Effect of Aerobic Exercise (Walking) Training on Functional Status and Health-related Quality of Life in Chronic Stroke Survivors
A Randomized Controlled Trial

Carron D. Gordon, PhD; Rainford Wilks, DM; Affette McCaw-Binns, PhD

Background and Purpose—Little is known about the effects of community-based walking programs in persons with chronic stroke. The purpose of this study was to determine the effects of aerobic (walking) training on functional status and health-related quality of life in stroke survivors.

Methods—A single-blind randomized controlled trial was conducted. The intervention group (n=64) walked overground for 30 minutes, 3 times per week for 12 weeks. The control group (n=64) received massage to the affected side. Medical Outcomes Short Form, 36-Item Short Form Health Survey (SF-36), was used to assess health-related quality of life; Barthel Index and Older Americans Resource and Services scale for functional status; 6-minute walk test for endurance; and Motricity Index for lower extremity strength.

Results—There was a trend toward greater improvement over time for the Physical Health Component of the SF-36 (P=0.077) and significantly greater improvement over time for distance walked in 6 minutes in favor of the walking group (P<0.001).

Conclusions—Aerobic walking improves the physical health component of quality of life and endurance in persons with chronic stroke. It should form part of a comprehensive health promotion strategy.

Clinical Trial Registration—Trial was not registered as enrollment commenced before 2005. (Stroke. 2013;44:1179-1181.)

Key Words: exercise training ■ randomized trial ■ stroke ■ walking
Table 1. Clinical and Demographic Characteristics of Subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Intervention</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>n=64</td>
<td>n=64</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>64.9 (11.1)</td>
<td>63.4 (9.4)</td>
<td>0.401</td>
</tr>
<tr>
<td>Range</td>
<td>43–90</td>
<td>42–85</td>
<td></td>
</tr>
<tr>
<td>Sex, % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>45.3 (29)</td>
<td>45.3 (29)</td>
<td>1.0</td>
</tr>
<tr>
<td>Female</td>
<td>54.7 (35)</td>
<td>54.7 (35)</td>
<td></td>
</tr>
<tr>
<td>Type of stroke, % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ischemic</td>
<td>84.3 (43)</td>
<td>87.3 (48)</td>
<td>0.875</td>
</tr>
<tr>
<td>Hemorrhagic</td>
<td>7.2 (8)</td>
<td>12.7 (7)</td>
<td></td>
</tr>
<tr>
<td>Side of lesion, % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>65.6 (42)</td>
<td>56.3 (36)</td>
<td>0.365</td>
</tr>
<tr>
<td>Left</td>
<td>34.4 (22)</td>
<td>43.8 (28)</td>
<td></td>
</tr>
<tr>
<td>Time since stroke, mean (SD), mo</td>
<td>11.8 (3.6)</td>
<td>12.8 (3.6)</td>
<td>0.122</td>
</tr>
<tr>
<td>Use of walking aid at recruitment</td>
<td>32.8 (21)</td>
<td>26.6 (17)</td>
<td>0.562</td>
</tr>
<tr>
<td>Non</td>
<td>67.2 (43)</td>
<td>73.4 (47)</td>
<td></td>
</tr>
</tbody>
</table>

Control
The control group received light massage to the affected limbs for 25 minutes, 3 times per week, for 12 weeks, at home.

Outcomes
Primary outcomes were the Physical and Mental Component Summary scores of the Medical Outcomes Survey, 36-Item Short Form Health Survey (SF-36), the Barthel Index, and the instrumental activities of daily living dimension of the Older Americans Resources and Services Questionnaire.

Secondary outcomes were functional exercise capacity/endurance (6-minute walk test), resting heart rate, and lower limb strength. Resting heart rate was recorded using a polar A1 heart rate monitor (Model#1902690 by Polar Electro Oy, Finland). Lower extremity strength was determined with the Motricity Index.

Data Analyses
To detect a difference of 5 points (SD of 10) between the groups on the SF-36, with an α-level (2-sided) of 0.05 and β of 20 (80% power), a sample size of 63 per group was needed.

The groups were compared at baseline on all variables using χ² and Student t test. Between-group differences were examined using a 2-way mixed ANOVA with time as a repeated-measures factor. The significance level was set at 0.05. An intention-to-treat analysis was performed for missing data.

