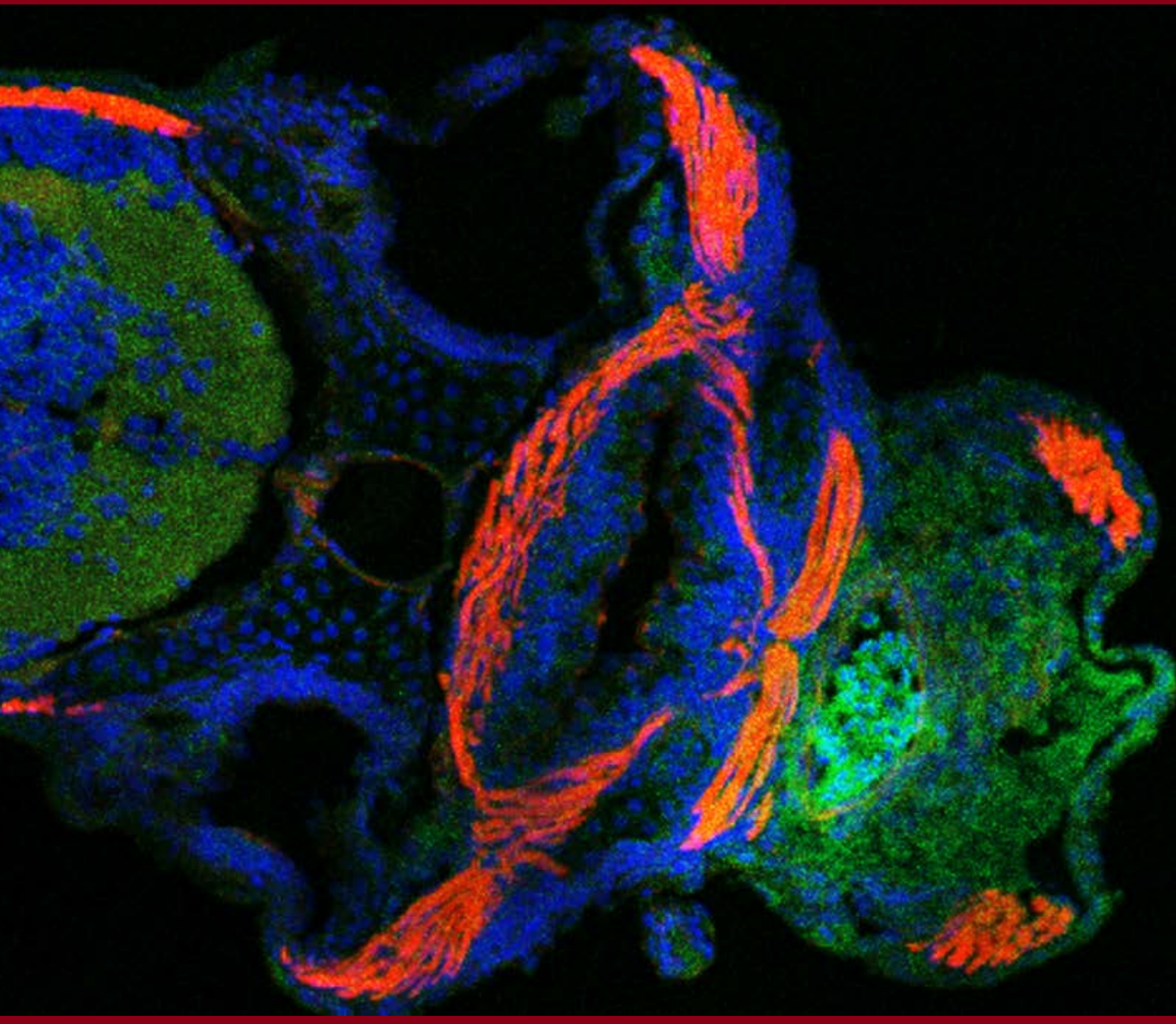
LA TROBE
UNIVERSITY • AUSTRALIA

Department of Microbiology, Anatomy, Physiology and Pharmacology

School of Agriculture, Biomedicine and Environment

Scientists at the forefront of knowledge into how biomolecules, cells, organ systems, disease and the environment interact to form functioning organisms (i.e. viruses, bacteria, animals, humans, etc.)



latrobe.edu.au/school-agriculture-biomedicine-and-environment

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Cover Photo:
Expression of fibronectin in the anterior region of a zebrafish larva (Photo Credit: Nishanthi Mathiyalagan)

About the School of Agriculture, Biomedicine and Environment

The School of Agriculture, Biomedicine and Environment is one of the largest in the University, with more than 170 continuing and fixed term staff across multiple campuses. Over the last three years the School has seen significant growth in both research and teaching revenue. Staff in the School currently generate a significant proportion of the University's teaching revenue and research income, and supervise more than 270 higher degree research students. The School is responsible for 7 undergraduate degree courses at the main Bundoora campus in Melbourne, and our regional campus at Albury-Wodonga. It is a leader in teaching innovation and student satisfaction within the university.

The School undertakes teaching and research across a broad range of disciplines, including: Agriculture, Botany, Soil Science, Animal Science, Plant Science, Ecology, Environmental Geoscience, Evolution and Genetics, Conservation Biology, Zoology, Neurobiology, Microbiology, Physiology, Pathophysiology, Pharmacology and Anatomy, Biochemistry, Chemistry and Cardiovascular Physiology. The School is a major contributor to research strengths in both the Biological and Agricultural Sciences, achieving the highest possible rating '5 - well above world standing' from the Australian Research Council in the fields of Ecology, Zoology, Plant Biology, Physiology, Microbiology, Biochemistry and Cell Biology, Crop and Pasture Production, Genetics, Soil Science, and Veterinary Science, and rated as '4 - above world standing' in Ecological Applications.

The 5 departments in the School are:

- Animal, Plant and Soil Sciences
- Baker Department of Cardiovascular Research, Translation and Implementation
- Biochemistry and Chemistry
- Environment and Genetics
- Microbiology, Anatomy, Pharmacology and Physiology

The School of Agriculture, Biomedicine and Environment research environment is dynamic and growing, and includes these major research centres:

- La Trobe Institute of Agriculture and Food (LIAF)
- ARC ITRH (Industry Transformation Research Hub) for Medicinal Agriculture
- ARC CoE (Centre of Excellence) Plant Energy Biology
- Centre for Livestock Interactions with Pathogens (CLiP)

- Centre for Cardiovascular Biology and Disease (collaboration with the Baker Heart and Diabetes Institute)
- Research Centre for Extracellular Vesicles
- Centre Research Biomedical and Environment Sensor Technology (BEST)
- Research Centre for Molecular Cancer Prevention
- La Trobe Institute for Molecular Science
- Research Centre for Future Landscapes (collaboration with the Arthur Rylah Institute of DELWP)
- Centre for Freshwater Ecosystems (formerly the Murray-Darling Freshwater Research Centre)
- Research Centre for Applied Alpine Ecology

- Mallee Regional Innovation Centre (MRIC)(a joint venture with The University of Melbourne)

Professor Shaun Collin
Dean, School of Agriculture, Biomedicine and Environment, Co-Director of AgriBio

Department of Microbiology, Anatomy, Physiology and Pharmacology

The Department of Microbiology, Anatomy, Physiology and Pharmacology is one of the largest academic departments at La Trobe University. The Department consists of more than 60 continuing and fixed-term academic staff, including one Tracey Banivanua Mar Fellow, one ARC Future Fellow, one ARC DECRA Fellow, and one NHMRC/National Heart Foundation ECR Fellow. Professor Grant Drummond serves the role of Head of Department.

We teach >3000 undergraduate students enrolled across 32 subjects. We take great pride in providing a friendly and supportive environment, taking particular care to ensure a positive experience for undergraduate students.

We teach into La Trobe's undergraduate Science, Biomedicine and Allied Health ` and offer fully online subjects through Open Universities Australia. A number of our teaching staff have been recognised as Fellows/Senior Fellows of the UK's Higher Education Academy, and have received university and national awards for innovation and excellence in curriculum design and delivery.

Our Department produces graduates who are ready to take up a diverse range of job opportunities, with potential careers in government departments and agencies, hospitals, community health centres, rehabilitation centres, pharmaceutical and biotech companies, private health-care organisations and research centres.

The Department has a dynamic Higher Degree by Research (HDR) program that reflects the disciplinary interests of the staff. We are currently training 75 PhD and Masters students and 30 Honours (4th year Research) students from Australia and overseas.

Research carried out in the Department is world leading and focusses on some of today's biggest challenges in health and the environment. Staff and postgraduate students research the structure, function and environment of microbes, animals and humans in health and disease. Our breadth of expertise and co-location in world-class facilities create opportunities for new discoveries in cardiovascular biology and disease, neuroscience, developmental biology, musculoskeletal function, host-pathogen interactions and microbial ecology. Through this research, members of the Department are key contributors to La Trobe's new Research Themes of:

- Understanding and preventing disease
- A healthy, safe and equitable life course for everyone
- Production of quality foods and medicines
- Protection and restoration of vulnerable ecosystems

The Department's research activities also underpinned La Trobe University's ratings of '5 – well above world standard' in the latest round of Excellence in Research Australia (ERA) in the disciplinary areas of Physiology, Microbiology and Cardiovascular Medicine. The Department also contributed to similarly high ratings in the areas of Neuroscience and Soil Science.

The Department's research environment is dynamic and growing, and includes close relationships with world-renowned medical research institutes such as the Baker Heart and Diabetes Institute and the Howard Florey Institute of Neuroscience. We also have research partnerships with state, federal and non-government agencies, and are home to a major Research Centre:

- The Centre for Cardiovascular Biology and Disease Research

Research Centre

- Centre for Cardiovascular Biology and Disease Research (collaboration with the Baker Heart and Diabetes Institute)

Centre for Cardiovascular Biology and Disease Research

Cardiovascular disease comprises a class of chronic diseases involving the heart and/or blood vessels, often leading to heart attack, stroke, heart failure and kidney disease. Cardiovascular disease is also a major cause of dementia.

In Australia, 4 million people suffer from cardiovascular disease, costing the economy $5 billion annually. Alarmingly, cardiovascular disease claims more than 40,000 Australian lives per year, with the highest death rates observed amongst Aboriginal and Torres Strait Islander peoples, socioeconomically disadvantaged groups, and those living in remote and regional areas. It is for these reasons that cardiovascular disease is recognised as a National Health Priority area by the Australian Government.

There is an urgent need for more research and greater public awareness to address the enormous health and economic impacts of cardiovascular disease.

Our research spans the spectrum of cardiovascular biology and diseases, encapsulating basic mechanistic research, clinical and allied health research, and epidemiological studies.

Work in our laboratories involves all major technologies of modern biomedical sciences with unique strengths in experimental animal models, mouse genetics, immunology, genomics and drug discovery, enabling translation of our findings into new diagnostics, preventions and treatments for cardiovascular disease. More specifically, the scope of our cross-disciplinary research includes:

- Unravelling the role of inflammation and activation of the immune system in the pathogenesis of hypertension and chronic kidney disease.
- Studying the inflammatory mechanisms occurring in the brain after a stroke or as a result of reduced blood supply due to stenosis of the carotid arteries.

- Examining changes in contractile properties of the heart during disease and how this is affected by sex hormones.
- Characterising the changes in the gut microbiome during hypertension, diabetes and stroke and determining how these changes influence disease progression.
- Investigating the role of foetal programming in the development of cardiovascular disease.
- Determining the functional components of diet that may protect against or increase the risk of developing cardiovascular disease.
- Utilising 'big data' statistical approaches to reveal associations and relationships between experimental variables and disease parameters, as well as risk factors for cardiovascular events from de-identified hospital and clinical data.

We strive for:

- Research Excellence; by integrating a range of disciplines, using cutting-edge multi-disciplinary technologies, and employing best practice in experimental design, to define the causes of cardiovascular disease and stroke.
- Collaboration; with world-leading researchers working in universities, hospitals and medical research institutes around Australia and across the globe.
- Being future-focused; we want to recruit, support and train the next generation of scientists committed to solving the most pressing global health problems.
- Impact; by partnering with government, the pharmaceutical industry and biotech, NGOs, philanthropic organisations, and communities, especially those in the north of Melbourne and regional Victoria, to share new knowledge and ensure it is translated into guidelines, diagnostics and therapies that reduce the socioeconomic burden of cardiovascular disease.

Co-Directors:
Profs Chris Sobey and Grant Drummond.

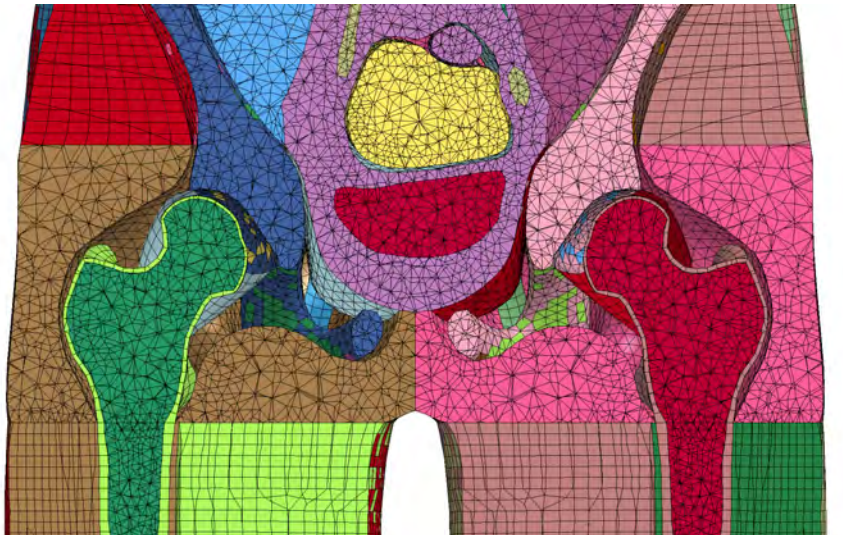
Group Leaders:
Prof Garrie Arumugam (Vascular Dementia);
Dr Alex Pinto (Cardiac Cellular Systems);
Dr Antony Vinh (Immunity and Hypertension);
Dr Helena Kim (Stroke and Brain Inflammation);
Dr Maria Jelinic (Obesity and Diabetes);
Dr Michael De Silva (Cerebrovascular Disease).

