

**Secondary stroke prevention: Developing a health
enhancing lifestyle clinic for individuals with stroke**

James Faulkner

Winston Churchill Memorial Trust Travel Fellowship

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A.Prof Rita Van Den Berg-Emons, Department of Rehabilitation Medicine, Erasmus MC, Rotterdam.

Sweden

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Abbreviations

AAS - Action After Stroke

CPD - Continued Professional Development

ESD - Early Supportive Discharge

HELP - Health Enhancing Lifestyle Programme

INSsPIRE - International Network for Secondary Stroke Researchers

NHS - National Health Service

NICE - National Institute for Health and Care Excellence

TIA - Transient Ischaemic Attack

UCD - University College Dublin

UK - United Kingdom

WCMT - Winston Churchill Memorial Trust

Glossary

Pubmed - is a free search engine accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics

Researchgate - A social networking site for scientists and researchers to share papers, ask and answer questions, and find collaborators.

Stroke - A stroke is a serious life-threatening medical condition that occurs when the blood supply to part of the brain is cut off

Transient Ischaemic Attack (TIA) - blood supply to the brain is temporarily interrupted. This causes what's known as a mini-stroke, often lasting between a few minutes and several hours.

Professional Experience

My name is Dr James Faulkner, a Reader in Exercise Physiology at the University of Winchester, UK (2015-present). My interest in stroke rehabilitation began in 2005 during my PhD study at the University of Exeter. Between 2005 and 2008 I co-ordinated Action After Stroke (AAS), a small independent charity which provided twice weekly rehabilitation exercises to stroke patients from the Exeter and Devon area. Although external to my PhD in Sport and Exercise Science (2005-2009), the experiences encountered in AAS encouraged me to focus my research career with this clinical population during the commencement of my first academic post. As such, and during my appointment to a Lectureship role at Massey University, New Zealand (2009-2015), I started to undertake research into the benefit of exercise as an early secondary prevention treatment strategy for patients with minor stroke and transient ischaemic attack (TIA). On my return to the UK in 2015, I have wanted to demonstrate that my research findings could have ecological (real-world) validity and lead to the creation of a community-based, exercise and education programme for stroke survivors and TIA patients. This aptly leads on to the purpose of my application to the Winston Churchill Memorial Trust (WCMT) for a Travel Fellowship.

Executive Summary

Focus to fellowship:

Stroke is a leading cause of death worldwide, and is a prominent cause of chronic disability, causing significant physical and cognitive impairments. With the burden of disease caused by stroke expected to double by 2030, people with stroke need better access to effective rehabilitation services. Compared to other clinical conditions (e.g., cardiac patients) the secondary care of patients post-stroke is very limited once discharged from Hospital. There is therefore significant potential to fill this void by improving the exercise and educational opportunities for stroke patients in the community. Accordingly, I would like to develop such a clinic called the HELP (Health Enhancing Lifestyle Programme) Hampshire Stroke Clinic, a programme which would provide individuals with stroke with community-based opportunities to engage in activities that will improve their physical and psycho-social well-being.

The purpose of my WCMT Fellowship was to identify whether key European sites, based on academic expertise in the area of lifestyle modification (exercise and education) for individuals living with stroke, deliver secondary prevention, community-based opportunities for patients with stroke, and whether any practices could be implemented back in the UK setting. I was also interested in identifying whether any educational practices

and research initiatives/collaborations identified and facilitated during the Fellowship could be embedded in my UK academic setting, and possibly within a community-stroke clinic.

Primary findings:

1. In the European sites visited, there were a lack of community-based, exercise and education programmes for patients with stroke.
2. In the sites visited, it was only in Norrköping (Vrinnevi Hospital) whereby a dedicated community-clinic had been established for patients with a 'major' stroke diagnosis.
3. Different exercise (gym, dance, swimming) opportunities were available in Vrinnevi Hospital. This provides a varied exercise environment and one which may cater for individuals of different ages, genders and exercise interests.
4. There were limited opportunities for minor stroke patients and individuals diagnosed with a Transient Ischaemic Attack to take part in a community-based exercise and education programme. Where programmes were available, it was primarily focused on patients who were recovering from a major stroke.
5. Students from an undergraduate physiotherapy course had aspects of their taught degree embedded in a Hospital-based stroke clinic. These sessions were primarily aligned with modules that had 'Clinical Exercise Physiology' embedded in them. This may be important when developing the HELP Hampshire Stroke Clinic in the UK so students from local physiotherapy programmes have real-world opportunities of working with stroke patients in a community-based setting.
6. There is significant potential for research collaboration in the area of secondary stroke prevention through various lifestyle modification (exercise and education) strategies. This has been demonstrated with stakeholders visited during the WCMT Fellowship.

Recommendations:

- The inclusion of different exercise sessions, including gym-based, dance and hydrotherapy should be implemented in a community-based, exercise and education programme for individuals with stroke.
- Individualised and group-based exercises should be implemented in a community-based programme to enable the delivery of a varied exercise programme.
- Community-based programmes should be aligned with a University's so that taught students (i.e., physiotherapy) can engage and get a real-world learning experience.

- Research should be implemented in community-based exercise and education programmes to further our knowledge on what exercise sessions, including frequency, duration and intensity) should be delivered for individuals with stroke.
- There is significant need to develop and deliver a community-based secondary prevention clinic for stroke patients, in the UK and throughout Europe.

Introduction to the project

Background description to project:

Stroke is a leading cause of death worldwide, and is a prominent cause of chronic disability, causing significant physical and cognitive impairments. In the United Kingdom (UK), there are more than 100,000 strokes each year, with 1.2 million people currently living with the debilitating effects of stroke [1]. Stroke is estimated to cost the NHS up to £9B per year [2]. With the burden of disease caused by stroke expected to double by 2030 [3], people with stroke needing access to effective rehabilitation services will increase [4].

A stroke is a brain attack whereby blood flow to parts of the brain is reduced. Strokes are either ischaemic (reduced blood flow in brain due to a clot/blockage) or haemorrhagic (bleed) in nature. A Transient ischemic attack (TIA) is a diagnosis whereby patients have the signs of stroke, but they usually last less than 24 hours, although most typically last no longer than 1 hour.

The National Institute for Health and Care Excellence (NICE) guidelines [5], along with other European and Worldwide agencies [6-8], recommend the prescription of anti-platelet- and/or anti-coagulation agents, and possible use of blood pressure- and lipid lowering medication post-stroke. However, medicinal management alone appears suboptimal [9,10] with only 11% of stroke patients having adequate control of their vascular risk factors [11]. NICE recommend lifestyle and behaviour modification (exercise, dietary advice, patient education), in addition to drug therapy, to reduce morbidity and mortality in individuals at high risk of, or with cardiovascular disease [4,5]. A meta-epidemiological study of randomized controlled trials has demonstrated that physical activity is more effective in reducing mortality risk post-stroke than anti-coagulant and anti-platelet medication alone [12]. Accordingly, non-pharmacological interventions, including exercise, dietary advice, lifestyle counselling, and patient education, may have an important role to play in averting a secondary stroke or TIA [13,14].

In the UK and worldwide, the provision of care post-stroke is rather limited compared to other clinical conditions (i.e., cardiac rehabilitation patients). To the majority of stroke

patients, once an individual has been diagnosed with a major stroke and has been an inpatient on an NHS Foundation Trusts acute stroke ward, which is approximately 14+ days, they will be discharged to the 'Early Supportive Discharge' (ESD) team. During ESD, Allied Health Professionals including physiotherapists and occupational therapists will support patients in their home for usually 6 weeks. Thereafter, patients who have the finances to attend private physiotherapy services can continue to receive physical therapy for months if not years, while those who are unable to pay for such services are left to their own devices with regards to their recovery. Although there may be opportunities to take part in NeuroFit classes in local leisure centres, the availability of community-based exercise and education programmes for patients with stroke is severely limited, for both patients who have had a major stroke, and those who have experienced more minor diagnoses. Accordingly, there is significant opportunity to develop, community-based, exercise and education programmes to assist stroke patients, of all severities and socio-economic backgrounds, in their recovery from the debilitating effects of stroke. Improvements in short-and long-term physiological and psycho-social health outcomes for this population group, decreased risk of experiencing further strokes, and a reduced number of hospital admissions could all be evident from the effective delivery of an exercise and education programme. There is significant scope for the creation of a structured secondary prevention pathway for this population group which is not currently available in the NHS. Such programmes should be designed so that both a research and learning environment is created to help improve the knowledge and standard of care provided to stroke patients following their discharge from hospital.

