

Research focus and capacity

The Nutritional Physiology Research Centre (NPRC) has an international reputation for human research on the roles of nutrition and physical activity in attaining and maintaining optimal cardiovascular, metabolic and mental health and in counteracting obesity and the diseases of affluence. Comprising a multidisciplinary research team of 30 senior academics, research fellows, research



assistants and postgraduate students with expertise in nutrition, metabolism, cardiovascular and exercise physiology, psychology and anthropometry, the NPRC is affiliated with the Sansom Institute for Health Research at The University of South Australia and the ATN Centre for Metabolic Fitness, a national collaborative research network.

The NPRC is equipped with state-of-the-art facilities for assessing anthropometry (3-dimensional body scanning), body composition (dual-energy x-ray absorptiometry), physical activity (accelerometry), physical fitness (treadmill and cycle ergometry), muscle strength (isokinetic dynamometry) and metabolism (metabolic rate by indirect calorimetry and blood lipids glucose, insulin, cytokines, etc by autoanalyser and ELISA). The NPRC has established a suite of non-invasive techniques to assess cardiovascular function, including endothelial dilatation in both systemic and cerebral circulations (brachial artery and transcranial Doppler ultrasound), arterial compliance (cardiovascular profiler) and heart rate variability. Blood pressure is recorded at rest (automated oscillometry), by 24hr ambulatory monitoring and by continuous Finapres monitoring, e.g. to assess pressor responsiveness to stress. These facilities are operated and maintained by a team of five research and administrative assistants. Additionally, a wide variety of validated questionnaires are used to evaluate physical activity, diet composition and energy balance, together with batteries of mood and cognitive function tests to assess mental health status.

These facilities enable the NPRC to comprehensively evaluate the impact of diet and lifestyle modification on human health in controlled intervention trials. In addition to competitive grants and other government funding, the NPRC receives substantial support from the food industry, both locally and internationally, to define and substantiate health benefit of functional foods and nutrients, providing a broad range of research projects for student and postdoctoral engagement. The quality of its research is evidenced by peer-reviewed publications (36 to date in 2009) in high-impact factor journals.

Potential Honours Projects for 2010

Students will be required to attend an interview with the supervisory panel to discuss their interest in a project prior to applying to undertake this project for their Honours year. Selection will be based on academic merit and assessment of suitability at the interview.

Project Title	Developing an index of physiological recovery following exercise
Supervisors	Associate Professor Jon Buckley and Professor Peter Howe.
Expected Start Date	February 2010
<p>State the aims, objectives and significance of the study (max 200 words) Athletes often undertake intensive training to improve their performances. However, if they become overtrained as a result of insufficient recovery this can predispose them to poor health and injury. At present there is no objective method for assessing the recovery state of an athlete to inform the subsequent development of appropriate training.</p> <p>The purpose of this study is to develop an index of recovery that can be used to develop optimal training programs to avoid overtraining and injury and assist athletes in realising their physiological potential.</p>	
<p>Provide a brief description of the research plan / methodology (max 200 words) In a recent study by Hautala et al it was shown that muscle sympathetic nerve activity was inversely related to subsequent exercise performance. It is difficult to assess muscle sympathetic nerve activity so the purpose of the current project is to identify novel parameters of the heart rate response to submaximal exercise which are influenced by the balance of sympathetic and parasympathetic activity, are easy to assess, and might predict exercise performance, and determine whether these heart rate parameters alter in response to fatigue induced by exercise.</p> <p>Competitive cyclists will have the heart rate response to a pre-exercise warm-up routine assessed before performing a maximum exercise performance test on a cycle ergometer when either well rested (control condition) or after prolonged heavy fatigue inducing exercise which impacts negatively on the physiological status of the athlete. Relationships between heart rate variability, specific heart rate parameters and exercise performance when well rested or fatigued will be investigated and used to develop an index of recovery.</p>	
<p>Provide 1-2 references which would assist potential students to understand key principles or methods within this project. Hautala et al. Muscle sympathetic nerve activity at rest compared to exercise tolerance. Eur J Appl Physiol (2008) 102:533–538</p>	