Strategic Partners:
Australian Cardiovascular Alliance
Baker Heart and Diabetes Institute
Beluga Foundation.

Research Groups

Anthropometry and Impact Biomechanics Laboratory

The application of human topographic anatomy to various disciplines is the main focus of this laboratory. The multidisciplinary approach of combining anatomical and biomechanical techniques to investigate injury prevention strategies has constituted the majority of work to date. Research has concentrated on hip fracture prevention, particularly the role of the gluteal muscles as an energy absorption medium when using energy shunting type hip protectors. Anthropometric studies have quantified variations in pelvic bony and soft tissue anatomy to improve the design of hip protectors and other prosthetic devices. This laboratory has a number of existing local and national collaborations including the Victorian Institute of Forensic Medicine (VIFM), The Forensic Engineering Society of Australia (FESA), The University of Melbourne (Body Donor Program) and the University of New South Wales (Transport and Road Safety Research Centre).



THUMS pedestrian fracture baseline
(Photo credit: UNSW, Transport and Road Safety Research Centre)

Anatomical and biomechanical basis of hip protector design

Hip fracture is a major cause of death and disability among older persons. Anatomical and biomechanical design considerations for shunting-type hip-protectors is being studied by this laboratory. Hip protectors are protective devices worn over the hip region to protect against injury during a fall by redistributing kinetic energy to adjacent anatomical structures. To date work has involved Computed Tomography and dissection techniques to create a three-dimensional map of human gluteal muscle thickness. This serves to aid in anatomically designed hip protecting devices. Biomechanical work involved developing a new method to measure material properties of skeletal muscle under fall conditions (dynamic impact) by impacting muscles in the in-situ state, substituting ovine for human specimens. Finite Element Modelling (FEM) are being used to evaluate the body's response to hip-protector function. These models are virtual computer-generated representations of real-world structures built with many elements, very much like a Lego model is built with many bricks. Each element can be assigned specific material properties, the net effect allows kinematic data to be attained from simulations of an impact to the model. The Total HUman Model for Safety (THUMS) was developed for use in the automotive industry for crash evaluation. This laboratory has worked to modify and use it to study fall related injuries in older people.

Anthropometric assessment of skeletal dimensions for prosthetic devices

Skeletal anthropometic studies enable the design of prosthetic devices and improve their fit to patients. Using the VIFM CT scan database, measurement of skeletal dimensions were used with mathematical models to estimate a key measurement required to fit prosthetic legs. This work was completed in collaboration with Assoc. Prof. Michael Dillon, Prosthetics and Orthotics, La Trobe University.

Forensic anatomical assessment of Egyptian mummies

This laboratory collaborates with the Victorian Institute of Forensic Medicine, to conduct forensic anatomical evaluations. Recently an intracranial review and gender determination of juvenile Egyptian mummies was undertaken using computed tomography 3D imaging. Collaboration with Dr Janet Davies, Victorian Institute of Forensic Medicine and Dr John H Taylor of the British Museum.

Review of La Trobe University's skeletal material for Aboriginal remains

In 2018 an audit reviewed all of the human skeletal material in the Department of Physiology, Anatomy and Microbiology to assess possession of Aboriginal remains. Ongoing assessment is performed on any newly donated human skeletal remains to ensure Aboriginal remains are repatriated.

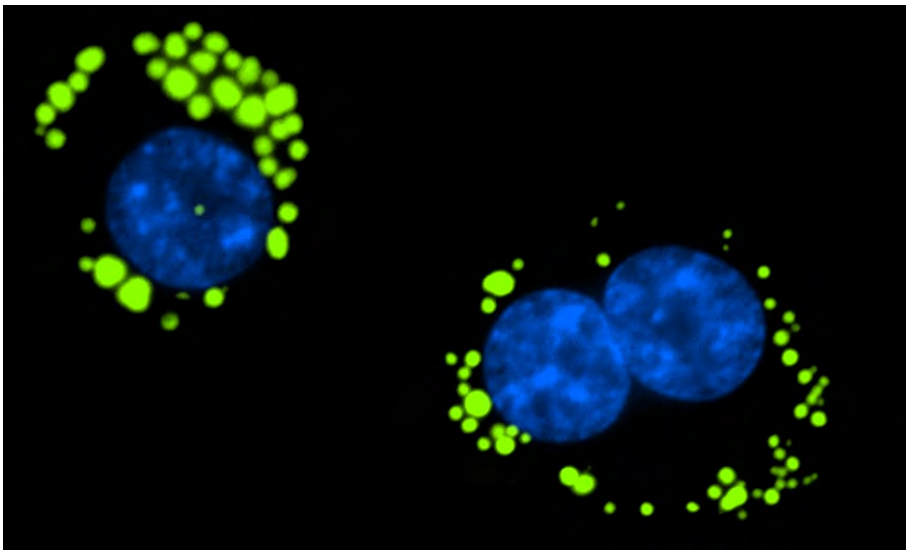
Lab Head: Dr Richard Fernandez.

Fields of Study:
Topographic anatomy; anthropometry; injury prevention; impact biomechanics; forensic applications of anatomy.

Capabilities and Techniques:
Human anatomical dissection; Computed Tomography scanning; anthropometric evaluation; Finite Element Modelling; Dynamic impact testing of biological tissue.

Antiviral Innate Immunity and Viral Genomics Group

Viruses infect all living organisms. Our laboratory studies both viruses of animals and humans to unravel the role of novel host and viral proteins in the control of viral infection, with a goal towards development of novel strategies to combat viral infection in both humans and animals. Our group uses advanced imaging, molecular, and genomic techniques to perform research across 4 main themes.



Macrophage lipid droplets. (Photo credit: Karla Helbig)

Detection of novel and emerging viruses (Helbig and Sarker Group)
Understanding the diversity of viruses in our environment has been limited by our ability to detect them. Since the advent of more sensitive next generation sequencing approaches, many new viruses have been described. Along with external partners we focus on three main areas of viral discovery: (1) detection of viral pathogens involved in new wildlife diseases; (2) analysis of viromes; and (3) detection and sequencing of new bacteriophages that target specific antibiotic resistant bacterial pathogens in animals. We investigate the development of new therapeutics and vaccines for animals and inform government of wild 'pest' risks to Australian livestock.

Host Induction of an efficient antiviral response
When a virus infects a cell, the host cell has sentinel receptors to detect foreign viral material. Receptor activation triggers a cascade of signaling pathways resulting in the upregulation of interferons, the main antiviral cytokines, which further upregulate thousands of antiviral gene products. Limited drugs are available to treat viral infections, and many significant viral infections have no treatments other than supportive care. We study molecular mechanisms that underpin the ability of a host cell to upregulate the most effective antiviral response. We focus on multiple viral pathogens across many animal and human models to uncover novel pathways and host proteins that will assist in developing next generation anti-viral drug treatments for multiple viruses.

Control of viral pathogens
Viral pathogen control is solely restricted to vaccines in the veterinary sector, with vaccines and a small handful of drugs available for the treatment of some viral infections in humans. In collaboration with the Beddoe Group (APSS) we work on developing new vaccines and tools to run vaccine trials for the veterinary sector. We focus on solutions for viral pathogens in small aquatic animals, where they do not have an adaptive immune system, and rely on innate immunity to control viral pathogens. We use our host induction research to develop new immune priming strategies to target viral pathogens in the aquatic livestock industry.

Understanding structure and function of viral protein (Sarker Group)
In-depth understanding of the structure and function of important viral proteins is crucial for development of potential anti-viral drugs or vaccines to successfully resolve viral diseases. Our research uses new technologies to uncover viral protein atomic structures. This enables a deeper understanding of viral protein functions to develop new anti-viral drugs or vaccines of benefit to threatened animal species vital for sustainable ecosystems.

Lab Head: Assoc Prof Karla Helbig.
Lab members: Dr Subir Sarker (DECRA Fellow); Ms Monique Smith; Ms Ebony Monson; Mr Keaton Crosse; Mr Jose Huaman-Torres; Ms Stephanie Lynch; Ms Jacinta Agius; Mr Jay Laws; Ms Ajani Athukorala.

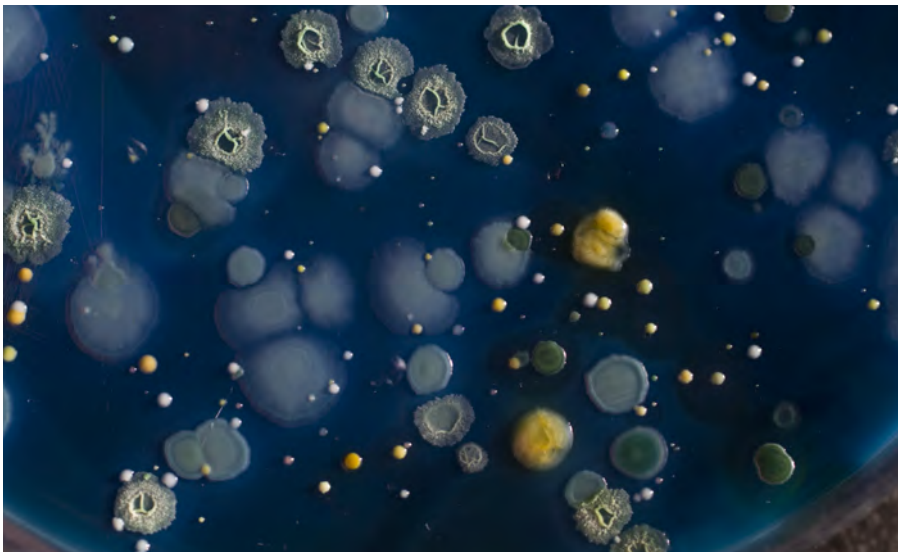
Fields of Study:
Virology; Innate Immunology; Structural biology; Viral metagenomics; Veterinary pathogens.

Capabilities and Techniques:
Microscopy: transmission electron, confocal, super resolution, light, fixed, live, static & movies; X-ray crystallography; Cell & virus culture & propagation; Primary cell culture; animal husbandry (mice/silkworms/ abalone); Viral delivery of genetic material; CRISPR/ cas; proteomics/lipidomics; bacterial & phage infection silkworm models; Protein expression & purification; Next generation sequencing; General molecular biology.

Translational Opportunities:
Viral animal pathogen detection; targeted drug development and management; bacteriophage solutions for antibiotic resistant infections in animals.

Applied and Environmental Microbiology Group

Our research investigates a diverse range of microbiomes associated with plant, human and ecosystem health. We have in-house Illumina Next-Generation sequencing facilities and develop custom bioinformatic pipelines for structural and functional community analysis. We have custom made equipment for the study of anaerobic microorganisms including electroactive bacteria, gut and soil microbes. We collaborate with medical, soil science and ecology researchers as well as NGOs, corporate partners, landholders, national and international partners. We lead the microbial branch of the La Trobe Applied Microbiomes project (LAMP) and pioneer the use of functional trait-based approaches for understanding of microbial communities.



Culturing diverse microorganisms (Photo credit: Gene Drendel)

Microbial trait ecology (what is your microbiome doing?)

Functional traits are physiological or morphological attributes that increase the fitness of a microbe in a given environment. Traits go beyond looking at 'who' is present in a community, to understanding 'how is the community behaving'. We are pioneering trait-based approaches for understanding microbial community behaviors in health, disease and the environment, leading to identifiable opportunities for 'engineering' these communities for beneficial outcomes.

The human microbiota and branched fatty acids promoting infant health

The human microbiota contains trillions of microbial cells with most present in the gut. Branched chain fatty acids (BCFA) in breast milk influence normal human microbiota development, infant gut epithelial cells, and the immune system. Preterm infants and those mainly fed on formula often lack BCFAs. We isolate bacteria producing BCFAs to study their impact on human microbiota and gut health. Our research may lead to new infant formulas for optimal infant gut and microbiota development.

The microbiome in health and disease

The human microbiome, performs vital health functions that influence immunity, synthesis of essential molecules, and even our mood. Interactions between the microbiome, genetics and physiology are complex. We collaborate with clinicians, neurobiologists and physiologists to study the microbiome's role in Parkinson's disease, Autism, cerebral malaria and gynaecological disorders.

Promoting plant productivity and diversity from the ground up

Agricultural and natural ecosystems rely on soil microorganisms for soil and plant productivity and wider ecosystem function. We study soil microbiology, plants, climate and soil management interactions to generate practical information that can be incorporated into improved farming practices and holistic conservation and management strategies.

Applied electromicrobiology

The developing field of electro-microbiology investigates bacteria with novel electrical properties including the ability to transfer electrons between each other and onto stable surfaces such as electrodes.

We use microbial fuel cells (MFCs) and plant MFCs to study these electroactive microbes and key roles they play in corrosion in bioremediation processes.

Lab Heads:

Dr Jennifer Wood & Prof Ashley Franks.