Therefore, since 2015 I have considered creating an exercise and education programme, which would be led by the University of Winchester, entitled the Health Enhancing Lifestyle Programme (HELP) for stroke patients (HELP Hampshire Stroke Clinic). I envisage the programme to be one which provides exercise and educational opportunities for stroke patients of differing demographics and stroke severity (for further information see Purpose). However, it is important to deliver an efficacious and beneficial clinic that meets the needs and requirements of individuals living with the debilitating effects of stroke. My application for a WCMT Fellowship was undertaken to allow me to visit a number of different European sites to see what practices are undertaken with regards to secondary-prevention, community-based care for people recovering from a stroke.

Aims:

The aim of this WCMT Fellowship is to explore how secondary-prevention care programmes for stroke patients, and any ensuing research studies, are undertaken in a

variety of healthcare settings (Hospital, University etc.) in selected European Countries (Denmark, Ireland, Netherlands, Sweden). The long-term aim to the project is to develop a community-based, secondary-prevention, Health Enhancing Lifestyle Programme (HELP; exercise and education) for stroke patients in Hampshire (HELP Hampshire Stroke Clinic).

Objectives:

[OB1] Explore how different secondary prevention programmes, if any, are conducted with stroke patients in Europe.

[OB2] Identify how learning and teaching could be embedded into secondary-prevention programmes for patients with stroke.

[OB3] Identify opportunities to undertake research within secondary-prevention programmes for patients with stroke.

Purpose:

The long-term purpose of this body of work is to develop a secondary-prevention, community-based, exercise and education programme for patients with stroke in Hampshire, UK (HELP Hampshire Stroke Clinic). The purpose of this proposed clinic is to:

1. Demonstrate **patient benefit**, both physically and psycho-socially, by improving the health and well-being and quality of life of stroke patients who attend.
2. Provide **Learning and Teaching opportunities** to Undergraduate and Postgraduate students who are interested in providing clinical exercise and educational support to stroke patients
3. Provide an environment that will foster the possibility of undertaking novel **research** studies that will continue to examine the efficacy and benefit of physical activity, exercise and education in improving health outcomes in patients with stroke.
4. Demonstrate a **health-economic benefit** to the local NHS Foundation Trust by reducing hospital admissions, number of strokes and surgeries.

The WCMT Fellowship Approach

The WCMT Fellowship provided me with the financial support to allow me to travel to four European countries whereby Stroke research/programmes are delivered (Denmark, Ireland, Netherlands, Sweden). As my proposed HELP Hampshire Stroke Clinic focuses on the importance of lifestyle modification (exercise, nutrition, education etc.), I firstly wanted to identify pertinent academics/researchers in Tertiary Education across Europe who focus on this area of interest. As an academic myself, I thought this would be a sensible strategy to use to help me identify suitable places and individuals to visit. To assist me with this process I firstly contacted Dr Margaret Lawrence (Glasgow Caledonian University), Chair to the International Network for Secondary Stroke Prevention Researchers (INSsPIRE). After joining the INSsPIRE network I was able to make preliminary communication with the following academics/consultants who were also members of the INSsPIRE organization. This was initially through email and then later via online meetings via interactive technology (zoom/skype):

- *A/Prof Eric Asaba, Head of Division of Occupational Therapy, Karolinska Institute, Stockholm, Sweden.*
- *Dr Olive Lennon, Lecturer, School of Public Health, Physiotherapy and Sports Science, University College Dublin, Ireland.*
- *Dr Christina Krusse, Stroke Consultant, Herlev Hospital, Copenhagen, Denmark.*

As these individuals are leading the way in their respective fields of work (occupational therapy, physiotherapy, research-focused stroke consultant, respectively) with regards to the benefit of incorporating lifestyle and behaviour change strategies for individuals post-stroke, I thought this would be a good place to start when examining community-based stroke services. I used my INSsPIRE networks to help facilitate a detailed itinerary in Denmark, Sweden and Ireland, whereby I had the opportunity to be based and work at established and world-renowned institutions such as the Karolinska Institutet, Linköping University and University College Dublin, who all have a strong reputation in delivering health and well-being programmes. My WCMT Fellowship did however incorporate four independent, European visits. These included:

Copenhagen, Denmark; 10-14th July 2017 ,

Amsterdam & Rotterdam, Holland; 24-28th July

Dublin, Ireland; 30th October - 8th November 2017

Stockholm, Norrköping, Linköping, Sweden; 17th February - 2nd March 2018

**For the full itinerary please see Appendix 2*

Once I had identified the core locations I wanted to visit, I searched for various practitioners and academics via Researchgate and PubMed. This led me to contact and meet Dr Hendrika van den Berg-Emons, Senior Researcher in the Department of Rehabilitation Medicine at Erasmus MC, Rotterdam during my Fellowship. A search of recent journal publications through PubMed in the area of stroke rehabilitation also led me to contact Klas Sandberg, Departments of Internal Medicine and Medical and Health Sciences, Linköping University, Sweden.

When arranging my visits, I decided to stay in a location for at least 5 working days to allow me to meet and discuss the aim, objectives and purpose of the WCMT Fellowship with my primary point of contact, but also with various colleagues and associates at the sites visited. To garner interest in my Fellowship, I provided a keynote presentation entitled:

‘Putting academic research into real-world practice: The utility of physical activity as a secondary prevention strategy for patients with stroke and TIA’

(see Appendix 3)

The presentation was delivered at the following locations:

- Herlev Hospital, Copenhagen Denmark
- University College Dublin (UCD), Dublin, Ireland
- Mater Misericordiae University Hospital, Dublin, Ireland
- Vrinnevi Hospital, Norrköping, Sweden
- Linköping University, Linköping Sweden

Small intimate presentations (n = 4 to 10) were presented at UCD to their Physiotherapy Department and at Linköping University, whereby videoconference facilities were used to foster research discussion with Sabina Borg and Maria Back who were based at Gothenburg University. All other presentations were undertaken in front of approximately 30 to 50 people, including consultants, physiotherapists, nurses, exercise practitioners, academics and students. These presentations fostered positive discussions and raised some important issues that I need to consider as I look to develop my HELP Hampshire Stroke Clinic (i.e., what is the optimal exercise intensity to prescribe for patients with stroke? when should we commence exercise programmes for individuals with stroke?). Beyond these presentations, tours of facilities, one-to-one discussions with key personnel, small meetings etc. were

established to give me a better understanding of what secondary programmes are available in Europe (Obj1), and how learning and teaching (Obj2) and research (Obj3) is embedded within the various institutions (Hospitals, Universities etc.) visited.

Project Findings

Delivery of Community-based, secondary prevention stroke care [Obj1]:

Overview

A primary objective to the WCMT Fellowship was to identify the practices that are implemented, if any, in various European countries with regards to community-based, exercise-focused care for stroke patients. The novelty of the proposed HELP Hampshire Stroke Clinic for patients from across the spectrum of stroke (major stroke to minor stroke/TIA) was evident during my Fellowship travels. Similar to the UK, there was a lack of structured exercise and education programmes for stroke patients in the various European sites visited. Of the sites visited, it was only really Sweden, and in particular the opportunities provided in Norrköping (Figure 1), whereby the community care for this population group went beyond that typically provided by the Allied Health Professions of Physiotherapy and Occupational Therapy in the weeks/months following a stroke.



Figure 1: The old industrial town of Norrköping, Sweden

Vrinnevi Hospital Norrköping is a well-respected emergency hospital with broad operations, modern diagnostics and high-quality care and treatment. Since it's opening in 1988, the hospital has been described as "the hospital with the human face", providing

patients with safe and effective care, but also enabling patient-oriented research and education. Vrinnevi Hospital has a well established and close collaboration with the Faculty of Medicine at Linköping University and many employees are actively involved in research and education of the future healthcare staff. Currently, the hospital is preparing to train more medical students in the coming years and a handful of academic combination services will strengthen clinical research in Norrköping.

The hospital has rehabilitation opportunities for both acute and outpatient activities for a range of clinical diagnoses. At Vrinnevi Hospital in Norrköping, once patients have been discharged from the acute stroke ward they are eligible to engage in community-based exercise opportunities through their outpatient rehabilitation clinic. These opportunities were actually based on the hospital site itself within an outpatient facility. Dedicated rehabilitation spaces (gym), dance studios and a swimming pool (hydrotherapy) are made available for stroke patients recovering from their event. Although these facilities are also available for other clinical conditions such as cardiac patients and individuals with neurological disorders, it was encouraging to see that such opportunities were available for stroke patients who have been discharged from hospital and live back in the community.

