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Health at Curtin

The School of Physiotherapy and Exercise Science at Curtin University has built a strong reputation for quality research activity across basic science, clinical practice, health outcomes, and education in physiotherapy and exercise science related areas.

Physiotherapy and Exercise Science

Message from the Head of School

Professor Keith Hill
Head of the School of Physiotherapy and Exercise Science

Across the lifespan, physiotherapy and exercise science have the potential to make major contributions to the health and wellbeing of the community. As professions they focus on the following:

Lifestyle behaviours including exercise and physical activity, to maintain good health and prevent or minimise risk of health problems or injury developing.

Approaches to optimising performance and minimising injury in sport and exercise at all levels, from community level through to elite sports.

Rehabilitation approaches for people with acute or chronic disease or injury, to achieve maximal recovery and ideally, return to previous activities, work or function.

Curtin University’s School of Physiotherapy and Exercise Science has a number of priority areas of research, including:

- pain
- musculoskeletal health and disease
- cardiopulmonary health and disease
- ageing
- motor control and neuroscience
- ergonomics and work safety
- lifestyle, physical activity, exercise and sport across the lifespan, and women’s health.

The School has a strong research team, many with national and international profiles, annually publishes over 100 peer-review papers and has over 35 PhD or master research students. The School also has a growing number of research projects with a focus on innovative approaches to teaching and learning.

There is a clear emphasis of the research conducted by the School on understanding movement and movement dysfunction and employing movement based interventions, exercise and physical activity to improve health outcomes.

The School has excellent facilities to support leading-edge research including a state-of-the-art motion analysis laboratory, an exercise physiology laboratory and a rehabilitation, strength and conditioning laboratory.

This publication provides a snapshot of the diverse range of research being undertaken by staff in the School. It showcases projects across all ages, highlights targeting of major contributors to disease burden in Australia and incorporates projects utilising cutting-edge technology.

For further information visit healthsciences.curtin.edu.au/teaching/physiotherapy_home.cfm
BEATING LOWER BACK PAIN

Curtin has become internationally recognised for its research into lower back pain, with its innovative models for treatment the foundation of three international trials.

The Global Burden of Disease study published in the Lancet listed lower back pain as the most prevalent healthcare disorder for ‘years lived with disability’, that brings with it enormous societal, financial and personal impacts.

More troubling, perhaps, is the fact that despite substantive investment by the healthcare sector in advanced scanning technologies and medical therapies to treat lower back pain, the problem is worsening.

A team of researchers from Curtin’s School of Physiotherapy and Exercise Science has been conducting long-term research aimed at unravelling the myriad of factors around lower back pain and developing innovative treatment models that now have strong international interest and collaboration.

The team’s population-based studies are being conducted as part of the Western Australian-based Raine Study, currently one of the most comprehensive pregnancy birth cohort studies in the world.

The Raine Study provides a rich resource for the understanding of environmental and genetic factors that affect health and development, with participants now aged 24.

The Curtin team – including Peter O’Sullivan, Leon Straker, Anne Smith, Garth Kendall, Helen Slater, Amity Campbell and Darren Beales – is amongst more than 100 researchers utilising the Raine Study. Collectively, all participating researchers bring expertise from 25 broad areas of study, with the Curtin team carrying out the musculoskeletal health component of the project.

“One key study involves tracking participants in the Raine Study from adolescence into adulthood to monitor development and impacts of lower back pain,” explained Professor Peter O’Sullivan, currently one of the top ten most-published authors in refereed publications on lower back pain.

“Our findings so far show that about 40 per cent of participants have already reported lower back pain by the age of 14. By age 17, one in five participants in our study sought care for spinal pain. The really novel finding, however, has been the fairly significant impact of lower back pain on young people’s lives and wellbeing.”

The study has also found that individual beliefs and attitudes about how back pain impacts quality of life is a determinant of behaviours such as work and school absenteeism and participation in sport activities.

“Higher levels of fear around the fragility of the back often lead to someone protecting their back and so opting out of social and physical activity – while an easy going attitude can mean someone continues to live with a relatively normal lifestyle,” he said. “Additionally, protective behaviours developed early on in life abnormally alter muscle and joint function, exacerbating the problem.”
A CURTIN-LED RESEARCH TEAM IS EXPLORING NEW AND INNOVATIVE WAYS TO HELP HEART-FAILURE PATIENTS SELF-MANAGE THEIR CHRONIC CONDITION WITH TECHNOLOGY.

n estimated 30,000 Australians are diagnosed with heart failure annually. Additionally, 300,000 Australians are living with the chronic condition, in which the heart loses the ability – or ‘fails’ – to pump enough blood to meet the body’s metabolic requirements.

