ASSESSING AND TRAINING CARDIORESPIRATORY 
FITNESS AFTER STROKE

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STATEMENT OF ORIGINALITY

The thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968.

STATEMENT OF COLLABORATION

I hereby certify that the work embodied in this thesis has been done in collaboration with other researchers. I have included as part of the thesis a statement clearly outlining the extent of collaboration, with whom and under what auspices.

STATEMENT OF AUTHORSHIP

I hereby certify that the work embodied in this thesis contains a published paper and scholarly works of which I am a joint author. I have included as part of the thesis a written statement, endorsed by my supervisor, attesting to my contribution to the joint publication and scholarly works.

Dianne Marsden

Date 13th November 2015
STATEMENT OF CONTRIBUTION

I, Neil Spratt, attest that Research Higher Degree candidate Dianne Marsden contributed significantly to the study design, data collection, data analysis and writing of the publication/ manuscripts entitled:


Marsden DL, Dunn A, Callister R, McElduff P, Levi CR, Spratt NJ. Applying Interval Training Principles to Task-Specific and Ergometer Workstations Enables Stroke Survivors to Exercise at an Intensity Sufficient to Improve Cardiorespiratory Fitness. Under review: Disability and Rehabilitation (Chapter 6)

Marsden DL, Dunn A, Callister R, McElduff P, Levi CR, Spratt NJ. An individually-tailored program of home- and community-based physical activity can improve the cardiorespiratory fitness and walking endurance of stroke survivors: a pilot study. For resubmission: Disability and Rehabilitation (Chapter 7)

She collaborated with her fellow authors from the University of Newcastle to undertake this work.

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Date: 13th November 2015
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OTHER PUBLISHED PAPERS CO-AUTHORED BY THE CANDIDATE

(not included as part of this thesis)


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Awards


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ABSTRACT

Introduction: Cardiorespiratory fitness levels of people after stroke are low compared to non-stroke people of the same age and sex. Improving cardiorespiratory fitness has many potential health benefits for stroke survivors. Despite this, cardiorespiratory fitness is often overlooked in post-stroke management. Access to metropolitan-based services can be difficult for residents of regional and rural communities.

Aims: The aims of the project were to:

1. Identify the characteristics and to determine the effectiveness of interventions to improve cardiorespiratory fitness after stroke.
2. Compare cardiorespiratory responses and performance measures during three clinically-applicable exercise tests.
3. Examine the exercise intensity parameters achieved by stroke survivors during task-specific and ergometer workstation activities.
4. Explore the feasibility and efficacy of an individually-tailored home- and community-based exercise program to improve cardiorespiratory fitness in stroke survivors.

Methods: Characteristics of exercise interventions were investigated by systematic review. Change in cardiorespiratory fitness, measured by peak oxygen consumption (VO_{2peak}), was examined by meta-analysis. Community-dwelling stroke survivors were recruited. The primary outcome, oxygen consumption (VO_{2}) was assessed using a portable metabolic measurement system. Cardiorespiratory responses and performance measures were assessed on three exercise tests [Six-Minute Walk Test (6MWT), distance;
Shuttle Walk Test (SWT), number of shuttles; cycle progressive exercise test (cPXT), final workload]. VO$_2$ was recorded during an individualised circuit exercise session incorporating an interval training approach on 5-minute workstations (task-specific and ergometer activities). A pilot controlled trial of an individually-tailored exercise program was undertaken. Feasibility was measured by retention, participation and adverse events. Control and intervention groups both received usual care, and the intervention group undertook the 12-week program, including once-weekly telephone/email support. Cardiorespiratory fitness was assessed at baseline and 12 weeks.

Results: Aim 1: Twenty eight studies were included in the systematic review with 12 randomised controlled trials able to be included in the meta-analysis. Baseline fitness was low (8-23mL/kg/min). Interventions were typically centre-based, included an aerobic component and used three 30 to 60 minutes sessions per week at a prescribed intensity. Despite the modest dose of interventions, cardiorespiratory fitness improvement favoured intervention [increase in VO$_{2peak}$ of 2.27 mL/kg/min (95% CI: 1.58 to 2.95)]. Aim 2: There was no difference in VO$_{2peak}$ among the three exercise tests (range: 17.1- 18.1 mL/kg/min). Correlations between VO$_{2peak}$ and performance measures were high (r=0.78, 0.73, 0.77). Aim 3: Nine task-specific (e.g. walking, stairs, balance) and three ergometer (upright cycle, rower, treadmill) workstations were used. Participants exercised for at least 11 minutes on the circuit. Moderate or higher intensity was achieved for 78% of task-specific and 83% of ergometer workstations. Aim 4: All intervention participants reported undertaking their prescribed program. No adverse events occurred. VO$_{2peak}$ improved by 16%
more in the intervention group (1.17 ± 0.29 to 1.35 ± 0.33 L/min) than the
control group (1.24 ± 0.23 to 1.24 ± 0.27 L/min) (p=0.044).

**Conclusions:** I have shown it is feasible to assess and train cardiorespiratory
fitness using strategies applicable to most clinical settings. The 16%
improvement in cardiorespiratory fitness observed in the home- and community-
based program was similar to centre-based, resource-intensive programs.
Performance measures of the 6MWT, SWT and cPXT may be clinically useful
as proxies for cardiorespiratory fitness. An interval training approach using task-
specific and ergometer activities appears a promising way to incorporate both
cardiorespiratory fitness and functional training into post-stroke management.
The studies provide preliminary data to inform the design of a future large,
multicentre randomised controlled trial. This trial would the test effectiveness of
the home- and community-based exercise intervention in improving
cardiorespiratory fitness and functional recovery of stroke survivors living in
metropolitan, regional and rural areas.