Delivery of exercise sessions

Gym-based exercise

Scheduled, practitioner-led classes were available in each of these exercise sites at Vrinnevi hospital. Gym-based exercise tended to be group-focused to encourage the development of social support. During my visits to the Hospital, attendance seemed to vary from as little as four people for a designated session, to up-to ten people. In these sessions, a Senior Physiotherapist would lead and co-ordinate the session, although they would have assistance from approximately 2 to 3 staff members or students from Linköping University's Division of Physiotherapy to ensure the safe undertaking of the different aerobic and resistance movements. Various aerobic equipment was available including a treadmill, a number of monark cycle ergometers and cross trainers. Multi-station gym equipment was used allowing patients to engage in a variety of simple upper and lower body exercises, including lateral pulldown, upright row, leg curl and leg extension, among others. Balance, co-ordination and postural control exercises were also employed during upright and seated exercises. Buso and core-stability balls were used to challenge patients balance, body awareness and range of motion, and as such also activate stabiliser muscles, by eliciting an unstable surface to undertake the exercises on. The practitioners delivering and monitoring the sessions appeared very knowledgeable with regards to clinical exercise physiology and clinical exercise prescription, providing a range of beneficial yet individualised exercises for

the stroke patients that attended. Practitioners also appeared very friendly and engaged with the patients who attended the gym sessions. I imagine that such a supportive environment encourages patients to attend and adhere to such programmes. As my own research has shown that regular exercise participation may improve the cardiovascular disease risk profile of stroke patients (blood pressure, blood lipid profile) and their psychosocial health, the adherence of patients to exercise programmes post-stroke is very important [13-16].

Dance

The use of a dance studio as a part of the exercise opportunities available in a rehabilitation setting was of great interest. Recent research has started to investigate and demonstrate the feasibility and practicality of using different forms of dance for patients with stroke [17,18]. Previous research has shown good overall satisfaction of subacute stroke patients when engaging in a dance class. Although I was unable to see a dance class in action during my Fellowship travels I was able to see the space utilised for the dance sessions, and was able to discuss the dance/aerobic-type classes delivered at Vrinnevi hospital with Marie Kleist, a physiotherapist in the Department of Rehabilitation who delivers such sessions. Marie also showed me some video footage of the dance classes delivered. These sessions were group focused with a lead physiotherapist co-ordinating the session. The video footage that I viewed appeared to demonstrate zumba type exercises. Zumba is a combination of dance and aerobic movements performed to energetic music with the inclusion of lower-limb squat and lunge type exercises. Although the rhythm of the music was less intense than what you would typically consider if engaging in zumba exercise in a UK leisure centre, a variety of different movements and exercises were implemented. The dedicated space and availability of equipment was very good. Sessions that I viewed in the video footage seemed to be fun and motivating. I was informed that attendance and patient satisfaction with the programme has been encouraging. Although subjective in nature, Marie informed me that post-stroke participants perceived both walking and balance benefits following participation in the dance classes. Accordingly, I would seriously consider the inclusion of dance in the proposed HELP Hampshire Stroke Clinic based on my observations and discussions at Vrinnevi hospital. There could be significant potential for dance sessions to address physical, cognitive and psychological impairments. Going forward, I would consider that both zumba and ballroom dancing classes could be incorporated into the clinic. In my opinion ballroom dancing could be of interest as it may be of interest to older stroke patients wishing to engage in some physical activity opportunities, but it may also encourage partners/carers to take part in the classes delivered. The delivery of dance sessions in the

HELP Hampshire Stroke Clinic could be undertaken at the University of Winchester due to the facilities available (i.e., fitness and dance studio), or in local community halls.

Hydrotherapy

Vrinnevi Hospital also offer hydrotherapy exercises for neuro-rehabilitation. Hydrotherapy sessions may improve mobility as patients are able to perform activities and movement patterns which they may be unable to undertake on dry land. The support of the water and the reduced fear of falling can aid mobility practice. Exercises against the resistance of water and dynamic exercises within the water can also improve muscle strength, balance and co-ordination. A recent study has shown that the combination of water- and land-based exercises has the potential for improving balance in chronic and less-impaired stroke groups [19]. A huge strength to the programme delivered in Vrinnevi hospital Norrköping is that their exercise sessions cater for lots of different people regardless of age, gender or ethnicity. Discussion with the therapy team demonstrated that hydrotherapy sessions are primarily delivered one-to-one for stroke patients, although patients can engage in group-based classes if they have made sufficient recovery to engage in water-based exercises without needing a physiotherapist to work with them independently. Again, patients appear to enjoy the sessions, although the logistics of running a session, both in terms of a patient preparing (changing) for a session, and for some patients, actually entering the water through an automated harness, can take a long time, and as such, may not be the most cost-effective rehabilitation exercise. However, the varied nature of the rehabilitation programme delivered in Vrinnevi hospital is encouraging. Although I like the idea of incorporating a water-based exercise session in a hydrotherapy pool as a part of the HELP Hampshire Stroke Clinic, and thus providing a distinct and varied exercise opportunity, the likelihood of this occurring will be difficult. Firstly, Winchester Leisure Centre does not have a facility to cater for such exercise classes, while the local NHS Foundation Trust, although having a hydrotherapy pool, heavily use it for post-natal swimming classes.

Patient referral

Vrinnevi Hospital has an 18 bed acute stroke ward and see's over 300 major ischaemic, inpatient stroke patients each year. Although I was never made aware of the actual number of stroke patients who use the facilities, I was under the impression that their rehabilitation centre was more focused on major ischaemic stroke patients. However, there is significant potential to engage minor stroke and TIA patients in such programmes, particularly when such population groups are at heightened risk of experiencing a major ischaemic stroke, other cardiovascular complications (e.g., heart attack) or early mortality in the months and

years that follow [15,18]. For example, it has been reported that 12 % of all diagnosed TIA patients die within 12 months of their diagnosis. As such, improved services are needed for patients with minor stroke and TIA. Their referral to exercise and education programmes available in Norrköping, or indeed the proposed HELP Hampshire Stroke Clinic which is planned to be delivered in the UK, could have significant benefit to the patient, economic costs (e.g., reduced hospital admissions) and overall delivery of the healthcare system.

Environment and location

An additional strength to the programme at Vrinnevi hospital in Norrköping is that the programme is delivered in an environment which makes it possible for people to attend. Firstly, the location of the hospital is very good. Vrinnevi Hospital is fairly central in terms of the city Norrköping, but is very accessible due to being near the major roads that enter the city. This makes the hospital easily reachable in terms of car travel, but also through the use of public transport (buses, trams), which appears very good. Furthermore, there were plenty of parking spaces for those who travel by car. This set-up most certainly helps with regards to potential participant adherence as it is easy for patients to get to and from the hospital site. This could be an important point to consider for the proposed HELP Hampshire Stroke Clinic. The University of Winchester is centrally located in the City of Winchester. However, it is situated below the City's hospital (Royal Hampshire County Hospital), is not on a major road that enters the city and is surrounded by a residential area. As such, the logistics of participants getting to an exercise session delivered at the University may be challenging. This is for two reasons. Firstly, the nearest park and ride stop is approximately 0.5 miles from where exercise sessions would be delivered, thus making it a time-consuming and fatiguing exercise to get to the clinic. Secondly, as the University has limited parking, and which is heavily used by the staff and students between September and May each year, parking availability for those who travel by car will be restricted, excluding the summer months. As such, it is important that we consider the use of community centres and village halls in the suburbs of the city as this may allow more patients to attend, and importantly, adhere to the programme.

Despite the positives of the Vrinnevi hospital rehabilitation programme, I was made aware that partners of the stroke patients attending the exercise classes were not able to attend sessions. This could be an important facet to consider for the proposed HELP Hampshire Stroke Clinic as such support could be important with regards to attendance and adherence. If carers/husbands/wives are able to attend and take part, the benefits that they gain, both physically and psycho-socially, may also help elicit further attendance for

their partner who lives with the effect of stroke as they may truly appreciate the value of such a programme.

Herlev Hospital health checks

In Herlev Hospital, Copenhagen, stroke patients are provided a general health check-up approximately 3 months after discharge from the acute stroke ward. The check-up with an appropriate Health professional includes basic cardiovascular risk factor assessment (blood pressure, body mass index etc.) and a discussion surrounding the importance of exercise, good nutrition, smoking cessation and reducing alcohol intake. This process is actually very similar to the follow-up service adopted in the National Health Service (NHS). However, the consultants and physiotherapists at Herlev Hospital do encourage patients to engage with physical activity/exercise after discharge by offering them opportunities to participate in research studies that focus on the benefit of physical movement (Obj3). Regular check-ups post-stroke are important. In the proposed HELP Hampshire Stroke Clinic I would consider undertaking health and fitness assessments every 3-to-6 months to ensure that the patients are constantly and consistently monitored. This would allow us to engage with GPs and consultants as and when needed, and would allow us to ensure that the most efficacious, and individualised, programme is delivered to the patient.