Lab Members:

Dr Anya Schindler; Mr Gene Drendel; Ms Sarah Knowler; Mr Joshua Vido; Mr Matt Brewer; Ms Jacqulyn Evans.

Fields of Study:

Microbiology; Ecology; Health; Bioremediation; Soil Science.

Capabilities and Techniques:

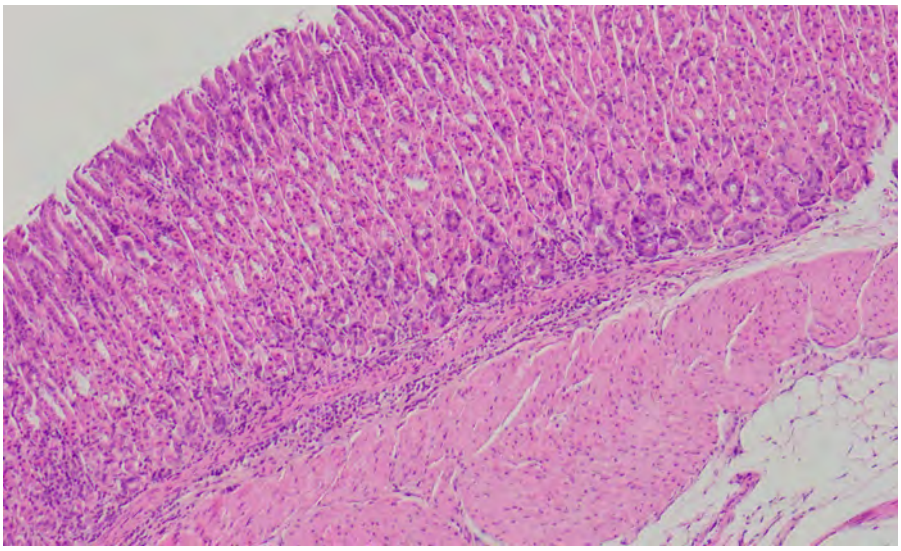
ARISA community profiling; Next-generation sequencing, quantitative PCR; Anaerobic microbiology (gassing station & anaerobic chamber); Electro-microbiology; multivariate statistics; bioinformatics.

Translational Opportunities:

Early detection/alleviation of human disease phenotypes (in Parkinson's Disease & Autism); improved sustainable agricultural land management practices; holistic ecosystem conservation and monitoring; soil contaminants bioremediation.

Bacterial Pathogenesis Group

Our body has about 39 trillion bacteria and everyday we encounter more bacteria, some of which cause disease. Our lab focuses on two fundamental questions: How do bacteria and their products interact with and cause disease in humans, and how does the host detect and respond to bacterial pathogens and their products resulting in immunity? Our facilities enable the detailed examination of host-pathogen interactions mediated by bacteria and their products. Our research, funded by Victorian, National and International agencies, involves national and international collaborators. We use cutting edge microbiology, immunology, and imaging techniques to study the cellular and molecular mechanisms of host-pathogen interactions.



Gastritis in response to *H. pylori* infection (Photo credit: Maria Liaskos)

Bacterial membrane vesicles (BMVs)

Bacterial membrane vesicles (BMVs) are spherical, bi-layered membrane nanostructures (20 to 300 nm in size) that are naturally produced by all bacteria as part of their normal growth. BMVs contain many of the components present within their parent bacterium in a non-replicative form, including lipopolysaccharide, toxins, DNA, proteins and enzymes. Our team studies the complex mechanisms used by bacteria to produce BMVs and regulate their cargo composition, in addition to determining how BMVs mediate disease in the host. We aim to understand the roles of BMVs in bacterial survival, promoting disease and enabling horizontal gene transfer within and between bacterial species. We are also developing methods to refine the use of BMVs as vaccines, and as nano-delivery molecules to deliver biological material into target cells.

Immune responses to the human gastric pathogen *Helicobacter pylori*

H. pylori is a bacterium that infects more than 3 billion people worldwide, causing lifelong infections resulting in gastritis, gastric ulcers and cancer. The mechanisms used by *H. pylori* to manipulate the immune system to mount an ineffective and chronic inflammatory response, and to survive remains unknown. Our team in collaboration with national and international clinicians and researchers focuses on identifying the mechanisms used by *H. pylori* to enable lifelong colonisation and disease. We use molecular, microbiology and immunology techniques, (animal models, human clinical samples and advanced immunological assays) to characterise immune responses to *H. pylori* and to identify targets to prevent *H. pylori* mediated disease.

Detection of bacteria by innate immune receptors

Host surface and cytoplasmic innate immune receptors detect bacterial pathogens and initiate an immune response. The host immune receptor nucleotide oligomerisation domain-1 (NOD1) detects a peptidoglycan motif present in all Gram-negative bacteria, resulting in an immune response. How NOD1 controls immune signalling and bacterial disease remains unknown. Our team studies how Gram-negative bacterial peptidoglycan is detected by NOD1 in order to identify methods to limit NOD1-mediated inflammation and disease in humans.

Microbiome and BMVs

We analyse BMVs produced by the human microbiota to understand their contribution to maintaining immunity and gut health.

Lab Head: Assoc Prof Maria Liaskos (publishing as Maria Kaparakis-Liaskos).

Lab Members:
Dr Natalie Bitto; Ms Ella Johnston; Ms Lauren Zavan; Mr William Gilmore; Ms Kalara Jayawardene; Ms Sarah Signorello.

Fields of Study:
Microbiology; Host-pathogen interactions; Innate Immunity; Cell biology; Immunology.

Capabilities and Techniques:
Bacterial/eukaryotic extracellular vesicles purification & characterisation; innate and adaptive immune responses to bacterial pathogens; microbiology; molecular microbiology; cell culture; live cell imaging; confocal & transmission electron microscopy; infection/vaccination animal models; flow cytometry.

Translational Opportunities:
Bacterial/eukaryotic vesicles; bacterial disease & animal models; Vaccine design/ delivery; development of biological nanocarriers; bacterial pathogenesis; characterisation & modulation of innate/ adaptive immune responses; protein expression; antimicrobial resistance mechanisms; horizontal gene transfer; microbiota immunological/biological functions.

Cardiac Disease Mechanisms group

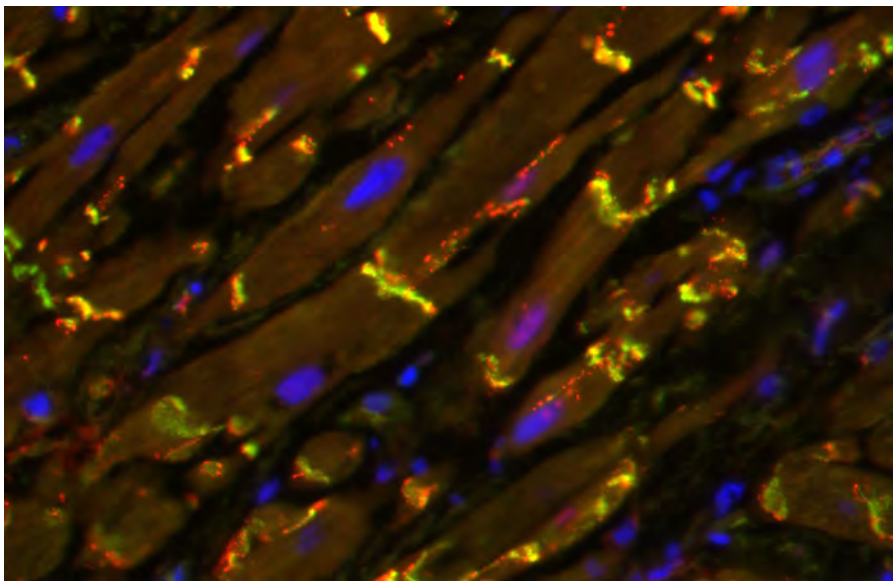
The Cardiac Disease Mechanisms Laboratory seeks to understand the cellular and molecular mechanisms driving diseases in the heart in a bid to identify new candidate targets for future therapies. One in five of all deaths in Australia are due to heart disease – a devastating public health and economic burden that will continue to escalate with an increasingly aged and obese population. This new research group within the Department has extensive expertise in in vivo, in vitro and molecular methodologies, with a focus on examining the underlying causes and pathological consequences of irregular heart rhythms (arrhythmias), heart attacks (myocardial infarction) and chronic heart failure.

'Heart fat' emerging as a critical mediator of heart disease

Increased body fat (especially visceral tummy fat) is known to be an important contributor to the development of heart disease, releasing factors into the blood that travel to the heart and disrupt function. Up until recently though, the role of the fat immediately surrounding the heart has been largely overlooked. This 'heart fat' increases markedly in obesity, with aging, and in post-menopausal women – all important risk factors for heart disease. Heart fat is increasingly thought to be critical to the development of irregular heart rhythms and relaxation abnormalities that represent a primary component of cardiac demise.

Inter-cellular communication between heart fat and muscle cells drive irregular heart rhythms

We have very recently shown that heart fat exerts a unique, detrimental influence on the surrounding heart muscle. Our findings show that the very close proximity between the fat and muscle cells within the heart greatly increases the potential influence of this local fat on heart function. We have taken the first steps in identifying the factors released from the heart fat, and look to establish how these modulate the function of neighbouring heart muscle cells in a manner that increases their vulnerability to potentially fatal irregular heart rhythms.



Cell-to-cell communication proteins in human cardiomyocytes (Photo credit: Jim Bell)

Relaxation abnormalities in fatty hearts?

We are also taking the field in a new direction, by investigating a very recently described clinical link between heart fat and the capacity of the heart to relax. An inability of the heart to relax properly disrupts its capacity to fill with blood, and is an emerging global health issue with no effective therapies available. Building on our growing understanding of the factors released from heart fat that influence heart rhythmicity, we seek to also identify how these may drive relaxation abnormalities that eventuate in heart failure and death.

Our research capacity is supported by ongoing pre-clinical/clinical collaborations developed both locally (University of Melbourne, Baker Heart Institute) and internationally (University of Birmingham, UK).

Lab Head: Dr Jim Bell.

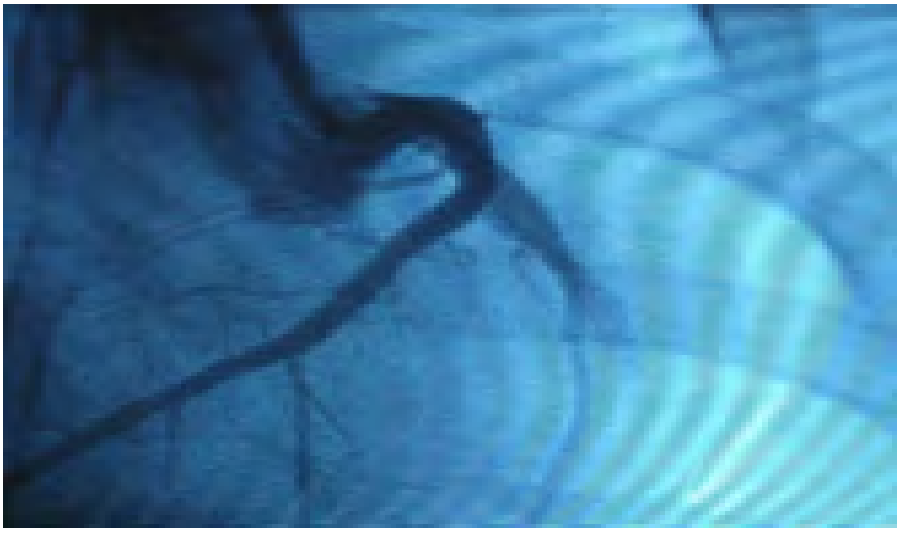
Fields of Study:
Cardiac arrhythmias; Heart failure; Adipose tissue; Intercellular signalling; Sex steroids.

Capabilities and Techniques:
Human cardiac tissue collection & rodent models of obesity; isolated heart & cardiomyocyte contractility; electrophysiology & conduction mapping; protein biochemistry; fibrosis/adipose infiltration quantification.

Translational Opportunities:
This research will identify novel molecular targets that advance preventative therapies for aged and obese populations at risk of developing heart disease.

Cardiovascular Physiology Group

Our collaborative clinical research involves local, national and international partners. Our laboratory-based coronary heart disease and heart failure research features an integrated approach of simultaneously monitoring blood pressure, heart rate and blood flow via indwelling or wireless monitors for long time periods. We conduct Proof-of-concept small animal model studies to screen and assess new interventions/drugs, and use large animal models, with similar anatomy and physiology to humans, to translate discoveries into clinical therapies.



Using contrast dye to evaluate coronary blood flow (Photo credit: Colleen Thomas)

Myocardial Ischemia-Reperfusion Injury

Heart attack patient survival depends on the amount of heart muscle damaged. The most effective treatment is to re-establish blood flow in the blocked artery which saves heart tissue, but also causes cell death. This is called ischemia-reperfusion (IR) injury and there are no drugs to prevent it. Along with collaborators, we developed a highly potent flavonol drug which significantly reduces myocardial IR injury and has multiple beneficial actions (antioxidant; inflammatory; ability to stimulate pro-survival kinase pathways in heart cells). We are developing a non-invasive intervention to reduce cardiac IR injury called remote ischaemic preconditioning (RIPC). This consists of multiple episodes of brief blood loss to a limb to stop prolonged blood loss in the heart. We developed a large animal RIPC model to study cardioprotection mechanisms and have assessed zinc homeostasis impairment in cardiac IR injury.

Gene Therapy for Heart failure

As populations age, and obesity and diabetes rates increase heart failure (HF) is becoming worse. About 25% of heart attack survivors develop HF which has no cure. We study the activation of 'good' genes as opposed to inhibiting 'bad' genes that cause heart disease and are trialling new gene therapies in mice to assess their therapeutic potential for acute and chronic HF.