With the burden on the healthcare system of heart-failure costing more than $1 billion per year – largely due to recurrent hospitalisations – Associate Professor Andrew Maiorana, from Curtin’s School of Physiotherapy and Exercise Science, is investigating ‘telehealth’ technology to enable patients to self-manage and improve their condition – and keep them out of hospital.

“We are currently working with Medtech Global in developing and trialling the system in a nurse-supported environment,” Associate Professor Maiorana said.

“We think that a nurse-associated model is particularly valuable because it maintains a human element in managing a patient’s health.”

The telehealth intervention involves the patient connecting through computer tablets and smart phones to home-monitoring equipment that automatically uploads their data, via Bluetooth, to a central database. A nurse then accesses the data remotely, monitoring the patient’s condition.

“It’s an approach that supports the patient in managing their condition,” Associate Professor Maiorana said, an accredited exercise physiologist who has also been working with the Advanced Heart Failure and Cardiac Transplant Service at Royal Perth Hospital since 1998.

People with heart failure are often re-admitted to hospital, largely because they have trouble self-managing their condition. The technology will help identify when patients are becoming unwell in their heart failure and attend to that in a timely fashion so they don’t continue to deteriorate.

For example, weight gain is a significant indicator of a heart-failure patient not managing their condition well. In the telehealth trial, patients – who will be supplied with a tablet, internet connection, blood pressure monitor, activity monitor and scales – will be required to weigh themselves daily.

“If you can monitor key clinical indicators and respond to these early, you can reduce a patient’s rate of rehospitalisation,” Associate Professor Maiorana said.

“The nurse provides the patient with education, a heart-failure management plan and an action plan to enact when they experience worsening symptoms.”

Patient populations are becoming more ‘tech-savvy’ and looking to technology to help support the management of their health. We’re on the cusp of an era where technology is going to play a significant role in healthcare management,” Associate Professor Maiorana said.

Heart-failure patients recruited to the trial will be aged between 18 and 80.

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The project will evaluate the impact of the telehealth intervention on clinical outcomes, and identify the strengths and limitations of telehealth and any challenges for patients with using the technology.

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Maiorana and his research team are in the final stages of testing the software before trialling it live with patients.

Curtin researchers involved in the project include co-investigator and general practitioner Professor Moyez Jiwa, Associate Professor James Boyd, and Debra Hendre. Psychological outcomes of the study will be evaluated by Professor Nikos Ntoumanis, Associate Professor Cecilie Thogersen-Ntoumani and Dr Daniel Gucciardi.

Other investigators are from WA Health’s Cardiovascular Health Network, Advanced Heart Failure and Cardiac Transplant Service at Royal Perth Hospital, Johns Hopkins University, The George Institute for Global Health (Australia) and Heart Foundation (WA).
In 2008, a Health Department grant supported a multidisciplinary team of 12 to develop and run a series of one-day workshops to up-skill health professionals in pain management. These workshops were also delivered in the regional centres of Broome, Kununurra, Bunbury and Albany. A similar workshop on a consecutive day was run for people living with pain. In this way, the workshops aimed to bridge the gap in pain management between consumers and health professionals regardless of where they live in WA.

“When talking to people who suffer persistent pain, I have heard, repeatedly, both as a clinician and in my research work, that people are told to ‘get on with it’ – with the idea that ‘it’s all in their head’,” said Associate Professor Slater.

“There is frequently a complete misunderstanding of pain by the community and health professionals. Our team’s main focus is to enable people with pain to improve their quality of life and function. So a big part of our efforts in this area has been to address this misunderstanding in a way that helps the person in pain.”

The team’s work over the past five years has culminated in an extensive multi-disciplinary review of models of care related to musculoskeletal health. The review has received national attention, including from the National Health Service in the UK.

Perhaps the most significant achievement – the real and immediate win for consumers – is the online platform that provides a holistic approach to managing pain.

Launched in April 2013, the platform – called painHEALTH – is an important step forward in Australia for people living with pain. The portal is a rich resource for consumers including explanations of different types of pain conditions, as well as usable tools that give people helpful things to do, and pain stories from people who live with persistent pain.

Importantly, it also provides options for where to seek further assistance. In the 18 months since its launch, the site has received 2.6 million hits and more than 140,000 visits from 142 countries.

“To develop the platform, we talked to consumers from around Western Australia,” explained Associate Professor Slater.

