**Institution: The University of Edinburgh**

**Unit of Assessment: 26 Sport and Exercise Sciences, Leisure & Tourism**

**Title of case study: Life after stroke – influence of physical fitness and exercise**

## 1. Summary of the impact

Every year 15 million people worldwide experience a stroke. Of these, 5 million die and 5 million are permanently disabled. Life after stroke is never the same for many survivors. The research by Mead and Saunders from 2001 to 2012 has demonstrated that exercise training improves the physical fitness and physical function of stroke survivors and thus improves their quality of life.

The research has influenced health policy by underpinning the production of National Clinical Guidelines for stroke in the UK (NHS England & Scotland) and internationally (Australia, NZ, Canada). It has also been used to design and develop exercise after stroke services which have been implemented in the UK since 2007.

## 2. Underpinning research

Physical fitness is reduced after stroke. Impaired fitness is associated with post-stroke disability. Many stroke survivors require rehabilitation, but fitness training was not included in most programmes.

This programme of research has:

- developed a rationale for physical fitness training after stroke;
- examined the evidence of effect for whether exercise is beneficial after stroke; and
- explored the barriers and motivators for stroke survivors to participate in exercise.

The key evidence was produced by Professor Gillian Mead and Dr David Saunders (both at the University of Edinburgh since 2001).

The methods used include observational studies, systematic reviews (which collate all available high-quality evidence), and meta-analyses which determine statistically the various effects of exercise after stroke. This research is designed to generate recommendations for evidence-based practice (and research).

### a) Developing the rationale for exercise after stroke

Systematic review methodology demonstrated that aerobic fitness is substantially impaired after stroke (1). This is important because low aerobic fitness is likely to increase the risk of recurrent stroke and exacerbate post-stroke disability. Original research (2) showed that impaired muscle power in the lower limb unaffected by stroke is associated with important functional impairments e.g. time taken to rise from a chair. Furthermore, impaired lower limb muscle power is associated with fatigue (3), which affects about 40% of stroke survivors and is one of the most distressing post-stroke symptoms. These observational data justify the testing of exercise training interventions to improve physical function and disability after stroke.

### b) Synthesis and meta-analysis of evidence for physical fitness training after stroke

The principal research outputs are a series of systematic reviews produced in association with the Cochrane Collaboration ('Physical fitness training for stroke patients'; 3, 4). These systematic reviews and meta-analyses synthesised all available evidence from clinical trials of exercise training after stroke in order to determine whether exercise interventions are beneficial for people with stroke. Individual clinical trials generally do not provide adequate evidence to form clinical guidelines for exercise after stroke, whilst meta-analyses provide the best level of evidence to answer clinical questions like these. For the last 10 years Mead and Saunders have led the production and updating of this body of evidence.

These meta-analyses have identified the effects of physical fitness training for patients. For example, cardiorespiratory training leads to clinically important improvements in mobility in stroke patients when provided as part of their rehabilitation. This is important because mobility is an outcome which is valued by stroke patients themselves. The evidence from the systematic reviews

and meta-analyses is of sufficiently high quality to justify the inclusion of exercise training into rehabilitation of stroke survivors.

Our research programme has also focussed on the implementation of this evidence in practice. For example, a systematic review found that key barriers to exercise were lack of motivation, environmental factors (e.g. transport), health concerns, and stroke impairments; and the key motivators were social support and the need to be able to perform daily tasks (5).

## 3. References to the research

**The role of physical fitness after stroke**


1. Smith, A. C., Saunders, D. H. and Mead, G. (2012), Cardiorespiratory fitness after stroke: a systematic review. International Journal of Stroke, 7: 499–510. In REF 2 (Mead).
2. Saunders,D.H., Greig,C.A., Young,A., & Mead,G.E. (2008) Association of Activity Limitations and Lower-Limb Explosive Extensor Power in Ambulatory People With Stroke. Archives of Physical Medicine & Rehabilitation, 89, 677-683. In REF 2 (Saunders).