Linking findings to HELP Hampshire Stroke Clinic

The opportunities that were available in Vrinnevi hospital in Norrköping have encouraged me to consider the variety of exercise classes/activities that I provide for stroke patients in the proposed HELP Hampshire Stroke Clinic. I would postulate that such activities would help to improve fitness, co-ordination, communication, social support, among others. It may also provide an opportunity for carers to the stroke patients to engage in physical activity opportunities. The proposed inclusion of such activities (dance, hydrotherapy) has also encouraged me to consider how other activities, beyond your traditional gym-based or circuit-based exercise classes, could be incorporated in to the HELP Hampshire Stroke Clinic. As such, there could be the possibility to create exercise/activity sessions that consider gardening, walking, motor-skill development (i.e., walking football/netball) for those individuals who are able to engage in such activities. In some instances this may only be available for minor stroke/TIA patients, however, it would provide a varied exercise environment for patients to engage in.

Learning and Teaching [Obj2]

It is important to provide opportunities for people to enhance their understanding and allow them to become more aware of the importance of physical activity/exercise as a secondary prevention strategy, for stroke patients. In Vrinnevi hospital Norrköping, physiotherapy students would have rotational placements in the community-based programme that is delivered. Accordingly, such courses allow students to work with a range of different populations in the inpatient, outpatient and community environment. Not only does this provide the student with a more holistic, real-world and immersive learning experience, it provides students with far greater awareness of the type of career opportunities which could be available to them following graduation. Unfortunately, as Vrinnevi hospital in Norrköping was the only real location which delivered a community-based programme for stroke patients, my insight into the delivery of educational initiatives is somewhat limited. However, the inclusion of taught programmes into the proposed HELP Hampshire Stoke Clinic, at both undergraduate and postgraduate level, is something that is fundamentally important to me, particularly due to my own career being embedded in education. Furthermore, voluntary and 'Continued Professional Development' (CPD) opportunities could also be available to members of the community and local health care personnel who may wish to enhance their experiences with working with this population group in a community environment. Hampshire Hospitals NHS Foundation Trust have expressed an interest with providing such CPD opportunities to members of staff. This could be through staff-development workshops, or even via enrolment on an Masters of Research in Clinical Exercise Science. To my knowledge, such opportunities were not available at Vrinnevi Hospital.

The 2018/19 academic year will see the University of Winchester commence their inaugural undergraduate physiotherapy programme. Preliminary conversations with the Programme Leader (Dr Steve Ryall) and Placement Manager (Sophie Gay) has led to favourable discussions surrounding the use of the HELP Hampshire Stroke Clinic as a location for practical placement hours for physiotherapy students, similar to that adopted at Vrinnevi hospital in Norrköping. As clinical exercise physiology is a core component of a physiotherapy students curriculum, the opportunity for such students to engage in a community-based clinic with patients of varying stroke diagnosis and with varying physical and psycho-social challenges, would be a fantastic learning experience. Furthermore, as I myself am a Sport and Exercise Scientist with an interest with working with clinical populations, both undergraduate and postgraduate Sport and Exercise programmes at the University have modules which would allow students to gain valuable experience working with this population group. This could be in a second year 'Physiological Assessment' module, a third

year 'Clinical Exercise Science' module or a postgraduate module in 'Advanced Laboratory Techniques'. In addition to this, for the 2018/19 academic calendar there will also be a dedicated 'Practicum placement' module which would also facilitate a distinct learning environment for our students. Regardless of how opportunities are presented to the student population, all individuals assisting the delivery of exercise sessions will need to have a relevant and up-to-date First Aid qualification due to the nature of working with a high-risk population group.

Research [Obj3]

To date, this objective has perhaps been the most successful of all objectives originally identified in my WCMT Fellowship. Research and Knowledge Exchange has been identified as an important and fundamental component to the proposed HELP Hampshire Stroke Clinic. For us to deliver the best service possible to our stroke patient cliental, a strong research underpinning is needed. For us to determine the efficacy of exercise for different stroke population groups (major ischaemic stroke, minor stroke, TIA), ages, ethnicities etc., we need to undertake robust, well-designed and collaborative research studies. My vision is that innovative research studies, ideally driven by MSc and PhD students and post-doctoral appointments, will be undertaken within the Clinic to determine the value of different physical activity and/or exercise interventions and/or educational programmes have on health outcomes in patients living with stroke. These studies could consider the value of exercise and education on cardiovascular risk factors (blood pressure, arterial stiffness, blood lipid profile), biomechanical measures (gait, balance, posture), psychological indices (anxiety, depression, self-confidence) and quality of life. Research links and discussions were undertaken with a number of the individuals visited during the Fellowship. When considering that the sites visited as a part of WCMT Fellowship was originally due to academic links via the INSsPIRE network of researchers, it is unsurprising that this Fellowship objective has made progress, at least in the short-term. As such, research collaboration due to the WCMT Fellowship has already led to the design and collection of new data sets, conference grant bids and external research funding applications.

New research studies:

Dr Olive Lennon, University College Dublin, Ireland.

Title: The acute effect of using a bionic leg on physiological cost index and biomechanical measures in chronic stroke patients

The visit to UCD (Figure 2) led to the discussion of a proposed research study with Dr Lennon regarding the short-term effect of using a wearable Bionic Leg on Physiological Cost Index (i.e., heart rate responses) and biomechanical measures (i.e., walking gait, balance) in chronic stroke patients.



Figure 2: Entrance to UCD Campus

In recent years, robotic devices are commonly used in both upper- and lower-limb stroke rehabilitation. As most patients use robotic technology in a physiotherapy environment, we believe it is important to determine whether there are any short-term benefits to wearing robotic technology. This study was based on our joint interest in the value of implementing robotic therapy on physical and movement outcomes in patients with stroke [20]. Since my return to the UK from my trip to Dublin, Dr Lennon and I have been in communication (via skype and email) with regards to the proposed design and implementation of a study that will investigate *‘The acute effect of using a bionic leg on physiological cost index and biomechanical measures in chronic stroke patients’*. Due to my current research links with a robotic technology company called AlterG, which enables me to have access to externally-wearable, lower-limb robotic devices such as the Bionic Leg, it was decided that the study would be undertaken at the University of Winchester. The study intends to recruit approximately 15 patients with lower-limb impairment due to stroke. To assist with data collection I recruited two MSc Sport and Exercise Science students to assist in the implementation, collection and analysis of the study. This study commenced in April 2018 and is ongoing. To date, seven participants have been recruited from local

physiotherapy practices and stroke support groups. The study will determine whether there are any short-term benefits to using a lower-limb Bionic leg on the ability of a stroke patient to undertake important everyday movement activities such as sit-to-stand exercises, walking, step-ups and balance exercises. Results will be published in an appropriate academic journal in 2019 and research findings will also be disseminated via social media to stroke patients, the wider community and physiotherapists. Although the study does focus on the use of robotic technology, it will serve as another example as to how exercise can be used to improve walking and balance efficiency in this population group. There could be important practical implications from the study for physiotherapists as it may help determine whether such robotic technology is implemented as an adjunct to physical therapy for stroke patients requiring continued physiotherapy support, or whether it has no real short-term benefit. If beneficial, lower-limb robotic technology could be used with patients in the HELP Hampshire Stroke Clinic during the delivery of various exercise/physical activity classes (gym classes, circuit training, dance classes). Based on the findings of this study, the long-term implications of regular using lower-limb robotic technology in physiotherapy and/or physical activity sessions, on physiological and biomechanical outcomes, could be assessed in the future.

Klas Sandberg, Linköping University and Vrinnevi Hospital (Norrköping)

My visit to Vrinnevi hospital in Norrköping generated some of the most stimulating research conversations surrounding the use of exercise as a pertinent treatment strategy for patients with stroke. My visit centred around meeting Klas Sandberg a physiotherapist at Vrinnevi hospital who is undertaking a PhD with Linköping University. During my visit to the hospital, researchers and consultants presented recent research from their body of work. Research studies concerning the effect of regular aerobic exercise in early subacute stroke was discussed as well as the exaggerated blood pressure responses that may be observed during exercise in patients with stroke [21,22]. This led to detailed conversations surrounding how research that has an exercise focus can be embedded in to the acute pathway for stroke patients. Research studies surrounding the monitoring and assessment of patients via subjective perceptions of exertion was discussed, as well as the value of high-intensity intermittent exercise compared to continuous exercise training. We discussed the potential of undertaking research studies that examine the value of supine and/or seated exercise on cardiovascular health in patients with stroke whilst staying on an inpatient ward post-stroke. Furthermore, and perhaps most importantly, we discussed the need to undertake research studies with stroke and TIA patients which can elucidate the

true value of aerobic exercise programmes, and how they compare to resistance training programmes, combination therapy (aerobic and resistance together) and/or the inclusion of education. This would be a mutual area of interest due to the work that Klas and I have independently undertaken in recent years. Such studies could be undertaken and embedded into the proposed HELP Hampshire Stroke Clinic. There is significant potential to engage in research collaboration with Klas Sandberg and colleagues. As similar secondary prevention programmes will hopefully be delivered in Norrköping and in Winchester, there will be opportunities to collect larger data sets when investigating a specific research questions, such as those highlighted above. This will be important when continuing to assess the efficacy of exercise as a secondary prevention treatment strategy for patients with stroke, and when trying to further our knowledge and understanding regarding it's application. However, further progress with regards to this collaboration will be dependent on the creation of the HELP Hampshire Stroke Clinic in the coming years.