“We developed various prototypes, which we refined after input from an expert multidisciplinary reference group and consumers with pain. The key to its success is that it’s all about the person in pain. It’s their platform – they helped design it and bring it to life.

“While we designed this for consumers, a number of service organisations have also begun to use it, including State Health Services and the Commonwealth Government (via the Veterans’ Mates initiative), who produced a resource based on the platform and circulated it to 5000 GPs and pharmacies throughout Australia and internationally.”

To visit the painHEALTH platform, go to painhealth.csse.uwa.edu.au

The researchers collaborating on these, and other musculoskeletal health projects, include co-lead Andrew Briggs, Darren Beales, Samantha Burral, Jason Chua, Stephanie Davies, Robyn Fany, Peter O’Sullivan, Richard Parsoni, Sonia Ranelli and Anne Smith.
Research looking at musculoskeletal playing-related problems in children aims to better inform and promote musician well-being among music educators and health professionals to facilitate optimal performance and an enjoyable life-long playing experience.

Musculoskeletal playing–related problems (PRMP) are common amongst professional musicians, music teachers and university music students. While several risk factors for adult musicians have been identified, there is little evidence around the rates of, and risk factors contributing to, problems in younger musicians.

Early career researcher Dr Sonia Ranelli, Lecturer in the School of Physiotherapy and Exercise Science, is addressing this gap. She recently completed a PhD thesis (supervised by Professor Leon Straker and Associate Professor Anne Smith) that established the prevalence and location of problems in child and adolescent musicians. Her study also established the independent association of potential risk factors with problems accounting for gender and age.

From surveys of 731 instrumentalists aged between seven and 17, Dr Ranelli’s work found that problems are common across childhood with the prevalence and location of problems in children disconcertingly similar to that in adults.

Examination of the potential risk factors associated with PRMP in children found that individual factors – including gender, age, the experience of non-music activity-related soreness, and the experience of music performance anxiety – were significantly associated with problems in young instrumentalists.

Dr Ranelli also found that music-related factors – such as instrument type, years of playing their primary instrument, practice time and patterns of practice – were also significantly associated with problems in this group of musicians.

“I think the most important application of these findings is working with music educators to help them better understand the factors contributing to musician wellbeing, specifically those factors they are able to influence,” said Dr Ranelli.

“The effect of the music teacher in a musician’s life is well known. They are, therefore, integral to minimising and preventing problems in young musicians.

“In addition, physiotherapists are well placed to assess and manage musculoskeletal problems in this population. However, it is important that they have specific knowledge about musicians and their art. Research to collaborate with national and global music medicine experts is necessary to develop an evidence-based international music physiotherapy education program so musicians across the life-span and world-wide will be managed appropriately.”

Earlier this year, Dr Ranelli presented her research at the Music Teachers’ National Association inaugural preconference workshop in Chicago. She has also established research links between Curtin University and the Physiotherapy School at the Hochschule Osnabrueck, Germany.

Dr Ranelli’s current research builds on her doctoral work. She is undertaking a laboratory study including detailed analysis of posture and muscle activity of young musicians with and without problems.

Dr Ranelli also works clinically as a physiotherapist with a special interest in treating hand and upper limb problems. Her clinical and academic skills have seen her collaborate on translational research projects for musculoskeletal pain, including on the RAP-eL (Rheumatoid Arthritis Physiotherapy e-Learning resource) project, and on the painHEALTH initiative, the online educational resource for consumers.

Before embarking on her PhD, Dr Ranelli worked in Oxford, UK, and established the Hand and Upper Limb Therapy Service at The Radcliffe Infirmary NHS Trust. She earned a Master of Science in Evidence Based Health Care from Oxford University.

In 2010, Dr Ranelli won the Performing Arts Medicine Association (PAMA) Alice G. Brandfonbrener Young Investigator of the Year award. She is currently on the PAMA board and co-chairs the organisation’s research committee.
With funding from the former Health Workforce Australia (HWA) to the tune of $5.75 million, a major project involving a consortium of 16 Australian universities is underway to embed simulation training into the clinical placement component of their physiotherapy undergraduate and graduate-entry programs. The national project is being coordinated by Professor Tony Wright and Dr Penny Moss from Curtin’s School of Physiotherapy and Exercise Science.

Simulation training involves role-playing, by trained actors, of a broad range of patient scenarios that students are likely to encounter in professional practice on graduating. The training will replace 20 per cent of the traditional clinical placement time during one five-week placement, providing students with one week of simulation training within the existing curriculum.