**Physical fitness training interventions after stroke**


3. Saunders DH, Greig CA, Mead GE, Young A. Physical fitness training for stroke patients. Cochrane Database of Systematic Reviews 2009, Issue 4. Art. No.: CD003316. DOI: 10.1002/14651858.CD003316.pub3
4. Brazzelli M, Saunders DH, Greig CA, Mead GE. Physical fitness training for stroke patients. Cochrane Database of Systematic Reviews 2011, Issue 11. Art. No.: CD003316. DOI: 10.1002/14651858.CD003316.pub4
5. Nicholson, S., Sniehotta, F. F., van Wijck, F., Greig, C. A., Johnston, M.,McMurdo, M. E. T., Dennis, M. and Mead, G. E. (2012), A systematic review of perceived barriers and motivators to physical activity after stroke. International Journal of Stroke. DOI: 10.1111/j.1747-4949.2012.00880.x


## 4. Details of the impact

This research has influenced policy and practice in the UK and internationally by contributing to clinical guidelines and through training with health and exercise professionals working with stroke survivors.

**The Cochrane Review on fitness after stroke: influencing clinical practice**

Cochrane systematic reviews help providers, practitioners and patients make informed decisions about health care, and are the most comprehensive, reliable and relevant source of evidence (The Cochrane Collaboration http://www.cochrane.org/cochrane-reviews).

The 2012 update of our Cochrane systematic review of fitness training (Brazzelli et al. 2012) is the 4th most cited Cochrane review about stroke and the 7th most accessed Cochrane review (2,164 full-text accesses during 2011) about stroke (5.1. Source: The Cochrane Library Impact Data Pack, 2011). One of the world's leading stroke journals 'Stroke', aimed at a clinical audience, invited us to write summaries of each review (5.2).

The Cochrane review evidence directly informed clinical practice via the following National Clinical Guidelines for stroke:

i) *Scottish Intercollegiate Guidelines Network (SIGN) clinical guideline for management of stroke patients in Scotland*, SIGN 118 (2010) (5.3)

Our review was part of the evidence labelled as 1++ (i.e. high quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias). The evidence resulted in the following recommendation:

'Gait-oriented physical fitness training should be offered to all patients assessed as medically stable and functionally safe to participate, when the goal of treatment is to improve functional ambulation' (SIGN 118; Item 4.2.8 p17)

ii) *Royal College of Physicians (RCP) Intercollegiate Stroke Working Party. National clinical*

*guideline for stroke* (2012) (5.4)

Our Cochrane reviews (Saunders et al. 2009; Brazzelli et al. 2011) are cited as evidence to support the recommendation:

'After stroke, patients should participate in exercise with the aim of improving aerobic fitness and/or muscle strength unless there are contraindications.' (RCP 2012; Item 6.6 p82-83)

This evidence addresses a 'patient-important' outcome (walking) with large 'reach' in terms of numbers of patients ('all patients').

iii) NICE guideline. Stroke rehabilitation. Long-term rehabilitation after stroke. Guideline 162 (23rd May 2013). The Cochrane review (Brazzelli et al 2012) is cited as evidence to recommend exercise training is incorporated into the rehabilitation of stroke survivors. (5.5).

iv) *Best Practice Guidance for the Development of Exercise after Stroke Services in Community Settings*" (Best et al 2010, www.exerciseafterstroke.org.uk).

The Scottish Government funded the development of this guidance to increase Scottish provision of Exercise after Stroke services. This guidance cites Saunders et al 2009 as evidence for fitness training, and to guide the optimum type and frequency of training.

The guidance (http://www.exerciseafterstroke.org.uk/ (5.6)) has been accessed over 15,000 times on this website between 2009 and 2013. 50% of clicks on the main page relate to 'information for professionals, which shows the demand for the guidance is high. The guidance is also cited on the UK Stroke Improvement website:

(http://www.improvement.nhs.uk/stroke/CommunityStrokeResource/CSRLifeafterstroke/CSRLifeafterstrokeexercisepoststroke/tabid/226/Default.aspx).

v) The Cochrane reviews Saunders et al (2009) and Brazzelli et al (2011) are cited as evidence in clinical guidance around the world (5.7); for example

- Australian National Clinical Guidelines for Stroke Management (2010)
- New Zealand Clinical Guidelines for Stroke Management (2010)
- Canadian Best Practice Recommendations for Stroke Care (2011-2013)

**Informs Training & Knowledge of Practitioners**

The research forms key chapters in 'Exercise and Fitness Training after Stroke A handbook for evidence-based practice' (Eds. Mead and van Wijck 2012). The book was conceived to enable health professionals to design and deliver safe and effective exercise programmes for stroke survivors. The book outlines the underpinning evidence (including research by Mead and Saunders) then describes how to translate this research into practice. Between November 2012 and July 2013, 652 copies had been sold (5.8).

