



1 January - 31 December 2020



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Twins Research Australia is Australia's only national twin research centre of excellence and maintains one of the largest volunteer twin research registries in the world. It both undertakes and supports twin research in institutes and hospitals across Australia and globally. Twins and their families make research possible by volunteering to be part of studies.

Based at the Melbourne School of Population and Global Health, University of Melbourne, the two main goals of TRA are: (1) to bring twins and researchers together to undertake health research to benefit everyone and (2) to advocate for and engage with twins and multiples.

Our vision

Our vision is for a vibrant and unified global twin research community to improve health and wellbeing through new knowledge for the benefit of all humankind.

Our values



Accountability

To be accountable to our members, our researchers, our supporters and each other.



Integrity

To act honestly and ethically in the way that we conduct ourselves.



Excellence

To use our expertise, energy and resources to deliver best-practice, sustainable results.



Collaboration

To build and facilitate domestic and international connections within the twin, research and wider community to more effectively advance health and wellbeing.



Innovation

To find resourceful and inventive solutions to advance people's health and wellbeing.

Key activity areas

Twins Research Australia activities fall across three key areas: research, knowledge exchange and building research capacity.



Research

a. Conduct research:

lead innovative twin research to accelerate research advances.

b. Cost effectiveness:

leverage cost efficiencies available through the application of the twin design and twin registry access.

c. Enable research:

provide access to participants, de-identified data, expert advice on research methods (twin model design) and twin data analytic services.

d. Registry management:

maintain and build a people bank of over 75,000 twin and family members willing to participate in research. 2.

Knowledge exchange

a. Research community:

translate knowledge in twin research and registry management to the research community through education programs and resources, publications and mentoring.

b. Twin community:

provide evidence-based resources; advocate for their needs to influence policy and practice; and stimulate discussion on the experiences and needs of the twin and multiple-birth community.

c. Wider community:

Communicate study findings back to key stakeholders to influence policy and practice. Raise awareness of the value of research to the wider community. 3.

Building research capacity

a. Education:

teach, train, mentor and support researchers and students in research methods that harness the unique contribution of twins.

b. Collaborative partnerships:

build interdisciplinary collaborations to optimise new knowledge and availability to expertise and research resources nationally and internationally.

2020 highlights

Research impact

- 33 papers published
- Actively recruiting studies covered research into the impact of COVID-19, resilience, genetic impact on decision-making, breast cancer, and health and lifestyle
- Launch of special twin online survey in collaboration with <u>FluTracking</u> to monitor the spread of flu-like-illness in communities across Australia and New Zealand

COVID-19 response

- In January, the first case of COVID-19 was identified in Australia. By April, TRA launched the first of a series of surveys called *Twins Research Australia COVID-19 Knowledge, Experience, Reaction and Resilience* (TRACKERR)
- This research aimed to capture a holistic view of how Australian twins were dealing with the pandemic by collecting data on physical, mental, and social health
- Three surveys completed two for adults and one for parents of junior twins with **5500** participants; two reports published, outlining findings

Fast tracking research

- Despite the COVID-19 pandemic, our members volunteered magnificently, achieving a record year for TRA research with over 7228 families and 10,184 individuals participating in eight studies
- 36 Australian and international institutes involved in our research
- A record of over 67,000 invitations sent to twins to participate in our studies

Expanding twin research capability and capacity

- TRA, in collaboration with the Centre for Health Equity at the University of Melbourne, received seed funding from the Melbourne Centre for Data Science to establish a 'proof of concept' project with the Victorian Government's Centre for Victorian Data Linkage
- TRA received official recognition of its online serial publication, *Conversations in Twin Research*, with the awarding of an International Standard Serial Number (ISSN: **2652-5518**)
- TRA hosted an international seminar, facilitated by the Australia-Korea Alliance for Science, Innovation and Action in Population and Global Health, on twin and family studies of environmental exposures, the human genome and DNA methylation
- TRA joined with Generation Victoria (GenV) to recruit all twins born in Victoria over the next two years to create the first-ever Australian twin-birth cohort

Our lifetime impact



Nearly 11% of Australia's twin population volunteer for studies and help to fast track research.

Twin research has contributed to break-through knowledge into major health issues including diabetes, epilepsy, breast cancer, brain ageing, bone health, autism, children's education and learning.





Our researchers collaborate in universities, hospitals and institutes Australia-wide (and globally) to generate new knowledge in priority health issues.

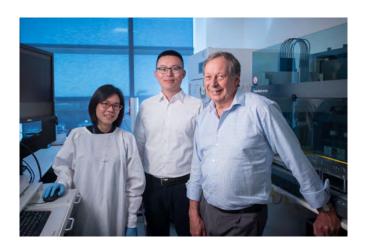
We translate study findings into practice, policy and evidence-based resources for our communities.

1,261
PUBLICATIONS



Director's message

In 2020, we consolidated the mandate of Twins Research Australia as a research-active organisation dedicated to undertaking and facilitating projects focused on improving the health and wellbeing of all Australians. Once again, we benefitted from the time and energy of our enthusiastic and generous volunteer community of twins and their families who continue to be actively involved in distinctive research that enables both ourselves and our researchers and collaborators to uncover advances of benefit to us all.



As foreshadowed in last year's Annual Report, Twins Research Australia is now a recognised leader in the fields of public health and health promotion, and we continue to expand our reach by exploring the possibilities for the implementation and use of largescale population administrative data linkage initiatives.

The year's highlights

The year 2020 will be remembered by many, the world over, as the year of the pandemic, when public life stood still for a while. The advent of the coronavirus disease, and the associated lockdown measures, saw Twins Research Australia move its operations to working-fromhome arrangements.

For many of us this was a very difficult time. In their usual professional way, however, the TRA team took the new arrangements in their stride, with the result

that 2020 was one of our most significant years of achievements in terms of research, member support and innovation.

In March we saw the importance of asking our members: how was COVID-19 impacting on their lives? To that end, we developed and implemented the first of our Twins Research Australia COVID-19 Knowledge, Experience, Resilience and Reaction (TRACKERR) surveys in as little as four weeks. TRA staff and researchers, and other external collaborators, worked together to complete this mammoth task, with the first survey invitation sent to members on 15 April, just three weeks after social distancing restrictions were introduced. The first report from our landmark study was released in July 2020 and received much media exposure. A further two surveys were conducted throughout the year, and we plan to conduct future follow-ups to ensure we collect valuable longitudinal data, allowing us to understand the ongoing impact of COVID-19 on twins and their families.

In 2020 we continued to expand our collaborative networks, conducting and enabling ground-breaking research with a number of expert multidisciplinary teams into breast cancer risk, neurodevelopmental disorders, emotional wellbeing and resilience, as well as understanding risk-taking behaviour, to name just a few. Our standard practice of providing researcher training and events was put on hold during the year due to COVID-19, and we were unable to offer our usual round of travel grants. However, we continued to promote our free online training in twins' statistical analysis and,

as promised, implemented a new section on our website that allows researchers to access geospatial information on all TRA-registered twins who have completed our *Health and Lifestyle Questionnaire*. This data resource is saved in an electronically secure de-identified format which is made available to researchers for ethically-approved projects.

