓↓
Oxygen consumption (mL/kg/min)	↑ at submaximal workloads	• ↑↑ at submaximal workloads • ↓ at maximal exercise • ↓ at ventilatory threshold	More severe dysfunction than Stage II
Effects of exercise training	• ↑↑ CD4 cell count • Delayed symptom onset • Increase in muscle size and strength • ↓ symptom severity • ↓ % body fat	• ↑ CD4 cell count • ↓ symptom severity • Delayed onset of AIDS • Improved quality of life • Decreased viral load • Improved mental health	Further research needed

NOTE: ↑ = increased, ↑↑ = very increased, ↑↑↑ = extremely increased, ↓ = decreased, ↓↓ = very decreased, ↓↓↓ = extremely decreased.

significant as those observed by Roubenoff et al. in individuals exposed exclusively to resistance training.

Effects of Exercise on Body Composition

One of the side effects of HAART is lipodystrophy, a condition characterized by fat atrophy from the face, buttocks, and limbs, as well as fat deposition in the abdomen (Balt & Nixon, 2001; Carr et al., 1998). AIDS- and HIV-related wasting, defined as a loss of greater than 10% of baseline body weight, is another example of body compositional changes following HIV infection (MacDougall, 1997). Both aerobic and resistance exercise can positively affect body composition in HIV-infected patients. Roubenoff and colleagues (1999c) found that resistance training three times per week for 16 weeks resulted in the loss of 3.3 pounds of body fat, much from the abdomen. This fat loss occurred without the accelerated peripheral fat loss seen with testosterone administration. Aerobic exercise also alters body composition values. Smith and colleagues (2001) found that after 12 weeks of endurance training, body mass index (kg/m^2), waist girth, and body weight decreased.

Effects of Exercise on Psychological Markers

HIV infection is often accompanied by symptoms of anxiety and depression (Cabaj, 1996). It is well established that HIV infection can lead to insomnia, defined as insufficient quantity or quality of sleep (Nokes & Kendrew, 2001). Insomnia itself may increase the stress level of an HIV patient, precipitating more real-life stressors such as unemployment and decreased quality of life (Darko, Mitler, & White, 1995). In 1987, Membreno et al. first reported elevated cortisol levels in HIV patients compared to uninfected patients, presumably from stress.

Several authors have noted a correlation between HIV disease progression and stress. Leserman et al. (1997) found a negative correlation between stress levels and lymphocytes in HIV-positive individuals. Several studies by Schneiderman (Antoni et al., 2002; Cruess et al., 2000) indicated that stress management can delay disease progression and ward off secondary infections in HIV-seropositive individuals.

Few studies have examined the effects of exercise on psychological health in an HIV-infected population. In 1990, LaPerriere and associates found that aerobically trained HIV-infected men were protected from stress-related impairments in immune function compared to sedentary controls. A 1997 study by Stringer, Berezovskaya, O'Brien, Beck, and Casaburi (1998) found that 6 weeks of aerobic training significantly increased quality-of-life scores. Conversely, a study by Birk, McGrady, MacArthur, and Khuder (2000) found no significant improvement in mental or emotional health following 12 weeks of combined massage and exercise treatment. Muscle wasting, weakness, fatigue, and disability can contribute to depression and low quality-of-life scores in HIV-infected patients. Theoretically, by improving the

underlying symptoms that contribute to this depression, exercise therapy may be able to positively affect the psychological health of HIV-infected patients (see Table 1).

Prescribing Exercise for HIV-Infected Patients

An appropriately trained clinical exercise physiologist or nurse should monitor all exercise sessions involving an HIV-infected patient until the patient demonstrates the ability to tolerate the prescribed workload. There are several factors that need to be considered when prescribing exercise for an HIV patient, including medications, symptoms, functional capacity, and the stage of disease of the individual patient. The goals of the exercise prescription should include the improvement of functional work capacity and increases in muscular strength.

The number of weekly exercise sessions should be increased until the patient can tolerate three to five sessions weekly. The duration of each session should increase until the patient is exercising from 20 to 60 minutes each session. If the patient is debilitated, sessions may be performed discontinuously. For example, instead of one 30-minute session, the patient could perform three 10-minute sessions until able to complete 30 continuous minutes. Exercise should be performed at a moderate intensity: from 11 to 14 on the Borg Rating of Perceived Exertion Scale, at 50% to 85% of peak heart rate, or at 45% to 85% $\dot{V}O_2max$. Heart rate reserve methods such as the Karvonen equation are not recommended for determining exercise intensity (LaPerriere, Klimas, Major, & Perry, 1997).