Project Title	The association between omega-3 fatty acid status, cardiovascular disease and periodontitis
Supervisors	Dr Alison Coates, Professor Peter Howe and Professor Mark Bartold
Expected Start Date	February 2010
State the aims, objectives and significance of the study (max 200 words)	
<p>The aim of this study is to investigate the relationship between omega-3 fatty acid status, cardiovascular disease (CVD) risk factors and severity of periodontitis</p> <p>Periodontitis is a chronic inflammatory condition affecting 1 in 5 Australian adults involving bacterial infection and subsequent inflammation of the gingival tissues. The long chain omega-3 polyunsaturated fatty acids (LC n-3 PUFA) from fish oil help reduce inflammation in several chronic conditions and results from a recent animal study (1) in our group indicate that fish oil may be useful as an adjunct therapy in this condition. Whilst periodontitis is associated with oral tissue destruction which has serious health implications by itself, it is also associated with increased risk of cardiovascular disease. Information from this study will be used to inform public health campaigns about the increased risk of CVD in patient with periodontitis and the protective role that LC n-3 PUFA may have.</p>	
Provide a brief description of the research plan / methodology (max 200 words)	
<p>A double-blind, randomized, placebo-controlled intervention trial will be conducted in 126 patients with newly diagnosed periodontitis by a collaborating team from the Colgate Australian Clinical Dental Research Centre, University of Adelaide and the Nutritional Physiology Research Centre, University of South Australia. Prior to the initial periodontal treatment, symptom severity will be determined by a periodontal hygienist and a fasting blood sample will be collected from the antecubital vein from which erythrocyte LCn-3PUFA content and biomarkers of CVD risk (eg CRP, lipids) will be measured. Participants will also complete a food frequency questionnaire.</p> <p>The honours project will look at data collected at baseline from volunteers enrolled into this 12 month supplementation trial and relate periodontal disease markers with omega-3 status, dietary intake and CVD biomarkers. The student will work closely with volunteers in recruitment and setting up the trial and also be involved in sample collection and analysis.</p>	
Provide 1-2 references which would assist potential students to understand key principles or methods within this project.	
<ol style="list-style-type: none"> 1. Bendyk A, <i>et al.</i> Effect of dietary omega-3 polyunsaturated fatty acids on experimental periodontitis in the mouse. <i>J Periodontal Res.</i> 2009; 44, 211-216. 2. Rosenstein ED, <i>et al.</i> Pilot study of dietary fatty acid supplementation in the treatment of adult periodontitis. <i>Prostaglandins Leukot Essent Fatty Acids.</i> 2003; 68, 213-8. 	

Project Title	Relationships between endothelial dysfunction in cerebral and peripheral arteries
Supervisors	Dr Narelle Berry, Assoc Prof Jon Buckley, Prof Peter Howe, Dr Alison Coates
Expected Start Date	February 2010
State the aims, objectives and significance of the study (max 200 words)	
<p>This study aims to compare endothelium dependent dilation in the cerebral circulation with that in the systemic circulation in subjects with coronary artery disease and depression. Ultrasound assessments of flow mediated dilatation (FMD) will be made in the brachial artery and in the cerebral circulation.</p> <p>There is increased interest in the relationship between decreased cerebral perfusion and cognitive decline. However, the mechanisms behind this are largely unknown. In a recent review from our research centre, we hypothesised that one mechanism for this decline in perfusion maybe due to impairments in endothelium dependant vasodilatation. There are a number of diet and lifestyle modifications that been shown to improve endothelial function (measured in the brachial artery). However before we attempt to evaluate whether we can then improve cerebrovascular function we need to determine if a relationship exists between the capacity for vasodilatation in these two vascular beds.</p>	
Provide a brief description of the research plan / methodology (max 200 words)	
<p>40 patients will be recruited from an existing study to attend the NPRC clinic for vascular assessments. The patients were recruited from the Queen Elizabeth Hospital angiographic database, hospital wards and outpatient clinics.</p> <p><i>Measurement of endothelium dependant vasodilatation.</i></p> <p>Endothelial function will be assessed using ultrasound to measure FMD in the brachial artery following forearm occlusion. A blood pressure cuff will be inflated to suprasystolic levels for 5 min. Upon release of the cuff, images of the brachial artery will be obtained and changes in the diameter of the artery will be measured to determine the degree of dilatation.</p> <p><i>Measurement of cerebrovascular reactivity</i></p> <p>Transcranial Doppler ultrasound (TCD) will be used to assess cerebrovascular reactivity in response to hypercapnia. TCD is a non-invasive technique performed with participants in a supine position. The ultrasound transducer is placed on the temporal window of the skull. During assessment participants will breathe in a 5% CO₂ mixture for 2 minutes. The inhalation of the gas induces cerebrovascular vasodilatation and changes in blood flow velocity will be measured to assess blood vessel reactivity.</p> <p>The honours student will be involved in data collection and ultrasound image analysis. Recruitment will be completed prior to the commencement of the study.</p>	
Provide 1-2 references which would assist potential students to understand key principles or methods within this project.	
<p>Lavi S, et al. Impaired cerebral CO₂ vasoreactivity: association with endothelial dysfunction. Am J Physiol Heart Circ Physiol. 2006;291(4):H1856-61.</p> <p>Sinn N, Howe PRC. Mental health benefits of omega-3 fatty acids may be mediated by improvements in cerebral vascular function. Biosci Hypotheses. 2008; 1:103-108.</p>	