While our in-person knowledge translation efforts were also impacted in 2020 due to COVID-19, we continued to enhance our efforts to stay connected with the multiple-birth community by redeveloping the content of our very important *Twin Pregnancy* booklet and its exciting new companion website, *Twin Pregnancy and Parenthood*. Both of these exciting initiatives are due to be launched in 2021 – Twins Research Australia's 40th anniversary year. Our ongoing engagement with clinical and healthcare professionals also continues and is evidenced, in part, in a new book (now due out in 2021) about *Twin and Higher-Order Pregnancies*, as well as articles in a special 2020 edition of the *International Journal of Birth & Parent Education*.

Our need for funding has never been more urgent as we continue to seek ways to creatively achieve our goals and ensure our continued operation. Once again we applied for several grants in 2020, which we hope will be competitive. As highlighted in last year's Annual Report, these grants tie in with our enhanced focus on health for all of society.

As always it takes time and a great deal of energy to identify and complete these grant applications on top of our normal workloads. The small (but extremely dedicated) team at TRA work long hours to help put these together. Their dedication was recognised at the end of 2020, when the team was awarded a Research Achievement Award in the Research Support (Team-based) Category from the Melbourne School of Population and Global Health. It was a fitting end to a very busy year.

Future initiatives

TRA continues to undergo growth and change, and we are now actively pursuing the establishment of innovative data linkage and public health proposals – and we hope to announce some exciting new developments in the months ahead. One of these initiatives has involved preliminary discussions with the team at the Murdoch Children's Research Institute

which is establishing the Generation Victoria (GenV) project. This will recruit all babies born in Victoria for the next two years and thereby establish the state's first birth cohort. TRA's involvement could see us develop the first-ever Australian *twin* birth cohort nested within a population cohort. This will not only allow innovative twin and family studies, it will also allow important comparisons to be made between twins/multiples and the general population. This could lead to important insights into the relative health and wellbeing of *all* Australian twins, and establish an evidence-base about the needs of twin families.

As mentioned earlier, 2021 will be the 40th anniversary of Twins Research Australia, and we have exciting plans to commemorate the occasion with a gala and fundraising event for our members (COVID-19 permitting), as well as the launch of our new twin pregnancy resources. From our humble beginnings in 1981, we have grown from a small registry of twin participants to a world-renowned data resource comprising more than 75,000 members as well as a research-active and research-enabling organisation. We are fortunate to have such dedicated twins and their families to thank for this, as well as our research collaborators – and, at our core, TRA's wonderful team of dedicated professional staff. As we already know from past experience – and as the COVID-19 pandemic has shown us even more clearly - we are stronger together. I would like to personally thank each and every one of our members, their families and friends, and our collaborators, for their ongoing commitment and support of Twins Research Australia.

Warm regards,

Professor John Hopper AM

Director, Twins Research Australia
Director (Research),
Centre for Epidemiology and Biostatistics
Melbourne School of Population and Global Health
The University of Melbourne





Overview

Twins Research Australia facilitates, conducts and enables research involving twins through our expertise in study design, twin and family recruitment, data analysis and maintaining membership and study data.

There were 89 active and ongoing studies utilising TRA services and/ or involving TRA members in 2020. These studies were undertaken in 26 institutes around Australia as well as 10 international institutes.

Diagram 1. Location of TRA's active and ongoing studies

International

University of Helsinki, Finland Aberystwyth University, UK King's College London, UK St George's University of London, UK University of Aberdeen, UK Stanford University, USA The University of Southern California, USA Wellesley College, USA

Queensland

Griffith University Queensland University of Technology Royal Brisbane and Women's Hospital The University of Queensland

Western Australia Lions Eye Institute The University of Western Australia South Australia Flinders University The University of Adelaide

Victoria

Austin Health Australian Catholic University Deakin University **Epilepsy Research Centre** Monash University Murdoch Children's Research Institute Royal Children's Hospital Royal Women's Hospital The University of Melbourne

New South Wales

Macquarie University Sydney Children's Hospital The Sutton Arthritis Research Laboratories The University of Sydney University of New England University of New South Wales University of Technology Sydney Victor Chang Cardiac Research Institute

TRA's research work included the active processing of seven expressions of interests (EOIs) for new research and three new research applications throughout the year. There were also 10 studies actively recruiting participants in 2020. TRA also provided ad hoc support to studies in varying stages of development, data collection, data analysis and writing up.

Table 1. Total number of studies supported by TRA/involving TRA members in 2020 by status

Study Status	Number
Application (EOIs, full application, protocol change)	11
Recruiting	10
Recruitment on hold	4
Data collection/data analysis	14
De-identified data analysis	16
Writing up/publishing*	34
Total	89

^{*}includes studies awaiting final follow-up from researchers

Actively recruiting studies

The studies highlighted below were actively recruiting participants through TRA in 2020.



The Resilience Study

Collaborators: Dr Justine Gatt at Neuroscience Research Australia and the University of New South Wales in collaboration with Associate Professor Robin Turner, Professor Leanne Williams, Dr Haeme Park, Miranda Chilver, Javad Jamshidi, Arthur Montalto and Rebecca Alexander

This study aimed to identify the psychological and brain factors that contribute towards resilience over a 10-year and 12-year follow-up period. It also aimed to determine the role of genetics and environment in altering these pathways over time. By studying identical and non-identical twins, it is possible to understand more complex questions about these processes, including the factors that may protect someone from becoming mentally ill, even if they have been exposed to significant stress.



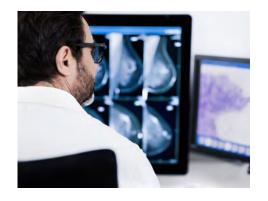
During 2020, 750 TRA members out of the 1291 who were approached 10-years-ago (and did not undergo MRI imaging) agreed to participate in this follow-up phase.

Genetic Impact on Decision-making

Collaborators: Dr Nathan Kettlewell at the University of Technology Sydney and Professor Agnieszka Tymula at the University of Sydney

The purpose of this study was to investigate how genes and environment affect people's financial preferences and decisionmaking. It was designed to better understand how financial-related behaviours and choices impact on people's lives and are passed from one generation to the next. These choices can be very important influences on life outcomes and can potentially impact health and wellbeing. It is hoped the findings will contribute to future policies and measures to better support people's desired life outcomes.

This study was a major recruitment project for TRA in 2020, with 803 pairs agreeing to take part.



The International Breast Cancer Study

Collaborators: Professor John Hopper at the University of Melbourne, Professor Thomas Mack at the University of Southern California and Dr Lucas Calais-Ferreira at the University of Melbourne

This study is funded by the National Institutes of Health (USA) in collaboration with Professor Thomas Mack based at the University of Southern California. It aims to research twins where at least one of the twin pair has been affected with breast cancer. It is investigating the genetic and environmental risks of developing breast cancer for all women. The researchers aim to answer questions around why only one twin in a pair (with a similar familial background) develops breast cancer, and to identify environmental factors that are protective against breast cancer. This knowledge could support the establishment of effective preventive strategies worldwide.

Given the highly specific study sample, this was a very successful recruitment project for TRA in 2020, with 127 complete pairs agreeing to take part.

The health and lifestyle questionnaire



The Health and Lifestyle Questionnaire was launched in 2014, in part, to better describe TRA's membership through the publication of summary statistics for both the twin and researcher communities. These statistics include zygosity, age, gestation term and medical conditions.

The HLQ enables identification of potential participants for specific research studies thus reducing recruitment time and costs for researchers, and unnecessary approaches to ineligible TRA members. It also enhances fasttrack research by providing de-identified data to researchers for ethically approved research analyses.

