THE ORIGINS PROJECT

TELETHON KIDS INSTITUTE
Discover. Prevent. Cure.

Joondalup Health Campus
Part of Ramsay Health Care

The ORIGINS Project
LOCAL RESEARCH.
GLOBAL IMPACT.

A collaboration between
Telethon Kids Institute and Joondalup Health Campus

ANNUAL PERFORMANCE REPORT 2020-2021

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originsproject.telethonkids.org.au

A HEALTHY START for a Better Future

The ORIGINS Project acknowledges the Aboriginal and Torres Strait Islander people as the Traditional Custodians of the land and waters of Australia. We also acknowledge the Nyoongar Wadjuk, Yawuru, Kariyarra and Kaurna Elders, their people and their land upon which the Institute is located and seek their wisdom in our work to improve the health and development of all children.

Contents

The ORIGINS Project: a unique interventional birth cohort

New interventional birth cohorts are examining ways to optimise the health potential of individuals and communities from early life. They are aimed at going beyond preventing disease, to identifying the conditions that enable flourishing from an early age.

Local community projects, such as **The ORIGINS Project,** are taking a broader approach to the protective and buffering factors that enhance an individual, such as building nature-relatedness, interpersonal relationships, mindfulness, and positive emotions. In addition to scientific pursuit, interventional cohorts can contribute to solutions in every community - empowering individuals and communities towards positive change.

The largest study of its kind in Australia, The ORIGINS Project ("ORIGINS") is a partnership between Telethon Kids Institute and the Joondalup Health Campus, aimed at reducing the rising epidemic of non-communicable diseases (NCDs) by providing a healthy start to life. ORIGINS researchers are collecting detailed information about babies and their families to understand more about how the early environment influences the risk of diseases and the optimal time for interventions for early detection and prevention.

Changing the Health of Future Generations

The ultimate goal of The ORIGINS Project is to reduce the rising epidemic of non-communicable diseases through 'a healthy start to life'

How is ORIGINS different from other cohort initiatives?

ORIGINS is grounded in making meaningful changes in policy and practice that will reduce the burden of common health conditions through early interventions.

In addition to observational data, ORIGINS provides a framework for a series of smaller intervention studies nested within the main cohort to improve modifiable aspects of the early life environment, such as nutrition, physical activity, microbial diversity, microplastics, weight gain, language development and mental wellbeing.

This innovative approach enables strategic interdisciplinary collaboration, focused follow-up and a holistic multi-system approach to identify how to achieve healthier lives from the start, ultimately benefiting the whole community. The ORIGINS Project is a catalyst for change, intervening as soon as anomalies are detected by referring participant families to appropriate community and health services. Not only does the project provide a framework for new discoveries, it is also a facilitator of collaboration across disciplines, sectors and communities. The potential for manifold benefits is endless.

- **A 'responsive' system with 'real-time' feedback to families and systems:** The integration with local and state-based service networks, and new technological capability, provides capacity for 'real-time' data generation and feedback. Early screening and identification of children at risk (for example, early autistic features, developmental delay, allergic diseases and/or unhealthy growth trajectory) provide timely referrals to early intervention. To our knowledge this is completely unique and is the first cohort to take this approach.

- **Collaboration and engagement are fundamental elements of ORIGINS at every level:** ORIGINS has been established on a foundation of collaboration with consumers, government, clinical services, researchers, service providers and academic institutions. We have strong links with other birth cohorts locally, nationally and internationally, and are working towards developing a global cohort network to harmonise and mutually enhance research capacity.

The Aim of ORIGINS

The ORIGINS Project's aim is to improve the health of the next generation through a better understanding of how to optimise the early environment. Over a decade we aim to recruit 10,000 women and their partners early in pregnancy at Joondalup Health Campus and collect biological samples, routine data and web-based questionnaires on physical and mental health, diet, physical activity patterns and a range of environmental factors, creating an extensive Biobank and Databank.