Project Title	Relationship of Vitamin D status to cardiometabolic health
Supervisors	Associate Professor Jon Buckley, Dr Rebecca Thomson, Dr Alison Coates, Dr Simon Spedding, Professor Peter Howe.
Expected Start Date	February 2010
State the aims, objectives and significance of the study (max 200 words)	
<p>The objective of this study is to conduct a systematic review of the literature relating to the cardiometabolic health benefits of Vitamin D to determine whether inadequate Vitamin D status is associated with poor cardiovascular and metabolic health outcomes.</p>	
Provide a brief description of the research plan / methodology (max 200 words)	
<p>A number of cross-sectional studies have identified relationships between Vitamin D status and health.</p> <p>In the present study electronic data bases will be searched for publications which identify relationships between Vitamin D status and cardiometabolic health. The searches will be conducted using pre-determined search strategies. If sufficient literature is available a meta-analysis will be performed.</p>	
Provide 1-2 references which would assist potential students to understand key principles or methods within this project.	
<p>McGill et al. Relationships of low serum vitamin D3 with anthropometry and markers of the metabolic syndrome and diabetes in overweight and obesity. Nutr J. (2008) 28;7:4.</p>	

Project Title	Effects of weight loss on a total plasma cysteine, a novel plasma correlate of obesity
Supervisors	Dr Alison Coates, Dr Rebecca Thomson, Professor Peter Howe, Associate Professor Jon Buckley
Expected Start Date	February 2010
State the aims, objectives and significance of the study (max 200 words)	
<p>Recent studies have shown that plasma total cysteine (tCys) is related to body mass index (BMI) and that changes in tCys over time were related to changes in BMI and fat mass.</p> <p>This study aims to confirm the previously established relationships between tCys and BMI and body fat using blood samples and body composition data from pre-existing studies. Secondly, the study aims to use the data and blood samples from a large intervention trial which resulted in significant weight loss to determine whether substantial weight loss reduces plasma tCys, and whether any reductions are correlated with changes in BMI and body fat. This will be the first study to assess the effects of weight loss on tCys concentrations and it will also provide evidence to support the role of tCys in regulation of body composition (or otherwise).</p>	
Provide a brief description of the research plan / methodology (max 200 words)	
<p>Blood samples from several pre-existing studies that also have body composition data (~400 samples) will be analysed for the measurement of tCys using HPLC and fluorescence detection using a commercially available kit to investigate the associations between tCys and baseline adiposity.</p> <p>Blood samples will also be analysed from a previous large intervention trial where subjects experienced significant weight loss (n=150). This will allow investigation of whether plasma tCys levels are altered with weight loss and how these changes in tCys are related to changes in BMI and body composition.</p>	
Provide 1-2 references which would assist potential students to understand key principles or methods within this project.	
<p>El-Khairi, L., S.E. Vollset, H. Refsum, and P.M. Ueland, <i>Predictors of change in plasma total cysteine: Longitudinal findings from the Hordaland Homocysteine Study</i>. <i>Clinical Chemistry</i>, 2003. 49(1): p. 113-120.</p> <p>Elshorbagy, A.K., E. Nurk, C.G. Gjesdal, G.S. Tell, P.M. Ueland, O. Nygard, A. Tverdal, S.E. Vollset, and H. Refsum, <i>Homocysteine, cysteine, and body composition in the Hordaland Homocysteine Study: Does cysteine link amino acid and lipid metabolism?</i> <i>American Journal of Clinical Nutrition</i>, 2008. 88(3): p. 738-746.</p>	