In 2020, invitations for the child HLQ were sent to 476 parents of twin child pairs, 151 of whom participated. No adult HLQ invitations were sent during 2020 due to the high volume of TRACKERR surveys being sent to adult twins (see below for details).

At the end of 2020, a total of 21,139 adult individuals and 12,272 parents of child twin pairs had been invited to participate in the HLQ. Of everyone invited, 7374 adult individuals (1976 pairs and 3422 singles), and 5145 parents of child pairs had completed the questionnaire.

HLQ data was also used to target study recruitment to appropriate people; to develop educational materials for genetic epidemiology post-graduate level classes and twin statistical methodology workshops; and to provide examples for twin statistical methodology concept papers.

Twins Research Australia COVID-19 Knowledge, Experience, Reaction, and Resilience



In April 2020, TRA began the *Twins Research Australia COVID-19 Knowledge, Experience, Reaction, and Resilience* (TRACKERR) study. The study consists of a series of surveys aimed at investigating the short, medium and long-term impacts of the COVID-19 pandemic on Australian families. Different surveys will be created - for adult twins, junior twins and parents of junior twins – and rolled out in a series of 'waves' over the course of the pandemic.

TRA completed two waves of the adult version of the TRACKERR study during 2020. Wave 1 collected responses from 15 April to 23 July 2020, while Wave 2 collected responses from 14 August to 20 October 2020. Nearly 4000 individuals participated in the Wave 1 survey, and nearly 3000 in the Wave 2 survey. Approximately 2200 individuals took part in both. A <u>summary of Wave 1</u> findings was released earlier this year, and the next step will be to perform a comparative analysis with the results from the Wave 2 survey, to see how responses have changed over the course of the pandemic.

Additionally, TRA completed the first wave of our parents of twins and triplets TRACKERR survey, which was run from 12 May to 9 July 2020. A preliminary synopsis of the results is available in this <u>infographic</u>. A second wave survey of parents of twins and triplets is currently in development and will focus on the longer-term impact of COVID-19 restrictions on parents and families.

Data from the TRACKERR surveys will soon be available for analysis by external researchers. Additionally, it is planned for use in an upcoming Master of Public Health research project by a student at the University of Melbourne.

Our research impact

Wellbeing

For more than 10 years, Dr Justine Gatt from Neuroscience Research Australia has led a large twin study investigating emotional wellbeing. Many important and novel findings have arisen from her research so far. In 2014, Gatt and her team published a paper concluding that genes and environment have a roughly equal impact on our wellbeing. In 2016, a paper using data from the study supported the idea that clinical symptoms and a person's wellbeing are not necessarily the same thing, and both should be used to fully evaluate someone's mental health. In 2017, it was found that wellbeing was positively associated with various measures of cognitive ability, such as working memory (short-term retention of information for future use) and motor coordination (e.g. finger tapping). In 2018, Gatt and her team found that a brain structure, called the *pons*, was associated with levels of wellbeing in individuals. In 2020, they found that different instruments used to measure wellbeing impacts the predictive power of polygenic risk scores, and they presented their COMPAS-W Wellbeing Scale as a reliable instrument for measuring wellbeing. In 2019 and 2020, recruitment of previous participants was undertaken for a 10-year follow-up study, which undoubtedly will lead to many more exciting findings in the future.

Causation assessment

TRA's Professor John Hopper and colleagues published a paper in 2020 titled *Inference About Causation From Examination of Familial Confounding (ICE FALCON): A Model for Assessing Causation Analogous to Mendelian Randomization* in the International Journal of Epidemiology. They introduced a novel method, ICE FALCON, which uses twin and family data to assess if an exposure has a causal effect on an outcome – the Holy Grail in epidemiological research. ICE FALCON shares conceptual similarities with Mendelian randomisation (a widely used method using genetic data to assess causation) and empirically they give the same conclusion, but ICE FALCON is more efficient and powerful. ICE FALCON can be applied to circumstances in which Mendelian randomisation cannot be applied, such as when there is no prior genetic knowledge and/or data available to create a valid instrumental variable for the exposure of interest, or when the assumptions underlying Mendelian randomisation analysis are suspect, to provide insights into causality for a wide range of public health and medical questions.

Breast cancer

TRA's Professor John Hopper has also been leading research into developing novel mammogram-based breast cancer risk measures based on image brightness and texture. One of the studies which has come from this research, published in 2020 in the *International Journal of Cancer*, found that when these measures are combined, they are more effective in

stratifying women in terms of their risk of breast cancer than breast density and all the known genetic risk factors. The study was run through the University of Melbourne and involved researchers and twin members from TRA, alongside collaborators and other participants from a variety of organisations across Victoria. The researchers hope that, if successfully adopted, their new measures could substantially improve screening, make it more effective in reducing mortality and make it less stressful for women, and therefore encourage more to be screened. Professor Hopper believes that in terms of understanding how much women differ in their risks of breast cancer, these developments could be the most significant since the breast cancer genes BRCA1 and BRCA2 were discovered 25 years ago.

Restless Legs Syndrome

Associate Professor David Champion – a long-time collaborator with TRA – led a research team in investigating painless and painful subsets of paediatric Restless Legs Syndrome (RLS) for genetic influence and for associations with iron deficiency and common paediatric pain disorders. The study used a sample of twins and their families to pursue these aims. The researchers found that paediatric RLS is a hybrid condition, with contrasting painless and painful phenotypes. Painless RLS was found to probably not be heritable and was associated with female gender, history of iron deficiency and persistent pain disorders. Painful RLS, on the other hand, was found to have a genetic influence and accounted for the heritability of paediatric RLS, and was associated with primary pain disorders and recurrent abdominal pain.

Back pain

Researchers from Australia are investigating the longitudinal relationship between low back pain and physical activity while controlling for familial factors. This is the *AUstralian Twin BACK Pain and Physical Activity* (AUTBACK) study, and it has recruited 644 twins from the TRA registry. The study will collect weekly data on low back pain status and monthly data on physical activity levels, alongside a variety of other health, lifestyle and physical activity measures. Data collection is still ongoing, although in 2020 the researchers published an initial cohort profile. The AUTBACK group has planned a number of projects for the data, with the main one being the investigation of the influence of physical activity on recurrence of low back pain. Data linkage opportunities are available, including with other studies conducted by TRA.

Exercise

Researchers at the University of Western Australia and the University of Melbourne, in collaboration with Twins Research Australia, conducted a study involving twins to investigate whether the reason some people respond differently to the same exercise program has a basis in genetics. The study found there was an optimal exercise strategy for everyone but it differs between people and was not determined or limited only by their DNA. This research had a large international impact, and their findings were summarised in the New York Times.

Trust

Researchers from Australia and the UK involved over 1200 twins in a joint study to better understand the basis of trust and what makes some of us trust more readily than others. They found it was not specific facial features, genetics or a shared experience that affected people's judgement, but an individual's personal experience that influenced their perception of a trustworthy face. This study provided new insight into the basis of trust, as previous research found that individual differences in face identity recognition was strongly driven by genes.

The value of twins for medical and health research

A special edition of Twin Research and Human Genetics was published online in early 2020. Twins Research Australia staff (Dr Jeff Craig and Dr Lucas Calais-Ferreira) and colleagues published a paper titled *The Value of Twins for Health and Medical Research: A Third of a Century of Progress* which discusses how far this endeavour has progressed since Hrubec and Robinette's 1984 review. The paper shows that twin studies now benefit from an expanded set of statistical models and a concerted global effort to coordinate twin research projects. Twin studies have changed the way we think about the etiology of such disorders as epilepsy, autism and schizophrenia. They have also demonstrated that heritability can differ according to age, socioeconomic status and total phenotypic variance. Research involving twins has been accelerated since the inception of twin registries and networks worldwide.