We will intensively follow up these families until five years of age, assessing how these early life exposures influence child growth, development and health. Our aim is to recruit 4,000 'active' participants (undertaking multiple data and sample collections at specific time points) plus 6,000 'non-active' participants that includes all routinely collected hospital data, opportunistic samples and linkage to government and non-government databases.

The data from the ORIGINS research platform (Biobank and Databank) will assess how early life exposures influence a child's growth, development and health. Initially the families will be followed up until the child is five years of age. ORIGINS' significant Biobank (DNA, breast milk, urine, plasma and mononuclear cells) will build substantial additional future capacity to address critical questions (including genetic, epigenetic, metagenomic and metabolomic studies) as technologies and new avenues of investigation evolve.

Annual Performance Report 2020-2021

This Annual Performance Report outlines the progress made and deliverables achieved during the reporting period 1st July 2020 to 30th June 2021. It includes an update on our current status, key achievements; key challenges across the Project; and identifies opportunities for 2021-22.

Overall Current Status

Since its commencement in July 2017, The ORIGINS Project has;

- Recruited more than **5,600** women (2,890 active and 2,710 non-active), **3,000** babies and **1,500** fathers/partners.
- Completed over **1,000** checks on one-year infants
- Enrolled **547** mothers for two or more pregnancies
- Collected more than **250,000** biological samples
- Collected more than **1,000** individual early, and **2,000** late pregnancy collections
- Filled **nine** large freezers and **one** liquid nitrogen tank in use to house these collections, which is one of the largest Australian cohort collections.
- Collected more than **12 million** data points in our Databank
- Integrated **30** nested sub-projects looking at multiple aspects of child and family health and development
- Established **15** active ORIGINS Research Interest Groups (RIGs), including a collaborative RIG, that meets on a regular basis to facilitate collaboration, provide expertise, develop nested sub- projects, and support students. There are over **150** RIG members, with 10 to 46 members in each RIG. Members include researchers, clinicians, community members, service providers and educators.
- Supported **29** ORIGINS students, including undergraduate Biomedical Science students undertaking placements with the ORIGINS Biobank; Honours students; Masters students; MD students undertaking scholarly research activities; College Projects by graduate doctors; and PhD candidates.
- Connected with over **500** national and international researchers who are actively engaged in ORIGINS.
- Achieved **full integration** of research into clinical and diagnostic services in a leading secondary care hospital.

Highlights for the Year (30 June 2020 - 1 July 2021)

- **1,951** participant families were recruited into ORIGINS, (i.e., 726 active families recruited and 1,225 non-active families) - **a 38% increase on total recruitment in the past 12 months**
- **13** sets of twins were recruited
- **704** participants enrolled in one or more sub-projects (424 active and 280 non-active participants) i.e. 13% of the whole cohort
- **13** proposed sub-projects 'in the pipeline' – awaiting funding or ethics approval to commence
- **A Family Liaison Model** was established whereby each family has direct contact and follow-up from an individual Family Liaison Officer, enabling targeted engagement and support.
- Development of an **ORIGINS SmartApp** to enable participants to book their own appointments, see where they are on the ORIGINS journey.
- An ORIGINS **Family Event** held in March 2021 attended by over **200** families
- Project adaptations and modifications in response to the **Coronavirus (COVID-19) pandemic** with minimal impact on project implementation.
- Introduction and implementation of an **agile project management framework**, with associated software, by the ORIGINS Project Team
- **720** children attended an appointment with a paediatrician and feedback report was provided to their General Practitioner (GP)
- As part of ORIGINS' real-time feedback, **low iron levels** were detected in many of our participant children at the 1- and 3-year appointments. Each child was individually followed up by a paediatrician with advice on how to raise ferratin levels.
- **Telethon Beneficiary Wrap** – newspaper wrap in The West Australian with double spread on ORIGINS, achievements and 5,000 families
- **25** research papers were published on ORIGINS and the sub-projects

Return on Investment

The ORIGINS Project infrastructure has been a catalyst for investment in nested sub-projects. The set-up of ORIGINS enables researchers to implement their research projects, leveraging a fully developed platform providing cost savings and economies of scale. ORIGINS recoups costs back into the Project, to sustain and increase the capacity of ORIGINS' resources. A degree of cost recovery is required from those requesting and granted use and/or access to the cohort.