Why simulation training?
Project lead Professor Tony Wright, said the reasons are two-fold. “There is a limitation on the availability of clinical placements – they’re a fairly stretched resource,” Professor Wright said.

“Secondly, when doing simulation you are very much focused on student learning. In a clinical setting the focus is always on the patient, so student learning takes a back seat at times. Simulation training focuses on student learning.”

This is particularly so, Professor Wright said, in emergency situations or if a patient presents as “unsafe”, meaning they could potentially fall. “If a student is on a clinical placement and it looks like a patient is about to fall, a supervisor will often step in, whereas in simulation an actor will ‘fall’, and if a student hasn’t done anything to prevent that from happening, they have the opportunity to re-run the scenario and do something different to prevent the problem arising,” Professor Wright said.

“It gives the students more responsibility.”

Scenarios can be adapted to suit various levels of a student’s development during the training.

The project focuses on three areas of physiotherapy practice – cardio-respiratory, neurological and musculoskeletal. Simulation will take place in hospitals or on university campuses, depending on the participating university and type of placement.

Barriers to using simulation training, as highlighted in a previous HWA-funded survey of all Australian physiotherapy schools that used the training, include funding and resources.

“We’re hoping it will remain embedded to a considerable degree. It will vary between universities as to how much, but we’re hoping all will continue to do some form of simulation training,” Professor Wright said.

“This has been a very positive collaboration between all of the partner universities, with great leadership from a dedicated group of staff employed to work on the project.”

As for the future of simulation training in physiotherapy education in Australia. “I’m anticipating it will become an established component within clinical education,” Professor Wright said.

Results of the project’s evaluation will be published in 2016.

“Having the right sorts of spaces in which to do simulation is one barrier,” Professor Wright said, “and hiring actors to perform simulation is a significant cost.”

Dr Penny Moss is leading the day-to-day management of this project and to date, 900 students from across most of the 16 universities have participated in simulation. The project’s target is 1,840 before April 2015. Professor Wright said it is one of the largest teaching and learning projects conducted in Australia.

The consortium is currently gathering data from questionnaires and focus groups. In February 2015, the universities will meet to gather feedback on the project’s progress and discuss how they envisage continuing with simulation once the project ceases in June 2015.

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COPD is a serious, progressive and disabling condition that limits airflow in the lungs. Breathlessness on activity is the most distressing symptom of COPD. Smoking is the main, but not only, cause of COPD. Many individuals with COPD develop significant symptoms in their 50s and 60s.

Curtin University's School of Physiotherapy and Exercise Science Associate Professor Sue Jenkins, together with Associate Professor Kylie Hill from the School, researchers from Sir Charles Gairdner Hospital (SCGH) and Sydney University were involved in a National Health and Medical Research Council (NHMRC) funded trial examining if a supervised walking training program had any benefits for people with COPD.

“The study involved more than 140 people with COPD, recruited in Perth and Sydney, who were randomised to a treatment group who underwent an eight-week ground-based high intensity walking program, or to a control group who did not receive any exercise training.

“We found is that walking training alone – supervised by a physiotherapist – significantly improved walking capacity and quality of life compared to the outcomes in the control group,” Associate Professor Jenkins said.

“Our objective for investigating walking training as the sole modality of exercise is because it is an important activity of daily living, requires no specialised equipment and can therefore be easily implemented in rural and remote areas where gyms are lacking.”

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The humble computer game has been labelled as antisocial, a time waster and preventing children from heading outdoors to play.

The information gained during the home visit is used in the practical class where students discuss and develop a falls risk management plan for Mrs James, Ms Furness said.

As a serious game there is a sense of fun that has also been built into the program so students can earn points for the number of potential hazards and risks they find.

“Although the students play the game on a computer that provides a two dimensional presentation, it can also be played using the Oculus Rift Headset providing a three dimensional presentation and this has the potential to increase engagement in the experience,” Ms Furness said.

Ms Furness is now collecting data on the program from students, but said it would be used as a learning tool for the next three years.
THE ROLE OF EXERCISE IN CORTICAL PLASTICITY

STUDIES TESTING THE INFLUENCE OF ACUTE AEROBIC EXERCISE ON CORTICAL PLASTICITY HOPE TO CONTRIBUTE TO THERAPEUTIC INTERVENTIONS THAT CAN SPEED UP REHABILITATION AFTER INJURY.

Dr Andrew Lavender, Lecturer in the School of Physiotherapy and Exercise Science, has built up a body of work looking specifically at the influence of acute physical activity on cortical excitation. Cortical plasticity is known to play a key role in memory and learning, as well as in motor and cognitive development.