The patient should complete 4 to 6 weeks of aerobic training before initiating a resistance training program. This will improve conditioning and prevent overtraining, thereby decreasing the chance of immune complications early in the exercise intervention. Resistance training should focus on large muscle groups, such as the chest, biceps brachia, quadriceps, and hamstrings. The intensity should again be moderate. A weight should be selected with which the patient can comfortably perform 8 to 12 repetitions. Resistance should be increased as 8 to 12 repetitions become less stressful, or additional sets of 8 to 12 repetitions should be added as the patient can tolerate the increase workload. When resistance training is implemented, it is recommended that free weights be avoided because of the increased risk of injury.

It is recommended that all patients receive medical clearance from their physicians before beginning exercise programs because of the varied symptomology of HIV patients. A physician-monitored exercise stress test is also recommended because several factors may be present that have the potential to limit exercise tolerance. Diarrhea, poor diet, and poor nutrient absorption place HIV patients at risk for dehydration and electrolyte abnormalities, both of which can lead to muscle cramps and cardiac dysrhythmias. Anemia and muscle wasting can cause increased fatigue and further limit exercise capacity. Special care should be taken if a patient has had previous pneumocystis pneumonia because residual lung scarring may decrease alveolar volume, leading to oxygen desaturation at moderate exercise intensities, further limiting exercise capacity.

Clinical Implications

Research supports the use of therapeutic exercise as an adjunct therapy in the treatment of symptoms of HIV infection. In patients without acute infections or severe wasting, exercise therapy should begin as soon as possible after the diagnosis of HIV infection in an attempt to delay the onset of symptoms, decrease the severity of those symptoms already present, and potentially delay disease progression. Exercise therapy may also decrease the ultimate cost of treating HIV-infected patients by prolonging the asymptomatic period of the disease, thereby decreasing medication use and health care utilization rates, although further research is needed to clarify the effects of exercise in these areas.

When implementing therapeutic exercise programs for HIV-infected patients, it is recommended that programs be individualized on the basis of the functional capacity and individual symptomology of each client. Patients present with varying types and intensities of symptoms so that no one exercise program can adequately deal with the special needs of all HIV-infected patients. Suggested exercise modalities include

Table 2. Metabolic Equivalent (MET) Values of Selected Exercise Modalities

Activity	MET Intensity
Leisure bicycling, <10 mph	4.0 METs, 14 mL/kg/min
Stationary cycling, 100 W	5.5 METs, 19.25 mL/kg/min
Rowing ergometer, 50 W	3.5 METs, 12.25 mL/kg/min
Water aerobics	4.0 METs, 14 mL/kg/min
Ballroom dancing	5.5 METs, 19.25 mL/kg/min
Mowing lawn, power mower	4.5 METs, 15.75 mL/kg/min
Walking at 3 mph	3.3 METs, 11.5 mL/kg/min
Jog/walk combination	6.0 METs, 21 mL/kg/min
Badminton, social	4.5 METs, 15.75 mL/kg/min
Slow-pitch softball	5.0 METs, 17.5 mL/kg/min
Golf, carrying clubs/walking	4.5 METs, 15.75 mL/kg/min

moderate-intensity aerobic activity using large muscle groups, such as walking, cycling, and rowing. After 5 to 6 weeks of aerobic training, progressive resistance training can be initiated as described above.

Ainsworth and associates (2000) compiled a compendium of physical activities and their associated metabolic equivalent (MET) levels. The MET level of an activity can be determined by dividing its metabolic cost (in mL/kg/min) of oxygen consumption by 3.5 mL/kg/min, the metabolic cost at rest. With even asymptomatic HIV-infected individuals having reduced functional capacities ($\dot{V}O_2max$ = 28 mL/kg/min, 8 METs), it is recommended that individuals exercise at an intensity between 3 and 6 METs. Activities in this intensity range include bicycling at speeds less than 10 mph; water aerobics; dancing; routine gardening; walking at 3 mph on a level surface; low-intensity jogging; and low-intensity sports such as badminton, fencing, and golf (see Table 2) (Ainsworth et al.).

Conclusion

Despite evidence that exercise does not negatively affect immune measures and can increase CD4 cell counts, many physicians still caution their HIV-infected patients against participating in structured physical activity. Therapeutic exercise has the potential to increase functional work capacity and muscular strength and endurance while reversing muscle and fat wasting and improving several psychological measures in the HIV-infected population. Exercise derives these benefits without the high cost and potentially severe side effects of medical and pharmacological interventions. Further research is needed to fully clarify the role of exercise as a complementary treatment for many of the symptoms related to chronic HIV infection.

References

Ainsworth, B. E., Haskell, W. L., Whitt, M. C., Irwin, M. L., Swartz, A. M., Strath, S. J., et al. (2000). Compendium of physical activities: An update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise*, *32*(9), S498-S516.