**Informs Training Course for Practitioners *'Exercise and Fitness Training after Stroke'***

The research is a key part of the evidence base for the only UK course for exercise professionals that has received professional endorsement from SkillsActive (Sector Skills Council for Active Leisure, Learning and Well-being): The course is endorsed by UK Stroke Forum for training, approved by Chartered Society for Physiotherapists. It is delivered commercially in the UK by LaterLifeTraining (5.9). By December 2012 over 170 exercise practitioners were qualified and a further 50 are in training. This course is recommend in NHS action plans as follows:

'NHS Boards, through their stroke MCNs, should continue to work with leisure industry representatives to make best use of the new training course [Exercise After Stroke] to improve access to exercise and fitness training for people with stroke in their area.'

"*Better Heart Disease and Stroke Care Action Plan*" (NHS Scotland, 2009). (5.10)

**5. Sources to corroborate the impact**

Webpages have been archived at: https://www.wiki.ed.ac.uk/display/REF2014REF3B/UoA+26

5.1 The Cochrane Stroke Group Impact Data Pack (2011)

http://www.dcn.ed.ac.uk/csrg/entity/stroke.pdf

Corroborates that Fitness after Stroke was the 4th most cited and 7th most accessed Cochrane review on stroke in 2011.

5.2 Brazzelli, M., Saunders, D. H., Greig, C. A., & Mead, G. E. (2012). Physical Fitness Training for Patients With Stroke Updated Review. Stroke, 43(4), e39-e40. http://stroke.ahajournals.org/content/43/4/e39.short

5.3 Smith, L. (Chair.) et al. (2010) Management of Patients With Stroke: Rehabilitation, Prevention and Management of Complications, and Discharge Planning: a National Clinical Guideline. Series: SIGN publication, 118. SIGN. ISBN 9781905813636 http://www.sign.ac.uk/pdf/sign118.pdf (cited section 4.2.8 p17)

5.4 Intercollegiate Stroke Working Party. National clinical guideline for stroke, 4th edition. London: Royal College of Physicians (RCP), 2012. (cited section 6.6 'Exercise; pages 82-83) http://www.rcplondon.ac.uk/sites/default/files/national-clinical-guidelines-for-stroke-fourth-edition.pdf

5.5 National Clinical Guideline Centre. Stroke Rehabilitation Long term rehabilitation after stroke Clinical guideline 162 Methods, evidence and recommendations 29 May 2013 (http://www.nice.org.uk/nicemedia/live/14182/64094/64094.pdf, accessed 16.7.13) Brazzelli et al is cited on page 339. Pages 340 to 397 cite the trials included in the review.

5.6 Best C, van Wijck F, Dinan-Young S, Dennis J, Smith M, Fraser H, Donaghy M, Mead G. Best Practice Guidance for the Development of Exercise after Stroke Services in Community Settings 2010. Edinburgh: Edinburgh University. http://www.exerciseafterstroke.org.uk/resources/Exercise_After_Stroke_Guidelines.pdf

5.7 International sources

National Stroke Foundation. Clinical Guidelines for Stroke Management (2010). Melbourne Australia. ISSBN0-978-0-9805933-3-4 http://strokefoundation.com.au/site/media/clinical_guidelines_stroke_managment_2010_interactive.pdf

Stroke Foundation of New Zealand and New Zealand Guidelines Group. Clinical Guidelines for Stroke Management 2010. Wellington: Stroke Foundation of New Zealand (2010). http://www.stroke.org.nz/resources/NZClinicalGuidelinesStrokeManagement2010ActiveContents.pdf

5.8 Mead G.E., van Wijck F. & Donaghy M. (2012) Exercise after stroke: a handbook for evidence-based practice. Elsevier ISBN 978 0 7020 4338 3. Supplied on request.

Chapter 4: Saunders D.H. & Greig C.A. Fitness and function after stroke. Pages 77-91

Chapter 5: Mead G.E. & Saunders D.H. Evidence for exercise training after stroke. Pages 93-107

For further information on how the research informs training and knowledge of practitioners, contact Institute for Applied Health Research and School of Health, Glasgow Caledonian University, Cowcaddens Road, Glasgow G4 0BA

5.9 'Exercise and Fitness Training after Stroke' course delivered by LaterLifeTraining http://www.laterlifetraining.co.uk/courses/exercise-for-stroke-instructor/

Contact: info@laterlifetraining.co.uk

5.10 "Better Heart Disease and Stroke Care Action Plan" (NHS Scotland, 2009). http://www.scotland.gov.uk/Publications/2009/06/29102453/2.

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