Dr Lavender’s main research interests include motor control and how neuromuscular function is affected by ageing, exercise and neuromuscular disorders, spinal cord injury and recovery of motor function.

Dr Lavender’s most recent work looks at the use of TMS to assess short-interval intracortical inhibition (SICI) – a technique used to measure the internal pathways of the motor cortex. Using posterior-anterior (PA) and reverse coil anterior-posterior (AP) TMS across different stimulus intensities and muscle activation states, his study in older individuals found that coil orientation is a key factor to consider when assessing age-related differences in SICI.

“Reverse coil AP TMS activates neural elements that are susceptible to SICI, and can therefore reveal age-related changes in SICI,” said Dr Lavender.

Results revealed a younger demographic showing strong trends towards increases in cortical excitability, an indication of adaptability, following PAS of the right motor cortex – although this failed to reach statistical significance. Exercise appears to have had a dampening effect on the changes in cortical excitability induced by PAS in the young group.

The older group showed a much reduced response to PAS compared with the younger group suggesting that plasticity, although present, may be reduced in older volunteers and potentiation is not augmented by a single bout of low to moderate aerobic exercise.

The collective aim of this work is to develop interventions that can enhance rehabilitation. It has a range of applications in sports injury, psychiatric disorders and age-related injuries such as stroke.”

He uses a range of experimental approaches and technologies to study the ways in which the human brain can change and how this affects behaviour and neuromuscular function.

Much of his work makes use of the Curtin University’s Neuroscience Laboratory (CNL). The lab has the equipment necessary to use a range of non-invasive brain-stimulation techniques, including transcranial magnetic stimulation (TMS) and Paired Associative Stimulation (PAS) – amongst others. These approaches can assess intracortical inhibition and facilitation using surface electromyographic (EMG) measures of muscle activity.

CNL is accessed by multi-disciplinary research teams at Curtin with interests in ageing, non-invasive brain stimulation, rehabilitation of movement and cognition, Parkinson’s Disease, stroke and exercise.

“These changes were previously not evident with conventional PA TMS. “Since these inhibitory circuits are involved in fine control of movement, it is important to study them and how they may be implicated in age-related movement disorders involving tremors and poor movement control.”

Several graduate students currently supervised by Dr Lavender are also conducting a variety of related studies testing specific interventions of human movement and their effects on cortical excitability.

Curtin Physiotherapy honours student Richelle Jarvis-Spinks recently completed a research project examining the influence of a short period of moderate aerobic exercise on the adaptability of the motor cortex in healthy older adults. Her study used PAS – a technique combining low-frequency electrical stimulation at the radial nerve paired with TMS.

The data are preliminary, and changes in cortical excitability following PAS in the older group have not reached statistical significance in this study at this time. However, current testing is ongoing with more participants in future studies.

A master student’s project – with Tori Shae Smith, James Carolan and Matthew Smith – is investigating changes in the cortex after TMS intervention amongst women with a history of concussion using transcranial magnetic brain stimulation (TMS). The study responds to a gap in the literature around the long-term effects of concussion on cortical plasticity in women, particularly with a focus on short-term effects of concussion on cortical plasticity in women.

The data suggest that women may have different cortical plasticity compared with men following TMS intervention, which is supported by other studies. The study is ongoing with more participants to be recruited.

Curtin researchers are working to improve the health and safety of volunteer bushfire fighters through training and sustainable work practices.

“A lot of our volunteers come from work so they are generally quite tired and they are often dehydrated as well and they go into this hot, smoky environment where they can be put at a lot of risk,” Dr Netto said.

Dr Netto said now that researchers understood their work, they were working towards establishing a centre of excellence in emergency services and bushfires and developing a training program and sustainable workflow practices to minimise the risk of common injuries such as muscle strains and sprains.

“A change in workflow for firefighters is one option being considered for managing their work demands.

“Fighting to improve health to fight fires”

Dr Kevin Netto, from Curtin’s School of Physiotherapy and Exercise Science, has carried out research on the stress that fighting bushfires has on the health and safety of volunteer bush firefighters in Australia.

For part of his work, he collected samples of body stress, hydration, airflow and muscle fatigue during a fire.

Dr Netto said Australian firefighters carried out physically demanding work such as building fire breaks in hot and smoky conditions.

“We are trying to design a training program for volunteers that combines elements of firefighting with traditional exercises, which will better prepare them for fighting bushfires,” Dr Netto said.