Challenges and frustrations associated with research visits:

The primary purpose of my visit to the Netherlands was to visit the Amsterdam Movement Sciences Institute. In preparation for my visit I contacted a number of eminent researchers in the Institute including Professors/Drs Janssen, Roerdink, Beek, Van Wegen, Kwakkel, Houdijk and Gerrits. Unfortunately, only Dr Roerdink and Houdijk were able to meet during my planned visit, however, within 7 days of my actual travel, both individuals informed me that they were unable to meet due to other work/annual leave commitments. I tried to visit the site through PhD students of the aforementioned academics, but again this did not appear feasible due to their commitments during this trip. Although disappointing I intend to discuss research with both individuals later in the year due to their interest in the use of physical training with stroke patients to enhance health, mobility and functional performance. Dr Roerdink in particular is very keen to discuss my proposed secondary prevention, community-based stroke clinic. There may be some potential for research collaboration between the two of us in the future.

Despite the above disappointment I was able to visit A.Prof Rita Van Den Berg-Emons at Erasmus MC in Rotterdam. Prof. Berg-Emons works at a University Hospital and focuses on the utility of physical activity in improve health outcomes in patients with chronic conditions, including stroke. Her department has similar interests to myself with regards to creating a community-based programme for patient groups. Although my body of work appears further forward than their proposed ideas, I was very interested to discuss her research interests and primary outcome measures (i.e., accelerometry) as my community-clinic will be created to enable high-quality research to be undertaken. Although

accelerometry is a part of my research it was very valuable to discuss some of the specific ways her research team use accelerometry data to interpret physical activity/sedentary time. I was also introduced to Hans Bussman, another member of the Erasmus MC research team, and we plan to discuss stroke research further at a later date in the year. During my time in Holland I was also in communication with Prof. Anna Visser-Meily from UMC Utrecht. She has been leading a clinical trial into the effect of increasing exercise intensity and physical activity in stroke patients. It was too short notice to arrange a face-to-face meeting with Anna but I hope to speak to her research team later in the year.

In sum, my visit to the Netherlands was not as productive as anticipated. One of my biggest challenges in arranging my WCMT Fellowship has been to visit pertinent sites at times that are convenient for my proposed colleagues, but also for myself. Due to my lecturing commitments at the University of Winchester between September and May each year, I only have two windows within term time to visit sites as a part of the travel Fellowship (November and March). Accordingly, I have had to visit other sites, such as the Netherlands and Denmark, during the academic summer break, which in turn has meant it has been challenging to see everyone I have wanted to.

External funding applications:

My visit to Herlev Hospital led me to discuss the proposed HELP Hampshire Stroke Clinic with consultants, nurses, physiotherapists and PhD students. These conversations fostered an environment that allowed us to also discuss dual site research collaboration. As such, two prospective projects associated with acute bouts of physical activity on health outcomes in stroke patients were discussed with Dr Christina Kruse. These have been submitted to Denmark's TrygFoundation.

Title 1: Cognitive Function and Cerebrovascular Reactivity in Small Vessel Disease Stroke: Effect of Physical Training

This study will investigate changes in cerebral perfusion, cerebrovascular reactivity and blood brain barrier function in patients with cerebral small vessel disease (SVD) during early mobilisation including physical training after ischemic stroke. The observed findings will be related to the level of fatigue and cognitive decline and compared to aged-matched control subjects.

Title 2: PITFAL - Effect of Post-stroke Information and Training on Future Activity Level.

The purpose of this study is to increase adherence to exercise and to improve health behaviour in stroke patients after discharge from the stroke unit. The primary aim is to increase the amount of habitual daily activity to at least 60 minutes per week. It is hypothesised that those patients who are able to increase their habitual level of physical activity will demonstrate improvements in physiological parameters (i.e., blood pressure) as well as improvement of known psychological impairments (anxiety, depression) post-stroke compared to a usual-care control group.

The funding applications are requesting financial support to cover consumable expenses and the costs associated with supporting a PhD student (Mia Kolmos) at Herlev Hospital. These grant applications are currently under-review. Although these studies would not necessarily require HELP Hampshire Stroke Clinic to be set-up to allow them to be conducted, if the clinic was established, participants recruited to the study would be embedded in the clinic.

Conference funding application:

During my visit to Stockholm I spent three days discussing the HELP Hampshire Stroke Clinic and lifestyle and behaviour change for stroke patients with a number of academics from the Karolinska Institutet (Figure 3). My primary contact at Karolinska, like many of the places I visited, was a member of the INSsPIRE network, Associate Professor Eric Asaba. Although Eric's primary focus of interest is with regards to Occupational Therapy, he too is interested in examining the benefit of lifestyle modification strategies for patients with stroke. One project that we worked on during my time was the development of an initial conference grant application around stroke prevention, due to take place in Stockholm in late 2018. The purpose of the conference would be to strengthen an international network of scholars, clinicians, and consumers focusing on preventing stroke and secondary stroke and cardiovascular events. The conference would allow for a broad set of presentations and an expert panel to be brought in to further discuss the role and importance of implementing effective non-pharmacological secondary stroke prevention strategies. It is anticipated that 100 delegates would attend. This application is currently under review.



Figure 3: Karolinska Institutet

Equipment capabilities:

My visit to Herlev Hospital in Copenhagen allowed me to see Dr Kruuse's research laboratory which was actually based in the acute stroke ward of the Hospital. I was able to observe and discuss the equipment capabilities of their laboratory. Two pieces of equipment in particular, that of Transcranial Doppler and the Endopat (a measure of endothelial health), could be useful pieces of equipment for my laboratory back in Winchester, UK, due to my interest in measures of vascular health (Figure 4). The Endopat is a non-invasive measure of endothelial health and could easily be embedded in my research studies that look into the benefit of exercise for stroke patients. As a number of my research investigations are interventional in nature, typically including a 10- or 12-week exercise programme of some description, the Endopat would complement my usual measures of assessing vascular health (arterial stiffness, blood pressure) and provide a more comprehensive and detailed understanding of how exercise has affected the health of the stroke patients assessed. Like most pieces of equipment in a Physiology laboratory, the Endopat is expensive and would require financial support from the University or would need to be embedded into a successful grant application.

During my visit to Herlev Hospital I was also able to shadow Rikke Steen Krawczyk, a PhD student of Dr Kruuse, during one of her experimental sessions with a stroke patient (Figure 5). It was good to see and discuss the study design, methods and data collection techniques with Rikke. She implemented an incremental exercise test which is fairly novel

in its approach with stroke patients. Most exercise tests on a cycle ergometer are graded in nature, starting at a low intensity and increasing every few minutes at fixed workrates. Test termination is usually when set physiological criteria (i.e., heart rate) has been achieved. However, the work undertaken by Rikke terminates the exercise test when a patient is unable to read a short-paragraph without breathlessness. This is an interesting design for an exercise test with stroke patients, and one that appeared to be successfully implemented. I would consider using this test in the future, pending the validity and reliability of the study protocol.

The prospect of developing a research laboratory in an acute stroke setting in the UK is one which would be challenging due to space and funding issues between a University and our local NHS Foundation Trust. Although such relationships are evident in other cities, as the University of Winchester and Hampshire Hospitals NHS Foundation Trust are only now just starting to develop a health research agenda, such opportunities may not be available for a number of years. However, it would ultimately enable the delivery of high-impact and informative research studies, whereby various exercise and/or education studies could be undertaken. This proposed collaboration would actually fall-outside of the proposed HELP Hampshire Stroke Clinic due to being based in the acute setting rather than in a community environment, but it would help to contribute to the delivery of a better rehabilitative care pathway for stroke patients admitted to the hospital.