Flu tracking

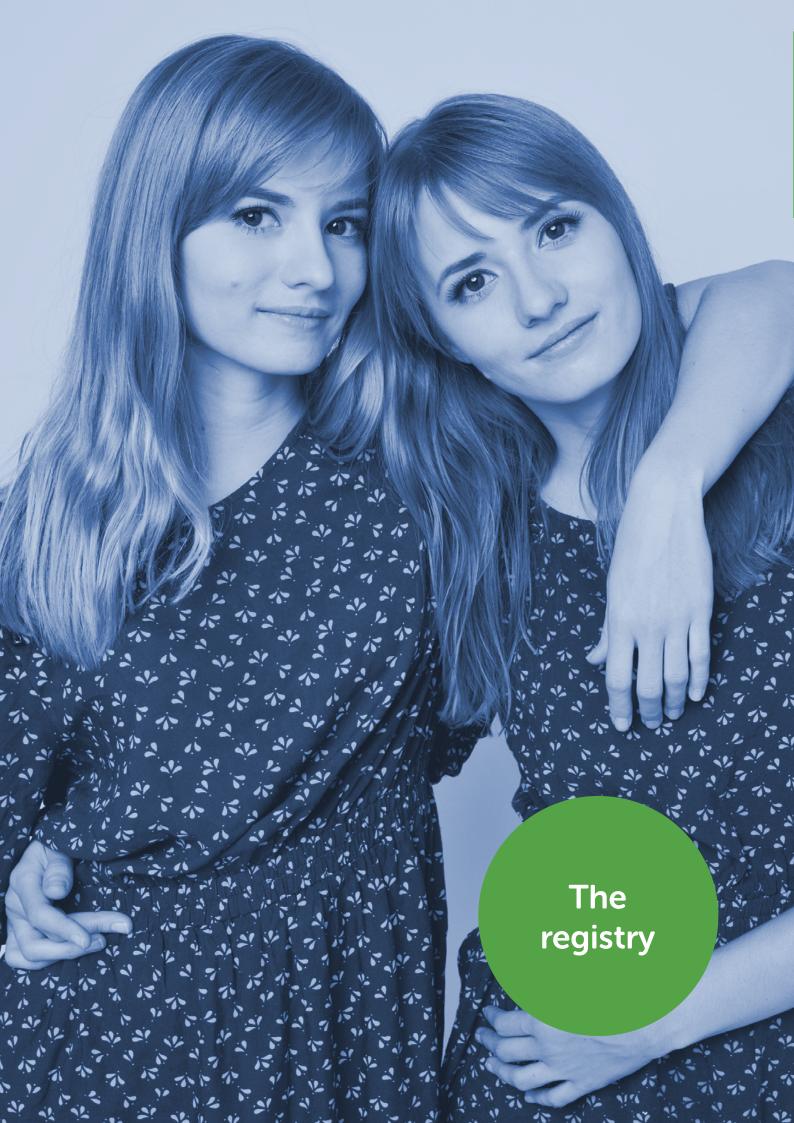
A special online Twins FluTracking Survey, launched in May 2020, was developed especially for twins/HOMs to report weekly if they had symptoms of flu (this survey is separate and not part of TRA's COVID-19 TRACKERR study). The FluTracking.net project is a joint initiative of the University of Newcastle, Hunter New England Population Health, and Hunter Medical Research Institute with funding by the Commonwealth Department of Health. Data is collected to help track the spread of influenza-like illness across Australia and New Zealand; provide early warning of potential outbreaks; and monitor trends during pandemics. The FluTracking team collaborated with TRA to develop the special twins' survey with the aim to investigate the interplay between genes and environment in determining people's experience of flu-like symptoms, and whether they get a flu vaccine or not. This has great implications for improving vaccination campaigns, as it tells researchers whether members of the same family are more or less likely to get vaccinated.

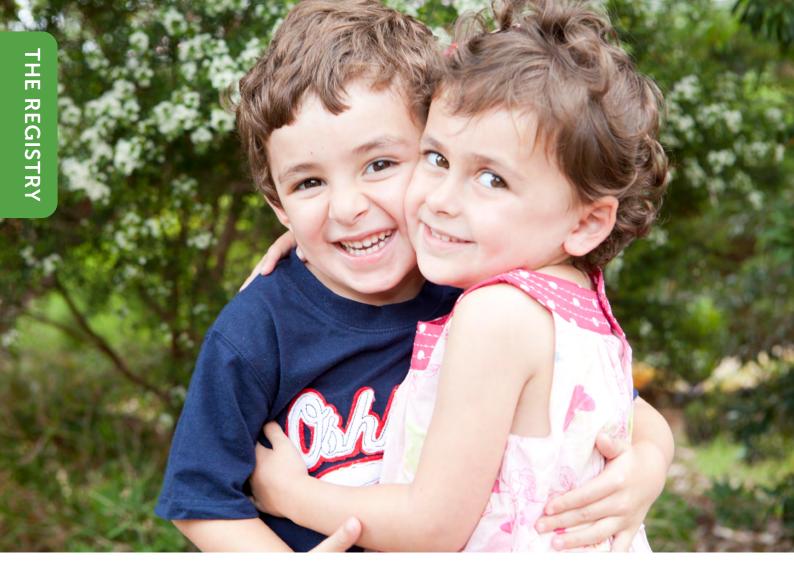
Study invitations

Mail-outs to prospective participants for individual studies are a core component of TRA's daily operations. The scheduling of mail-outs, and the total number of sent approaches, is dependent on the requirements of each research project. During 2020, a total of 67,193 study invitations were sent for eight different studies. This included four TRA internal studies and four studies with external researchers. To preserve membership, TRA limits the number of study invitations per year to each member (where possible). Thus, due to such a busy year of study invitations in 2020, four studies (including TRA's *Men's Health Questionnaire*) were delayed and are currently pending availability of twins in 2021.

Database upgrade

Twins Research Australia's membership database has been undergoing a major revamp in the last couple years. The previous database had been in place for over 12 years. Built on outdated software, it had limited functionality and support. Developers at Kiandra IT worked with TRA staff and technical specialists at the University of Melbourne to create a new front-end system that was released in October 2018. Ongoing updates to the new database still remain a priority to allow TRA to more efficiently manage member, researcher and other stakeholder information and processes in the future.





Twins Research Australia's volunteer members are an integral part of the organisation, and management of the membership is a core component of its function.

TRA maintains an up-to-date register of twins and higher order multiples (HOMs) - or in the case of twins and HOMs under the age of 18, their parents - willing to consider involvement in scientific studies.

TRA seeks to keep its members active and engaged by undertaking a wide range of activities. These include: providing opportunities for members to update their details on TRA's website; communicating via a regular eNews; undertaking phone calls to twins (or their second and third contacts); and following up 'return to sender' mail from study approaches.

TRA continues to update and improve internal database processes and mechanisms to better assist staff in providing a cost-effective and efficient service to twins and researchers.

Membership overview

Twins and HOMs – including triplets, quadruplets and quintuplets - of all ages, sex combinations and zygosity – are eligible to enrol with TRA. In 2020, the database held data on 100,041 individuals, representing 49,301 twin pairs and 478 HOM sets. Of these, 75 percent are adult (18 years of age or older) twins/HOMs, and 25 percent are children (under 18 years of age) twins/HOMs.