“I call it training by stealth because we’ve incorporated cardiovascular and strength training exercise elements into existing firefighting drills, which we think will have a positive outcome and help to reduce the risk of injury for firefighters.”

A change in workflow for firefighters is one option being considered for managing their work demands.

“He said the volunteer workforce was an aging one, and many worked full-time but gave their time for free because they had a strong connection to their local community.”
HEALTH
ESSENTIAL SKILLS SUCH AS DRIVING A VEHICLE.

CURTIN
Another has led researchers to question if this ability can be used to teach elite athletes’ ability to transfer their skills from their chosen sport to another.

Dr Rosalie, from Curtin University’s School of Physiotherapy and Exercise Science, has found elite karate athletes could use their knowledge in other sports such as football and Taekwondo even if they had not played the game.

Dr Rosalie has now turned his attention to exploring if this ability, known as transfer of learning, can be used in other essential life skills such as driving a car, particularly for learner drivers.

“When you are driving you experience varied conditions, you have day and night as well as changing weather conditions so you are exposed to lots and lots of different contexts,” Dr Rosalie said.

“And when you are a learner driver you obviously won’t have the skill or expertise to transfer your driving skills over those contexts, which is one of the reasons why you might get involved in more accidents.”

As part of his research, Dr Rosalie is looking at whether experience separates out anticipation skills and driving, and if learner drivers can learn how to drive effectively before they get a licence and reduce their accident risk by increasing their anticipation skills.

He is using junior motor sport, in particular go-karting for his research, which focuses on understanding how skilled drivers anticipate how the car in front will change speed and direction before it does.

“Current tests used to study anticipation in the field wouldn’t be safe to use in this research study. Consequently, I’m in the process of developing safe methods of studying a driver’s ability to anticipate a vehicle’s motion while they are driving. This approach will provide accurate and reliable data but will also be robust enough to stand up to the rigours of motor sport,” Dr Rosalie said.

“If young people started learning how to anticipate and evade other vehicles and practised their skills extensively in a broad range of controlled conditions before they get their licence, then maybe they’ll be able to avoid accidents when they do start driving on the roads.”

This approach will provide accurate and reliable data but will also be robust enough to stand up to the rigours of motor sport. Professor Rosalie said.

“Helping teenagers develop good activity and food habits will not only help them as individuals, but reduce the cost of healthcare for all Australians.”

Research shows adults who adopt a lifestyle with unhealthy food options and lack of exercise face a shorter life span and a reduced quality of life. Often those habits are developed when they are adolescents and continue throughout their life unless they make lifestyle changes.

“Helping teenagers develop good activity and food habits will not only help them as individuals, but reduce the cost of healthcare for all Australians,” Professor Straker said.

He said research had found there were very few services and opportunities for teenagers.

“Most of the services are aimed at younger children or adults, and some services are only available when it is nearly too late – when teens are really sick,” Professor Straker said.

“We are working to ensure policies encourage services to provide opportunities for teenagers.”

One service is the Curtin University Activity, Food and Attitudes Program (CAFAP), a free eight-week healthy lifestyle program for those aged between 12 and 16 and overweight. The program involves the whole family in the approach to changing lifestyles and creating healthy life-long habits.

“Family support is really important, and parents play a major role in the CAFAP program – they set themselves goals for how they can support their teen to make changes and keep on with the new habits,” Professor Straker said.

Kyla Smith, CAFAP coordinator said a major feature of CAFAP was that it focused on positive behaviour changes that teens can make, and not on their weight.

“One reason for this is that we know physical and mental health improve with better behaviours – regardless of whether weight changes and that means teenagers don’t need to feel discouraged about how slow and hard it is to change their weight – and can focus on ‘doing’ positive things,” Ms Smith said.

An evaluation of CAFAP funded by a Healthway research grant and conducted by Dr Erin Howie found teenagers were able to make modest changes in physical activity, sedentary behaviour, fruit and vegetable consumption and junk food consumption and maintain many of these changes for 12 months after the program.
It is easy to take for granted everyday tasks such as walking and running—until injury occurs. From athletes and accident victims to stroke survivors and cerebral palsy sufferers, the inability of the legs to function optimally after physical or neurological impairment affects all sectors of the population, young and old.

Developing effective treatments for the widespread problem has been the focus of research for Curtin’s Professor of Neuroscience and Trauma Physiotherapy, Garry Allison. For the past five years, Professor Allison has led a series of projects focusing on a greater understanding of the interaction between the mechanical characteristics of the leg muscles and tendons and the messages sent to the muscles from the brain. "We are interested in controlling the lower-limb stiffness in different populations," Professor Allison said. "As a result, we have a stream of research examining each element."

