



## Aerobic training in persons who have recovered from juvenile dermatomyositis

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### Abstract

A recent study has shown that 36 persons who had recovered from juvenile dermatomyositis (JDM) have on average an 18% decrease in maximal oxygen uptake. The objective of this study was to investigate the effect of a 12-week aerobic training program in this group, and assess whether aerobic training can normalize aerobic capacity to the expected level for age and gender.

The patients participating in the study, one male and nine females (16–42 years of age), were in remission from JDM, defined as no clinical or biochemical evidence of disease activity and no medical treatment for 1 year. The patients had a median disease duration of 3.4 years (1.4–10.3), a median treatment duration of 2.4 years (0.4–9.3) and a median duration of remission of 7.0 years (1.2–30.0).

Patients trained at home on a cycle ergometer for 12 weeks at a heart rate interval corresponding to 65% of their maximal oxygen uptake ( $VO_{2max}$ ).  $VO_{2max}$  and maximal workload ( $W_{max}$ ) were determined before and after the 12-week training period through an incremental cycling test to exhaustion. The patients served as their own controls.

Eight patients with JDM in remission completed the 12-week exercise program; one patient completed 9 weeks out of the 12-week program and one dropped out of the study. Training increased  $VO_{2max}$  and  $W_{max}$  by 26% and 30% ( $P < 0.001$ ). Creatine kinase (CK) levels were normal pre-training and did not change with training, reflecting no muscle damage. We also found that at a given workload, heart rate was lowered significantly after the 12-week training period, indicating an improvement in cardiovascular fitness.

This study shows that 12 weeks of moderate-intensity aerobic training is an effective and safe method to increase oxidative capacity and fitness in persons who have recovered from JDM. The results indicate that the low oxidative capacity in JDM patients in remission is reversible and can be improved. Thus, we recommend frequent aerobic training to be incorporated into supervised physiotherapy sessions in the treatment of JDM patients in remission.

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### 1. Introduction

Juvenile dermatomyositis (JDM) is a rare idiopathic inflammatory disease that manifests itself in children causing skin rash (heliotrope changes and Gottron sign) and muscle inflammation; both due to an inflammatory angiopathy of vessels supplying skin and muscle.

Arthritis, contractures, ulcers and calcinosis are other possible findings in JDM. The muscle inflammation causes muscle weakness and fatigue, and in some patients it results in significant disability [1]. Recently, we have shown that patients with JDM in remission have an 18% decrease in maximal oxygen uptake ( $VO_{2max}$ ) compared to healthy controls [2]. However, it is not known whether this is caused by and inactive life style, muscle damage from the disease or other factors.

$VO_{2max}$  is the maximum volume of oxygen that can be utilized during intense or maximal exercise. It is generally considered that  $VO_{2max}$  is the best indicator of

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cardio-respiratory function and aerobic fitness [3]. Cardiovascular training, also termed aerobic, dynamic or endurance training increases  $VO_{2max}$  to a level that depends on the duration, intensity and frequency of the training. Besides training,  $VO_{2max}$  is also governed by genetic disposition [3].

Decreased  $VO_{2max}$  is closely related to cardiovascular disease, early onset of diabetes mellitus, metabolic syndrome, and an increase in mortality. Furthermore, diseases such as arthritis and depression are also known to be worsened by low fitness [4]. With a  $VO_{2max}$  that is almost 20% lower than healthy controls [2], patients with JDM in remission are at greater risk of being diagnosed with one or more of the above conditions.

To date, management of JDM patients has not included endurance training, even though it has been demonstrated that JDM patients with active disease [5–7] and other myopathic diseases benefit from aerobic training without causing muscle damage [8–10]. Wiesinger et al. reported how adult patients with polymyositis (PM)/dermatomyositis (DM) benefit from both a 6-week short-term training program and a 26-week long-term training program, including cycling and step aerobics [11,12]. Likewise, Alexanderson et al. reported of beneficial outcomes after a 12-week home exercise program consisting of strength exercises, stretching and walking in adult patients with inactive PM and DM [13]. In all cases, exercise resulted in an improvement in clinical symptoms [14]. Little information has been reported on patients with JDM in remission. Only one report (2010) describes the effects of exercise training in a 7-year-old patient who had recovered from JDM [15]. Muscle strength, aerobic fitness and muscle function all improved after a supervised 16-week training program [15].

Based on the above preliminary findings, we investigated the effect of a 12-week aerobic training program, and hypothesized that training would improve endurance and aerobic capacity in persons who have recovered from JDM.

## 2. Methods

### 2.1. Subjects

The subjects were identified from a national JDM study [16]. Twenty-one patients with juvenile dermatomyositis in remission were contacted and ten agreed to participate in the study; one male and nine females (16–42 years of age). Eight patients completed a 12-week cycle exercise program, and one patient completed only a 9-week training program due to unexpected hospitalization. One patient dropped out of the study, because of low compliance. Hence, the study is based on training results from nine patients with median disease duration of 3.4 years, a median treatment duration of 2.4 years and a median duration of remission of 7.0 years (for characteristics see Table 1).

To be included, the patients had to fulfill the Peter and Bohan criteria of *definite* JDM [17], be at least 15 years of age, and be in remission from JDM. Remission was defined as no clinical or biochemical evidence of disease activity and no medical treatment for 1 year. A control group of patients with JDM undergoing no intervention was not used, not only because of patient unavailability, but also because there is no learning effect associated with the primary outcome measure,  $VO_{2max}$ , and patients served as their own control. Also, the patients that chose to participate in the study were in full remission with no disease activity. A change in oxidative capacity over 3 months with no intervention is therefore not expected.

All patients complained of muscle weakness and exertional fatigue even in their state of remission. On inclusion, three patients exercised two times per week, the nature of which was of such low intensity that they were allowed to be included in the study. The other six patients were inactive prior to the study. During the 12-week training program all patients performed only the prescribed exercise (see *training program* for details).

None of the patients suffered from cardiovascular diseases, and with the exception of one patient treated with antidiabetic drugs for diabetes mellitus, none were treated with drugs.

The ethics committee of the Capital Region had approved the study (H-4-2010-105). All patients received oral and written information and gave written consent according to the Declaration of Helsinki (for the three patients who were below 18 years of age, the consent form was signed by a parent).

### 2.2. Training program

The subjects were instructed to train at home on a cycle ergometer for 12 weeks at a heart rate interval corresponding to 65% of their  $VO_{2max}$ . The patients monitored their heart rate by use of a polar pulse watch, which they wore during all exercise sessions. The pulse watch recorded date, exercise duration, and heart rate during exercise. Pulse watch data were collected after 3, 6, 9 and 12 weeks to ensure compliance.

The 12-week training program consisted of a total of 42 training sessions. The subjects trained every other day throughout all 12 weeks. Sessions were 20 min long in the first two weeks, 25 min long in weeks three and four, and during the last eight weeks, sessions were 40 min in duration. Training sessions began with a 5-min warm up at a low workload.

During the 12-week training period, the patients kept a training diary and had regular telephone or internet consultations with the principal investigator.

### 2.3. Experimental protocol

Primary outcome measures were changes in  $VO_{2max}$  and  $W_{max}$ .

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