Members of TRA are recorded under a specific status, depending on the currency of their contact details and individual preference for involvement in research activities. The current status of individual members of TRA is summarised in Table 2 while the current status of twin pairs of TRA is summarised in Table 3.

Table 2. Registration status of individual twin/HOM members

	Adults	Juniors	Total	Percent
Active	56,773	23,860	80,633	80.60
Questionnaire	1,001	70	1,071	1.07
Newsletter	511	10	521	0.52
Non-active/current	17,179	637	17,816	18
Total	75,464	24,577	100,041	100

Table 3. Registration status of twin pairs

	Adults	Juniors	Total	Percent
Both active/ questionnaire	25,854	11,747	37,601	76.27
One active/ questionnaire	2,568	-	2,568	5.21
Neither active/ questionnaire	8,823	309	9,132	18.52
Total	37,245	12,056	49,301	100

Of the active adult twin individuals, 21,202 have up-to-date email addresses listed with TRA. Of the active junior twin pairs, 10,292 have an up-to-date email address of at least one parent listed with TRA.

Active twin pairs by sex and zygosity

The current numbers of active twin pairs by sex and zygosity are shown in Figure 1. It includes both adult and junior twin pairs where both twins have a registration status of Active or Questionnaire. Of these twin pairs, 42.3 percent are identical twins, 54.4 percent are fraternal twins and 3.3 percent are of unknown zygosity. Thirty-four percent of these pairs consist of two males, 43 percent of two females and 24 percent of one male and one female.

Adults 8,000 **Juniors** 7,000 6,000 5,000 4,000 3,000 2,000 1,000 MZ males DZ males DZ females MZ females DZ male-female Unknown

Figure 1. Active twin pairs by sex and zygosity

Ages of active twin pairs

Parents of twins register themselves and their twin children from birth and members often stay active until the late stages of their lives. Figure 2 and Figure 3 show the distribution of active twin pairs by age groups. Thirty-one percent of active TRA twin pairs are juniors (less than 18 years of age) and 69 percent are 18+ years of age.

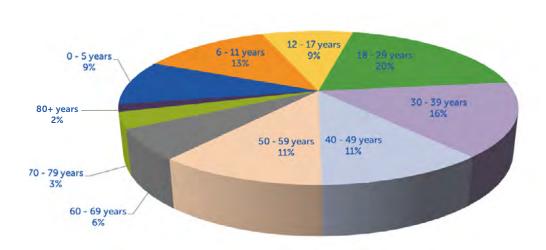
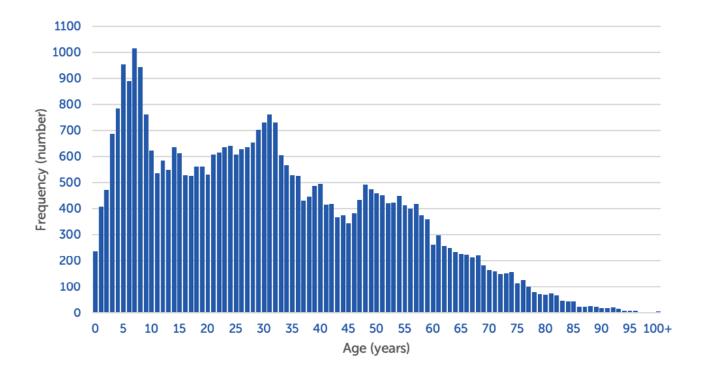


Figure 2. Percentage of active twin pairs by age groups

Figure 3. Age distribution of active twin pairs



Distribution of active twin pairs

Members reside in all states and territories of Australia. The distribution of active twin pairs by location is shown in Figure 4 together with the overall distribution of the Australian population by state and territory (as reported by the Australian Bureau of Statistics in June 2020). Comparison of the two groups shows that most populated states are also the states where most active TRA members reside.

Figure 4. Percentage of active twin pairs by states and territories compared with the Australian population as reported by the Australian Bureau of Statistics, 2020



New member recruitment

Continuous recruitment of new members is vital to ensure the future viability of TRA. In the reporting period 1 January 2020 to 31 December 2020 TRA recruited a total of 582 twin and HOM sets, 574 of which were twin pairs. The numbers of new registrations by year since 2004 are represented in Figure 5. The 2020 figures show that the number of registrations received are on par with TRA's usual numbers. In 2021 TRA will institute new processes to follow up with adult members aged 18 and above whom we may have lost touch with. In addition, TRA will work in collaboration with GenV – a new Victoria-wide initiative to follow-up on all births. These initiatives and others aim to boost TRA's registration numbers in future years.

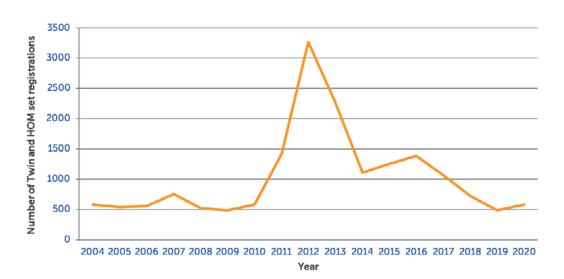


Figure 5. Number of new twin and HOM sets registered with TRA by year since 2004

Sources of recruitment

In 2020, Facebook was the dominant means of registration (26 percent), followed by the TRA Twin Pregnancy Booklet (23 percent), internet searches (14 percent), word of mouth (11 percent), and media exposure (10 percent). Recruitment via Facebook and other media sources grew in 2020 due to greater engagement with a range of media outlets to promote our TRACKERR study. Figure 6 shows each of the main recruitment sources in 2020.

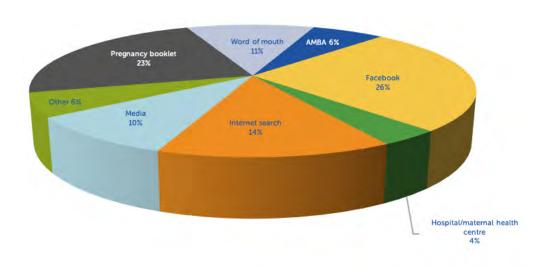
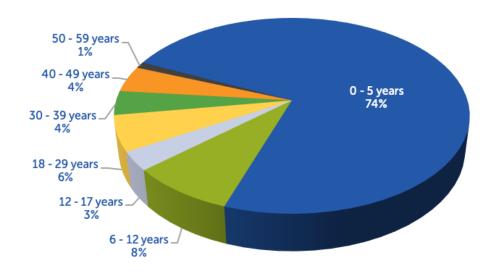


Figure 6. Registration ascertainment 2020: major sources

New member ages

The majority of new members are enrolled by their parents with TRA in the first couple of years after birth. As Figure 7 shows, 74 percent of new enrolments in 2020 were aged 0-5 years. This is a slightly lower percentage than previous year (in 2019 it was 80%) due to more registrations in older age groups.

Figure 7. Age break-down of 2020 new member registrations



Updating records

TRA also undertakes proactive tracing of its members. This is an ongoing and important maintenance activity and ensures that the registry remains viable. Our TRACKERR surveys and promotion of the TRACKERR study in the media helped us to update 3446 existing member contact details in 2020. This included email, mobile and residential address updates.