In the current project, Allison and his research teams are using dynamic assessments on people suffering from Achilles tendinopathy. Applying principles developed in a previous study of individuals with neurological injury, Professor Allison is now examining the underlying mechanical factors that impact lower-limb function using "low-load plyometric" training, where the person is asked to hop, at different speeds.

"The lower limb acts like a spring and we walk and run by changing the stiffness of the spring. However, the brain chooses the stiffness matched to the mechanical properties of the legs," Professor Allison said.

Applying plyometric training, using a low-load program of hopping, Professor Allison tested two groups comprising people diagnosed with tendinopathy and in pain, and people without the condition, but who were injected to feel pain.

"Early findings show that pain induces a change in the pattern of how an individual without Achilles problems hops, and this pattern of hopping looks more like someone with Achilles tendinopathy," Professor Allison said.

"The perception of pain changes the behaviour. If this is maintained this could be maladaptive. People learn this motor pattern and maintain it, even when pain disappears, and it becomes the preferred pattern. This changes both the neurological and mechanical factors that control lower-limb stiffness."

The research teams include PhD and Honours students in health and mechanical engineering. Using robotics, the students are building a moveable platform that will automatically measure the minimal perceptible differences in the ankle when hopping.

"We also have PhD students looking at fibres within the tendon to assess stiffness, to develop rehabilitation models," Professor Allison said.

"It’s a translational research model, moving from the benchtop to bedside to better health in the community."

Rehabilitation programs have been implemented in several Western Australian hospitals, following Professor Allison’s study on neurology patients. Longer-term aims of the ongoing research are to see programs rolled out more widely to reduce the cost burden on the healthcare sector.

The research has received funding totalling $750,000 over the past five years, including from the Neurotrauma Research Program and the State Health Research Advisory Council.

A multidisciplinary research project at Curtin is using ‘dynamic rehabilitation’ to focus on high-level mobility for people with lower-limb dysfunction.
In the world of sport, developing ‘mental toughness’ has become a major focus for players and coaches. A collection of related research projects at Curtin is developing a sharper understanding of this psychological capacity with research already contributing to some of Australia’s National Sporting Organisations.

**Understanding Mental Toughness**

Despite growing attention within academic circles to the term ‘mental toughness’, along with constant use of the term in sport settings, there remains no agreed-upon understanding of what the term really means. Yet there is a strong sense that mental toughness plays a vitally important role for the most successful elite athletes.

Dr Daniel Gucciardi, currently a Senior Lecturer in the School of Physiotherapy and Exercise Science at Curtin, began defining the term during his doctoral studies in 2005 and has continued his work at Curtin along with several doctoral students and colleagues. Their work over the past three years has focused on three broad questions: What is mental toughness? How do we measure it? And how do we develop it?

Their research has implications for optimising player performance – particularly in terms of coaching styles. Generally, most researchers working in the field agree that mental toughness is the personal capacity to deliver high-performance on a consistent basis despite varying degrees of situational demands – and that this personal capacity is underpinned by attributes such as confidence, perseverance and being able to manage your emotions and attentional focus.

“The typical measurement approach has been to infer mental toughness by asking athletes to report on their own thoughts, feelings, values, and attitudes – such as self-belief, optimism and sports intelligence,” said Dr Gucciardi. “We have taken that a step further, by posing slightly different questions that might disentangle the complexity of the term in a user-friendly manner.”

In one study that reframed the question of personal attributes, PhD student John Mahoney from The University of Queensland, looked at the ‘motivational experiences’ of mental toughness. His approach extends the idea of personal attributes by asking what these resources allow the individual to achieve.

Viewed against the backdrop of ‘self-determination’ theory, Mahoney has developed a model around ‘striving, surviving and thriving’ with implications for coaching contexts. His research found that ‘autonomy-supportive’ training environments may serve coaches well.

In one of the most recent studies by Dr Gucciardi, he and his colleagues examined the association between mental toughness and behavioural persistence, using the classic multi-stage fitness test (aka the shuttle run) as a proxy for this aspect of the striving component of their model.

“Persistence, effort or perseverance is often reported as a behavioural signature of mental toughness,” said Dr Gucciardi. “We looked to test this idea in a naturalistic study using the beep test, which is common to most aspiring elite athletes these days.”

“We found that a footballer’s assessment of his mental toughness was related with higher performance on the beep test, even when we accounted for the influence of age, height, weight and football experience. These data support our expectation that mental toughness is an important ingredient for pushing through physically and mentally demanding situations or tasks.”