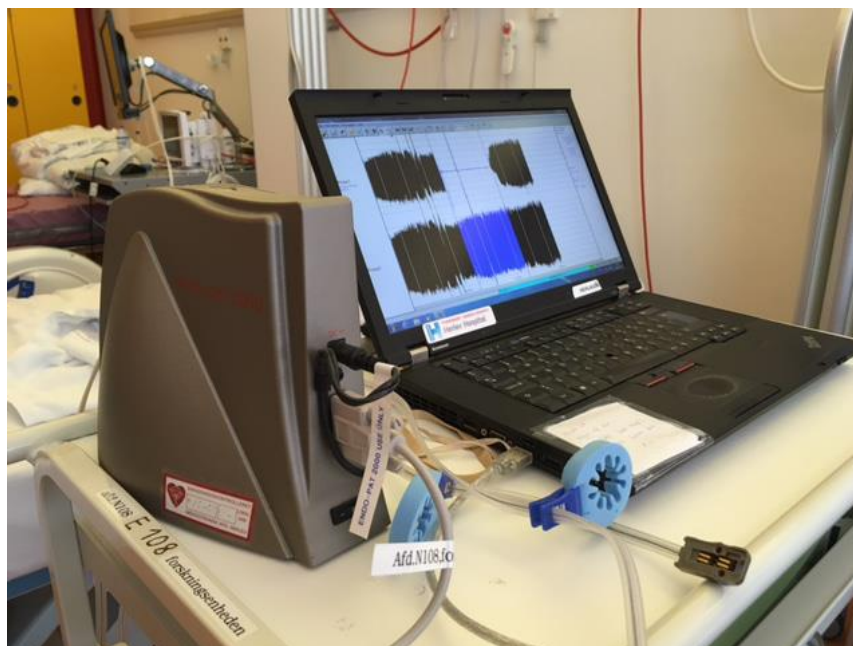


Figure 4: Endopat as used in the Herlev Laboratory on the Acute Stroke Ward



Figure 5: Dr Christina Kruuse (middle), Rikke Steen Krawcyk (right) and I in Copenhagen.

Conclusions

My WCMT Travel Fellowship allowed me to travel to various European sites, whereby expertise in stroke rehabilitation was present. Although my Fellowship met many aspects of the aims and objectives originally identified, not all of them were as successful as intended. Despite identifying pertinent locations through visiting members of the INSsPIRE network, of the four countries visited, it was only really the visit to Norrköping in Sweden, and that of Vrinnevi hospital, whereby I was able to assess the success of a community-based exercise programme being delivered for stroke patients. Although this met Objective 1 to my Fellowship application and most certainly opened my eyes to the logistics of running such a programme, it was disappointing not to see similar approaches used in other countries visited. At Vrinnevi hospital, Linköping University embed a taught degree programmes (i.e., physiotherapy) in the community practices delivered (Obj 2). This is important as we look to foster and develop people's interest in working with stroke patients in a community setting. This is vital as we seek to improve the health, well-being and quality of life of this population group. It was good to see that the hospital provided exercise sessions in a gym-based environment, dance studio and hydrotherapy pool, in both individual and group-based exercise sessions. This increases the opportunities for exercise engagement across individuals of differing ages, gender, ethnicity and stroke severity. It was also encouraging to see the enthusiasm and passion of the practising physiotherapists. The location, facilities and space provided, including the accessibility of Vrinnevi hospital, is also a huge strength

to the programme. Due to the lack of community-based programmes delivered in the other sites visited, the uniqueness and novelty of the proposed HELP Hampshire Stroke Clinic, which fundamentally underpins the entire WCMT travel Fellowship, is augmented. The delivery of the programme in Norrköping will underpin the creation and development of the HELP Hampshire Stroke Clinic, particularly with regards to the consideration of the location, equipment, exercise sessions delivered and spaces available, and the incorporation of taught undergraduate and postgraduate degree programmes from the University of Winchester.

Beyond the work undertaken at Vrinnevi Hospital, Objective 3, and that of the consideration of research collaboration within the area of secondary stroke-prevention, is for me the next most important experience garnered from the Fellowship. Positive discussions were held at all sites visited with regards to developing and undertaking research. It was the opportunities to meet and discuss research with Dr Olive Lennon (University College Dublin, Ireland) on the use of lower-limb robotic-assisted technology for stroke, and Dr Klas Sandberg (Norrköping University) on the application of exercise interventions soon after stroke diagnosis, whereby research links have been created due to WCMT Fellowship. There will be significant opportunity to collaborate with such individuals and research institutions in the future, and to undertake research within the proposed HELP Hampshire Stroke Clinic.

Recommendations

Secondary prevention stroke clinics need to be created:

My WCMT Fellowship has encouraged me to continue my quest to develop a community-based secondary-prevention clinic for patients with stroke. It is evident from the four countries that I have visited, like the UK, there are a dearth of opportunities for stroke patients to engage in exercise and educational activities post-stroke to help their health and well-being. It was only Vrinnevi Hospital in Norrköping which incorporated some form of secondary prevention programme. There is huge potential to create a programme which has major benefit for a large number of patients, who have various diagnoses of stroke. It is important to note that since the awarding of the WCMT Fellowship, the UK Stroke Association have started to pilot a 'Moving Forward' exercise rehabilitation programme for patients with stroke. The pilot is due to finish in July 2019, and if successful, may lead to various programmes being developed in the UK, to which the HELP Hampshire Stroke Clinic could be strongly aligned with the objectives of the Stroke Association.

Learning and Teaching and Research should be embedded in the clinic:

I would also state that based on the various practices observed, both in terms of Learning and Teaching (Vrinnevi hospital Norrköping) and research (all sites visited), there would be significant potential to embed educational opportunities in to the proposed HELP Hampshire Stroke Clinic. This could be in the form of undergraduate or postgraduate taught modules, or the delivery of specific, well-designed and innovative research studies. For this to be possible, the University of Winchester's Department of Sport, Exercise and Health and Senior Management Team would need to support the delivery and staffing of such educational initiatives. However, due to a lack of specific modules and research programmes into lifestyle and behaviour change for Stroke survivors across the UK's tertiary education sector, this could be a unique selling point for the University with regards to future student recruitment. An increase in student numbers to the Department's undergraduate and postgraduate programmes, and the actual enrolment on 'stroke specific' modules would help to demonstrate the success of the programme, as well as changes in career employability pathways following the graduation of our students.

Future for developing a clinic:

Based on the above, and since the completion of the WCMT Fellowship I have started to make progress with creating the HELP Hampshire Stroke Clinic. Firstly, the University of Winchester are willing to support the clinic and have provided some seed money to allow a Project Manager to make significant progress in the creation of the clinic. A Clinic logo (Figure 6) and website (Figure 7) has been created. A Facebook and Twitter page has also been developed, however, this has not yet gone 'live'. We intend to approach external stakeholders, such as local businesses and industry, and University alumni, in the coming months to help provide the financial support to create and deliver the programme. Such funding would support Project Manager costs, consumable and equipment expenses and practitioner costs for running the HELP Hampshire Stroke Clinic. Funding will be sought from June 2018. We have support from Hampshire Hospitals NHS Foundation Trust, GP practices and physiotherapists with regards to patient referrals when the programme does commence. This will ideally take place in late 2018, although a 2019 start date is more likely.



Figure 6: HELP Hampshire Stroke Clinic Logo



Figure 7: HELP Hampshire Stroke Clinic Webpage (www.helphampshire.co.uk)

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Appendices

Appendix 1; Map of Europe

Appendix 2; Travel Itinerary

Appendix 3; Example presentation

Appendix 1A; Map of Europe



Order of WCMT Fellowship Travel

1 = Denmark; 2 = Holland; 3 = Ireland; 4 = Sweden

Appendix 2; Travel Itinerary

| Location | Dates | Summary of itinerary/meetings |
|--|--|---|
| Herlev Hospital, Copenhagen, Denmark | 10-14 th July 2017 | <ul style="list-style-type: none"> • Tour of acute stroke ward • Visit 3-month follow-up clinic and relevant Allied Health Professionals • Presentation (Appendix 3) to consultants, physiotherapists and nurses at Herlev Hospital of WCMT Fellowship • One-to-one discussion of current research practice at Herlev Hospital with consultants (including Dr Christina Kruuse), physiotherapists and nurses • Observation and discussion of PhD student (Rikke Steen Krawczyk) testing in acute stroke ward laboratory. • Practice and familiarisation with research equipment (i.e., Endopat) |
| Amsterdam/ Rotterdam, the Netherlands | 24-28 th July 2017 | <ul style="list-style-type: none"> • Meetings with Prof Rita Van Den Berg-Emons at Erasmus MC in Rotterdam |
| University College Dublin, Dublin, Ireland | 30 th October- 8 th November, 2017 | <ul style="list-style-type: none"> • Tour of UCD facilities • Presentations (Appendix 3) at UCD and Mater Misericordiae University Hospital • Discuss secondary stroke prevention with physiotherapists at Mater Hospital and UCD. • Meetings with Dr Olive Lennon, Dominick McCabe, Prof. Colin Boreham to discuss secondary stroke prevention • Take part in INSsPIRE meeting • Assist in lifestyle modification Delphi study with Dr Olive Lennon |

