# Cardiorespiratory Fitness after Transient Ischemic Attack and Minor Ischemic Stroke: Baseline Data of the MoveIT Study

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*Background:* Cardiorespiratory fitness (CRF) is reduced in patients with stroke. It is unclear whether it is also reduced in patients with a transient ischemic attack (TIA) or minor stroke. We investigated the CRF in patients with a recent TIA or minor stroke and explored which determinants are associated with a lower fitness. *Methods:* In 113 patients with a recent TIA or minor ischemic stroke (64 (SD = 10) years of age; 49 (IQR 27-86) days post TIA or stroke), the peak oxygen consumption (VO2peak) was determined in a symptom-limited ramp exercise test. Physical activity level, vascular risk factors, history of vascular or pulmonary disease, and stroke characteristics were recorded at inclusion and related to the VO2peak. *Results:* Mean VO2peak was 22 mL/kg/min (SD = 6), which is the fifth percentile of age- and sex-related normative values. Increasing age and female sex were associated with a lower VO2peak (B (95% CI): per 10 years –2.57 mL/kg/min (–3.75; –1.40) and female sex –5.84 mL/kg/min (–8.06; –3.62)). Age- and sex-adjusted linear regression analyses showed that a history of cardiovascular disease and pulmonary disease was associated with a lower VO2peak. In addition, a lower level of physical activity, hypertension, smoking, and overweight were associated with a lower VO2peak. History of stroke and stroke characteristics were not related to VO2peak. *Conclusion:* The majority of patients with a recent TIA or minor ischemic stroke have a poor CRF. Our findings suggest that premorbid cardiovascular and pulmonary disease and vascular risk factors, but not TIA- or stroke-related factors, contribute to a reduced CRF. **Key Words:** Exercise test—stroke—transient ischemic attack—risk factor—physical activity.


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## Introduction

In patients with a disabling stroke, cardiorespiratory fitness (CRF), measured with the peak oxygen consumption in milliliter per kilogram per minute (VO2peak), is reduced both in the subacute and the chronic phase after stroke.[1,2] In 3 studies performed in patients in the subacute phase after a disabling stroke, values for the VO2peak ranged between 12 and 18 mL/kg/min, which is lower than 60% of age- and sex-related normative values.[3-5] These values may have clinical impact as the accepted minimal value necessary for independent living is estimated at 15 mL/kg/min[1] and values below 21 mL/kg/min have been associated with an increased mortality among patients with coronary artery disease (CAD).[6] In the general population, values lower than the 20th percentile of age and sex, an indicator of a sedentary lifestyle, are also associated with increased all-cause mortality.[7]

The determinants responsible for the reduced CRF after stroke have not yet been elucidated. Both stroke-related factors and a low premorbid fitness attributable to health-, lifestyle- and age-related declines probably influence CRF. It has been suggested that cardiac comorbidity plays a central role in the reduced exercise capacity,[3] as about one fifth of patients after stroke also have asymptomatic CAD.[8,9] Significant associations between VO2peak and the Barthel index,[3,4,10] Fugl-Meyer test,[11] and the Berg Balance Scale[12,13] have been found, indicating that less disabled persons have a better CRF. Higher age and female sex have also been associated with a lower exercise capacity.[3]

Until now, most studies have been performed in patients in the subacute phase after a disabling stroke. It is conceivable that in patients with a TIA or a nondisabling ischemic stroke, stroke-related impairment will play a smaller role in low CRF than in patients who suffered from a disabling stroke. Data on CRF and its determinants in patients with a recent TIA or minor ischemic stroke are lacking. This study aimed to investigate CRF in patients with a recent TIA or minor ischemic stroke and to explore the possible determinants associated with CRF in these patients.

## Methods

### *Participants*

Data were retrieved from the baseline assessment of the MoveIT-study, a randomized controlled trial investigating the effects of an aerobic exercise program on cognition in patients with a recent TIA or minor ischemic stroke. Details of the design of this study have been described elsewhere.[14] Study procedures were approved by the local university and hospital research ethics committee. Written informed consent was obtained from all participants. The study was registered at the Dutch trial registration (Nederlands Trial Register—NTR3884).

In brief, between May 2012 and July 2014, 120 adult patients with a TIA or minor ischemic stroke defined as National Institutes of Health Stroke Scale score less than or equal to 3,[15] with an onset of signs and symptoms less than 1 month ago and the ability to walk independently, were included. Exclusion criteria were (1) dementia or a Mini-Mental State Examination score less than 24, (2) aphasia or inability to speak Dutch, (3) cardiopulmonary contraindication for physical exercise and exercise testing as outlined by the American College of Sports Medicine (ACSM),[16] or (4) chronic disease with an expected survival less than 2 years.

Patients were screened for cardiac contraindications using a checklist that included history of cardiac disease, symptoms of current cardiac disease, and results of electrocardiogram (ECG). Before enrollment, all patients with a positive checklist were examined by a cardiologist to exclude cardiac contraindications for maximal exercise testing or a physical exercise program.

### *Cardiorespiratory Fitness*

The peak exercise capacity (VO2peak), or peak oxygen consumption in milliliter per kilogram per minute (mL/kg/min), was used as the measure of CRF.[17] A symptom-limited ramp exercise test was performed on a Jaeger cycle ergometer. During the test, continuous electrocardiographic monitoring was performed, and the blood pressure was measured every minute. Oxygen consumption (VO2) was continuously measured using a metabolic measurement system, which performed breath-by-breath gas analysis (Oxycon Pro, Jaeger, Hoechberg, Germany). The testing protocol was adjusted to the capabilities of the patient.[16] Exercise was terminated if participants were fatigued or earlier when fulfilling the ACSM's guidelines "Indications for Terminating Exercise Testing."[16] A cardiologist and pulmonologist reviewed all results of the exercise tests. In case of ECG abnormalities, a cardiologist examined the participant to diagnose or exclude cardiac disease. The maximal VO2 value obtained was considered the VO2peak. Other descriptive measures of exercise testing were maximal workload, peak heart rate, and Borg's 15-point Ratings of Perceived Exertion scale,[18] a scale of 15 points to measure subjective exertion. The use of beta-blocker medication was recorded.

### *Clinical Characteristics*

Clinical characteristics included demographic characteristics, medical history, and risk factors for vascular disease (smoking, alcohol consumption, hypertension, diabetes mellitus, hyperlipidemia, body mass index (BMI), and premorbid physical activity) and stroke characteristics. Hypertension was defined as blood pressure lowering drug use or a blood pressure at baseline assessment higher than 140/90 mmHg. Hyperlipidemia was defined as low-density lipoprotein cholesterol level higher than 2.5 mmol/L