To date the ORIGINS Project infrastructure has attracted independent grant funding in excess of $14 million. **This represents an outstanding return on investment in the ORIGINS Project, at the rate of an estimated 1:1 return on annual investment of $4 million a year.**

Key challenges over the last 12 months and how these were addressed

The ORIGINS Project has met anticipated and unforeseen challenges during the year, and has sought to address these promptly, efficiently and effectively to limit any impact on participants, and other stakeholders.

- **Ongoing impacts of COVID-19** – ORIGINS has continually adapted to changes in protocol, procedures, processes and working environment due to the COVID-19 pandemic. While disruptive, many staff could immediately transition to working from home during lock down periods, undertaking telehealth appointments and continuing to run the Project. Core clinical staff were available to cover screening and ongoing recruitment within JHC. The ORIGINS courier services were increased so that participants could continue delivering samples to the Biobank without leaving their homes.
- **Participant engagement** – there are specific timepoints where engagement could be improved. A re-engagement campaign was launched during the year and new procedures were put in place to improve participant engagement through ensuring Family Liaison Officers undertook regular touch points with participants and implemented reminder systems.
- **Space restrictions at JHC** – as more families reach ORIGINS milestones, there is an increasing need for appointments and space is limited. We have therefore increased availability of telehealth appointments for our 1- and 3-year-old checks.
- **JHC redevelopment and increased demand for antenatal outpatient clinic capacity** – this has impacted ORIGINS participants' ability to park and attend appointments. ORIGINS was able to accommodate the needs of participants by providing appointments at the antenatal clinics in addition to within The ORIGINS Project clinical suites. The participants were also offered virtual telehealth appointments with separate sample collection clinics.
- **Biological sample collections** - an emerging key challenge is the retention of samples in short supply, which often applies to those collected from infants and young children where only small sample volumes can be obtained. We are hard at work with the Biobank Governance Committee to establish a prioritised framework to ensure a fair and appropriate balance between the release and retention of samples in short supply.
- **Data integration –** over the last four years ORIGINS has collected vast datasets on thousands of participants. Telethon Kids Institute is developing a bespoke Data Hub to integrate these data collections. This system is still under development which has meant that data extractions continue to be manual from independent systems, until the Hub is complete and functional later in 2021.

- **Nesting sub-projects** - additional resources are needed to facilitate and integrate independent sub-projects. This has been addressed by initiating and executing Sub-Collaboration and Letter Agreements with Project Partners and Investigators of nested sub-projects to ensure cost recovery and other sub-project contributions.
- **Staff capacity** – as ORIGINS transitions to the peak period of the Project, with multiple participant touchpoints, staffing capacity is stretched. This has been addressed through regular staff communications, staff development and team planning sessions.

Project Opportunities for the next 12 months

We constantly review and refine our processes to ensure we enhance project design and community reach. We strive to make project implementation improvements iteratively.

