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An aerobic walking programme versus muscle strengthening programme for chronic low back pain: a randomized controlled trial

Ilana Shnayderman¹ and Michal Katz-Leurer²

Abstract

Objective: To assess the effect of aerobic walking training as compared to active training, which includes muscle strengthening, on functional abilities among patients with chronic low back pain.

Design: Randomized controlled clinical trial with blind assessors.

Setting: Outpatient clinic.

Subjects: Fifty-two sedentary patients, aged 18–65 years with chronic low back pain. Patients who were post surgery, post trauma, with cardiovascular problems, and with oncological disease were excluded.

Intervention: Experimental ‘walking’ group: moderate intense treadmill walking; control ‘exercise’ group: specific low back exercise; both, twice a week for six weeks.

Main measures: Six-minute walking test, Fear-Avoidance Belief Questionnaire, back and abdomen muscle endurance tests, Oswestry Disability Questionnaire, Low Back Pain Functional Scale (LBPFS).

Results: Significant improvements were noted in all outcome measures in both groups with non-significant difference between groups. The mean distance in metres covered during 6 minutes increased by 70.7 (95% confidence interval (CI) 12.3–127.7) in the ‘walking’ group and by 43.8 (95% CI 19.6–68.0) in the ‘exercise’ group. The trunk flexor endurance test showed significant improvement in both groups, increasing by 0.6 (95% CI 0.0–1.1) in the ‘walking’ group and by 1.1 (95% CI 0.3–1.8) in the ‘exercise’ group.

Conclusions: A six-week walk training programme was as effective as six weeks of specific strengthening exercises programme for the low back.

Keywords
Chronic low back pain, walking activity, strength training, randomized controlled trial

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Introduction

Low back pain is a widespread health problem in developed countries, with lifetime and one-year prevalence rate of 60–80%. Low back pain becomes a chronic condition in 5–10% of the patients.1 There are many approaches and methods of treating chronic low back pain. In the scientific literature there is evidence that active approaches, such as strengthening of the abdominal and back muscles, core stabilization exercises, coordination exercises, general training or aerobic exercise, reduce pain and improve functional abilities.2–4 In a systematic review of 43 clinical trials, active approaches, in particular muscle strengthening, were found to be significantly more effective in functional ability gain than other treatment techniques.4

Regular aerobic activity is known to have many advantages in improving functional status,5 pain, depression,6–8 fear of movement9 and mood.10 Of the total aerobic physical activities recommended for the general population, walking exercise known to be the safest with a low injury rate.11,12 At the clinic, walking practice is often recommended for people with low back pain.11,13 A limited number of studies have assessed the effectiveness of walking as an autonomous treatment for people with chronic low back pain.1,11,14,15 These studies performed interventions that include moderate intensity walking training,14 ski poles walking training15 and walking training with vertical ambulatory lumbar traction.1 Pain reduction and functional gain were noted in all three. The effectiveness of an aerobic walking programme for people suffering from chronic low back pain has not yet been described.11

The purpose of this study was to assess the effect of aerobic walking training as compared to active training, which includes muscle strengthening, on functional abilities among patients with chronic low back pain.

Methods

The six-minute walk test was the main outcome parameter in this study, Sample size calculations were based on the studies of Lamoth et al.16 and Al-Obaidi et al.17 that described a significant difference in walking velocity between healthy subjects and patients with chronic low back pain: 1.3 (±0.2) m/s vs. 0.92 (±0.3) m/s, respectively. In addition, Chatzitheodorou et al.14 noted that active walking exercise improves functional performance among patients with chronic low back pain.14 Based on these and to provide 80% power to detect a difference of 0.15 m/s between groups with an alpha level of 0.05, a sample size of 26 subjects per group was needed.

Subjects were recruited from the Department of Physiotherapy, Maccabi Healthcare Services in Lod, Israel. Inclusion criteria: males and females between 18–65 years, with chronic (≥3 months) low back pain with/without radiation to the lower limb. Exclusion criteria: physically active on regular basis (defined as participation in regular physical activity more strenuous than slow-paced walking twice or more times a week),18 fracture and/or surgery in the spinal or lower extremity within the previous six months, active cardiac disease as unstable angina/congestive heart failure/coronary arteries bypassed in the last six month, receiving treatment for cancer or suffering low back pain due to a road traffic accident.

The research proposal was approved by the ethics committees of Health Maintenance Organization ‘Maccabi’, Tel Aviv University and the Health Ministry of Israel. All the participants signed informed consent in advance of the study.

