

Endurance Exercise Following Stroke

Approximately 750,000 people in the United States experience a stroke or cerebrovascular accident (CVA) each year. Strokes are the third leading cause of death (after heart disease and cancer) in the United States and the leading cause of disability in adults. There are an estimated three million stroke survivors in the US; the combined direct and indirect costs of stroke are estimated at an annual \$30 billion. Because of the similarities between coronary artery disease and ischemic stroke, it is not surprising that many of the risk factors for the two diseases seem to overlap. In particular, high blood pressure, smoking, poor blood lipid levels, elevated blood glucose and diabetes mellitus, and excessive alcohol consumption increase stroke risk. A variety of studies have also indicated that increased levels of physical activity are associated with decreased incidence of stroke.

With respect to physical function following a stroke, approximately 14 percent of stroke survivors achieve full recovery and need no long-term rehabilitation. But half the survivors experience severe long-term effects such as partial paralysis. Between 25 and 50 percent need at least some assistance with the activities of daily living. It is also apparent that after a stroke, individuals may be intolerant of activity. The elderly, who comprise the majority of stroke survivors, are especially at risk for this intolerance. Such intolerance is likely due to several factors, such as bed-rest-induced deconditioning, the presence of pre-existing cardiovascular dysfunction, and/or increased energy cost during walking. Indeed, the motor effects of stroke can make the energy cost of walking up to two times higher than normal. These factors can conspire to create a vicious cycle of further decreased activity and greater activity intolerance, leading to even poorer cardiovascular conditioning. This is especially troubling given the prevalence of cardiovascular disease risk factors in this population; factors that might be modifiable with exercise training.

The rehabilitation of individuals after a stroke typically ends within three to six months following the stroke, and it is commonly thought that most if not all recovery of motor function is limited to this brief time period following the stroke. Further, most rehabilitation efforts are focused on tasks associated with everyday living, such as getting dressed; little if any effort is spent on traditional cardiovascular exercise. Recent new research has indicated that aggressive rehabilitation beyond this time period can result in significant improvement in physical function.

It is well accepted that aerobic exercise elicits a variety of positive effects in people of all ages. However, only recently has formal aerobic exercise been examined for its potential benefit to persons recovering from a stroke. Significant improvements in aerobic exercise capacity were evident in individuals following stroke who underwent structured cycling exercise, 30 minutes per day, three days per week for 10 weeks. The improvements in aerobic exercise capacity were correlated with improvements in sensorimotor function. While resting blood pressure was not reduced, there was a significant reduction in the blood pressure increase during exercise, suggesting that the exercise decreased the risk associated with physical activity.

Studies have also examined the use of structured treadmill exercise in individuals who are well outside the three- to six-month post-stroke rehabilitation window. These studies have indicated that this type of exercise can significantly improve performance of functional activity. For example, structured treadmill exercise increases gait efficiency, so less energy is used for walking, making the task of walking less stressful. In addition, the improvement in aerobic capacity with this type of exercise means that as individuals walk, they do so at a smaller percentage of their maximal capabilities, further easing the physical burden.



There are several appealing aspects of treadmill training. One is that treadmill training requires persons to perform a task required for everyday life, namely walking. The second is that use of hand-rail support and “un-weighting” devices allow individuals to walk on a treadmill who would otherwise be unable to walk. These un-weighting devices are simply harnesses with cables threaded through pulleys and attached to weights. These weights serve to “lift” the person a bit, effectively decreasing their weight. In this way, individuals who have gait dysfunction may still be able walk on a treadmill and receive benefits. Third, in persons with limited gait speed, exercise intensity can be increased by keeping the speed low but increasing treadmill grade.

In addition to the functional benefits apparent with exercise after a stroke, the cardiovascular and general health benefits of endurance training are important. Given that ischemic stroke is a vascular disease with risk factors similar to coronary artery disease, individuals who have had a stroke are at increased risk of other cardiovascular disorders and additional strokes. Indeed, deaths due to cardiac events are the leading cause of death in long-term survivors of stroke. It is reasonable to suppose that long-term regular endurance training would confer health benefits such as decreased blood pressure and improved blood lipids. However, there is little current data in this regard and further research is warranted.

While compromised motor function makes the implementation of formal aerobic exercise challenging, the significant improvements in fitness following exercise training make increased use of aerobic exercise an appealing intervention. Exercise professionals should expand their repertoire to design exercise programs for those who have had a stroke. Those recovering from stroke will benefit from the addition of a cardiovascular exercise program.

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