- **Big data projects**: as sample and data collections grow, the potential for large scale projects and the generation of big data increases. The Biobank will work hard towards the implementation of big data projects in the coming years.
- **Largescale collaborations** between Data and Biobanks from national and international cohort studies are becoming increasingly feasible and we will be pursuing collaborations for the generation of high-quality collaborative research.
- **WA Cohort Network:** the establishment of a WA Data Portal will harness longitudinal data from The ORIGINS Project, Raine Study and Busselton Health Study, maximising the opportunities for cross-cohort research.
- **Research capacity:** we will build and support research capacity of The ORIGINS Project Team, and continue to disseminate ORIGINS research activities, through publications and presentations.
- **Training opportunities for professional development** across the project will enable capacity building of team members to grow and develop in additional areas, improving retention of staff as the project evolves.
- **Quality improvements:** enhancement of data, through quality control and assurance of data and sample collections.
- **Diversifying the cohort:** implement strategies and procedures to increase the diversity of the ORIGINS Project cohort to priority population groups.
- **Sustainability planning:** we will undertake comprehensive strategic and financial planning to maximise the current ORIGINS infrastructure in its current 10-year lifecycle, and beyond.
- **Ongoing integration of sub-projects:** Mapping and feasibility planning for the continuation of current nested sub-projects and the capacity to integrate further future sub-projects
- **Student opportunities:** Increase engagement with universities and other stakeholders to attract high calibre, interested and relevant PhD candidates.
- **Community setting**: we are planning to establish an ORIGINS community clinic that will be a child friendly space to host our paediatric participant families. This should help to create a fun, friendly and interactive environment.
- **Enhancing participant engagement:** new strategies for improving engagement and retention include the development of the ORIGINS app, engagement in local community events, and promoting ORIGINS through social networks and the media.
- **Five-year checks**: we will commence seeing our first five-year-olds at the end of 2021. Planning has started for additional data collections at this timepoint, as well as the logistics involved in running additional clinic appointments.

Participant Recruitment & Retention

Pregnant women (and the non-birthing partner) are recruited with informed consent early in their pregnancy to collect detailed environmental and psychosocial data through questionnaires, medical records, diagnostic tools, and collection of biological samples. ORIGINS families are contacted at multiple touchpoints throughout their ORIGINS journey by their dedicated Family Liaison Officer.

Key Achievements in Reporting Period

From July 2020-June 2021, **1,951** families were recruited into ORIGINS, (i.e. **726** active families recruited and **1,225** non-active families), a 38 % increase on total recruitment in the past 12 months.

81% of 1 year old appointments were completed within the 6 months from the appointment due date

66% of 3-year-old appointments were completed within 6 months from the appointment due date

There were **58** withdrawals for the past 12 months and **133** withdrawals in total i.e. cumulative withdrawal of **2.4%** of the total cohort.

Participant Recruitment & Follow-up 2020-2021

Participant Recruitment	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total in reporting period	Project Cumulative Total
Active families enrolled	40	64	52	74	62	62	63	58	64	57	68	62	726	2857
Non-active families enrolled	114	109	108	119	102	89	71	63	84	118	115	133	1225	2655
	Total participant families recruited												**1,951**	**5,512**
Non-birthing partners	50	44	39	46	45	43	27	17	29	29	28	62	459	1,681
Active babies consented	48	40	68	67	42	45	56	62	67	52	48	59	654	2,298
Non-active babies consented	93	90	94	88	86	65	67	50	80	97	110	89	1,009	2,124
	Total babies consented												**1,663**	**4,422**

ORIGINS Child Appointments: Active Participant Families Only

ORIGINS One-Year Appointments	July 2020	August 2020	Sept 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	Total 2020-2021 FY
One-year appointment: expected based on birth date	38	50	73	47	59	51	63	53	46	44	45	40	**609**
One-year appointment: actuals at one-year	32	33	32	36	46	33	41	33	49	26	49	38	**448**
***Percentage Completion**	90%	90%	73%	63%	71%	86%	71%	79%	94%	68%	70%	82%	**78%**
ORIGINS Three-Year Appointments	**July 2020**	**August 2020**	**Sept 2020**	**Oct 2020**	**Nov 2020**	**Dec 2020**	**Jan 2021**	**Feb 2021**	**March 2021**	**April 2021**	**May 2021**	**June 2021**	**Total 2020-2021 FY**
Three-year appointment: expected based on birth date	23	27	40	49	47	47	38	36	59	42	56	36	**500**
Three-year follow up: actuals at three-year	15	11	13	16	18	20	19	20	41	20	39	40	**272**
++Percentage Completion	77%	56%	57%	56%	55%	65%	45%	82%	84%	48%	74%	65%	**64%**

Due to participant and appointment availability, participant families often do not attend clinic the corresponding month of their birthday. As a result, a new measuring tool was implemented to record more accurate attendance and compliance within the clinic appointment timepoint parameters, that is within 6 months of the appointment due date. A total of **1,375 child clinic appointments were completed.**

*One-year infant includes children between 12-18 months; therefore cumulative total of one-year child appointments will increase in future reporting periods as children reach the 12-18-month mark.