The six-minute walk test was the primary outcome of the study. Each participant was instructed to cover as much distance as possible in 6 minutes.19 Trunk flexor endurance was assessed by asking the subjects to curl up with straight arms pointing toward their knees until the lower edge of the scapula was raised from the table and to hold this posture for a maximum of 240 seconds. The test was terminated when the subject could not maintain the same position.20 Trunk extension endurance was measured by use of a modification of the Sorensen Back Extension Test.20 The Oswestry Low Back Pain Disability Questionnaire21 and the Fear-Avoidance Beliefs Questionnaire were completed by the participants as well.21 The health functional status was measured by a computerized
adaptive test based on the Back Pain Functional Scale and the 36-item Short-Form Health Survey Questionnaire (SF-36) and other questionnaires.22,23

Two senior physical therapists with 7 and 20 years of experience in musculoskeletal rehabilitation were responsible for the pre- and post-treatment assessments and were blind to subject allocations. A senior physical therapist with 17 years of experience in musculoskeletal rehabilitation was responsible for holding the exercise sessions with both intervention groups. The researcher who performed the data analyses was unaware of group allocation throughout the study.

Following the baseline assessment, participants were randomly assigned to either a ‘walking group’ or a control ‘exercise group’. Block randomization (four cells in each block) stratified by age groups (18–44 years, 45–65 years) were set up. Assignment was concealed in sealed envelopes and was revealed by an independent researcher not involved in the assessments or intervention.

The two experimental groups participated in six-week programmes. The training frequency for both groups was twice a week. Sessions lasted 20 minutes in the first week, and increased by 5 minutes a week up to the fifth week.

In the ‘walking’ group patients walked on a treadmill. Each training session consisted of a 5-minute warm-up of walking at a self-selected speed, followed by intense walking which was followed by a 5-minute cool-down walking, again at a self-selected speed. In the last four weeks the patients exercised for 40 minutes each session. The exercise intensity, low to moderate, was based on resting heart rate and calculated by the Karvonen formula: walking heart rate = ((220–age (years))–resting heart rate)×50%+resting heart rate, for men and ((226–age (years))–resting heart rate)×50%+resting heart rate, for women.

The ‘exercise’ group performed active movements and strengthening exercises for the trunk and upper and lower limbs. Each session begin with 5-minute of warm-up and ended with 5-minute of cool-down light exercise. The middle part of the exercise session started with low-load exercise, progressing through the duration of each exercise by increasing the number of exercise repetitions and by increasing loading positions (lying, sitting, kneeling).

All analyses were based on an intention-to-treat basis. Data were checked for normality by the Kolmogorov–Smirnov test. As the abdominal and back muscles violate the normality assumption, their values were squared by 0.5. Between-group comparisons post intervention were performed using analysis of covariance, with baseline measurements as the covariate. Within-group changes from pre- to post-exercise intervention were analysed by using paired Student’s t-tests. The level of significance was set at \( P<0.05 \). Data were analysed using the Statistical Package for Social Sciences (SPSS) version 17.0 (SPSS Inc., Chicago, IL, USA).

**Results**

Descriptive data for the study and control groups, 26 participants in each group, are shown in Table 1. There were no statistically significant baseline differences in demographic or clinical parameters between the study groups.

Six patients from the study group and three from the control group withdrew from the study (Figure 1). Baseline characteristics for those who completed the intervention and those who did not were not significantly different except for the Low Back Pain Functional Scale and Oswestry Disability Questionnaire scores. The Low Back Pain Functional Scale scores were, by mean, significantly higher (better condition) among those who withdrew from the programme compared with those who fulfilled the programme (57.9±8.0 points vs. 49.4±8.7, respectively). The Oswestry Disability Questionnaire score was significantly lower (which again means better condition) among those who withdrew compared with those who completed the programme (21.3±9.6% vs. 32.9±16.8%, respectively). Among those who completed the programme no significant differences between groups were noted.

Figure 2 shows the achievability of the walking programme. The \( x \)-axis represents time and the \( y \)-axis represents the velocity of walking (in km/h). The participants kept the target heart rate as
Table 1. Baseline characteristics of subjects by group