Overview

Twins Research Australia prioritises knowledge exchange and translation in its work to enable twin research to have impact in society. TRA's knowledge translation plan ensures it engages with stakeholders in a structured and systematic way. This plan focuses on the twin community and aims to maximise the transfer of research outcomes to health policy and practice. It aligns TRA with community and funding organisations that expect knowledge translation to be at the forefront of TRA's work.

TRA is also committed to developing long-term, mutually beneficial partnerships with research, community and corporate organisations that share its goals and values. Our partnerships reflect our local, state, national and international spheres of influence. Of particular note during 2020 was TRA's ongoing collaborations and information sharing with the Australian Multiple Birth Association, and the International Council of Multiple Birth Organisations.

Twin pregnancy guide



An ongoing popular resource is TRA's Twin Pregnancy Booklet. This free printed educational guide (also available as an eBook) is distributed to around 1000 expectant and new parents of twins Australia-wide each year. Across 2019/20, the booklet has been revised to reflect the latest evidence-based information and practices from experts in the field, and this new printed version will be available in TRA's anniversary year 2021. As well as its popularity with expectant parents, the booklet is being increasingly used as a resource for hospital prenatal classes and tertiary teaching institutes in nursing.

To expand ways of accessing its twin pregnancy resources, TRA is developing a microsite embedded within the TRA website to deliver online resources. This will enable TRA to provide added information and features in a costeffective way, and a more flexible, accessible and sustainable delivery channel. A framework for the microsite has been developed across 2019/20 - with content initially based on the booklet content - and this new channel will be launched in 2021 to coincide with the release of the booklet update.

General resources

TRA's comprehensive website is central to its communication/translational efforts for members and the broader twin community. New content and website updates were undertaken during the year to improve the user experience.

Other main communication/translational platforms are TRA's social media channels; quarterly online Member eNews and a separate Researcher eNews; emailed study (and SMS in some cases) invites, follow-ups, and feedback; and phone-assist (freecall 1800 037 021) service. All twins and parents of twins who participate in studies receive study-specific feedback. Facebook is TRA's strongest social media channel in terms of followers, reach and engagement – growing by 4.2 percent in 2020 to around 14,600 followers.

TRA's blog website page, *Twins Impact*, is an ongoing popular resource covering issues of interest to members and the broader twin community. The page features stories, opinions and news from researchers, experts, partners, members and staff. Blogs in 2020 covered issues such as <u>resilience and wellbeing</u> (which were well received given concerns about mental health during COVID-19-related sustained lockdowns and restrictions in some Australian states); and the <u>growing rate of Caesarean twin births</u> and the implications for mothers, their babies and obstetric practice.

Media activity

Twins and twin research continued to generate substantial media coverage and interest throughout the year. This coverage is important to raise awareness in the broader community about the value of twin research to population health. TRA also advocates for multiple-birth families and seeks to raise awareness of the unique lives and special interests of these families.

Unsurprising in the first year of the COVID-19 pandemic, there was substantial media interest in TRA's COVID-19 studies. TRA released a <u>Statement on Coronavirus</u> to inform its many stakeholders about the impact of the fast-evolving coronavirus situation on its studies and other services. In April 2020 when TRA announced it was seeking twins for a world-first study of the pandemic's impact, <u>the story</u> achieved <u>national and international attention</u>. There was ongoing media interest in how twins could help to <u>understand coronavirus impact</u>, and whether <u>twins were at higher risk</u> of contracting the virus compared with the general population. The media also covered the twin research of Dr Justine Gatt into resilience, with <u>stories</u> on how tough times (like the pandemic) can teach us resilience. Further media coverage followed when TRA released its first full report and findings from its <u>adult twins COVID-19 study</u> and, later, its <u>parents of junior twins study</u>.

Other twin-related stories that generated significant media interest Australia-wide during the year were: the <u>origins of trust</u> and people's capacity to change who we trust, for good or for ill; how twins can help find the <u>best exercise for you</u>; a study seeking twins where one or both twins have had a diagnosis of <u>breast cancer</u>; and <u>world-first techniques</u> for predicting breast cancer risk from mammograms.

Videos are being used increasingly by TRA and its researchers to explain and recruit twins to studies, and to gain media interest as shown by this video about a twin study into neurodevelopmental disorders.





Overview

Twins Research Australia works hard to ensure twin research becomes a standard part of the repertoire of population health researchers by promoting a range of capacity- and capability-building initiatives, and by facilitating collaborative research.

TRA is now an established research-active organisation, initiating and conducting projects that utilise its own twin registry and data resources. It also plays a vital role as a research-enabler, openly promoting the registry and associated resources to all researchers, across all disciplines. TRA provides researchers with an established infrastructure and access to a rapidly growing network of twin researchers, statisticians and administrative staff who are experienced in establishing and conducting studies. Further information on resources and access are available at TRA's website.

Research supervision, training and education programs

A key to the increasing success of TRA is its training and upskilling of researchers from many disciplines and of varying skillsets across the country and internationally. TRA's aim is to continually build capacity and capability in twin research through traditional and non-traditional educational training, professional development, and mentoring activities that are integrated with other TRA activities.

Seminar on twins and epigenetics research

In February 2020, researchers gathered at the Melbourne School of Population and Global Health, University of Melbourne, to present their most recent findings and to discuss analytical approaches to human epigenetics research. TRA facilitated this seminar in collaboration with the Australia-Korea Alliance for Science, Innovation and Action in Population and Global Health (AKASIA).

The seminar focused on twin and family studies of environmental exposures, the human genome and DNA methylation, and how they can contribute to this research area. Examples included the investigation of epigenetic profiles associated with cancers, epilepsy and neurodevelopmental disorders and risk factors such as smoking and gender.

The event showed the potential of twin and family study designs to detect changes in epigenetic profiles. Professor Joohon Sung, from Seoul National University in South Korea, was the main speaker. He showed how changes in DNA methylation are being used to predict smoking as a risk factor for cancers, and showcased his collaborative work with Professor John Hopper and his team on breast cancer research.

Educational resources

In March 2020, TRA received official recognition of its online serial publication, *Conversations in Twin Research*, with the awarding of an International Standard Serial Number [ISSN: 2652-5518]. This recognition highlights the importance of this series of papers, which continues to showcase the diverse application of the twin method to the research and health professionals' community. The series also aims to start a conversation regarding use of this approach in all areas of research, including education, early life origins of chronic disease, clinical trials and population health research.

As part of its national reach and peer-to-peer support, TRA coordinates an online Twin Researcher and Statistics Group using the social media platform, Facebook, to enable further teaching and learning from more experienced twin researchers. This group is aimed not only at early career researchers but all researchers new to, or interested in increasing their knowledge of, twin studies. Researchers and students can also access major global and Australian studies, training and events, and newly published papers and other resources, by subscribing to TRA's free Researcher eNews.

Networks and collaborations

TRA has continued to play a critical role in establishing and fostering collaborations to expand the knowledge and technology applied to twin studies in many areas of research, both nationally and internationally. In Australia, TRA has worked to increase the impact of its research and the contribution of its members by partnering with the Victorian Department of Health through its Centre for Victorian Data Linkage to create the Victorian Twin Cohort Study. The TRACKERR study is also a result of a collaboration between TRA and senior researchers in Australia, including researchers from the University of Sydney and the University of Technology Sydney.