++ Three-year children includes children between 3yrs - 3.5yrs; therefore cumulative total of three-year child appointments will increase in future reporting periods as children reach the 3 - 3.5yr mark.

Research Translation

As well as enabling strategic long-term research capacity, ORIGINS is a 'responsive' system with 'real-time' feedback to parents and their children, and translation to clinical and diagnostic services. This opportunity to intervene early could potentially change the long-term health trajectory of these children.

Key Activities in Reporting Period

- ORIGINS provides **real-time feedback and referral** to appropriate services for participants – mother, partners and infants. Examples of early identification and referral include developmental delay, allergic disease, unhealthy growth trajectory, sleep problems, psychosocial and mental health issues, and others.
- At one-year and three-years of age, ORIGINS children are invited to attend a health check (clinic appointment) where they are assessed by a paediatrician further to review of data collected using the Ages & Stages questionnaires. **100%** of participants (n=626) who attended clinic appointments at one and three years of age, **received direct feedback** from a paediatrician.
- All participants who attended a one- and three-year check were provided with a **feedback report** to make available to their General Practitioner (GP).
- As part of ORIGINS assessments, we look at ferratin levels: **low iron** was detected in many of our participant children at the one- and three-year appointments. At 1 years of age, **97** children had low iron (i.e. **22%** of the cohort who attended an appointment) and **120** children at three years (i.e. **44%** of the cohort) had low iron. Each child was individually followed up by a paediatrician and advised specific iron supplements or dietary advice.

Early Intervention for ORIGINS Infants

- Of those ORIGINS infants who have attended a one-year clinic appointment**, 20%** (n=250) were recommended for a General Practitioner or Child Health Nurse follow-up appointment.
- **Fifteen percent** (n=186) have been referred to a health care specialist for further assessment/treatment as follows:

Allergist/immunologist	24%
General paediatrician	20%
Child Development Service	19%
ENT (ear, nose, throat)	11%
Physiotherapist (private)	9%
Dietitian	8%
Ophthalmologist	5%

ORIGINS Biobank

The ORIGINS Biobank is collecting biological samples from participant families at 10 timepoints between the time of pregnancy and the child turning 5 years of age. The Biobank currently contains approximately 250,000 samples and this will continue to grow to an estimated 700,000 individual samples by 2027.

Key Activities in Reporting Period

- The **Open Specimen biobanking software** was successfully implemented and integrated with the clinical data capture software. While software optimisation is an ongoing process, the Open Specimen software is working to a high standard of accuracy and detail in sample tracking and fulfils the requirements of a very large and complex sample collection.
- Sample collections, including a comprehensive set of blood, buccal, saliva, urine, stool, hair and dust, are steadily growing. Accumulative figures are as follows;
    - **1,185** collections at the 20-week gestation timepoint
    - **1,350** collections from our pregnant participants at 28-weeks
    - **2,000** collections have been made at the 36-week gestation timepoint
    - **763** collections from non-birthing partners.
    - **1,500** collections at the time of birth (including cord bloods, placentas, meconium, colostrum and dried infant blood from heel pricks), with the placental samples soon to be expanded to facilitate sampling from a higher pregnancy risk subset of the cohort that otherwise bypasses the ORIGINS Biobank for clinical pathology analysis.
    - **700-900** individual sample collections at two months and six months of age, including urine, stool and breastmilk. These are collected by parents, in the participants home – which is associated with lower compliance rates than those achieved in scheduled visits.
    - **913** biological collections from our one-year-olds, including bloods, stool and urine.
    - **206** biological collections from our three-year-olds, as above.
- The total number of individual plastic and glass vials in the freezers is approximately **250,000** and there are currently **nine** large freezers and **one** liquid nitrogen tank in use to house these precious collections, making it **one of the largest Australian cohort collections.**

ORIGINS Databank

ORIGINS is collecting substantial data, in the form of administrative, physiological, biological and clinical data from the mother, non-birthing partner and child. Much of this data is collected at multiple time points to track development and change. A critical element of data management is the ability to link the numerous data sets. The potential richness of information from the curation of this comprehensive, longitudinal databank collection is immense.