Albright, A., Franz, M., Hornsby, G., Kriska, A., Marrero, D., Ullrich, I., et al. (2000). American College of Sports Medicine position stand. Exercise and type 2 diabetes. *Medicine and Science in Sports and Exercise*, *32*(7), 1345-1360.

American College of Sports Medicine. (1994). American College of Sports Medicine position stand. Exercise for patients with coronary artery disease. *Medicine and Science in Sports and Exercise*, *26*, 1-5.

American College of Sports Medicine. (2000). *Physical fitness, testing, and interpretation*. In American College of Sports Medicine Guidelines for Exercise Testing and Prescription (6th edition, pp. 57-90). Baltimore: Lippincott, Williams & Wilkins.

Antoni, M. H., Cruess, D. G., Klimas, N., Maher, K., Cruess, S., Kumar, M., et al. (2002). Stress management and immune system reconstitution in symptomatic HIV-infected gay men over time: Effects on transitional naive T cells (CD4(+)CD45RA(+) CD29(+)). *American Journal of Psychiatry*, *159*(1), 143-145.

Balt, C. A., & Nixon, H. (2001). Complications of HIV: Lipodystrophy, anemia, renal, cardiovascular, and bone diseases. *Nurse Practitioner Forum*, *12*(4), 199-213.

Basaria, S., Wahlstrom, J. T., & Dobs, A. S. (2001). Clinical review 138: Anabolic-androgenic steroid therapy in the treatment of chronic diseases. *Journal of Clinical Endocrinology and Metabolism*, *86*(11), 5108-5117.

Birk, T. J., McGrady, A., MacArthur, R. D., & Khuder, S. (2000). The effects of massage therapy alone and in combination with other complementary therapies on immune system measures and quality of life in human immunodeficiency virus. *Journal of Alternative and Complementary Medicine*, *6*(5), 405-414.

Brooks, G. A., Fahey, T. D., & White, T. P. (1996). *Exercise physiology: Human bioenergetics and its applications* (2nd ed.). Mountain View, CA: Mayfield.

Cabaj, R. P. (1996). Management of anxiety and depression in HIV-infected patients. *Journal of the International Association of Physicians in AIDS Care*, *2*(6), 11-16.

Carr, A., Samaras, K., Burton, S., Law, M., Freund, J., Chisholm, D. J., et al. (1998). A syndrome of peripheral lipodystrophy,

hyperlipidaemia and insulin resistance in patients receiving HIV protease inhibitors. *AIDS*, *12*(7), F51-F58.

Cruess, D. G., Antoni, M. H., Schneiderman, N., Ironson, G., McCabe, P., Fernandez, J. B., et al. (2000). Cognitive-behavioral stress management increases free testosterone and decreases psychological distress in HIV-seropositive men. *Health Psychology*, *19*(1), 12-20.

Darko, D. F., Mitler, M. M., & White, J. L. (1995). Sleep disturbance in early HIV infection. *Focus*, *10*(11), 5-6.

Durstine, J. L., & Haskell, W. L. (1994). Effects of exercise training on plasma lipids and lipoproteins. *Exercise and Sport Sciences Reviews*, *22*, 477-521.

JNC VI. (1997). The sixth report of the Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure. *Archives of Internal Medicine*, *157*(21), 2413-2446.

Keyser, R. E., Peralta, L., Cade, W. T., Miller, S., & Anixt, J. (2000). Functional aerobic impairment in adolescents seropositive for HIV: A quasi-experimental analysis. *Archives of Physical Medicine and Rehabilitation*, *81*(11), 1479-1484.

LaPerriere, A. R., Antoni, M. H., Schneiderman, N., Ironson, G., Klimas, N., Caralis, P., et al. (1990). Exercise intervention attenuates emotional distress and natural killer cell decrements following notification of positive serologic status for HIV-1. *Biofeedback and Self-Regulation*, *15*(3), 229-242.

LaPerriere, A., Fletcher, M. A., Antoni, M. H., Klimas, N. G., Ironson, G., & Schneiderman, N. (1991). Aerobic exercise training in and AIDS risk group. *International Journal of Sports Medicine*, *12*(Suppl. 1), S53-S57.

LaPerriere, A., Klimas, N., Major, P., & Perry, A. (1997). Acquired immune deficiency syndrome. In *ACSM's exercise management for persons with chronic diseases and disabilities* (pp. 132-136). Champaign, IL: Human Kinetics.

Leserman, J., Petitto, J. M., Perkins, D. O., Folds, J. D., Golden, R. N., & Evans, L. (1997). Severe stress, depressive symptoms, and changes in lymphocyte subsets in human immunodeficiency virus-infected men. A 2-year follow-up study. *Archives of General Psychiatry*, *54*(3), 279-285.