<table>
<thead>
<tr>
<th></th>
<th>Exercise group</th>
<th>Walking group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), mean (SD)</td>
<td>43.6 ± 13.5</td>
<td>47.0 ± 10.0</td>
<td>0.32*</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>7 (26.9%)</td>
<td>4 (15.4%)</td>
<td>0.30†</td>
</tr>
<tr>
<td>Height (m), mean (SD)</td>
<td>1.62 ± 0.08</td>
<td>1.61 ± 0.09</td>
<td>0.50*</td>
</tr>
<tr>
<td>Weight (kg), mean (SD)</td>
<td>71.9 ± 12.6</td>
<td>75.8 ± 16.5</td>
<td>0.34*</td>
</tr>
<tr>
<td>BMI, mean (SD)</td>
<td>27.3 ± 5.1</td>
<td>29.2 ± 4.7</td>
<td>0.16*</td>
</tr>
<tr>
<td>Diabetes, n (%)</td>
<td>2 (7.6%)</td>
<td>4 (15.3%)</td>
<td>0.33*</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>6 (23.1%)</td>
<td>6 (23.1%)</td>
<td>0.62†</td>
</tr>
<tr>
<td>Depression, n (%)</td>
<td>1 (3.8%)</td>
<td>3 (11.5%)</td>
<td>0.61†</td>
</tr>
<tr>
<td>Smoker, n (%)</td>
<td>10 (38.5%)</td>
<td>7 (27.0%)</td>
<td>0.48†</td>
</tr>
</tbody>
</table>

*P-value based on t-test (value: mean (SD)); †P-value based on χ² test.
BMI, body mass index.

Assessed for eligibility (n=79)

Excluded (n=27)
- Not meeting inclusion criteria (n=12)
- Declined to participate (n=15)
- Other reasons (n=0)

Randomized (n=52)

Allocated to ‘exercise’ group (n=26)

Allocated to ‘walking’ group (n=26)

6 weeks intervention

Discontinued intervention n=3
- 1 pregnancy
- 1 don’t have time
- 1 flu

Analysed (n=26)
- Excluded from analysis (n=0)

Discontinued intervention n=6
- 1 pregnancy,
- 2 don’t have time
- 2 flu
- 1 don’t know

Analysed (n=26)
- Excluded from analysis (n=0)

Figure 1. CONSORT flowchart for the study.
prescribed by the physiotherapist based on the Karvonen formula.

After the intervention, a significant improvement in both groups was noted in all outcome parameters (Table 2). These improvements were not significantly different between groups (Table 2). The mean distance in metres covered during 6 minutes increased by 70.7 (95% confidence interval (CI) 12.3–119.7) in the ‘walking’ group and by 43.8 (95% CI 19.6–68.0) in the ‘exercise’ group, with non-significant difference between groups. The trunk flexor endurance test showed significant improvement in both groups, increasing by a mean of 0.6 (95% CI 0.0–1.1) in the ‘walking’ group and by 1.1 (95% CI 0.3–1.8) in the ‘exercise’ group, with non-significant difference between groups of 0.4 (95% CI –0.4–1.3).

Discussion

This study assessed the effectiveness of an aerobic-walking programme compared with a strengthening exercise programme which, according to the literature, has been considered the most effective treatment for functional gain among people with chronic low back pain.4 It was found that both study groups improved with similar achievements in all outcome measures. Limited number of studies have assessed the effectiveness of walking as an autonomous treatment for people with chronic low back pain.1,11,14,15 These studies performed interventions that included moderate intensity walking training,14 ski pole walking training15 and walking training with vertical ambulatory lumbar traction,1 and varied in frequency and duration of treatment. In addition, two of these programmes treated patients with chronic problems1,14 and the third included patients with subacute low back pain.15 Furthermore, investigators used various outcome measures and different measurement tools. Nevertheless, the trends of improvements were comparable across these studies and the current study as well. These similarities may raise the hypothesis that coaching a patient for a moderately intense walking programme, as used in this work, is as good as more intensive walking training14 or walking training with a traction device, for achieving functional goals among people with chronic low back pain.1

In addition, the programme used by Chatzitheodorou et al.14 lasted 12 weeks whereas the length of the current study was only six weeks. The similar results may suggest that walking training for short periods shows functional achievements similar to those achieved by walking for the longer period.
The walking speed of people with chronic low back pain was found to be significantly lower – 0.92 m/s (SD = 0.2 m/s) on average compared to aged matched controls (mean of 1.3 m/s). In the current work, the average walking speed in people with chronic low back pain was 1.2 m/s (SD = 0.2 m/s). The first explanation for the difference might be related to the study’s methodology. In the current study the participants were asked to go as fast as they could, as detailed in guidelines of the six-minute walk test. In the study by Lamoth et al., the participants were asked to walk at comfortable speed. The ratio between walking speeds of the people suffering from chronic low back pain and the healthier patients in the study by Lamoth et al. was 0.7 (0.92) m/s compared with 1.3 m/s. In our study the significant improvement in average walking speed of the participants of the experimental group, especially among those who completed the programme, was 0.8 (1.16) m/s before the intervention and 1.4 m/s after the intervention, which may suggest that the achieved gain was a real functional gain.