Healthy Diet and Lifestyle for the Prevention and Management of Cardiovascular Disease

We study flavonols in plant-based polyphenols to see if healthy diet patterns improve CVD outcomes. We study plant-rich Mediterranean diets for heart disease-fighting properties and are trialling diet modifications to improve anti-inflammatory potential, including the clinical importance of polyphenol intake. We are assessing effects of legume and olive oil consumption in diabetes and heart disease, as well as diet and cognitive impairment risks in India.

Microbiome & Cardiometabolic disease

Links exist between heart inflammation and disruption to gut microbial colonies. In chronic low-grade inflammation diabetes, levels of anti-inflammatory protein Annexin-A1 (AnxA1) are reduced. We study AnxA1 deficiency effects on gut microbiome in diabetic mice. With clinicians, we are assessing gut bacteria composition changes after mini-gastric bypass surgery, and potential links to reversing obesity and diabetes.

Cardio-Renal Syndrome (CRS)

CRS occurs when the failure of the kidney or heart worsens the function of the other, leading to the failure of both. We are studying how to reverse uremic-toxin-induced vascular dysfunction.

Lab Head: Assoc Prof Colleen Thomas.
Lab members: Ms Shan Huang; Mr Sebastian Bass-Stringer; Mr Daniel Couch; Ms Denica Chahine; Ms Adonia Kalandos.

Fields of Study:
Cardiovascular Diseases; Public Health; Medical Biotechnology; Nutrition; Clinical Sciences.

Capabilities and Techniques:
Myocardial IR/RIPC animal models; Integrative Cardiovascular Monitoring; Blood flow/Haemodynamics (telemetry; chronic indwelling catheters, blood flow probes, electrocardiography); Biochemistry/ Molecular Biology; Clinical trial design & management; Anthropometry; Body composition - absorptiometry; Continuous glucose monitoring; Accelerometers for physical activity and Dietary assessment analyses; Dietary Inflammatory Index.

Translational Opportunities:
Cardiac myocyte-specific heart failure therapies; Highly potent flavonol application in stroke survivors; Hospital menu planning; Remote limb conditioning strategy (ambulances/sports rehab); Diabetic cognitive impairment screening; Digital/ mobile delivery MedDiet intervention.

Comparative Nutrition Group

The comparative nutrition laboratory has access to state-of-the-art facilities to investigate the role of diet in health and disease in a range of animals including animal models, livestock and human subjects. The research is collaborative and multi-disciplinary involving molecular, genetic and physiological approaches. Researchers use both in vitro and in vivo approaches to investigate the role of diet and dietary supplements in health and disease.

Caenorhabditis elegans group

Using a novel, liposome-based food delivery system, the model organism *C. elegans* is cultured in chemically defined, bacteria free medium to investigate the role diet and dietary components including phytochemicals in health and disease.

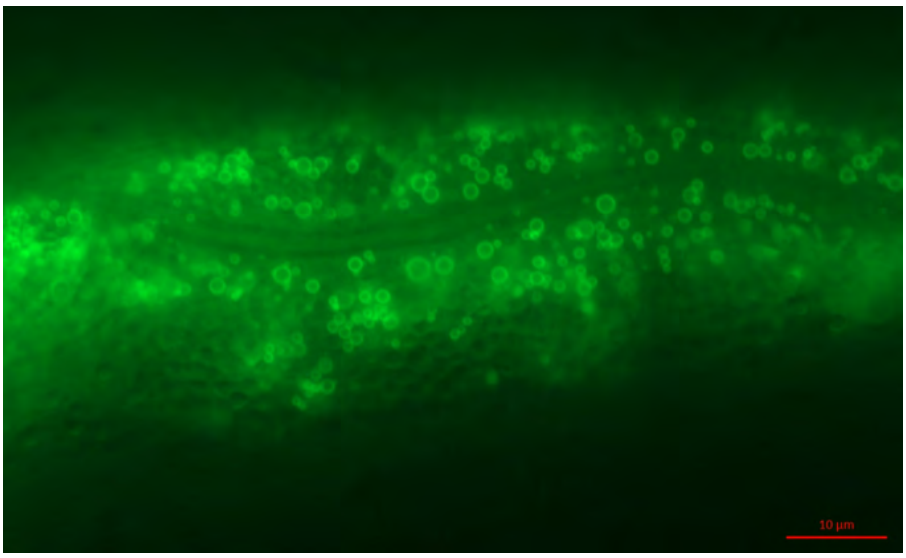
Current research projects:

- Effects of cocoa on the onset and progression of dementia induced by amyloid-βtoxicity in *C. elegans*
- Interactions between the diet, phytochemicals and the effects of anti-psychotic medications on body fat and health span
- Identification and functional characterization of sugarcane polyphenols
- Effects of macronutrient profile on lifespan and health span of *C. elegans*

Public Health Nutrition Group

Current research projects:

- Clinician-patient relations as barriers or enablers to uptake of interventions
- Understanding of self-management practices of Arabic-speaking people living with diabetes in Australia
- Dietary effects of culinary herbs and spices on body weight in patients on anti-depressants
- Effect of sugarcane polyphenols on glycaemic response in healthy subjects



Liquid droplets *C. elegans* (Photo credit: Mark Jois)

Ruminant Nutrition Group

Current research projects:

- Polyphenol-enriched formulations for sustainable dairy and beef industries: effects on enteric methane emission and on health and productivity of cattle
- Effect of PolygainTM on methanogenesis and microbiota in the rumen fluid dairy cows: a dose response study
- The relationship of perinatal maternal behaviour on ewe-lamb bond and lamb survival using sensor technology in extensive farming systems
- Application of sensor technology to assess pain and pain relief in lambs
- Effects of polyphenols on enteric methane emission in cattle
- Microbiome of the reproductive tract as a marker of fertility in dairy cows

Lab Head: Dr Markandeya (Mark) Jois.

Lab members: Dr Jency Thomas; Dr Sabrina Gupta; Dr Serpil Kucuktepe; Mr Rajneet Sohi; Ms Mihiri Munasinghe; Mr Abdullah Almotayri; Mr Awais Ahmed; Ms Deniz Heydarian; Mr Rahul Puvvada; Mr Anwar Althubyani; Ms Thi Huyen Trang Pham; Ms Chandana Deekshith; Ms Mia Bettio; Ms Alexandra Carroll; Mr Benjamin Chaffey; Ms Rochelle Joseph; Ms Atika Morrell; Ms Grace Shing-Francis.

Fields of Study:
Nutrition; Public Health; Clinical Sciences; Neurosciences; Animal Production.

Capabilities and Techniques:
Axenic *C elegans* culture; primary hepatocytes preparation; organ perfusion; surgical preparation of indwelling catheters; radiotracers; feeding/clinical trials; Dual Energy X-ray Absorptiometry; livestock feeding/rumination monitoring; remote sensing/monitoring livestock.

Translational Opportunities:
Bioactive compounds high throughput screening; clinical trials; public health policy; livestock productivity/welfare smart sensors; livestock methane output sensors/ mitigation.

Developmental Genetics Group

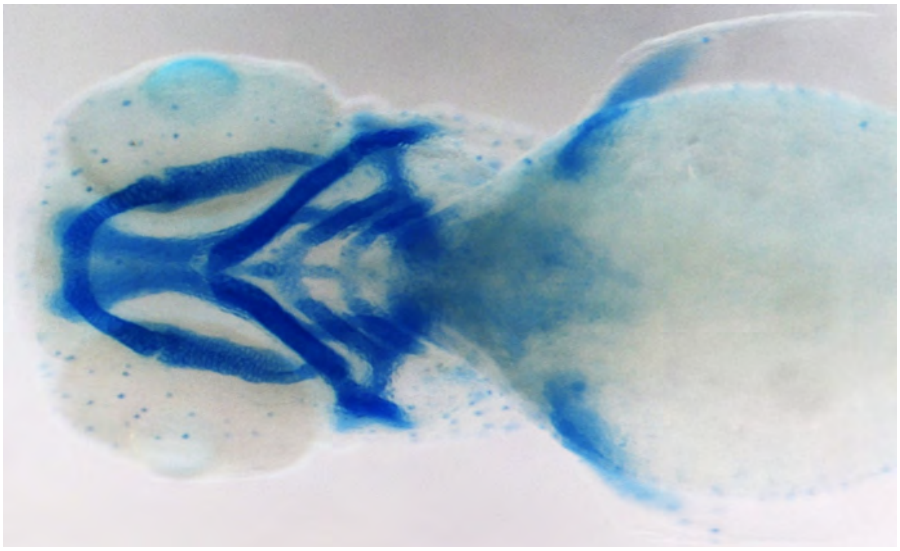
Cellular behaviours, particularly in the craniofacial region and neural tube, and the molecular pathways by which these behaviours are regulated, forms the cornerstone of understanding embryonic development. Using genetically-modified mouse and zebrafish models, our group identify critical genetic networks that underpin formation of the head (brain, skull and jaws) and epithelia of the body. We focus on the roles played by key conserved transcription factors *GRhl3* and *PLAG1* in regulating organ formation and behaviour in vertebrates. Our group aims to identify supplements that may overcome the severity and/or incidence of birth defects due to genetic deficiency.

Novel genetic pathways in skull, jaw and epithelial formation

Congenital anomalies affect the formation of the head, skull and jaws (craniofacial defects), are mainly caused by genetic mutations. We focus on the *Grainyhead like (Grhl)* genes, a key family that regulates craniofacial formation in flies, zebrafish, mice and humans. Mutations in these genes cause human craniofacial defects and disrupt epithelial development in the skin, lung and epididymis. We developed mouse and zebrafish models with impaired *Grhl* function, that identify new genetic pathways affecting skull, hard palate and lower jaw formation. Our animal models also identify the role these genes play in establishment and maintenance of healthy epithelia and ensuring correct organ function.

Environmental factors that affect embryonic development

Environmental factors (smoking, alcohol intake and bacterial/viral infection) can cause human birth defects. Supplements (folic acid, magnesium, zinc, vitamin B and iodine) reduce birth defect severity. We use zebrafish embryos and mouse palate explants to identify ways to reduce epithelial and craniofacial defects incidence and severity. We also study the effects of prolonged agricultural organophosphate insecticides exposure on adult behaviour and embryonic development.



Craniofacial skeleton in a zebrafish (Photo credit: Seb Dworkin)

Establishing zebrafish models of human craniofacial defects

Using both germline deletion and transient knockdown approaches, we establish zebrafish models to model structural human craniofacial skeleton birth defects. By identifying genes that are known to cause birth defects in humans and identifying and inhibiting the respective zebrafish orthologues of these genes, we study how and why mutations in these genes lead to defects, and how these may ultimately be overcome.

Animal models of neurocognitive and behavioural disorders

Using time-lapse microscopy, animal tracking software and mouse and zebrafish behavioural analyses, we study how genetic compromise during embryogenesis can lead to subsequent learning, memory and behavioural issues in later life. Using mouse models deficient for two genes – *PLAG1* and *Grhl3* - we study the habenula brain region that acts as a "handbrake" to guard against socially-inappropriate or overt risk-taking behaviours. Understanding how this neural center is established and maintained at the genetic level may lead to new therapies.

Lab Head: Dr Seb Dworkin.
Lab members: Mr Michael De Vries; Ms Nishanthi Mathiyalagan; Ms Stephanie Tran; Ms Joanne Wong; Ms Jemma Gasperoni; Mr Jarrad Fuller; Mr Jeremy Neylon.

Fields of Study:
Embryology; Genetics; Craniofacial Biology; Neurodevelopment; Animal models of disease.

Capabilities and Techniques:
Zebrafish model system; confocal and fluorescent microscopy; in-situ hybridisation; cartilage & bone staining; PCR & DNA/RNA molecular biology techniques; micro-injection; immunohistochemistry and basic histology; genetically-defined models (mouse, zebrafish) and mouse palate cultures.

Translational Opportunities:
Genetic counselling; Gene mutation identification for pre- and peri-natal healthcare to ameliorate craniofacial defects and behavioural disorders.

Diabetes and Metabolic Syndrome Group

The Diabetes & Metabolic Syndrome Laboratory uses innovative high-performance clinical and analytical techniques to assess the levels & activity of enzymes, hormones and trace elements in various biological samples in both animal model and human model.

The research group has established collaborations with local, national and international research teams aiming for better prevention and early management of diabetes mellitus and its cardiovascular complications.

The antioxidant, anti-inflammation and hypoglycaemic effects of selected nutraceutical supplements

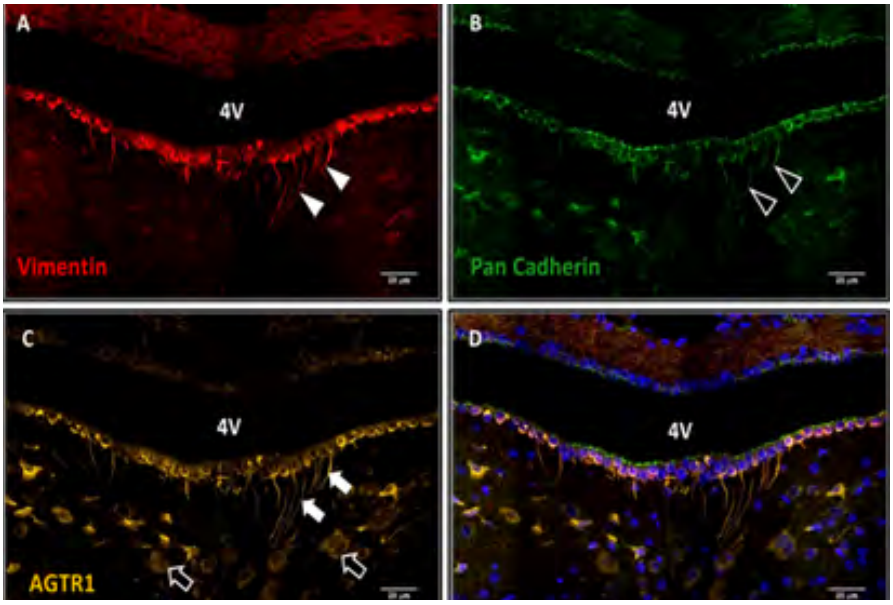
This research field aims to investigate the effects of a series of nutraceutical supplements (including citrus bioflavonoids and phytosterols) on the levels of oxidative stress, inflammation and glycaemic index in prediabetes and type 2 diabetes mellitus.

This project involves research collaboration from local (Professor Grant Drummond, Associate Professor Colleen Thomas, Dr Maria Jelinic), national (Dr Glenn Jacobson – University of Tasmania, Professor Catherine Itsiopoulos – Murdoch University) and international (Dr Lynne Chepulis –Waikato University, New Zealand).

Indicators of poor glycaemic control

The research group is working on the interplay of several biochemical markers associated with poor diabetes outcome which may precipitate the development of diabetes complications including cardiovascular disease.

In collaboration with research staff from Charles Sturt University and Khalifa University - United Arab Emirates, the research team introduced the oxidative stress and inflammation assessment as a routine clinical test of diabetes screening program in rural areas.



Immunofluorescence labeling of vimentin (A), pan cadherin (B), AGTR1 (C) and combined (D) in coronal sections of rat brain (Photo credit: Hayder Al-Aubaidy)

Improve diabetes management in developing countries

The research team has established collaborations with several clinicians and medical researchers from international universities in both Iraq and India to look for better ways to increase awareness of the risks of diabetes and its complications, through early diagnosis of prediabetes and type 2 diabetes mellitus.

This project involves researcher collaboration from University of Kufa, Al-Nahrain University, Al-Qadisiyah University and University of Basrah - Iraq, as well as the Era's Lucknow Medical College & Hospital, and Birla Institute of Technology & Science - India.

Through the above established collaborations, the research team managed to supervise several national and international research high degree students and generate high impact publications in peer reviewed journals and scientific conferences.

Lab Head: Dr Hayder Al-Aubaidy.

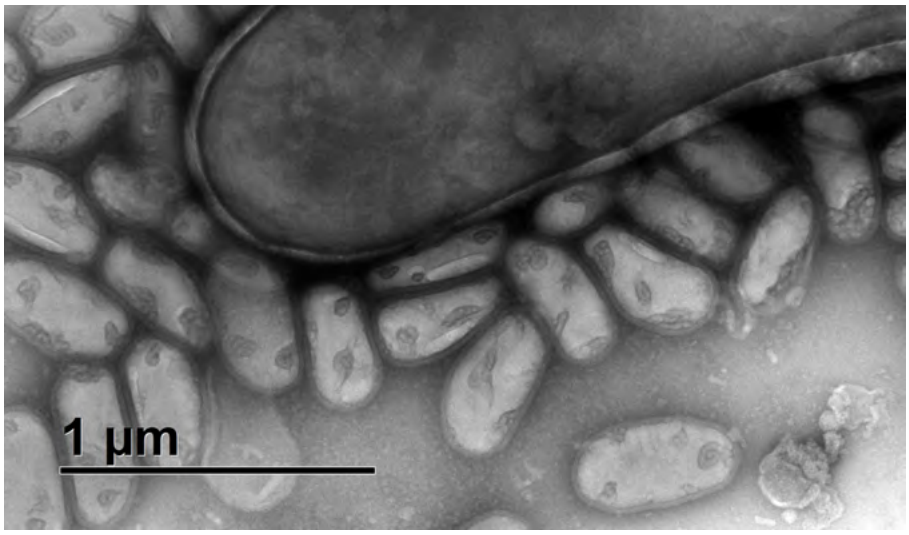
Fields of Study:
Diabetes Mellitus; Cardiovascular Disease; Prevention; Diagnosis; Early Management.

Capabilities and Techniques:
Ultra-Performance Liquid Chromatography-Mass Spectrophotometry; Enzyme Linked Immunosorbent Assay; Fluorometry; Molecular Biology; Epigenetics; Immunohistochemistry.

Translational Opportunities:
The current research work will provide a template for translational research aiming to test for the efficacy of selected nutraceutical supplements in reducing blood glucose levels and improving oxidative stress and inflammation in animal model as well as in human model.

Environmental Microbial Genetics Group

We study horizontal gene transfer (HGT) and genome sequencing, which is the mechanism of gene-swapping between bacteria of unrelated species. HGT provides opportunities for bacterial evolution over long and short timespans. HGT has contributed to antimicrobial-resistance amongst diverse, clinically significant, bacterial species, a situation that now threatens the usefulness of antimicrobials in the treatment of bacterial infections. We study plasmids, transposons and bacteriophages which are vital components of HGT. Our research group uses molecular genetic techniques, transmission electron microscopy, next generation sequencing, microbiological techniques and CRISPR/cas9 gene editing. We also have state of the art equipment, e.g. Illumina MiSeq, Nanopore sequencing facility, bioprocessing fermenter and other equipment to perform genetic analysis.



Transmission Electron Microscope Image of *Mycolasynbacter amalyticus* infecting *Gordonia pseudoamarae* (Photo credit: Steve Petrovski)

Bacterial horizontal gene transfer in *Pseudomonas aeruginosa*

Bacteria are evolving and are becoming resistant to antibiotics. Understanding how bacteria gain resistance can enable us to control the spread of resistance. *Pseudomonas aeruginosa* is a bacterium that thrives in environments including in humans where it can be part of the normal flora or an opportunistic pathogen that causes serious infections. *Pseudomonas* infection treatment is challenging because it is naturally resistant to antimicrobial agents and can carry plasmids that confer antibiotic resistance. We focus on the genetic elements in *P.* aeruginosa that contribute to the spread of antimicrobial resistance, particularly broad-host-range plasmids which are transmissible between diverse types of Gram-negative bacteria and serve as vehicles for HGT. We study the distribution and evolutionary relationships of these elements as well as the mechanistic basis of their mobility. Our aim is to prevent or limit the spread of antibiotic resistance and our research could also lead to new molecular biology tools that genetically manipulate bacteria.

Population dynamics and biocontrol of wastewater foams

Activated sludge processes remove excess nutrients from wastewater prior to release into other water bodies (oceans and/or lakes) but often fail due to microbiological foams. The brown scum surface foam in aeration tanks contains Candididatus '*Microthrix parvicella*' or "Mycolata" bacteria. We apply lytic bacteriophages directly to activated sludge plants to reduce the bacterial cell numbers below the foaming threshold. We have isolated >100 mycolata bacteriophages and have shown that we are able to control them. We also study bacteriophage interactions to identify their population dynamics.

Treating bacterial infections with phage therapy in humans and animals

With antibiotic resistance, alternative ways such as Phage therapy are needed to control serious bacterial infections. We are collaborating with Dr Joseph Tucci (School of Pharmacy) to find new phages for topical pharmaceuticals that fight bacterial infections and are developing pharmaceutical products that contain phages as an alternative to antibiotics. In collaboration with Defence Science Technology Group we are also developing bacteriophage bioterrorism biosensors to detect highly pathogenic organisms

Lab Head: Dr Steve Petrovski.

Lab members: Dr Steven Batinovic; Dr Mark Chan; Mr Vaheesan Rajabal; Mr Daniel Rice; Ms Aurelie Tsee; Ms Cassandra Stanton; Mr Jayson Rose; Mr Riley Scandolera; Mr Beau Patrick; Mr Damian Hughes.

Fields of Study:
Microbiology; Genetics; Microbial Ecology; Evolution; Biosensors.

Capabilities and Techniques:
Electron microscopy; Next Generation Sequencing; Microbial assays; Molecular Biology.

Translational Opportunities:
Developing potential bacteriophage cocktails to be applied to wastewater treatment plants to control bacterial proliferation that cause foaming and bulking; Developing novel pharmaceutical products containing bacteriophages; Developing Phage biosensors detection tools for use by Australian Defence Force.

Experimental Stroke and Inflammation Research Group

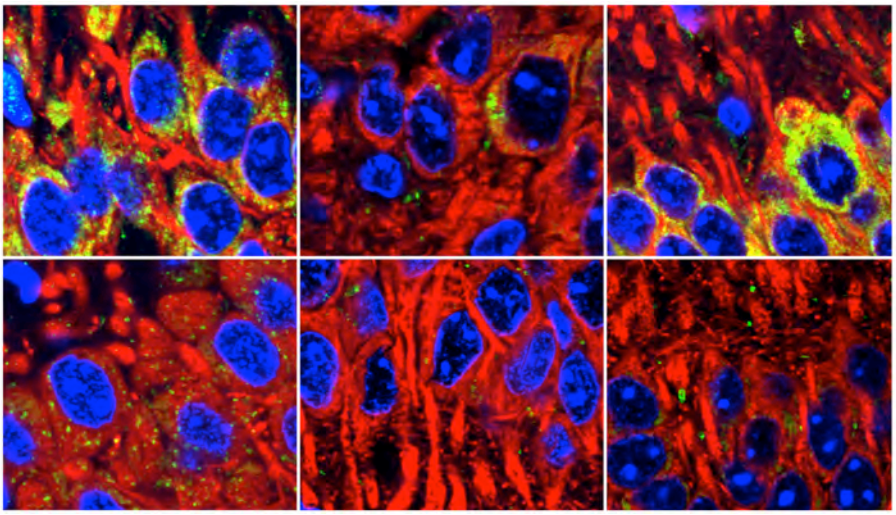
Our group aims to identify the molecular and cellular mechanisms that are involved in the injury process of ischaemic stroke and vascular dementia (VaD) and find new therapies for these diseases. We have discovered many new targets and used a number of pharmacological agents.

The Hypoxisome in Neuronal Resilience and Cell Death in Stroke

We have found that hypoxia (which occurs when part of the body is deprived of oxygen at the tissue level) and cerebral ischaemia (which occurs when insufficient amounts of blood flow to the brain) activate five signaling pathways that converge on a region called the 'hypoxisome' (a conserved DNA-associated nuclear multi-protein complex). The hypoxisome controls the genes that determine the fate of neurons. Our research is focused on how hypoxisome affects cell death following ischaemic stroke. We are studying when ischaemic injury is severe, and the hypoxisome up-regulates proteins that trigger and execute a neuronal death program. We also study the hypoxisome during remodeling following ischaemic stroke, when the hypoxisome up-regulates adaptive stress response genes encoding proteins that promote neuronal survival.

Uncovering the Mechanisms of Sterile Neuroinflammation in Stroke and Vascular Dementia (VaD)

Neuroinflammation causes neuronal tissue injury, impairments and disabilities. The mechanisms that initiate neuroinflammation following stroke are poorly understood. We found that cerebral ischemia/hypoxia activates innate immune receptors that initiate signaling cascades that activate protein kinases to start an inflammatory response. Activation of intracellular signaling pathways increases production of inflammasomes (multi-protein complexes) which contribute to cell death in tissue injury. We found inflammasomes affect neuronal tissue injury and behaviour in stroke (MCAO) and VaD (BCAS) models. We study how immune/PRRs recognize self-ligand in neurons undergoing metabolic stress, and activate inflammasomes and caspase-3 to initiate neuronal injury/death. We are studying how blocking the immune/PRRs signaling pathways weakens the amplification and initiation of inflammatory cell responses, to improve functional outcomes.



Immunofluorescence images of inflammasome activation in the hippocampus in Vascular Dementia (Photo credit: Garrie Arumugam)

Intermittent Metabolic Switching and Neurodegeneration

Studies found that healthy people with metabolic diseases have an increased risk for stroke and VaD. Intermittent fasting is a dietary protocol, where energy restriction is achieved by alternating periods of feeding and fasting. Intermittent fasting in rodents lessens or prevents cellular dysfunction and degeneration in cardiovascular disease models, including ischaemic stroke, via a preconditioning effect of energy restriction. How intermittent fasting alters expression of these proteins remains to be established. We found intermittent fasting protects from ischaemic stroke and cerebral hypoperfusion-induced brain injury. Studies have found epigenetic germline inheritance of diet induces obesity and insulin resistance. We found epigenetic changes occur in animals after intermittent fasting, and these changes may be responsible for the beneficial effects observed in several disease conditions. We aim to identify if intermittent fasting-induced epigenetic changes promote the expression of protective genes that improve outcome against ischaemic stroke and VaD.

Lab Head: Prof Thiruma V. Arumugam (Garrie).

Lab members:
Ms Luting Poh; Ms Sharmelee Selvarajii; Ms Vismitha Rajeev.

Fields of Study:
Neurobiology; Pharmacology; Molecular Biology; Epigenetics; Neurodegeneration.

Capabilities and Techniques:
Ischaemic stroke and vascular dementia animal models; Molecular Biology; RNA sequencing; Genomics; Proteomics; Flow Cytometry; Bioimaging; Cognitive Testing.

Translational Opportunities:
Our work on hypoxisome and inflammasome reveals novel cell death mechanisms and offers new therapeutic targets for ischaemic stroke and vascular dementia that could be translated in the clinical setting. Research outcomes from our group played an instrumental role to initiate three clinical trials for the treatment of stroke.

Labour Pain Group

There is an urgent need to improve approaches to supporting women through childbirth, to promote normal birth and positive experiences for women.

The pain associated with labour is unique and complex. While typical occurrences of pain tend to be associated with injury or disease, labour pain is different. It arises during a natural process in which it plays a role in driving the hormonal events of labour.

Despite the unique context and function of labour pain – which differentiates it from the pain associated with injury or disease – labour pain is most commonly treated as a pathological pain, associated with suffering. In countries such as Australia, intervention rates are escalating.

Over three-quarters of women use drugs for pain relief during labour, and one-third of women give birth by caesarean section. Although epidurals are very effective for pain relief, they paradoxically do not enhance women's labour experience and reduce their chances of having a normal birth.

Concerningly, the use of pharmacological pain interventions during labour increases the chance of poor health outcomes for women (e.g. emergency caesarean sections) and their babies (e.g. admission to special care), and is costly to the health sector.

Dr Laura Whitburn leads an innovative research program to reconceptualise labour pain. This program aims to develop a more sophisticated understanding of the nature and determinants of labour pain utilising contemporary pain science theories, and is based on the principle that labour pain is not a pathological pain condition.

Persephone's Birth (Photo credit: Jason Lander)

This research includes an investigation of the influences on women's attitudes and confidence as they approach labour (particularly on decisions to use pharmacological pain interventions) and the impact of the labour experience (particularly the ability to manage pain) on transition to parenthood.

This knowledge can then inform the development of novel strategies to improve women's experiences of labour and birth, enhance non-pharmacological pain management and reduce medically unwarranted interventions.

Current projects:

- Labour pain assessment: Evaluating a new woman-centred approach
- The language of labour pain: Understanding how words influence women's experiences of labour pain

Lab Head: Dr Laura Whitburn.

Collaborators:

- Prof Christine East (School of Nursing and Midwifery)
- Dr Mary-Ann Davey (Monash University)
- Mr Lester Jones (Singapore Institute of Technology)

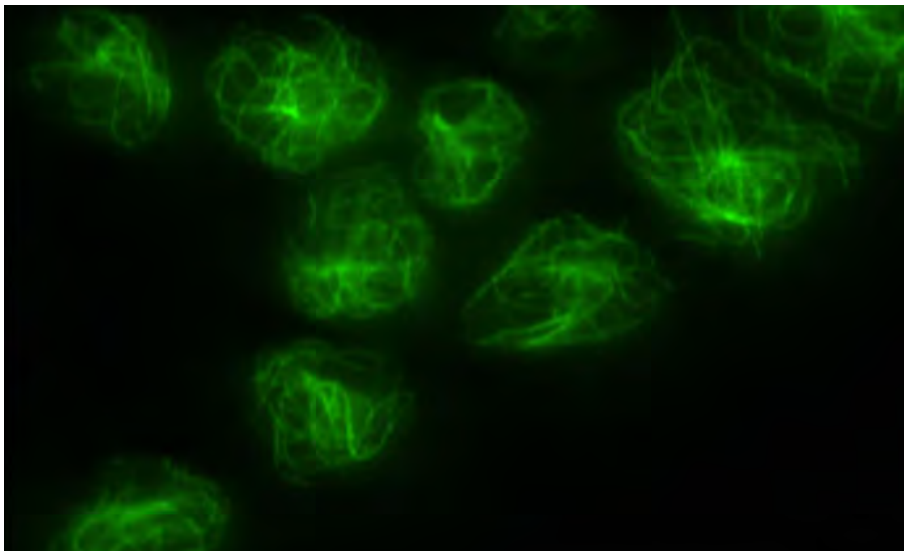
Fields of Study:
Medical and Health Sciences; Midwifery; Physiotherapy; Obstetrics; Gynaecology.

Capabilities and Techniques:
Qualitative research methods, particularly phenomenology; Longitudinal cohort studies.

Translational Opportunities:
The outcomes of this research aim to influence current practices in supporting women in labour, including policy and models of care.

Microbial Cell Biology Group

We investigate mitochondrial function and associated signalling pathways in neurodegenerative and neurological disorders – namely mitochondrial diseases, Alzheimer's Disease, Parkinson's Disease and Myalgic Encephalitis/Chronic Fatigue Syndrome (ME/CFS). Mitochondria are tiny organelles in cells that are often termed the powerhouses of cells because they are responsible for producing most (>90%) of the cell's energy. Dysregulation of the mitochondria or its associated signalling pathways is associated with neurological disorders, but the exact mechanism remains unclear. We employ different cellular models to investigate this including human cell models and a simple eukaryotic model *Dictyostelium discoideum*. Our ultimate aim is to characterise the underlying cytopathologies of certain neurological diseases and use this to identify disease biomarkers and develop diagnostic tests.



Dictyostelium cells showing microtubules in green. (Photo Credit: Katelyn Mcrozek)

Mitochondrial Disease

The organ system most commonly affected by mitochondrial dysfunction is the central nervous system and all of the major brain diseases are reported to involve impaired mitochondrial function. We use the simple eukaryotic model *Dictyostelium* to study mitochondrial disease. We create disease in *Dictyostelium* by disrupting (knockout), antisense-inhibiting (knockdown) or overexpressing wild type or mutant *Dictyostelium* or human disease genes. The main aim of this project is to characterise the changes to signalling proteins and pathways which occur in mitochondrial disease in order to increase our understanding and identify targets for therapeutic and diagnostic use.

Parkinson's Disease

Parkinson's Disease (PD), is a common neurodegenerative disease, no cure exists and the pathways leading to the disease are still unknown. We use different blood cellular models to investigate PD. In blood cells we characterise the mitochondrial function, measure activities of associated signalling proteins, and investigate pathways by exposing cells to pharmacological agents. We also investigate genetic forms of PD by either genetically altering homologous PD-associated genes in *Dictyostelium* or by expressing in *Dictyostelium* human PD-associated proteins. We then investigate the impacts of these on mitochondrial function and associated cellular signalling pathways. Using these two models allows us to investigate basic cellular roles of proteins and translate this information in a human system.

Myalgic Encephalitis/Chronic Fatigue Syndrome (ME/CFS)

Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) is incurable and affects 0.7-3.3% of the Australian population. The rate of recovery is only 5% and as the onset age is in the 30s, patients can remain ill for decades. We discovered mitochondrial and molecular and cell signalling abnormalities in ME/CFS cells, and have created new *Dictyostelium* cell models to investigate the causative molecular pathways.

Lab Head: Dr Sarah Annesley and Emeritus Prof Paul Fisher.

Lab Members:
Ms Oana Sanislav; Ms Claire Allan; Ms Katelyn Mcrozek; Mr Xavier Pearce; Ms Gizem Sen; Ms Claire Storey; Mr Daniel Missailidis; Ms Vanessa Musco; Ms Mayu Aburaya.

Fields of Study:
Cell Biology, Metabolism; Molecular Biology; Molecular Genetics.

Capabilities and Techniques:
All techniques of molecular biology; Seahorse respirometry assays; enzyme activity assays; immunofluorescence microscopy; diverse FRET-based; fluorometric and luminometric assays of cellular functions; transcriptomics; proteomics.

Translational Opportunities:
We have published a protocol for a diagnostic test for ME/CFS. It is a clinically useful biomarker test to aid in diagnosis of ME/CFS. We are also engaged in work on the development of a similar blood test for early, prodromal diagnosis of PD prior to it being clinically diagnosable by current neurological criteria.

Molecular Neuropharmacology Group

Understanding the ability of non-neuronal cells of the central nervous system to maintain neuronal health is critical to developing effective treatments for neurodegenerative diseases.

Our research focusses on the mechanisms underlying neuronal death in neurodegenerative diseases (such as Motor Neurone Disease, Parkinson's Disease and Alzheimer's Disease) and the role of non-neuronal cells in protecting against this neuronal death.

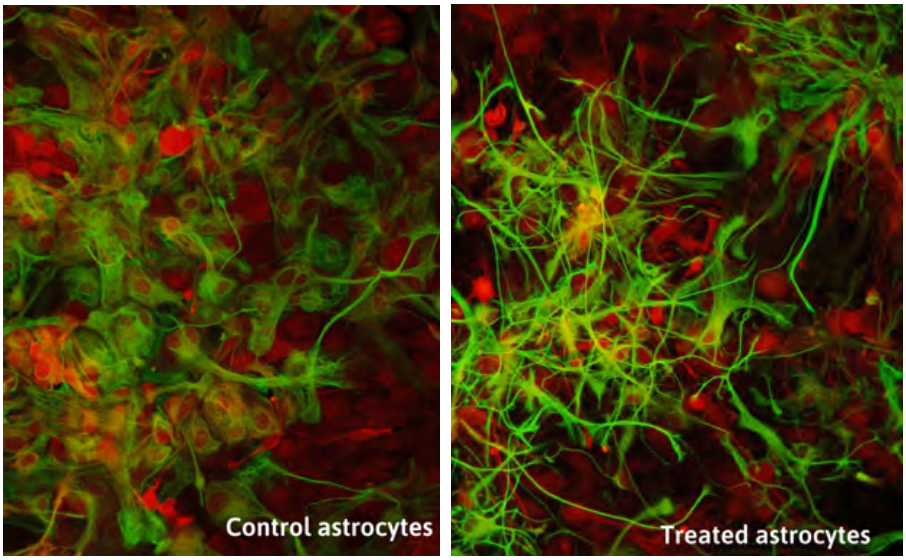
Astrocytes are the most abundant type of cell in the brain and play major roles in brain physiology and pathology.

The Molecular Neuropharmacology Laboratory focuses on identifying markers of "health" and disease in brain astrocytes and investigating pharmacological treatments that recruit astrocytes to protect neurones.

There have been numerous attempts to engineer neurones and stem cells for transplantation to promote re-establishment of function in neurodegenerative diseases, but targeting astrocytes for this purpose is a novel approach.

Astrocytes exert numerous positive influences on neuronal function by releasing trophic factors, controlling energetics and normalizing transmission; hence they represent a unique biological resource to keep "threatened" neurones alive.

Development of novel cell culture models to mimic brain injury and repair
Cell culture models are widely used to screen drug treatments affecting cellular processes, but lack key elements relating to brain function. We develop and implement cell culture models that more accurately reflect the nature of intact brain tissue and cell-cell interactions between diverse cell types. Models include organotypic (slice) cultures of brain regions, and 3D cell culture of brain astrocytes and neurones, using nanoscaffolds, to better model brain environment.



Modulation of astrocytes in cell culture (Photo credit: Ross O'Shea)

Identification of molecular pathways that promote neuronal survival
Astrocytes are extremely plastic cells that normally perform vital roles that maintain neuronal survival.

The activity of astrocytes is commonly impaired in neurodegenerative diseases; although these cells generally survive, their ability to promote neuronal viability is impaired. There is also evidence showing that astrocytes can actually initiate neuronal death in these diseases).

Numerous studies have demonstrated that astrocytes can be modulated in order to stimulate activities that support neuronal survival, and our previous work has identified important regulators of astrocytic structure and function.

Current work aims to investigate whether novel drugs with differing selectivity for inhibiting key pathways have differential effects on astrocytes that might promote neuronal survival.

Lab Head: Dr Ross O'Shea.

Fields of Study:
Pharmacology; Neurosciences.

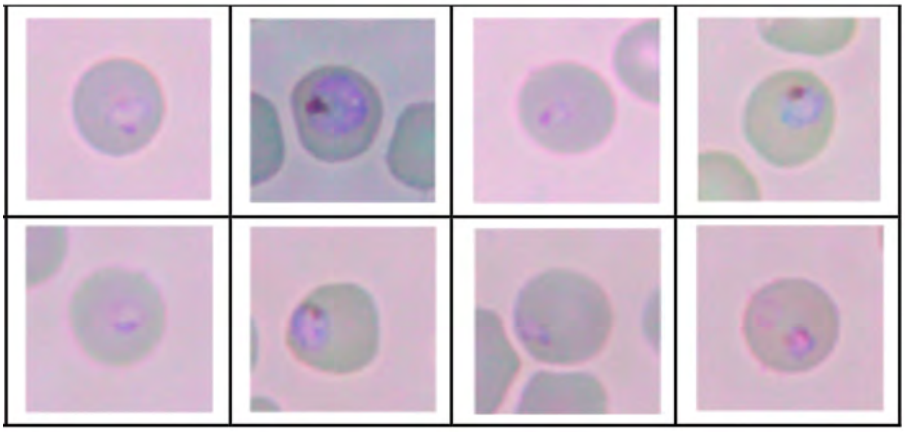
Capabilities and Techniques:
Cell culture – primary brain cells (astrocytes, microglia, neurones, mixed cultures, organotypic slice cultures); 3D cultures using nanoscaffolds; cell lines; Real-time imaging and immunocytochemistry in cultured cells (fluorescent markers of viability, metabolism, cytoskeletal function, protein localisation and abundance); Advanced image analysis of cell cultures and tissue sections – cell morphology; expression of proteins and cytoskeletal markers; viability; metabolism; Biochemical and pharmacological analysis of cell function in cultures; Western blotting including cellular fractionation (cytosol versus cell surface expression).

Translational Opportunities:
None as this is basic research.

Molecular Parasitology Lab

Parasitic infections heavily affect human and animal health. Indeed, half of the world population is at risk of contracting malaria, and one in four people on the planet suffer from soil-borne helminthic infections. Further, a variety of parasites also infect livestock, causing tremendous impact on animal health and significant economic losses.

Parasites can be transmitted by an insect vector, or simply present in water, soil or food, so infection rates can be very high. However, there are very few anti-parasitic vaccines available, and virtually none for human parasitic diseases. Treatment options can be limited and inefficient, and drug resistance is an increasing problem. Therefore, new treatment for parasitic diseases are urgently needed.



Testing of novel 3D-heterospirocycle compounds on malaria parasites (Photo credit: Teresa Carvalho)

How can we identify novel treatments for malaria?

Our laboratory studies *Plasmodium falciparum*, the most virulent of human malaria parasites that causes half a million deaths every year. In the absence of a malaria vaccine and with increasing drug resistance, it is urgent to identify novel anti-malarial treatments. Our team has a multi-disciplinary approach to this problem. We collaborate with chemists that produce novel chemical structures and test them for their anti-parasitic activity. We also test if treatments that are already available to treat other human disease (such as cancer) can be repurpose as anti-malarials.

From a fundamental perspective, we aim to understand the biological and genetic mechanisms that allow the parasite to survive inside its human host and cause disease. Ultimately, we use this knowledge to identify new molecules or re-purpose existing compounds, to prevent parasite growth and design novel treatments for malaria.

How to identify potential emerging pathogens?

Our research team also has a keen interest in animal parasites, and in particular in parasites of wildlife. Wild animals are well known to act as reservoir hosts of identified and emerging pathogens that can be transmitted to domestic animals, livestock and humans.

We aim to characterise the diversity of parasites that infect Australian wildlife, in particular in hosts such as wild deer and wild dogs. Wild deer and wild dogs have become increasingly prevalent in Australia in recent years and contact with livestock and human populations has increased.

We aim to evaluate if these animals constitute a pathogen reservoir populations and pose a risk of pathogen transmission.

Lab Head: Dr Teresa Carvalho.

Lab Members: Ms Coralie Boulet; Mr Jose Huaman; Ms Mary Fletcher; Mr Manon Reist; Ms Liana Theodoridis; Mr Lars Capule; Mr Derek Wong; Ms Lily Evans-Kenchington; Mr Corey Pollock.

Fields of Study:
Microbiology; Host-parasite interactions; Parasitology; Emerging pathogens; Biochemistry and Cell biology.

Capabilities and Techniques:
Parasite and human cells in vitro culture (PC2 laboratory); Fluorescent microscopy; Flow cytometry; Molecular biology; Drug inhibition assays; Protein expression; Protein immunoprecipitation; Mass spectrometry.

Translational Opportunities:

Drug repurposing; anti-parasitic drug discovery; host-directed therapies; animal parasite detection; emerging pathogens; zoonotic diseases.

Tweet: lab_carvalho

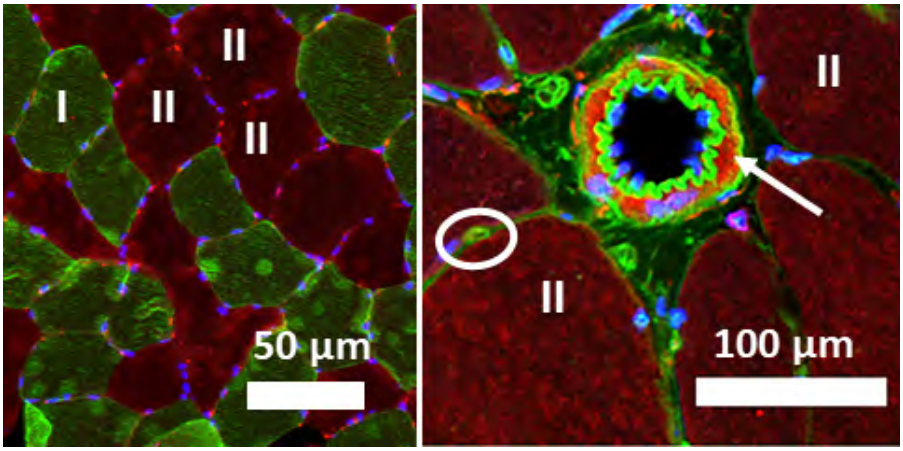
Website: www.latrobe.edu.au/physiology-anatomy-and-microbiology/research/carvalho

Musculoskeletal Research Group

Skeletal muscle tissue (the largest mass in the human body) accounts for 45% of total body weight and is essential for human health adapting in function and metabolism in response to increased physical activity and changes to metabolic demands. Loss of skeletal muscle mass leads to devastating consequences causing permanent disability and mortality in many conditions, including cancer, chronic heart failure, burn injury, kidney disease, diabetes, ageing, disuse, and numerous genetic disorders such as muscular dystrophy. We aim to understand the cellular mechanisms that regulate muscle plasticity and adaptation, so that we can identify new targets or develop treatment options for conditions with compromised skeletal muscle health. We study skeletal muscle adaptation and plasticity via a translational research approach using pre-clinical laboratory models including cell culture and multiple animal models of muscle adaptation and plasticity that are complemented with clinical models of exercise in humans.

Identifying novel supplements for muscle health
Endurance athletes consume supplements to minimize exercise-induced stress and enhance recovery and performance. Many supplements claim to positively influence exercise induced muscle adaptation but are poorly investigated regarding in vivo activity and efficacy in humans. We aim to understand supplement effects on healthy skeletal muscle function.

Improving muscle regeneration Skeletal muscle sports injuries are frequently associated with significant morbidity and prolonged loss of function. After injury, skeletal muscle regeneration has distinct phases: inflammation, degeneration and regeneration. These phase transitions are not fully understood. We use complementary cell culture experiments and muscle injury and regeneration animal models to study new muscle repair improvement therapies.



Fluorescent staining of myosin heavy chain and blood vessel in skeletal muscle (Photo credit: Nicole Stupka)

Characterizing genetic models of myopathy
Effective treatments for myopathies are difficult to find because the molecular changes underlying clinical phenotypes are poorly understood. Few mammalian models are available to study disease progression from juveniles to adult and finally in elderly mammals. Ageing effects are important for muscle related disorders as age-related changes in normal muscle protein expression, muscle strength and fibre-type composition can impact animal model responses to therapeutic strategies and pre-clinical therapeutic drug testing. We characterize and define age related changes in skeletal muscle phenotype in new muscle pathology models. We characterize new RyR1 myopathy models to test therapeutic strategies and drugs.

Targeting ER stress to improve skeletal muscle and bone health
The endoplasmic reticulum (ER) is pivotal in protein folding and calcium homeostasis in cell types including skeletal muscle. Selenium, essential for skeletal muscle, bone, and vascular health is present in selenoproteins. Selenoprotein S (Seps1) is one of seven ER selenoproteins and regulates Ca2+ movement and storage, oxidative and ER stress responses, inflammation, and adipocyte differentiation in skeletal muscle. Seps1 is a possible treatment for disorders with decreased muscle strength and endurance, loss of muscle mass, and bone degeneration. Our research group in collaboration with the Australian Institute for Musculoskeletal Science (AIMSS), is investigating the role of Seps1 in muscle and bone health.

Lab Head: Dr Chris van der Poel.

Lab Members:
Dr Jarrod Church; Dr Caroline Taylor; Dr Travis Dutka; Dr Giuseppe Posterino; Dr Brett Gordon; Dr Nicole Stupka.

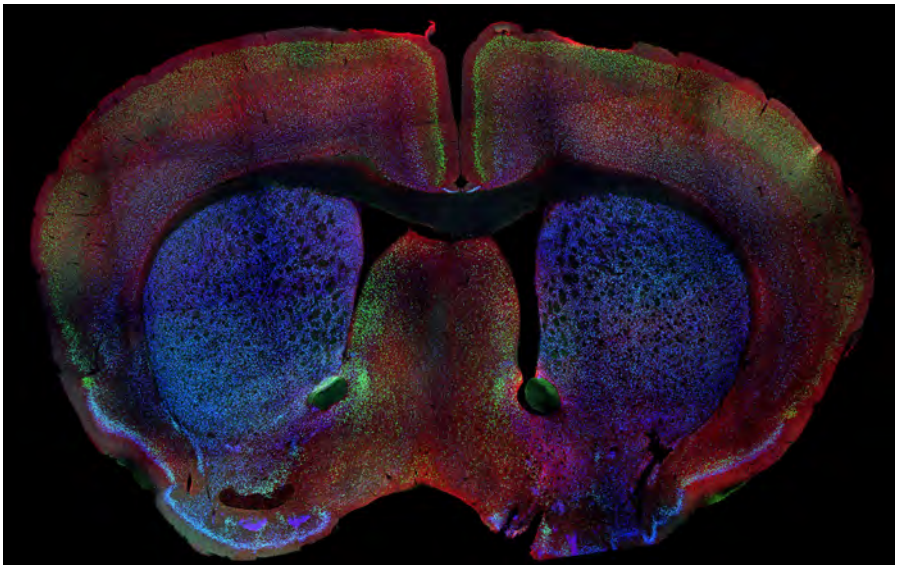
Fields of Study:
Skeletal Muscle; Sports Medicine; Cell Physiology.

Capabilities and Techniques:
Muscle injury models (chemical, stretch, and ischaemia-reperfusion); Skeletal muscle contractile function testing (in vitro, in situ); histology; immunohistochemistry; cell culture; biochemistry.

Translational Opportunities:
Muscle strength; Inflammatory Myopathies; Genetic Myopathies; Sarcopenia; Sports Supplements; Skeletal muscle health; Adaptation to exercise.

Neuropharmacology of Addiction Group

The Neuropharmacology Addiction Laboratory is interested in unravelling the underlying mechanisms in the brain involved in drug-seeking behaviour and relapse to drugs of abuse. We employ gold-standard techniques to assess drug-seeking behaviour in animal models, including the operant responding paradigm. In operant chambers, rodents learn to lever press for alcohol in the presence of cues, mimicking the experience of alcoholics in the real world. When the cues are removed, the behaviour is extinguished or reduced. The re-introduction of these cues is powerful enough to promote relapse (a process called cue-induced reinstatement or relapse). We are then able to investigate the potential of therapeutic drugs that may reduce lever pressing or cue-induced relapse. Our research also involves other behavioural neuroscience and neuropharmacological techniques using specialised equipment for behavioural phenotyping for assessing anxiety and depression, learning and cognition, and drug-induced changes.



Coronal section of rodent brain (Photo credit: Brad Turner)

Addiction and therapeutic targeting of pathways in the brain

Addiction is a chronic, relapsing disorder characterised by the use of a substance or act to the point of compulsion. There are several medical treatments available for the intervention of these disorders, however, the effectiveness of current therapeutics is far from adequate. Neuropeptides (biological molecules found in the brain) are known to modulate addictive behaviours and may provide new therapeutic targets for the potential treatment of substance abuse. Accumulating evidence suggests galanin as a potential important neuromodulator of addiction. Galanin is found in regions of the brain known to modulate reward-seeking behaviour. Both human genetic studies and animal models have also highlighted a role for this neuropeptide in affective disorders, as well as alcohol, nicotine, and opiate dependence. The main focus of our laboratory has therefore been on the role of galanin signalling in mediating alcohol-seeking behaviour.

Our group discovered that blocking the galanin-3 receptor in the brain using a compound called SNAP 37889, mitigated drug-seeking and cue-induced relapse, establishing this receptor as a therapeutic target in addiction.

Co-morbidity between addiction and mental health

There is strong evidence to suggest that a high number of people who suffer from substance abuse also suffer from an underlying affective disorder, such as depression and anxiety. Our laboratory is also interested in identifying new targets that may also improve symptoms of anxiety and depression, and therefore be beneficial in treating substance abuse. While we cannot fully model depression and anxiety in animals, we can model symptoms of these debilitating disorders. For example, the elevated plus maze is a gold standard technique for assessing anxiety-like symptoms in rodents. The elevated plus maze is in the shape of a cross and has two arms open to the environment and two arms that are closed to the environment. Rodents that are anxious will spend more time in the closed arm which is perceived as less of a threat than the open environment.

Many therapeutic drugs (e.g. diazepam, a benzodiazepine used for the treatment of anxiety) were originally identified using these behavioural tests. Our laboratory is interested in assessing all aspects of animal behaviour, including motor, cognitive and affective, which is fundamental for screening of new therapeutic drugs.

Lab Head: Assoc Prof Elly Djouma.
Lab members: Ms Shannyn Genders.

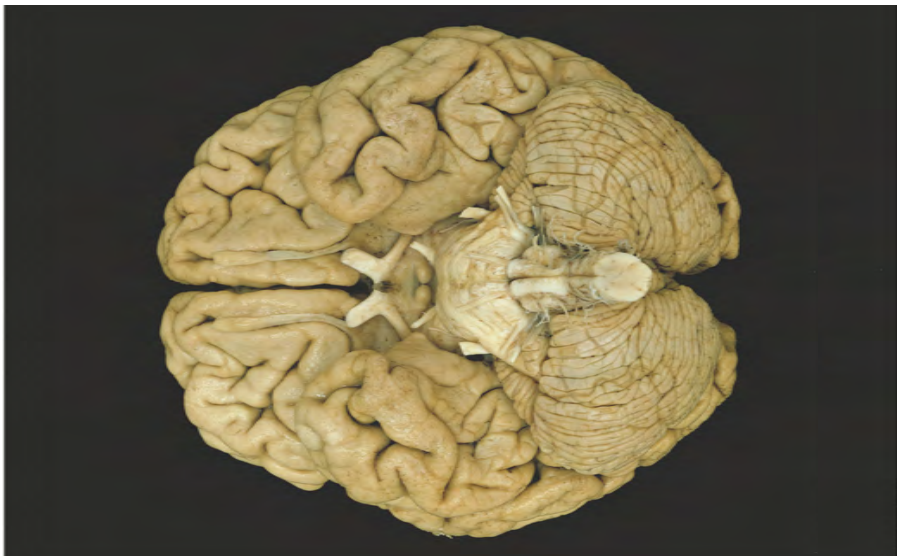
Fields of Study:
Neuroscience; Pharmacology; Addiction; Behaviour; Neuroanatomy.