This focus on the behavioural signatures of mental toughness is where Dr Gucciardi and his colleagues anticipate that the next wave of advancements will come from.

Mentally tough behaviours are also central to PhD student David Anthony’s research, supervised by Dr Gucciardi and Professor Sandy Gordon from The University of Western Australia. David is working with the West Coast Eagles to develop a novel tool to assess mentally tough behaviour specifically within an AFL context. The key to this study is its aim to directly assess mental toughness by taking a behavioural approach.

““We are looking at observable – rather than unobservable – factors,” explained Dr Gucciardi. “These include the regularity with which a player demonstrates things such as effort levels, taking responsibility, enjoying the pressure of challenging situations and taking decisive action.”

David’s work will match these behaviours to objective measures of performance in natural settings (such as match statistics) and controlled experimental settings (such as manipulating pressure in a laboratory context). It’s this correlation between the two domains that will create a more dynamic understanding of how mental toughness plays out.”

Dr Gucciardi has also collaborated with Tennis Australia to provide insight into the motivational correlates of mentally tough behaviour, capturing elements across multiple levels of our understanding of people.

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Several research studies have looked at lower back pain (LBP) in adult rowers. However, until recently, little was known about the mechanisms that contribute to lower back pain in adolescent rowers. The prevalence of LBP in adolescents is important as LBP during adolescence is known to be a risk factor for LBP in adulthood.

For his doctoral thesis, Dr Leo Ng from the School of Physiotherapy and Exercise Science, completed a series of interlinked studies that aimed to investigate the prevalence, pain intensity and risk factors associated with LBP in adolescent male rowers—and to compare this with the results from adolescent female rowers. His research also included testing a model for effective treatment.

Results from an initial survey of 150 male adolescent rowers found a significantly higher rate of LBP amongst this group—at more than 90 per cent compared to just over 70 per cent amongst their female counterparts.

“The fact that male rowers have higher rates of back pain might result from the greater force used by male rowers, which places more stress on the spine,” said Dr Ng.

“By comparison, female athletes, while using less force, tend to have greater muscle endurance.”

Initial findings from the survey were then validated by using an electromagnetic motion analysis system to measure regional spinal movement during training on an ergometer. Comparisons were made between healthy males and healthy females, as well as between healthy and LBP-suffering male adolescent rowers.

“Our electromagnetic motion analysis studies enabled us to examine posture very precisely during rowing” said Dr Ng.

“Our results showed us that male rowers slouch more than female rowers do. So not only do these male athletes place more strain on their backs by using more power, but they are doing this in a compromised position.

“The results also showed a correlation between the length of time rowing on an ergometer and the level of LBP with increments noted every minute.”

Unique in Dr Ng’s study was the testing of treatment for LBP using cognitive functional therapy (CFT). The randomised control trial (RCT) of 36 rowers consisted of three stages: the first was education about the structure and movement of the back; the second was postural help that promoted the importance of normal movement as possible; and the third was an exercise regimen that focused on movement dynamics on the ergometer to strengthen both leg and back muscles.

The intervention group reported significant improvement in pain during ergometer rowing compared to the non-intervention group. The intervention group also reported a reduction in disability at post-intervention and at the 12-week follow-up.

“We were fortunate to have a leading specialist sports physiotherapist from Rowing Australia, JP Caneiro, provide treatment during the CFT stage of the RCT” said Dr Ng. “Mr Caneiro later took the specific CFT treatment back to the Australian Institute of Sport (AIS), where he implemented it as part of the Australian rowing team training. One component of this was ‘mindfulness’ exercises and functional exercises with an aim to improve posture during rowing.

“The AIS received such favourable results that they presented the training approach—including the CFT around rowing to reduce and minimise back pain—at the Australian Physiotherapy Association Conference in Melbourne earlier this year.”

Dr Ng has published his work in several refereed journals. The RCT component of the research will appear in the British Journal of Physiotherapy later this year.

“The goal is to keep people playing sport, but to help them develop techniques to minimise injury,” said Dr Ng.

“My aim in this study was also to be able to give rowers the confidence to train in a way that protects their lower back, and coaches the knowledge to develop effective coaching techniques.”

Dr Ng was supervised by Professor Peter O’Sullivan, Dr Anne Smith and Dr Amity Campbell.

Lower back pain is the most common rowing injury. New research from Curtin provides significant insight into the rates and mechanisms of lower back pain in young rowers—and into effective treatment.