In previous studies it has been reported that walking speed of people with chronic low back pain was found to be significantly lower – 0.92 m/s (SD = 0.2 m/s) on average compared to aged matched controls (mean of 1.3 m/s). In the current work, the average walking speed in people with chronic low back pain was 1.2 m/s (SD = 0.2 m/s). The first explanation for the difference might be related to the study’s methodology. In the current study the participants were asked to go as fast as they could, as detailed in guidelines of the six-minute walk test. In the study by Lamoth et al., the participants were asked to walk at comfortable speed. The ratio between walking speeds of the people suffering from chronic low back pain and the healthier patients in the study by Lamoth et al. was 0.7 (0.92) m/s compared with 1.3 m/s. In our study the significant improvement in average walking speed of the participants of the experimental group, especially among those who completed the programme, was 0.8 (1.16) m/s before the intervention and 1.4 m/s after the intervention, which may suggest that the achieved gain was a real functional gain.

### Table 2. Mean (SD) of outcome measures by groups at pre and post interventions assessments

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Exercise group (N=26)</th>
<th>Walking group (N=26)</th>
<th>Adjusted difference† (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six-minute walk test</td>
<td>Pre (196.6–68.0)</td>
<td>Post (226.6–14.4)</td>
<td>Pre (196.6–68.0)</td>
</tr>
<tr>
<td>Low back pain functional scale</td>
<td>Pre (196.6–68.0)</td>
<td>Post (226.6–14.4)</td>
<td>Pre (196.6–68.0)</td>
</tr>
<tr>
<td>Oswestry Low Back Pain Questionnaire, physical activity</td>
<td>Pre (196.6–68.0)</td>
<td>Post (226.6–14.4)</td>
<td>Pre (196.6–68.0)</td>
</tr>
<tr>
<td>Fear-Avoidance Beliefs Questionnaire</td>
<td>Pre (196.6–68.0)</td>
<td>Post (226.6–14.4)</td>
<td>Pre (196.6–68.0)</td>
</tr>
<tr>
<td>Trunk flexor endurance</td>
<td>Pre (196.6–68.0)</td>
<td>Post (226.6–14.4)</td>
<td>Pre (196.6–68.0)</td>
</tr>
<tr>
<td>Trunk extensor endurance</td>
<td>Pre (196.6–68.0)</td>
<td>Post (226.6–14.4)</td>
<td>Pre (196.6–68.0)</td>
</tr>
</tbody>
</table>

Δ (post score – pre score).
†Analysis of covariance adjusted for baseline.
a 50% chance of participating in the aerobic walking group. Perhaps only people with low fear from physical activity agreed to participate in the current study.

Sample size: The walking group showed an improvement of 0.197 m/s (0.267 m/s without drop-outs) while the exercise group achieved an improvement of 0.119 m/s (0.138 m/s without drop-outs). Sample size calculation was based on the study by Chatzitheodorou et al. and it was hypothesized that the difference in walking velocity change during the study, between groups, would be 0.15 m/s. It should be noted that in the study by Chatzitheodorou et al. the control group received passive treatment. Based on the current study results the sample size needed is 54 people for each group.

Subgrouping of patients: The participants in this study were not classified and not divided into groups based on signs and symptoms. Clinicians agree that low back pain is a heterogeneous condition and that division into more homogeneous groups improves treatment outcomes. The traditional medical model to classify individuals who suffer from the low back pain is based on a pathoanatomical source of symptoms. However, identifying relevant pathology in people with low back pain has proved elusive, and is only identified in less than 10% of the cases. The Guide to Physical Therapist Practice recognizes that the primary goal of the diagnostic process is to classify patients based on clusters of signs and symptoms and not by presumed pathoanatomical causes.

Study duration: The study lasted six weeks. Possibly, a longer intervention could indicate significant differences between the intervention groups. It has been concluded that the number of sessions is significantly associated with effect of exercise on pain, and that each additional exercise session increased treatment effect size. As the study was conducted in the physical therapy department of a public health organization, it has to be feasible and applicable in the future for the therapist and patients. The mean number of physical therapy treatments for lumbar spine impairments is 7.1 (SD = 3.6) visits. In this study each subject attained 14 sessions: 2 testing sessions and 12 intervention sessions.

Long-term follow-up: Performing a long-term follow-up would enable us to assess whether different training has any long-term benefit; for example, does the walking group actually continue to improve by recognizing that they can walk without using a treadmill.

Clinical messages

- A moderate-intensity walking programme twice a week for six weeks improves functional performance and muscle endurance in people with chronic low back pain.
- The later impact of a home walking exercise on the functional status of people with chronic low back pain deserves to be studied.

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