Project Title	Exploring the relationship between intracellular signalling molecule s100B and cognitive function in older adults.
Supervisors	Dr Narelle Berry, Dr Natalie Sinn, Prof Peter Howe
Expected Start Date	February 2010
State the aims, objectives and significance of the study (max 200 words)	
<p>This study aims to explore the relationship between cognitive function and the intracellular signalling molecule s100B in older adults. Plasma s100B levels will be compared in adults aged over 65 year with out without mild cognitive impairment (MCI). Should we establish an elevation in s100B in cognitively impaired individuals we will then explore how omega-3 supplementation for 6 months improves these levels.</p> <p>Astrocytes located in the brain are thought to contribute to healing in response to acute neural damage. As we age cognition declines, in part due to neurodegeneration which can cause the astrocytes to over express intercellular signalling molecule S100B which is involved in the healing process. One proposed physiological effect that can lead to neurodegeneration is degradation of the blood brain barrier (BBB), if the BBB is not functioning properly s100B can cross from the brain into the blood stream, measurement of levels of s100B in the blood can therefore be used a marker of blood brain barrier dysfunction and may be related to cognitive decline.</p> <p>It has been suggested that omega-3 supplementation may help to improve functional integrity of the BBB.</p>	
Provide a brief description of the research plan / methodology (max 200 words)	
<p>77 adults aged over 65 years have been recruited to take part in a trial exploring the benefits of omega-3 supplementation on cognitive functioning. This group consists of 48 adults with MCI and 29 healthy age matched controls.</p> <p>Plasma samples have been obtained for these participants to assess levels of circulating s100B. This assay will be performed using a commercially available ELISA kit.</p> <p>The following comparisons will be made:</p> <ol style="list-style-type: none"> 1) plasma levels of s100B in individuals with MCI versus healthy controls. 2) plasma levels of s100B in the participants with MCI before and after 6 months of omega-3supplementation. <p>The honours student will be responsible for all laboratory assessments, data analysis and reporting.</p>	
Provide 1-2 references which would assist potential students to understand key principles or methods within this project.	
<p>Kleindienst A, et al. The neurotrophic protein S100B: value as a marker of brain damage and possible therapeutic implications. Progress in Brain Research: Elsevier; 2007. 317-25.</p> <p>Sinn N, Howe PRC. Mental health benefits of omega-3 fatty acids may be mediated by improvements in cerebral vascular function. Biosci Hypotheses. 2008; 1:103-108.</p>	

Project Title	Dose-response effects of restricted sleep on risk factors for Type 2 Diabetes
Supervisors	Associate Professor Jon Buckley, Dr Charli Sargent, Dr Alison Coates, Professor Drew Dawson, Professor Peter Howe.
Expected Start Date	February 2010
State the aims, objectives and significance of the study (max 200 words)	
<p>The aim of this study is to evaluate the dose-response effects of restricted sleep on risk factors for type 2 diabetes in order to identify whether there is a critical threshold for the amount of sleep required to maintain cardiometabolic health.</p> <p>The significance of this project is that while a number of studies have shown that restricted sleep contributes to poor cardiometabolic health and may predispose to type 2 diabetes, no study has identified the amount of sleep restriction that is required before these effects appear. This information will be used to inform public health campaigns to improve cardiometabolic health by achieving appropriate amounts of sleep.</p>	
Provide a brief description of the research plan / methodology (max 200 words)	
<p>12 participants will be recruited to participate in the study. The study will employ a randomised, counterbalanced, crossover design. Participants will complete five days of sleep restriction (5h sleep/night) and five days of normal sleep (8h sleep/night). Each condition will be preceded by a week of ad libitum sleep.</p> <p>Subjective mood will be assessed using the Profile of Mood States. Self-ratings of appetite will be made using Visual Analogue Scales. Subjective sleepiness will be assessed using the 9-point Karolinska Sleepiness Scale. Sleep will be assessed using standard polysomnographic techniques (PSG). Energy expenditure will be assessed using the doubly labelled water method. Macronutrient intake will be assessed over a two day period. Autonomic function will be assessed using HR variability and ambulatory BP monitoring. Rating of perceived exertion will be assessed during a sub-maximal exercise test. Glucose tolerance will be assessed using an oral glucose tolerance test. Plasma ACTH, cortisol, leptin and ghrelin concentrations will also be assessed.</p>	
Provide 1-2 references which would assist potential students to understand key principles or methods within this project.	
<p>Speigel et al. Journal of Applied Physiology (2005) Sleep loss: a novel risk factor for insulin resistance and Type 2 diabetes. 99;2008-2019.</p>	