TRACKKER study

The Twins Research Australia's COVID-19 Knowledge, Reaction and Resilience (TRACKERR) study was established in 2020 as a response to the challenges imposed by the COVID-19 pandemic and restrictions introduced by state and federal governments in Australia. The study aims to collect detailed information from twins and parents of young twins on their experiences at various stages of the pandemic, including data on COVID-19 tests and diagnoses, physical distancing, lifestyle factors, and overall aspects of physical, mental and emotional health. The first report of the study published in July 2021, received interest from various news media outlets, leading to wider recognition and interest from researchers. The TRACKERR study will continue to be a valuable resource for new studies and collaborations between TRA researchers and national and international colleagues in the years to come.

Victorian Twin Cohort Study

In collaboration with Dr Jesse Young and colleagues from the Centre for Health Equity and other centres at the University of Melbourne, Dr Lucas Calais Ferreira, Dr Sue Malta and Professor John Hopper from Twins Research Australia were successful in obtaining seed funding from the Melbourne Centre for Data Science to create the Victorian Twin Cohort Study. This project will establish a partnership between Twins Research Australia and the Victorian Department of Health, creating capacity to use existing anonymised data from state-wide health

and administrative databases in future twin studies to improve the physical and mental health of young Australians.

AUTBACK study

Led by Professor Paulo Ferreira, one of Twins Research Australia's Chief Investigators and his team, the protocol paper of the AUstralian Twin BACK pain and physical activity study (AUTBACK) was published in the British Medical Journal. This longitudinal study is an important resource for scientific studies to improve the prevention, prognosis and treatment of low back pain in adults by including detailed information on lifestyle factors and using motion sensor devices to measure the intensity and other patterns of physical activity. Data from the AUTBACK study will be used in several projects by PhD students and postdoctoral researchers within the Charles Perkins Centre (CPC) Musculoskeletal Hub at the University of Sydney. This is a direct outcome of the CPC's Twins Research Node, which was established by Twins Research Australia and collaborators in 2016 to enhance collaborations in twin studies in many areas of health and medical research.

International networks

TRA has maintained and expanded its ongoing collaborations with Brazilian researchers. In 2020, Dr Lucas Calais Ferreira continued his collaboration with researchers from the Federal University of Bahia, Brazil, to establish one of the largest twin cohorts in Latin America to conduct studies on risk factors for infant mortality in Brazilian twin pairs. The first study arising from this partnership will be published in 2021. TRA also continued its partnership with the Brazilian Twin Registry, which will now include the supervision of young Brazilian researchers by Dr Lucas Calais Ferreira to conduct studies with existing data from the more than 1000 registered twins, starting in 2021.

As one of the founding members of the International Network of Twin Registries (INTR), Twins Research Australia aims to play an essential role in the international conferences in twin studies scheduled for 2021.

Supervision of students by TRA Chief Investigators

Research capacity is also built through TRA-supported scholars and fellows supervising research students as well as providing workshop support for students. The research students are also given training and opportunities in statistical consulting and collaboration (as appropriate depending on skills). In 2020 TRA supervised 12 PhD students and five postdoctoral projects.

PhD

- Deborah Ashtree, Murdoch Children's Research Institute (supervised Dr Katrina Scurrah, Prof Jeff Craig)
- Eloise Cameron, Murdoch Children's Research Institute (supervised by Dr Marc Seal, Prof Jeff Craig, Dr Katrina Scurrah)
- Channa Marsh, University of Western Australia (supervised by Prof Danny Green, Dr Louise Naylor; advisor Dr Katrina Scurrah)
- Hannah Thomas, University of Western Australia, (supervised by Prof Danny Green, Dr Louise Naylor; advisor Dr Katrina Scurrah)
- Namitha Mohandas, Murdoch Children's Research Institute (supervised by Prof Jeff Craig and Dr Kylie Crompton)
- Henri Dohnt, University of New England (supervised by Dr William Conventry, Dr Katrina Grasby, Brad Verhulst and Dr Callie Little)
- Sally Larsen, University of New England (supervised by Dr William Conventry, Dr Callie Little, Dr Katrina Grasby and Dr Robert Whannell)
- Emma Ho, University of Sydney (supervised by Dr Milena Simic and Prof Paulo Ferreira)
- Kate Roberts, University of Sydney (supervised by Dr Paula Beckenkamp and Prof Paulo Ferreira)
- Carlos Castrillon, University of Sydney (supervised by Dr Paula Beckenkamp and Prof Paulo Ferreira)
- Thomas Patterson, University of Sydney (supervised by Dr Paula Beckenkamp and Prof Paulo Ferreira)
- Zhoufeng Ye, University of Melbourne (supervised by Prof John Hopper, Dr Shuai Li, Kevin Nguyen and Dr Gillian Dite)

Postdoc projects

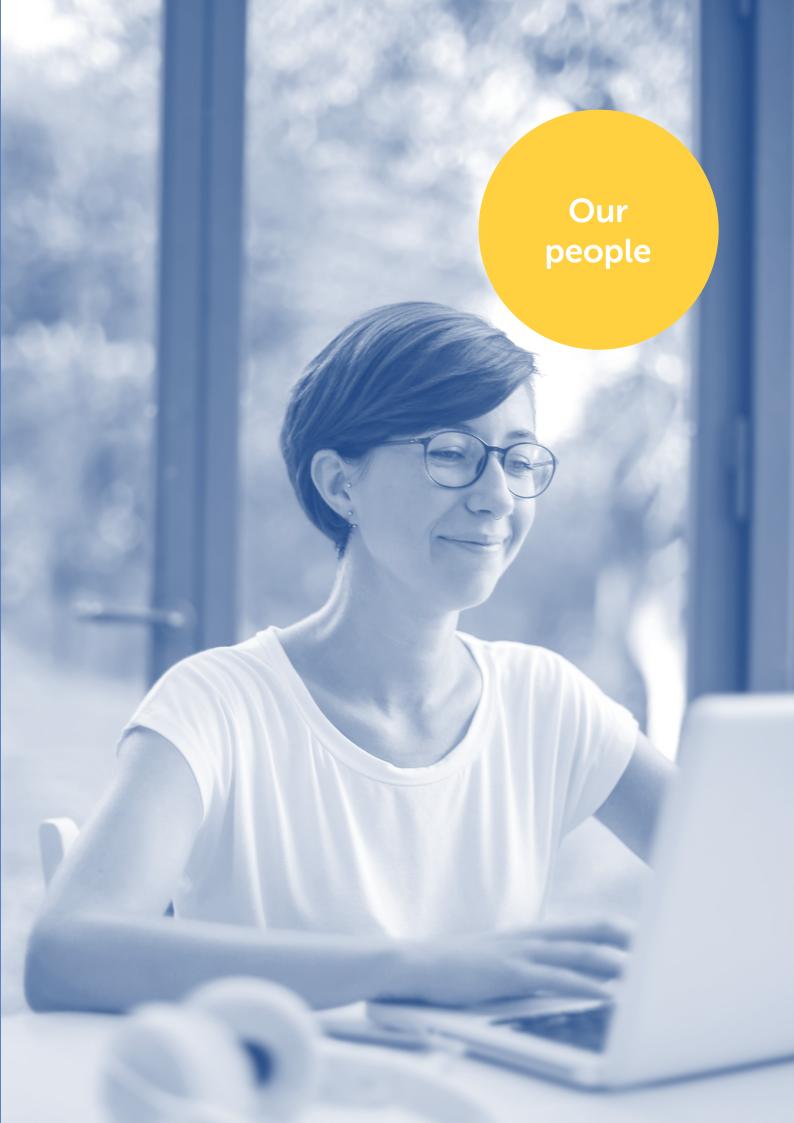
- Alison Gibberd, University of Melbourne (supervised by Prof Sandra Eades, Dr Katrina Scurrah)
- Mihiri Silva, Murdoch Children's Research Institute (supervised by A/Prof Nicky Kilpatrick, Prof David Burgner)
- Lucas Calais Ferreira, International Breast Cancer Twin Study (with Prof John Hopper and Prof Tom Mack, USA)
- Jane Loke, Murdoch Children's Research Institute (supervised by Prof Jeff Craig)
- Callie Little, University of New England (supervised by Dr William Conventry)



The Travel Grant Scheme aims to encourage the growth and development of twin research in Australia by:

- Offering financial assistance to Australian researchers to attend TRA workshops and events, thus supporting their training and development in the methodology and practice of studies involving twins
- Presenting and promoting TRA-based twin research studies at scientific conferences

Throughout 2020, there were significant travel and event restrictions affecting researchers in Australia and worldwide due to the COVID-19 pandemic. As such, there were no travel grant rounds held or travel grants awarded in 2020.