MacArthur, R. D., Levine, S. D., & Birk, T. J. (1993). Supervised exercise training improves cardiopulmonary fitness in HIV-infected persons. *Medicine and Science in Sports and Exercise*, *25*(6), 684-688.

MacDougall, D. S. (1997). NIH conference on AIDS wasting syndrome. National Institutes of Health. *Journal of the International Association of Physicians in AIDS Care*, *3*(8), 42-46.

Membreno, L., Irony, I., Dere, W., Klein, R., Biglieri, E. G., & Cobb, E. (1987). Adrenocortical function in acquired immunodeficiency syndrome. *Journal of Clinical Endocrinology and Metabolism*, *65*(3), 482-487.

Mustafa, T., Sy, F. S., Macera, C. A., Thompson, S. J., Jackson, K. L., Selassie, A., et al. (1999). Association between exercise and HIV disease progression in a cohort of homosexual men. *Annals of Epidemiology*, *9*(2), 127-131.

Nieman, D. C., Johanssen, L. M., Lee, J. W., & Arabatzis, K. (1990). Infectious episodes in runners before and after the Los Angeles Marathon. *Journal of Sports Medicine and Physical Fitness*, *30*(3), 316-328.

Nokes, K. M., & Kendrew, J. (2001). Correlates of sleep quality in persons with HIV disease. *Journal of the Association of Nurses in AIDS Care*, *12*(1), 17-22.

Parker, N. D., Hunter, G. R., Trueth, M. S., Kekes-Szabo, T., Kell, S. H., Weinsier, R., et al. (1996). Effects of strength training on cardiovascular responses during a submaximal walk and a weight-loaded walking test in older females. *Journal of Cardiopulmonary Rehabilitation*, *16*(1), 56-62.

Pothoff, G., Wassermann, K., & Ostmann, H. (1994). Impairment of exercise capacity in various groups of HIV-infected patients. *Respiration*, *61*(2), 80-85.

Rigsby, L. W., Dishman, R. K., Jackson, A. W., Maclean, G. S., & Raven, P. B. (1992). Effects of exercise training on men seropositive for the human immunodeficiency virus-1. *Medicine and Science in Sports and Exercise*, *24*(1), 6-12.

Roubenoff, R., McDermott, A., Weiss, L., Suri, J., Wood, M. Block, R., et al. (1999c). Short-term progressive resistance training increases strength and lean body mass in adults infected with human immunodeficiency virus. *AIDS*, *13*(2), 231-239.

Roubenoff, R., Skolnik, P. R., Shevitz, A., Snydman, L., Wang, A., Melanson, S., et al. (1999a). Effect of a single bout of acute exercise on plasma human immunodeficiency virus RNA levels. *Journal of Applied Physiology*, *86*(4), 1197-1201.

Roubenoff, R., Weiss, L., McDermott, A., Heflin, T., Cloutier, G. J., Wood, M., et al. (1999b). A pilot study of exercise training to reduce trunk fat in adults with HIV-associated fat redistribution. *AIDS*, *13*(11), 1373-1375.

Schambelan, M., Mulligan, K., Grunfeld, C., Daar, E. S., LaMarca, A., Kotler, D. P., et al. (1996). Recombinant human growth hormone in patients with HIV-associated wasting. A randomized, placebo-controlled trial. Serostim Study Group. *Annals of Internal Medicine*, *125*(11), 873-882.

Smith, B. A., Neidig, J. L., Nickel, J. T., Mitchell, G. L., Para, M. F., & Fass, R. J. (2001). Aerobic exercise: Effects on parameters related to fatigue, dyspnea, weight and body composition in HIV-infected adults. *AIDS*, *15*(6), 693-701.

Standish, L. J., Greene, K. B., Bain, S., Reeves, C., Sanders, F., Wines, R. C., et al. (2001). Alternative medicine use in HIV-positive men and women: Demographics, utilization patterns and health status. *AIDS Care*, *13*(2), 197-208.

Stringer, W. W., Berezovskaya, M., O'Brien, W. A., Beck, C. K., & Casaburi, R. (1998). The effect of exercise training on aerobic fitness, immune indices, and quality of life in HIV+ patients. *Medicine and Science in Sports and Exercise*, *30*(1), 11-16.

Winningham, M. L., MacVicar, M. G., Bondoc, M., Anderson, J. L., & Minton, J. P. (1989). Effect of aerobic exercise on body composition in patients with breast cancer on adjuvant chemotherapy. *Oncology Nursing Forum*, *16*, 683-689.