ORIGINS Data Sources

The ORIGINS Project collects data from multiple sources including ORIGINS specific data collections and existing routinely collected data through the hospital and health service providers. Data derived from samples ('omics data such as metabalomics, transcriptomics, proteomics) and microbiome analyses will need external supercomputing storage capabilities. All data will be linked through unique identifiers in order to track individual participants as well as family units.

Key Activities in Reporting Period

- Development of a bespoke **Data Hub** to integrate all data sets.
- Ongoing collection of data from ORIGINS participants at multiple ORIGINS timepoints, including completion of **2,595** ORIGINS core Questionnaires, **1,854** Ages and Stages Questionnaire; **311** Early Conners Questionnaire and **607** Australian Eating Surveys.
- Additional data collections via **hospital and healthcare provider interactions**, including antenatal care, ultrasound screening, specialist appointments.
- Provision of ORIGINS research data for **eight** sub-projects
- Development of an **ORIGINS SmartApp** to enable participants to book their own appointments, see where they are on the ORIGINS journey and also enable greater retention of participants by sending follow up reminders. The ORIGINS app will be launched later in 2021.

ORIGINS Research, Collaboration & Sub-Projects

As well as facilitating strategic long-term research capacity, ORIGINS is a pipeline for short-term productivity through a series of clinical trials, early interventions, mechanistic studies, and targeted research questions to improve maternal and paternal health, and the early environment of the child.

Find out more about how we collaborate with our partners on the new ORIGINS Project website – collaborators tab.

Key Activities in Reporting Period

- Of the 30 current or completed nested sub-projects, 23 have direct contact with ORIGINS Project participants.
- The ORIGINS Project has facilitated recruitment of over 1,000 participants to one of the largest ORIGINS sub-projects, Early Moves.
- Other sub-projects which have completed all participant recruitment during this reporting period include TUMS (Water Quality and the Microbiome Study); Breastfeeding and Eating Nuts and Eggs for Infant Tolerance (BENEFIT) Trial; The Cashew Study; and The SunPreg Study.
- See Appendix One for full list and outline of ORIGINS sub-projects.

ORIGINS Research Dissemination

Project dissemination, key ORIGINS publications:

Silva, D. T., Hagemann, E., Davis, J. A., Gibson, L. Y., Srinivasjois, R., Palmer, D. J., . . . Prescott, S. L. (2020). Introducing the ORIGINS project: a community-based interventional birth cohort. *Rev Environ Health*, 35(3), 281-293. doi:10.1515/reveh-2020-0057

Hagemann, E., Silva, D. T., Davis, J. A., Gibson, L. Y., & Prescott, S. L. (2021). Developmental Origins of Health and Disease (DOHaD): the importance of life-course and transgenerational approaches. Paediatric Respiratory Reviews. doi:10.1016/j.prrv.2021.05.005

A full list of publications can be found in Appendix Two.

Project presentations and representation at the following events to advocate, report, and share knowledge:

- 2020 Child Health Symposium
- inVIVO Planetary Health 2020 9th annual conference
- JHC Research Week 2020
- Science on the Swan 2021

New Research Networks

- Establishment of Interventional Cohort Working Group (with National and International collaborators)
- Establishment of ORIGINS Journal Club for ORIGINS staff and students.

Stakeholder & Community Engagement

ORIGINS is a community project with global implications; therefore, community collaboration is essential for the Project. We have created extensive relationships with a range of stakeholders and community groups and continue to work in collaboration for mutual long-term benefit.

Key Activities during the reporting period

- ORIGINS Booth at the Telethon Beneficiaries Expo at the Telethon Weekend, October 2020
- ORIGINS Family Event attended by over 200 families, March 2021
- ORIGINS Facebook group; 180 members
- Development and distribution of the 3-year appointment video
- