Growing up in Australia’s Child Health CheckPoint
2018 Student Projects

The Murdoch Children’s Research Institute and Royal Children’s Hospital, Melbourne, and CheckPoint collaborators
Dear student,

We are delighted you are considering undertaking a student project within Growing Up in Australia’s Child Health CheckPoint.

The Child Health CheckPoint offers new researchers involvement in Australasia’s premier national children’s study. This booklet summarises some projects available for commencement in 2017 – many more are possible, depending on the student’s interests. We offer PhD projects to students with funding stipends, e.g. via APA, university or international scholarships. All students contribute actively to the data management and derivation relevant to their project. If you are interested or would like to find out more about the project, please email lsac.childhealthcheckpoint@meri.edu.au or call 03 9936 6464.

Our supervisors are themselves top researchers spanning multiple disciplines, including

- Community child health
- Epidemiology
- Biostatistics
- IT
- Epigenetics
- Biobanking & biomarkers
- Health economics
- Health-related quality of life
- Use of time
- Mental health
- Respiratory health
- Cardiovascular health
- Obesity
- Inflammation & infection
- Physical activity and fitness
- Eye health
- Dental health
- Hearing
- Bone health

For more information about Growing Up in Australia’s Child Health CheckPoint: www.lsac-childhealthcheckpoint.org.au
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The Longitudinal Study of Australian Children

Growing up in Australia, also known as the Longitudinal Study of Australian Children (LSAC) is Australia’s largest and only nationally-representative children’s longitudinal study. It is funded by the Australian Government, and governed by three Government agencies: The Department of Social Services (DSS), Australian Institute of Family Studies (AIFS) and Australian Bureau of Statistics (ABS).

Growing Up in Australia was designed in 2002 to provide ‘a strong evidence base for policy development and service delivery on a wide range of issues relating to children’s development’. LSAC recruited two nationally-representative cohorts in 2004: the birth (‘B’) cohort aged 3-19 months, and the kindergarten (‘K’) cohort aged 4-5 years (not included in the Child Health CheckPoint). In a two-stage clustered sampling design, 10% of all Australian postcodes were randomly selected, stratified by state and urban/rural. 5,107 infants were recruited (64% uptake), with 91%, 88%, 86%, 91% and 84% retained to Waves 2, 3, 4, 5 and 6 respectively.

The main method of data collection is a biennial home interview, supplemented with questionnaires (children, parents, teachers), time diaries, limited direct assessments and data linkage to a number of national administrative data sets. There is a broad focus including health and development, education, family and parenting characteristics and socioeconomic environment.

LSAC has ongoing funding and is already highly productive with over 500 peer-reviewed papers and government reports.
Today, diseases of ageing increasingly drive the world’s burden of disease. The seeds of these non-communicable diseases—characterised by slow progression and long duration—are sown in childhood. They have related determinants and often cluster in individuals and families. It is believed that family, social, and environmental experiences all interact with the child’s innate biology to create shared modifiable pathways (such as chronic inflammation) to multiple diseases. Precursors of these diseases are already measurable as wide gradients of normal across many body systems in healthy children.

LSAC’s bold response to this ‘public health emergency in slow motion’ was to support a group of senior health researchers to leverage additional funding in a unique one-off addition to Growing Up In Australia. Throughout 2015-16, the LSAC 11-12 year olds from the original baby cohort participated in the Child Health CheckPoint. Each child and their accompanying parent attended a purpose-built assessment centre as it travelled around Australia. They undertook multiple state-of-the-art health measurements and provided biosamples (blood, saliva, hair, urine) during a busy 3.5 hour session. Nearly 2000 parent-child dyads took part, with the resulting digital and biological resource housed at the Murdoch Children’s Research Institute.

The Child Health CheckPoint targets multiple Australian health priorities. It will show how biology, environment and psychology ‘get under the skin’ during childhood and midlife via physiological adaptations that ultimately lead to the major causes of death and morbidity. We hope its findings will inform public health and service strategies that lessen the future of non-communicable diseases.

In this booklet, you will find a range of student opportunities. But these are only the beginning! If you have an important question that you think CheckPoint could answer, please contact us to discuss.
A series of interactive ‘CheckPoint’ stations, each assessing distinct body systems, were offered to the LSAC Baby Cohort at various purpose-built assessment centres and home visits across Australia. This involved the participation of children and one of their parents.

The measures collected within each station are shown in the circuit diagram below. Briefly, these included anthropological measurements, lung function tests, dental, bone and retinal imaging, audiology, cardiology assessments ... and many more!
The Murdoch Children’s Research Institute

The Murdoch Children’s Research Institute (MCRI) is based at the Royal Children’s Hospital, Melbourne. As the largest child health research institute in Australia, we are well positioned to make major discoveries to improve child health. With over 70 large research teams, we have the critical mass needed in modern day research to solve problems more rapidly.

At MCRI we work with our campus partners The Royal Children’s Hospital and the University of Melbourne’s Department of Paediatrics to improve the health and wellbeing of children.
PhD Project 1:

Micronutrient profiles and metabolic health in children and adults

Supervisors: Prof Martin Kussmann (m.kussmann@auckland.ac.nz) and Prof Melissa Wake (melissa.wake@mcri.edu.au)

This project can be undertaken by a student based at the Liggins Institute (University of Auckland, New Zealand).

Duration: 3 years

Aim: Analytical development and clinical application of a multiplexed panel of lipo-soluble vitamers.

Background: Nutrition is key to improving and preventing metabolic conditions such as diabetes and obesity. To date, technology and study designs have limited research to studying nutritional factors in isolation – a reductionist approach that does not reflect how physiology actually works. In fact, nutrient requirements and health outcomes are determined by the (individually subtle, yet concertedly strong) effects of multiple factors interacting across the life course to jointly exert an important health impact.

This PhD sits within a new partnership between the Liggins Institute (University of Auckland) and Australia’s Murdoch Children’s Research Institute partnership, aiming to advance the field to a new level of knowledge and capability regarding molecular nutrition and physiology. We will develop and apply both bio- and data-analytics, incorporating advanced biomathematics and computation to understand how molecular nutrition influences health.

Description: Micronutrients comprise vitamins, essential fatty and amino acids, and minerals (trace elements). Health depends on both micronutrient content of foods and micronutrient bioavailability in humans. These vary by genetics, environment and context. “Vitamers” is used as a term to cover the “parent” vitamin molecules plus their bioactive derivatives and metabolites. The PhD student shall develop, validate and apply an analytical approach for the quantification of lipo-soluble vitamins and their main circulating forms in human plasma. This multiplexed bioanalytical method can be developed and implemented on an already installed and functional LC-MS/MS systems at the Liggins, and should come as one integrated, high-throughput run for the analysis of clinical samples from ‘Growing Up in Australia’. PhD supervisor and systems biologist Kussmann has developed such platforms in his previous research laboratories (Meisser Redeuil J. Chrom. 2015; Petruzziello et al. Anal. Chem. submitted). Continued over...
Description (continued from previous page): The PhD candidate will be contributing to the data derivation and management of the relevant CheckPoint and LSAC datasets, in collaboration with the study team, and conducting quantitative analyses of the study data to address the study objectives. This project is available to students able to attract funding stipends, e.g. via university or international scholarships.
PhD Project 2:

One-carbon metabolism (the homocysteine pathway and folate cycle) and metabolic health in children and adults

Supervisors: Prof Martin Kussmann (m.kussmann@auckland.ac.nz) and Prof Melissa Wake (melissa.wake@mcri.edu.au)

This project can be undertaken by a student based at the Liggins Institute (University of Auckland, New Zealand).

Duration: 3 years

Aim: Analytical development and clinical application of a multiplexed panel for one-carbon metabolism substrates, enzymes and metabolites.

Background: Nutrition is key to improving and preventing metabolic conditions such as diabetes and obesity. To date, technology and study designs have limited research to studying nutritional factors in isolation – a reductionist approach that does not reflect how physiology actually works. In fact, nutrient requirements and health outcomes are determined by the (individually subtle, yet concertedly strong) effects of multiple factors interacting across the life course to jointly exert an important health impact.

This PhD sits within a new partnership between the Liggins Institute (University of Auckland) and Australia’s Murdoch Children’s Research Institute partnership, aiming to advance the field to a new level of knowledge and capability regarding molecular nutrition and physiology. We will develop and apply both bio- and data-analytics, incorporating advanced biomathematics and computation to understand how molecular nutrition influences health.

Description: One-carbon metabolism is a key regulator in metabolic processes, but only now does technology support its study at the population level. Today, there is no single analytical method available to monitor both metabolites and co-factors of the methionine/homocysteine cycle and folate pathway.

Continued over page...
**Description:** To address this limitation, the PhD student shall develop and implement a platform for simultaneous quantification of metabolites of these two key pathways. Such multi-analyte method can be based on ultra-performance liquid chromatography–tandem mass spectrometry (UPLC–MS/MS), as available at the Liggins. This will provide a novel metabonomic approach for large-scale observational and intervention studies. We expect such a robust method to be relevant for deep molecular phenotyping of individuals in relation to their nutritional requirements, health monitoring, and disease management. PhD supervisor and systems biologist Kussmannn has developed such platforms in his previous research laboratories (*Guiraud et al. Anal. Bioanal. Chem. 2016; DaSilva et al. Bioanalysis 2016*).

The PhD candidate will be contributing to the data derivation and management of the relevant CheckPoint and LSAC datasets, in collaboration with the study team, and conducting quantitative analyses of the study data to address the study objectives. This project is available to students able to attract funding stipends, e.g. via university or international scholarships.
**PhD Project 3:**

**Genetic architecture of obesity related phenotypes across generations**

**Supervisors:** Dr Justin O'Sullivan ([justin.osullivan@auckland.ac.nz](mailto:justin.osullivan@auckland.ac.nz)), Prof Richard Saffery ([richard.saffery@mcri.edu.au](mailto:richard.saffery@mcri.edu.au)) and Prof Melissa Wake ([melissa.wake@mcri.edu.au](mailto:melissa.wake@mcri.edu.au))

*This project can be undertaken by a student based at the Liggins Institute (University of Auckland, New Zealand) or the Murdoch Children’s Research Institute (University of Melbourne, Australia).*

**Duration:** 3 years

**Aim:** This PhD will dissect the role of genetic variation in shaping growth and anthropometry.

**Background:** The cumulative role of genetic variants on parameters of obesity phenotypes (e.g. BMI, adiposity, lipid profile and growth) has not been fully explored, particularly across different stages of the life course (childhood to adulthood).

**Description:** We are generating a unique multigenerational set of genotypic data from over 1500 parents and their children as part of the *Growing Up in Australia* study with which to dissect the genetic architecture of obesity-related phenotypes in both generations. This will be done using a four-dimensional network analysis approach (developed at the Liggins Institute, University of Auckland) to the unique biospecimens and paired cross-generational phenotypic data of *Growing Up in Australia*’s Child Health CheckPoint study. This network approach will maximise the utility of genomic data to predict risk and effective targeting of interventions to reduce obesity-related disease in children and adults, thereby providing opportunities to shape our social, health, and therapeutic strategies.

The PhD candidate will be contributing to the data derivation and management of the relevant CheckPoint and LSAC datasets, in collaboration with the study team, and conducting quantitative analyses of the study data to address the study objectives. This project is available to students able to attract funding stipends, e.g. via university or international scholarships.
PhD Project 4:

The interaction of dietary micronutrients with genetic factors in shaping obesity-related phenotypes in adults and children

Supervisors: Dr Justin O’Sullivan (justin.osullivan@auckland.ac.nz), Prof Richard Saffery (richard.saffery@mcri.edu.au), and Prof Melissa Wake (melissa.wake@auckland.ac.nz)

This project can be undertaken by a student based at the Liggins Institute (University of Auckland, New Zealand) or the Murdoch Children’s Research Institute (University of Melbourne, Australia).

Duration: 3 years, starting in 2019

Aim: This PhD will explore how micronutrient profiles influence underlying genetic risk for a range of obesity-related phenotypes in adults and their children.

Description: We will develop and ascertain the utility of a genetic-nutrition-based predictor (risk score) of obesity-related phenotypes across the first decade of life and across mid-life. This offers tremendous potential for a precision approach at two life stages critical to subsequent health, targeting those most likely to benefit from intervention in the longer term.

The PhD candidate will be contributing to the data derivation and management of the relevant CheckPoint and LSAC datasets, in collaboration with the study team, and conducting quantitative analyses of the study data to address the study objectives. This project is available to students able to attract funding stipends, e.g. via university or international scholarships.
**PhD Project 5:**

**Building your best day: optimising activity compositions for health**

**Supervisors:** Prof Tim Olds (tim.olds@unisa.edu.au), Prof Melissa Wake (melissa.wake@mcri.edu.au), Prof Julie Ratcliffe (julie.ratcliffe@unisa.edu.au), Dr François Fraysse (francois.fraysse@unis.edu.au)

This project can be supervised from the University of South Australia or the Murdoch Children’s Research Institute (University of Melbourne, Australia), and may be broad enough for more than one PhD student. This project would suit a PhD student with a background in computer science, engineering, maths or stats, epidemiology, or any science background with a love of numbers.

**Duration:** 3 years

**Aims/objectives:** This project will examine the relationship between activity compositions (how we use our time across a 24-h day) and health outcomes, and will identify the optimal activity composition for health.

**Background:** The three “movement behaviours” of physical activity (PA), screen time and sleep have each been linked to a wide range of physical and mental health outcomes in children and adults. Until recently, the focus has been on these behaviours individually, with governments and medical bodies producing separate guidelines for recommended amounts of physical activity, screen time and sleep. However, there is emerging evidence that optimal health may be associated with patterns of behaviours rather than individual behaviours.

Reframing the lifestyle-health link in terms of the 24-h day makes sense, because the day can be construed as a set of mutually exclusive and exhaustive behavioural domains. This means that to increase the time spent in one domain (such as PA) we must necessarily decrease the time spent in at least one other domain (such as sleep). The overall health effect will be a function of the overall change across all domains. The new paradigm talks of the activity composition rather than individual behavioural domains.

This requires a novel mathematical approach: compositional data analysis. Like many paradigm-changing ideas, this is a simple and obvious concept, but it means that the statistical models we have been using have been in many cases inappropriate, that many of our conclusions may be spurious, and that our conceptual frameworks have been poorly formulated.

Because activity compositions involve trade-offs of one behaviour against another (more physical activity may mean less sleep), it is not easy to locate the ideal activity composition for any given health outcome. To find the optimal activity composition for a given outcome or set of outcomes, we need to combine CoDA with another branch of mathematics called optimisation theory.
The primary dataset for this program of research will be the *Child Health CheckPoint* study of about 1800 11 year old children and their parents, which is embedded within the Longitudinal Study of Australian Children (LSAC). The CheckPoint study has a very wide range of health outcomes, plus 7-day 24-h accelerometry and 3-day 24-h use-of-time recalls using the MARCA. Through data linkage, we also have access to health services usage and academic performance.

The PhD candidate will be contributing to the data derivation and management of the relevant CheckPoint and LSAC datasets, in collaboration with the study team, and conducting quantitative analyses of the study data to address the study objectives. This project is available to students able to attract funding stipends, e.g. via university or international scholarships.
Honours or Masters Project 6:

The ‘Premmie Health Profile’: Do babies born early or small have distinct patterns of health and metabolic disparities?

Supervisors: Dr Susan Clifford ([susan.clifford@mcri.edu.au](mailto:susan.clifford@mcri.edu.au)), Prof Melissa Wake ([melissa.wake@mcri.edu.au](mailto:melissa.wake@mcri.edu.au)), others to be confirmed

This project can be undertaken by a student based at the Murdoch Children’s Research Institute (University of Melbourne, Australia).

Duration: 1 or 2 years, as an Honours or Masters project, respectively

Aims/objectives: This project will investigate the cross-domain profile associated with gestational age and birth weight, considering physical health, metabolomics, psychosocial and cognitive domains.

Background: Premature birth and being born small for gestational age (SGA) are costly to the healthcare system and elicit substantial concern amongst parents and clinicians. There is increasing interest in those born late preterm and early term, who make up a significant proportion of total births. Preterm children are more likely to experience health, cognitive and academic deficits than their peers in early childhood. Most studies evaluate outcomes in one domain but not multiple domains simultaneously in a single cohort to look for a cross-domain profile associated with prematurity.

Aside from being premature, being born small at any gestational age may also have a lasting legacy on later health. Previous studies have focussed on SGA children, but there may be impacts on later health across the full continuum of gestational size.

In a large national cohort of Australian 11-12 year old children, we will investigate the cross-domain profile associated with gestational age and birth weight, considering physical health, metabolomics, psychosocial and cognitive domains.

The Longitudinal Study of Australian Children (LSAC) is a national, population-derived cohort of Australian children. Commencing in 2004, soon after the children were born, the study has assessed the children and their families every two years, and in 2015-16, conducted a comprehensive physical health assessment and biosample collection module called the Child Health CheckPoint. This project will utilise pregnancy and birth data from LSAC Wave 1 (child age 0-1 year), cognition, academic outcome and emotional/mental health data from LSAC Wave 6 (10-11 years), and physical health (cardiovascular, renal, bone, respiratory, body composition) and biologic data from the CheckPoint (11-12 years).

The project will suit someone interested in health, epidemiology and/or statistics, and working closely with a strong interdisciplinary team. Given the large, high quality data available, findings are likely to be published in a quality journal.
Honours or Masters Project 7:

The ‘Premmie Health Profile’: Do babies born early or small have distinct patterns of health and metabolic disparities?

Supervisors: Dr Susan Clifford (susan.clifford@mcri.edu.au), Prof Melissa Wake (melissa.wake@mcri.edu.au), others to be confirmed

This project can be undertaken by a student based at the Murdoch Children’s Research Institute (University of Melbourne, Australia).

Duration: 1 or 2 years, as an Honours or Masters project, respectively

Aims/objectives: This project will investigate how physical health, metabolomics, psychosocial and cognitive domains are associated with gestational age and birth weight across the continuum, and determine the optimal age and size for later child health overall, and by specific health or metabolic outcome.

Background: Premature birth and being born small for gestational age (SGA) are costly to the healthcare system and elicit substantial concern amongst parents and clinicians. While previous studies have focused on early pre-term and SGA children, there is increasing interest in those born late preterm and early term, who make up a significant proportion of total births.

Being born early or small is associated with poorer outcomes in childhood health, cognition and academic achievement than average gestational age and size children, but little is known about the optimal gestational size and age associated with outcomes, and how this association varies across the physical and psychosocial health and cognition domains.

In a large national cohort of Australian 11-12 year old children, we will investigate how physical health, metabolomics, psychosocial and cognitive domains are associated with gestational age and birth weight across the continuum, and determine the optimal age and size for later child health overall, and by specific health or metabolic outcome.

The Longitudinal Study of Australian Children (LSAC) is a national, population-derived cohort of Australian children. Commencing in 2004, soon after the children were born, the study has assessed the children and their families every two years, and in 2015-16, conducted a comprehensive physical health assessment and biosample collection module called the Child Health CheckPoint. This project will utilise pregnancy and birth data from LSAC Wave 1 (child age 0-1 year), cognition, academic outcome and emotional/mental health data from LSAC Wave 6 (10-11 years), and physical health (cardiovascular, renal, bone, respiratory, body composition) and biologic data from the CheckPoint (11-12 years).

The project will suit someone interested in health, epidemiology and/or statistics, and working closely with a strong interdisciplinary team. Given the large, high quality data available, findings are likely to be published in a quality journal.
Next Steps

If you would like to hear more about any of the projects listed in this booklet, please contact the supervisor listed under each project title. You may also find it helpful to read general advice about Honours and PhDs in each of the universities where our current potential supervisors are based:

**University of Melbourne**

http://sc.mdhs.unimelb.edu.au/why-honours

https://futurestudents.unimelb.edu.au/info/research/phd-doctorates

**Deakin University**

http://www.deakin.edu.au/study-at-deakin/apply/apply-for-honours


**University of South Australia**

http://www.unisa.edu.au/Health-Sciences/Programs-and-Courses/Undergraduate/IHHL/


To keep in touch and up to date with the Child Health CheckPoint please visit www.lsac-childhealthcheckpoint.org.au. An updated list of Honours and PhD projects will be listed here.