Table 2. Group-by-Time Mean (SD) for SF-36 Summary Scores

<table>
<thead>
<tr>
<th>Domains</th>
<th>Group</th>
<th>Baseline</th>
<th>6 wk</th>
<th>3 mo</th>
<th>P Value*</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Health Component</td>
<td>Control</td>
<td>31.7 (11.5)</td>
<td>33.9 (14.9)</td>
<td>32.5 (12.6)</td>
<td>0.024</td>
<td>0.077</td>
</tr>
<tr>
<td></td>
<td>Intervention</td>
<td>33.5 (9.8)</td>
<td>37.5 (10.9)</td>
<td>39.1 (11.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental Health Component</td>
<td>Control</td>
<td>42.2 (12.4)</td>
<td>46.1 (11.4)</td>
<td>46.7 (11.7)</td>
<td>0.758</td>
<td>0.731</td>
</tr>
<tr>
<td></td>
<td>Intervention</td>
<td>43.7 (13.01)</td>
<td>45.8 (14.4)</td>
<td>47.2 (13.4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SF-36 indicates 36-Item Short Form Health Survey.
*P value for main effect of group.
†P value for group-by-time interaction.

Results
One hundred twenty-eight persons were randomized. Seven persons from the intervention and 5 from the control group dropped out due to: death (4), recurrent stroke (1), intervening comorbidity (4), program too difficult (1), did not like group assignment (1), or violence in community (1). No major adverse events occurred during or immediately after the sessions. The groups were similar on clinical and demographic variables (Table 1).

In the intervention group, there was a trend toward a significantly greater increase in Physical Health Component scores over time (group-by-time interaction; P=0.077). Significantly higher overall mean score (main effect of group) was also found for Physical Health Component scores in the intervention group compared with control (P=0.024). There were no group differences for the Mental Component Summary score (Table 2).

Although there were no group differences on functional status measures, the means for the 6-minute walk distance were significantly higher for the intervention group at 6 weeks and 3 months (Table 3). Resting heart rate increased in both groups from baseline to 6 weeks, but from 6 weeks to 3 months, it declined significantly in the intervention group but increased in the control group (Table 3). Motricity Index (strength) scores were not significantly different between groups.

Discussion
This supervised walking program improved Physical Health quality of life compared with a massage program. This improvement may be attributed to improved endurance and self-efficacy for walking as a result of repeated practice. This is the only study, to our knowledge, using a single modality of aerobic training that has shown improvement in this aspect of quality of life in chronic stroke survivors. Cycling did not produce any differences in Physical Health Component (SF-36 measure) compared with strength and combined strength and aerobic training in a previous study. The walking program did not show a superior benefit on Mental Health quality of life. This may be because of improvement in the control group attributable to the attention paid to the subjects.

Consistent with the findings of Bateman et al., the groups did not differ on functional status (Barthel Index) after training. In their sample of brain-injured persons (including those with stroke), aerobic cycling did not alter functional status as measured by the Barthel Index despite improved exercise capacity, suggesting that improved exercise capacity may not provide additional benefit for performing basic activities such as dressing.
Persons in the walking group improved in their endurance for walking over the 12 weeks of training. These findings were similar to others, who used treadmill training protocols, suggesting that overground walking used in the present study may be just as effective as treadmill walking. If persons are able to increase their ability to walk longer distances and to do so quicker, these have implications for their functional ambulation in the community. The lower resting heart rate in the walking group after training may be suggesting a cardiovascular training effect of overground walking.

The program could be considered labor intensive because training was done one-on-one. However, given the simplicity of the intervention (requiring no special equipment), over time, caregivers, including family members, could take over the supervision to improve its cost effectiveness.

**Limitations**

The study subjects were those whose stroke occurred 6 to 24 months before the study and could walk independently. The results cannot be extended to those more severely affected. Because subject recruitment was slower than anticipated, oversampling was not achieved. Attrition may have reduced the power to detect significant group differences on some outcomes.

**Conclusions**

Brisk overground walking could be incorporated into comprehensive, community-based exercise programs aimed at encouraging regular physical activity and improving overall health of moderately impaired community-dwelling persons with chronic stroke.

**Sources of Funding**

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**Disclosures**

None.

**References**

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