Our people

Twins Research Australia's system of governance ensures accountability, fairness and transparency with all its stakeholders. TRA comprises a leadership team of a director, deputy directors, chief investigators and associate directors from institutes around Australia. We are supported by a team of passionate staff and administered by the University of Melbourne.

Chief Investigators of the Centre for Research Excellence Grant from the National Health and Medical Research Council Professor John Hopper, TRA Director, University of Melbourne

Associate Professor Jeffrey Craig, TRA Deputy Director, Deakin University

Professor David Mackey, University of Western Australia

Professor Stephen Simpson, University of Sydney

Professor Brian Byrne, University of New England

Associate Professor Paulo Ferreira, University of Sydney

The Chief Investigators are supported by Associate Investigators who bring additional skills and expertise, such as being a twin or parent of twins, corporate management, expertise in legal and ethical matters, policy and research translation, molecular epidemiology, obstetrics and perinatal data.

Associate Investigators

Professor Elizabeth Sullivan, perinatal/maternal health

Professor Richard Saffery, molecular and cellular biology

Professor Brian Oldenburg, health policy

Professor Margaret Otlowski, health law

Karen Willetts, parent of twins

Professor Mark Umstad, obstetrics and perinatal data

Vince Pollaers, corporate management

Staff

John Hopper, Director

Jeff Craig, Deputy Director of Research

Kate Murphy, Deputy Director of Operations and Strategy

Sue Malta, TRA Manager and Researcher

Dr Lucas Calais Ferreira, Research Fellow

Dr Shaui Li, Senior Research Fellow

Dr Katrina Scurrah, Statistician

Lynette Walker, Marketing Communications Coordinator

Jess Tyler, Research Liaison and Coordinator

Jodie Lipman, Member Support and Administration

Alison Wright, Project and Administration Support

Angela Shi, Graphic Designer

Associate Professor, Dr Adrian Bickerstaffe, Research Computing

Nadira Hewabandu, IT Support

Stakeholder satisfaction

The Annual Researcher Satisfaction survey is administered each year as part of the Annual Progress Report submitted by researchers. This questionnaire provides feedback to Twins Research Australia on their services to twin researchers, and an opportunity to improve on these services where possible.

The survey requests feedback relating to the previous 12 months on:

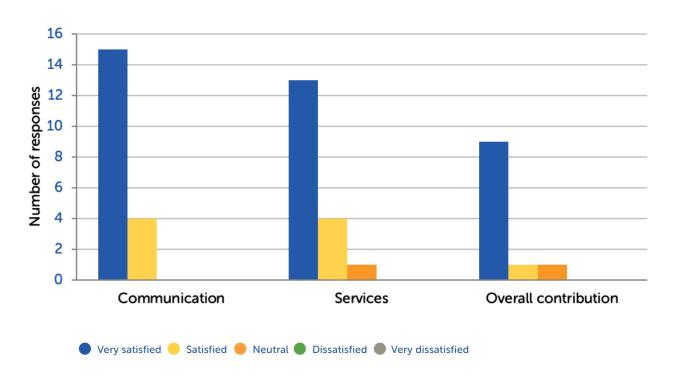
- The researcher's overall satisfaction with communication with TRA
- The researcher's overall satisfaction with the services that TRA provided
- The value of the contribution that TRA made to the overall research project

Responses are recorded as:

- 1 Very dissatisfied
- 2 Dissatisfied
- 3 Neutral
- 4 Satisfied
- 5 Very satisfied

Twins Research Australia received feedback from 23 research groups for 2020. The communication, services and overall contribution of the organisation were rated very highly. As shown in the figure below, the vast majority of researchers reported being "very satisfied" or "satisfied" across all domains.

Figure 8. Overall satisfaction scores from researchers: Evaluating communication, services and overall contribution provided by the registry



Testimonials

Dr Justine Gatt, Senior Research Scientist, UNSW and NeuRA I have worked with the TRA team for quite a number of years on our twin resilience project. From my experience, it has always been a pleasure to work with TRA and I have never had any doubts regarding their work efficacy, efficiency (particularly in demanding times), and attention to detail. Their professionalism, dedication and time commitment to project deadlines has always exceeded my expectations, and has enabled us to reach our many projected and often challenging recruitment goals. I would highly recommend working with the TRA team to anyone interested in twin research and I hope to maintain a long-term collaboration with them for years to come.

Associate Professor David Champion, Sydney Children's Hospital I and my research associates at Sydney Children's Hospital have been welcomed by and have been honoured to have worked collaboratively with Professor John Hopper and the staff of Twins Research Australia for the past eight years. We have received wise, practical and scientifically well informed guidance in our research-based exploration of the common pain disorders of childhood and related conditions, their familial relationships and genetic influence, and their clinical associations, leading to recognition of common causal influences. The collaborative work has led to international presentations and publications which have advanced knowledge in paediatric migraine, common tension-type headaches, growing pains, recurrent abdominal pain, low back pain, dysmenorrhoea, and also restless legs syndrome and iron deficiency. I have had the opportunity to visit the laboratories and offices in Melbourne and have been deeply impressed by the TRA staff, their knowledge, helpfulness and their collaborative relationships.



Funding

Twins Research Australia is governed under the auspices of a Centre of Research Excellence Grant (2015-2022) from the National Health and Medical Research Council. In terms of current funding, TRA is reimbursed by external research groups for the costs involved in study development, recruitment and analysis. Like most medical research initiatives, we continue to monitor and apply for external funding and philanthropic opportunities to continue our vital services, support the next generation of researchers and to ensure our ongoing sustainability.

Generosity of the twin community

One of our funding sources, other than government, has been TRA's Annual Appeal. In consideration of the impact of the COVID pandemic, we did not proceed with the 2020 Annual Appeal. With the lifting of restrictions we hope to be able to hold an in-person gala event and fundraiser to celebrate TRA's 40th anniversary in 2021.

Partnerships

An Australian organisation, EasyDNA, continued to provide a discounted zygosity testing rate, exclusive to members of Twins Research Australia. TRA receives a small fee for every EasyDNA test booked by a member through its website. This partnership enables TRA to provide affordable zygosity testing for its members while also helping to raise funds for its research work.

Gifts and bequests

Gifts and bequests in a person's Will are ways that TRA supporters can make a real difference to the future health of Australians. If you have any questions or comments, please call 1800 037 021 or email Dr Sue Malta at susan.malta@unimelb.edu.au.





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