| | | |
|--|--|--|
| Karolinska Institutet, Stockholm, Sweden | 17 th February-2 nd March 2018 | <ul style="list-style-type: none"> • Take part in INSsPIRE meeting • Assist in INSsPIRE definition of non-pharmacological secondary stroke prevention • Meet with A/Prof Eric Asaba, Dr Ann-Helen Patomella and Dr Susanne Guidetti concerning secondary stroke prevention from an exercise physiology and occupational therapist perspective • Discussion surrounding concept of 'prevention' from a non-pharmacological perspective • Draft external conference funding application • Presentation (Appendix 3) to Division of Occupational Therapy at Karolinska • Tour of facilities and laboratories |
| Uppsala University Hospital, Uppsala, Sweden | 17 th February-2 nd March 2018 | <ul style="list-style-type: none"> • Presentation (Appendix 3) to Dr Gunilla Elmgren Frykberg and Dr Birgit Vahlberg. • Discussion surrounding concept of 'prevention' from a non-pharmacological perspective • Tour of facilities and laboratories |
| Vrinnevi Hospital, Norrköping & Linköping University, Sweden | 17 th February-2 nd March 2018 | <ul style="list-style-type: none"> • Presentation (Appendix 3) to consultants, physiotherapists, nurses, students and researchers at Vrinnevi Hospital, Norrköping • Presentation (Appendix 3) to Researchers in the Department of Physiotherapy at Linköping University • Interactive technology videoconference discussion and presentations with Sabina Borg, Maria Back, Kristina Ahlund and Kristofer Hedman • Tour of acute stroke ward, facilities and laboratories |

| | | |
|--|--|--|
| | | <ul style="list-style-type: none"> • Visit and discussion surrounding rehabilitation unit/ambulation care • Presentations from Klas Sandberg, Marie Kleist and Magnus Wijkman surrounding secondary prevention stroke research • Round table discussion of future research studies in secondary stroke prevention with Klas Sandberg, Marie Kleist, Paul Enthoven and Magnus Wijkman • Presentation from Lena Tornfelt regarding stroke process at Vrinevvi Hospital |
|--|--|--|



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Putting academic research into real-world practice: The utility of physical activity as a secondary prevention strategy for patients with stroke and TIA

Dr James Faulkner



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Introduction

- Background information
- Research studies
- Developing a secondary prevention community clinic

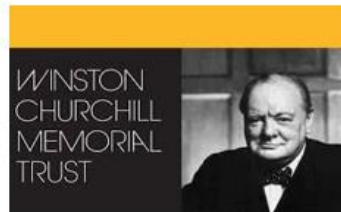
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Background Information

- Reader in Exercise Physiology
- Accredited Sport and Exercise Scientist
- Published > 70 research articles
- Supervise 10 PhD students



Effects of Early Exercise Engagement on Vascular Risk in Patients with Transient Ischemic Attack and Nondisabling Stroke

James Faulkner, PhD,* Danielle Lambrick, PhD,† Brandon Woolley, BSc,*
Lee Stoner, PhD,* Lai-kin Wong, BNurs (hons),‡ and Gerard McGonigal, MD§

- Why TIA/minor stroke?
 - Elevated risk of future strokes, cardiac complications
 - 12 % patient death within 12 months (AHA, 2014)
 - 43 % risk of major cardiovascular event within 10 years
- A reduction in the prevalence of TIAs and stroke post-TIA may have substantial impact for hospital, rehabilitation, and medication costs
- Physical activity interventions may be more effective than anti-coagulant and anti-platelet medications in reducing the risk of mortality post-stroke (BMJ, 2013)



Acute benefits of early exercise engagement on **cardiovascular disease risk factors**

Table 2. Vascular risk factors at BL, PI, and 3PI assessments

| | HEPAP | | | CON | | | Test by Condition interaction | |
|---------------------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------------------------|-------------------|
| | BL | PI | 3PI | BL | PI | 3PI | P value | η_p^2 |
| SBP (mm Hg) ^a | 140.0 ± 14.3 | 128.7 ± 13.8 | 123.3 ± 14.3 | 137.9 ± 12.0 | 136.4 ± 16.9 | 134.0 ± 15.5 | .024 [†] | .069 [‡] |
| DBP (mm Hg) | 81.9 ± 8.1 | 79.8 ± 8.7 | 78.1 ± 10.0 | 80.4 ± 8.0 | 80.2 ± 9.8 | 79.5 ± 16.1 | .020 [†] | .074 [‡] |
| TC (mmol/L) ^a | 4.14 ± 1.22 | 3.57 ± .69 | 3.70 ± .90 | 4.10 ± 1.09 | 4.06 ± 1.00 | 4.06 ± .96 | .255 | .126 |
| HDL (mmol/L) | 1.31 ± .60 | 1.31 ± .64 | 1.38 ± .63 | 1.28 ± .52 | 1.38 ± .51 | 1.43 ± .55 | .208 | .042 |
| TC:HDL ratio ^b | 3.71 ± 1.82 | 3.26 ± 1.42 | 3.07 ± 1.18 | 3.54 ± 1.34 | 3.27 ± 1.44 | 3.19 ± 1.43 | .250 | .024 |
| FBG (mmol/L) | 5.91 ± 1.48 | 5.60 ± 1.48 | 5.69 ± 1.41 | 5.88 ± 1.02 | 5.87 ± 1.07 | 5.95 ± 1.20 | .666 | .009 |
| All | 5.31 ± .66 | 5.12 ± .92 | 5.19 ± .82 | 5.50 ± .60 | 5.48 ± .69 | 5.57 ± .98 | .215 | .130 |
| Nondiabetic | 8.13 ± 1.57 | 7.35 ± 1.91 | 7.52 ± 1.64 | 7.20 ± 1.14 | 7.26 ± 1.06 | 7.27 ± 1.03 | .775 | .005 |
| Diabetic | 75.4 ± 14.5 | 75.2 ± 14.3 | 75.1 ± 13.8 | 80.4 ± 15.7 | 81.1 ± 14.9 | 80.6 ± 15.0 | .779 | .005 |
| Weight (kg) | 28.2 ± 4.3 | 28.1 ± 4.4 | 28.1 ± 4.2 | 28.8 ± 5.2 | 29.1 ± 5.1 | 28.9 ± 5.1 | .086 | .047 |
| BMI (kg/m ²) | 94.4 ± 14.8 | 92.8 ± 13.2 | 91.9 ± 12.5 | 98.6 ± 14.2 | 99.4 ± 14.6 | 99.3 ± 14.3 | .980 | .000 |
| WC (cm) | 98.0 ± 11.2 | 96.7 ± 11.4 | 96.3 ± 10.5 | 102.4 ± 12.9 | 101.1 ± 13.2 | 101.0 ± 12.6 | .359 | .020 |
| W-HC | .96 ± .09 | .96 ± .06 | .95 ± .07 | .96 ± .09 | .98 ± .09 | .98 ± .09 | | |

Abbreviations: BMI, body mass index; DBP, diastolic blood pressure; FBG, fasting blood glucose; HDL, high-density lipoprotein; HC, hip circumference; SBP, systolic blood pressure; TC, total cholesterol; WC, waist circumference; W-HC, waist-to-hip circumference.

^aSignificant time main effect between BL and PI ($P < .05$).

[†]Significant Test by Condition interaction ($P < .05$).

[‡]Significant time main effect between BL and 3PI ($P < .05$).

[§]Significant time main effect between PI and 3PI ($P < .05$).