Capabilities and Techniques:
Animal models of addiction including free-bottle two choice; operant responding; Behavioural testing including tests for anxiety and depression (elevated plus maze, open-field); brain histology.

Translational Opportunities:
Clinical trials for treatment of substance abuse and addiction.

Neurophysiology Group

The influence of the central nervous system (CNS) on long-term blood pressure (BP) levels and the relationship between BP and obesity and diabetes is a major focus of studies in the Neurophysiology Laboratory. Research in neurophysiology centres on cardiovascular neuroscience and fills a niche between the clinic and basic research. Work is carried out to understand the mechanisms that trigger cardiovascular diseases through environmental factors such as obesity. Obesity induced by a high fat diet is a main area of investigation and research is also being conducted into its effects in the CNS. We use animal models of obesity, programming of adult disease, as well as cutting-edge physiology, molecular biology, neuropharmacology and imaging techniques to address the most pressing questions in the field. Our work has provided new insights into the roles of neuronal signalling pathways such as leptin and insulin signalling pathways as key players of controlling sympathetic nerve system.



Brain (Photo credit: Joon Lim)

Role of brain neurotrophic factors in obesity induced cardiovascular disease

Obesity contributes to over 60% of newly diagnosed cases of high blood pressure (hypertension). While there have been many suggestions as to the cause of the hypertension, there is overwhelming evidence in experimental animals and humans to show that sympathetic nerve activity (SNA) is a major contributor. Using a rabbit, fed a high fat diet to induce obesity, we found that the ensuing hypertension can be abolished by either blocking SNA or by giving a leptin or melanocortin receptor (MC3/4R) antagonist into the ventromedial hypothalamus (VMH). We have shown that higher renal SNA is due to amplification of melanocortin receptor signalling within the VMH together with activation of brain derived neurotrophic factor (BDNF) and upregulation of MC4R. Increased release of alpha-melanocortin stimulating hormone (a-MSH) in the VMH and activation of MC4R is known to induce increased signalling related to other functions, but this is the first suggestion that this mechanism may be responsible for obesity hypertension. Our aim is to determine the mechanism responsible for the enhanced melanocortin signalling in the VMH and hence the cause of obesity induced hypertension.

Maternal obesity and programming of hypertension in offspring: Role of brain neurotrophic factors

It is not a secret that obesity is rapidly rising in both adults and in children world-wide. While in adults, behaviour promotes obesity and related cardiovascular disease, it is well established using animal models, that offspring of obese mothers undergo altered development and are more likely to develop obesity and hypertension even if their diet is not high in fat. This process, termed developmental programming, establishes a vicious cycle where maternal obesity "programs" offspring obesity in the absence of other risk factors, and this may explain the rapid rise in obesity in the past decades. A high fat diet (HFD) given to pregnant female rabbits and continued during suckling induces hypertension and increased sympathetic nerve activity (SNA) to the kidney in the offspring. This occurs even when they have been raised to adulthood on a normal fat diet. Our group have recently discovered an exciting finding by using microinjection of specific antagonists to the brain (hypothalamus). Our aim is to determine how changes in melanocortin signalling within the VMH of offspring from obese mothers cause hypertension and increased renal SNA.

Lab Head: Dr Joon Lim (Kyungjoon Lim).

Fields of Study:
Programming; Physiology; Development; Cardiovascular disease; Obesity.

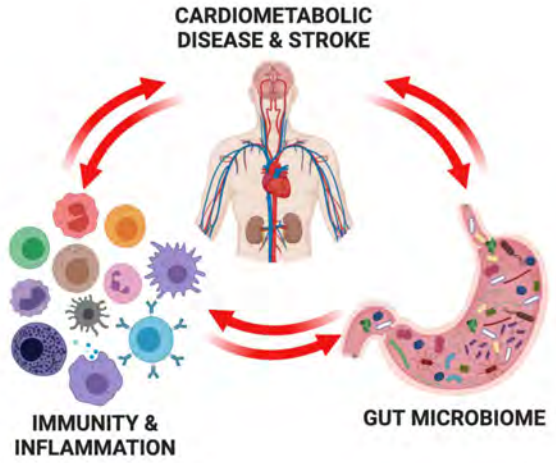
Capabilities and Techniques:
Sympathetic nerve recording in conscious animal; DEXA scanning; Echo cardiograph; immunohistochemistry; Molecular Biology; Stereology.

Translational Opportunities:
Treatment / prevention in maternal obesity and related development of obesity in offspring.

Vascular Biology and Immunopharmacology Group

Cardiometabolic disease claims 40,000 Australian lives per year due to events such as heart attacks and strokes. While current medications, which include blood pressure- and cholesterol-lowering agents, anti-arrhythmic drugs and blood thinners, reduce the risk of a deadly event in some patients, they are not effective in all cases. Thus, many patients remain at risk of a heart attack or stroke despite receiving best available care. Clearly, there are disease mechanisms at play that current medicines don't address. Our group is focused on identifying what these unknown mechanisms are and using the knowledge to identify new biomarkers for early disease detection and to develop more effective therapies. We study how disturbances to the immune system and gut microbiome promote inflammation and tissue damage in the brain, vascular wall, heart and kidneys. We use animal and cell culture models of cardiometabolic disease and stroke, as well as physiology, immunology, molecular biology, genomic and imaging techniques. We offer research projects for local and international students and postdocs.

Roles of innate and adaptive immunity in hypertension
Hypertension (high blood pressure) affects 40% of adults and is the leading risk factor for heart disease and stroke. It also promotes kidney disease, dementia and retinopathy (vision impairment). Drugs that increase urine production, dilate blood vessels and/or reduce heart rate are used to reduce blood pressure; but, over half of all patients still cannot control their blood pressure with these medications. Hypertension also affects the immune system. Inflammasome enzymes are switched on in the kidneys, blood vessels and heart in the early stages of hypertension, triggering cytokines to activate immune cells (T cells, B cells and macrophages). This chronic inflammatory response leads to tissue injury, scarring and an inability to regulate blood volume and vascular tone. We test drugs and strategies that inhibit inflammasome activity or block cytokine effects to reverse hypertension and end organ damage.



Targeting inflammation in stroke and vascular dementia
Stroke, from insufficient blood flow to the brain, is treated by clot-buster drugs or surgical clot removal to restore blood flow. However, these interventions are only suitable for 20% of patients and must be used quickly requiring advanced neuroimaging facilities. Brain cells may rapidly die from lack of oxygen or later from inflammation. We study acute and chronic stroke treatments that target and neutralise local inflammation. We assess brain injury, inflammation, motor function and cognition impairment, as well as vascular-related dementia and stroke treatments using stem cells, vitamin D and estrogen-like agents.

Defining links between gut health and cardiometabolic disease
Gut health strongly influences our wellbeing and protection from chronic disease. Our gut microbiota comprises bacteria and viruses that communicate with our nervous and immune systems. Imbalances in the gut microbiota, termed 'dysbiosis', disrupt these communication networks, leading to impaired function of many organs throughout the body. We study how changes in the gut microbiota during the development of hypertension, obesity and diabetes impacts immune function and inflammation within the kidneys, blood vessels, heart and brain. We identify the bacteria and viruses that are most affected during these diseases in order to design pre- , pro- and anti-biotic therapies to restore a healthy gut microbiota and promote cardiovascular health.

Lab Heads:
Profs Chris Sobey and Grant Drummond

Lab members: Antony Vinh; Brooke Huuskes; Courtney Judkins; Helena Kim; Maria Jelinic; Michael De Silva; Narbada Saini; Quynh Nhu Dinh; Richard Zhang; Ashleigh-Georgia Sherriff; Cecilia De Silva; Drishti Gelani; Henry Diep; Holly Brettle; Jemma Gasperoni; Flavia Wassef; Hericka Figueiredo Galvao; Jordyn Thomas; Liz Baretto; Vivian Tran; Buddhila Wickramasinghe; David Zhang; Frances Deen; Nitesh Gulia; Tayla Gibson Hughes; Abdiweli Warsame; Christian Kuneski; Jake Robertson; Joshua Hicks; Lida Hanna; Maral Baghaei.

Fields of Study:
Hypertension; Stroke; Immunology; Pharmacology; Neurobiology

Capabilities and Techniques:
Animal models of hypertension, stroke and obesity; flow cytometry; histopathology; immunohistochemistry; biomedical imaging; confocal microscopy; genomic sequencing; mouse behavioural/ cognitive testing; in vivo cardiovascular function; renal function, oxidative stress & inflammation assessment; vascular reactivity/compliance.

Translational Opportunities:
New drug targets, discovery, validation; Pre-clinical hypertension/stroke/chronic kidney disease drug assessment; stroke/ hypertension/dementia cell therapy and dietary interventions.

About La Trobe University

Our Mission

Advancing knowledge and learning to shape the future of our students and communities.

Our Vision

To promote positive change and address the major issues of our time through being connected, inclusive and excellent.

Our Values

Our early reputation as a radical and challenging institution continues to in uence the way we enrich the experience of our students and engage with our partners and communities.

We were founded half a century ago to broaden participation in higher education in Melbourne's north and, later, in regional Victoria. We have succeeded for many thousands of students who would otherwise have been excluded from the opportunities provided by a university education.

We continue to support access, diversity and inclusivity while undertaking world-class research that aims to address the global forces shaping our world and make a difference to some of the world's most pressing problems, including climate change, securing food, water and the environment, building healthy communities, and creating a more just and sustainable future.This approach is based on our values of:

- inclusiveness, diversity, equity and social justice
- pursuing excellence and sustainability in everything we do
- championing our local communities in Melbourne's north and regional Victoria
- being willing to innovate and disrupt the traditional way of doing things.

Of all Australian universities, we are the most successful at combining accessibility and excellence, and have become a place where social inclusion and globally-recognised excellence come together for the bene t of our students, our staff and our communities.

Our academics and researchers achieve national and international recognition, our public intellectuals demonstrate an enduring social conscience and in uence, and our alumni achieve extraordinary success and impact in government, industry and not for pro t organisations.

We strive to be exemplars for the sector in our commitment to gender equity and to inclusivity for marginalised groups; and we work with indigenous peoples and organisations to support their social, cultural and economic aspirations.

We embrace sustainable practices across all our campuses because we are committed to improving environmental, social and economic outcomes for our communities.

We contribute to economic development for our local communities, and our future activity will increasingly be international as we become a globally connected university in everything we do.

Our Culture

La Trobe Cultural Qualities

Our cultural qualities underpin everything we do. As we work towards realising the strategic goals of the University we strive to work in a way which is aligned to our four cultural qualities:

Connected

- We are Connected: Connecting the students and communities we serve to the world outside

Innovative

- We are Innovative: Tackling the big issues of our time to transform the lives of our students and society

Accountable

- We are Accountable: Striving for excellence in everything we do. Holding each other to account, and working the highest standards

Care

- We Care: We care about what we do and why we do it, because we believe in the power of education and research to transform lives and global society.

About Victoria and Melbourne

Experience Melbourne

Melbourne is the capital of the state of Victoria, and Australia's second largest city. It's a multicultural hub with 4.5 million people from over 153 countries. It's one of the world's best sporting cities, and is Australia's art and culture capital. Melbourne is a safe, well-serviced city in which to live. The main campus of the University at Bundoora is close to many world class hospitals, schools, research centres, shopping centres, bike paths and parklands. Melbournians enjoy, affordable healthcare, world-class education, reliable infrastructure, business opportunities and a healthy environment. In Melbourne you'll find just about every cuisine: French, Italian, Spanish, Greek, Chinese, Malaysian, Indian, Thai, Japanese, Moroccan and lots more. Melbourne has over 100 art galleries as well as theatres, international and local opera, ballet, comedy and live music.

Each year Melbourne hosts major international sporting events like the Australian Open Grand Slam tennis tournament, the Formula One Grand Prix, the Rip Curl Pro surfing championship, the Australian Masters golf tournament, the Melbourne Cup and the Grand Final of Australian Rules Football. As well as over 2500 festivals and events including the Melbourne International Arts Festival, Melbourne International Film Festival, Melbourne International Comedy Festival and the Melbourne Spring Racing Carnival.

Find out more: https://liveinmelbourne.vic.gov.au/discover

La Trobe University Campuses in Australia

Each of our seven campuses (Melbourne, Albury-Wodonga, City, Bendigo, Shepparton, Midura and Sydney) is a unique expression of place, people and history that play an important role in social, cultural and economic life. We are located in Victoria's major regional cities, creating a unique network of research, industry and innovation expertise that can be accessed across the state.

Victoria: The Garden State

Victoria has many notable gardens and 36 national parks covering two and a half million hectares. Victoria's many attractions include the Great Ocean Road, (stunning coastal views and the world-famous Twelve Apostles), the Grampians and the High Country.

Find outmore: visitvictoria.com

Melbourne Campus

La Trobe's Melbourne Campus has 27,000+ students and is surrounded by bushland. Students from across the world take advantage of state-of-the-art facilities, including our AgriBio Research Centre, the La Trobe Institute for Molecular Science and our very own Wildlife Sanctuary.

Albury-Wodonga Campus

La Trobe's Albury-Wodonga Campus has 800+ students and is home to our leading regional research centre, the Centre for Freshwater Ecosystems which focuses on water science and policy of the Murray-Darling basin. Here, undergraduate students work alongside Honours and research students on local issues.

School of Agriculture,
Biomedicine and Environment
La Trobe University