Faulkner et al., J of Cerebrovasc Dis, 2013

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Chronic benefits of early exercise engagement on **cardiovascular disease risk factors**

TABLE 3. Vascular risk factors reported for exercise and education intervention and control at each assessment (baseline, postintervention, 12PI)

| | EX | | | CON | | |
|---|-------------|-------------|-------------|--------------|--------------|--------------|
| | BL | PI | 12PI | BL | PI | 12PI |
| SBP (mmHg) ^{a,b} | 140 (14) | 129 (13) | 129 (12) | 139 (12) | 138 (15) | 138 (15) |
| DBP (mmHg) ^b | 83 (9) | 80 (9) | 78 (9) | 81 (9) | 81 (10) | 80 (11) |
| Pulse pressure (mmHg) ^{b,c} | 57 (11) | 49 (10) | 51 (13) | 58 (12) | 57 (15) | 58 (15) |
| Resting heart rate (b/min) | 69 (14) | 66 (12) | 64 (9) | 67 (14) | 65 (8) | 66 (9) |
| Double product (b/min/mmHg) ^b | 9.6 (2.3) | 8.5 (2.1) | 8.2 (1.2) | 9.2 (2.2) | 9.0 (1.7) | 9.0 (1.7) |
| Total cholesterol (TC; mmol/l) ^b | 4.02 (1.18) | 3.46 (0.53) | 3.54 (0.56) | 3.93 (0.87) | 3.89 (0.87) | 3.83 (0.88) |
| High-density lipoprotein (HDL; mmol/l) | 1.24 (0.54) | 1.24 (0.58) | 1.30 (0.54) | 1.31 (0.52) | 1.42 (0.49) | 1.36 (0.46) |
| TC: HDL ratio ^b | 3.77 (1.78) | 3.27 (1.39) | 3.13 (1.23) | 3.28 (1.02) | 2.97 (1.09) | 3.02 (0.83) |
| Fasted blood glucose (mmol/l) | 5.18 (1.54) | 5.34 (1.34) | 5.45 (1.22) | 5.51 (1.09) | 5.48 (1.14) | 5.66 (1.03) |
| Bodyweight (kg) ^{a,b} | 80.1 (16.5) | 79.5 (16.0) | 75.7 (16.0) | 75.4 (14.7) | 75.3 (14.5) | 75.7 (14.0) |
| BMI (kg/m ²) ^a | 28.8 (5.2) | 28.5 (4.9) | 28.2 (4.8) | 28.0 (4.4) | 28.0 (4.5) | 28.2 (4.5) |
| Waist circumference (cm) | 94.3 (14.7) | 92.5 (13.4) | 92.8 (12.2) | 98.3 (13.5) | 98.7 (14.2) | 96.1 (12.6) |
| Hip circumference (cm) | 97.5 (11.4) | 96.1 (11.9) | 97.6 (11.8) | 102.8 (13.1) | 101.0 (13.4) | 101.7 (14.7) |
| Waist: Hip ratio | 0.97 (0.09) | 0.96 (0.06) | 0.95 (0.08) | 0.96 (0.08) | 0.98 (0.09) | 0.95 (0.08) |

Faulkner et al., J Hypertension, 2014

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Long-Term Effect of Participation in an Early Exercise and Education Program on Clinical Outcomes and Cost Implications, in Patients with TIA and Minor, Non-Disabling Stroke

James Faulkner¹ · Lee Stoner² · Jeremy Lanford³ · Evan Joffe³ · Andrew Mischak¹ · Danielle Lambrick⁴

Transl. Stroke Res.

Table 2 Clinical outcomes reported for exercise and control groups following a 3.5-year follow-up period. Values are reported as number of people or events, and as a percentage of the study sample

| | | | Exercise | | Control | | t | P | ES |
|----------------------|---|------------------|----------------|--------------------|------------|--------------------|--------|--------------------|------|
| | | | People (n) | % Total events (n) | People (n) | % Total events (n) | | | |
| Stroke diagnosis | Major stroke | Ischaemic stroke | 0 | 0 | 0 | 0 | -1.439 | 0.155 | 3.72 |
| | | ICH | 0 | 0 | 2 | 7 | | | |
| | Minor stroke | | 1 | 3 | 5 | 17 | -1.764 | 0.083 | 0.45 |
| | | TIA | 2 | 7 | 6 | 20 | 1.879 | 0.074 | 0.45 |
| | Total (major stroke, minor stroke, TIA) | | 3 ^a | 10 | 6 | 43 | -3.094 | 0.003 ^a | 0.80 |
| MI | | | 2 | 7 | 1 | 3 | 0.557 | 0.581 | 1.38 |
| Unstable angina | | | 1 | 3 | 1 | 3 | 0.000 | 1.000 | 0.00 |
| Death | | | 0 | 0 | 4 | 13 | -2.112 | 0.043 ^a | 0.53 |
| CEA | | | 4 | 13 | 1 | 3 | 1.401 | 0.167 | 1.64 |
| Revascularisation | | | 1 | 3 | 1 | 3 | 0.000 | 1.000 | 0.00 |
| Angiogram | | | 3 | 10 | 2 | 7 | 0.460 | 0.647 | 0.11 |
| CABG | | | 1 | 3 | 1 | 3 | 0.000 | 1.000 | 0.00 |
| IHD | | | 7 | 23 | 8 | 27 | -0.293 | 0.770 | 0.09 |
| PVD | | | 2 | 7 | 1 | 3 | 0.584 | 0.561 | 0.14 |
| CHF | | | 3 | 10 | 0 | 0 | 1.795 | 0.083 | 0.46 |
| Hospital admissions† | | | 20 | 67 | 24 | 80 | -2.098 | 0.041 ^a | 0.54 |

CABG coronary artery bypass graft, CEA carotid endarterectomy, CHF congestive heart failure, ICH intra-cerebral haemorrhage, IHD ischaemic heart disease, MI myocardial infarction, PVD peripheral vascular disease, TIA transient ischaemic attack

N.B. ^aSignificant difference between groups ($P \leq 0.003$); ^{ab}Of the three patients in the exercise group who experienced a stroke or TIA, only one of these patients experienced multiple events; ^{ab}Of the thirteen control group patients who experienced a stroke or TIA, two patients experienced multiple events. ^aApproaching a significant difference between groups ($P < 0.05$); †ED admissions are analysed in relation to the total number of events

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ORIGINAL ARTICLE

Effect of early exercise engagement on arterial stiffness in patients diagnosed with a transient ischaemic attack

B Woolley¹, L Stoner¹, S Lark¹, L-k Wong², J Lanford³ and J Faulkner¹

- Patients who experience a Transient Ischaemic Attack (TIA) have similar predisposing modifiable vascular risk factors as cardiac rehabilitation patients (Prior et al., 2011).
- Analogous to these risk factors, the elastic properties of large arteries pose a strong and independent risk factor for stroke (Laurent & Boutouyrie, 2005).
- Although exercise has been shown to improve CVD risk factors in patients with TIA, The effect of exercise therapy on arterial stiffness in patients with TIA has yet to be established



| | | BL | PI | Δ | F | P | Partial eta squared |
|---|-----|--------------|---------------|--------------|-------|-------|---------------------|
| HR (b.min ⁻¹) | EX | 63 ± 8 | 59 ± 12 | -4 ± 8 | 2.258 | .147 | .093 |
| | CON | 65 ± 11 | 68 ± 11 | 3 ± 14 | | | |
| SBP (mmHg) | EX | 134 ± 15 | 127 ± 11* | -7 ± 9 | 6.210 | .021* | .220 |
| | CON | 125 ± 10 | 127 ± 11 | 2 ± 9 | | | |
| DBP (mmHg) | EX | 81 ± 11 | 72 ± 18* | -9 ± 15 | 5.217 | .032* | .185 |
| | CON | 79 ± 9 | 80 ± 8 | 1 ± 3 | | | |
| PP (mmHg) | EX | 56 ± 15 | 51 ± 12 | -6 ± 10 | .573 | .457 | .024 |
| | CON | 49 ± 12 | 47 ± 9 | -2 ± 14 | | | |
| DP (b.min ⁻¹ × mmHg) | EX | 8502 ± 1048 | 7581 ± 1185 | -921 ± 1356 | 4.244 | .052 | .168 |
| | CON | 8089 ± 1641 | 8518 ± 1354 | 430 ± 1743 | | | |
| Ddia (mm) | EX | 7.61 ± 0.86 | 7.39 ± 0.81 | -0.21 ± 0.23 | 3.739 | .066 | .140 |
| | CON | 7.27 ± 0.70 | 7.25 ± 0.69 | -0.02 ± 0.27 | | | |
| Δd (mm) | EX | 0.32 ± 0.10 | 0.35 ± 0.12 | 0.03 ± 0.06 | .828 | .372 | .035 |
| | CON | 0.27 ± 0.07 | 0.28 ± 0.08 | 0.01 ± 0.08 | | | |
| CC (mm ² ·kPa ⁻¹) | EX | 0.71 ± 0.24 | 0.83 ± 0.28* | 0.13 ± 0.16 | 4.350 | .048* | .159 |
| | CON | 0.70 ± 0.22 | 0.70 ± 0.18 | 0.00 ± 0.13 | | | |
| DC (10 ⁻³ ·kPa ⁻¹) | EX | 15.98 ± 5.95 | 19.49 ± 6.60* | 3.51 ± 3.94 | 5.906 | .023* | .204 |
| | CON | 17.16 ± 5.38 | 17.03 ± 3.24 | -0.13 ± 3.51 | | | |

Abbreviations: Compliance coefficient (CC), Distensibility coefficient (DC), Distension (Δd), Diameter during diastole (Ddia), Diastolic blood pressure (DBP), Double product (DP), Heart rate (HR), Pulse pressure (PP), Systolic blood pressure (SBP)

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- Provide exercise and education opportunities to minor stroke/TIA and ambulatory stroke patients



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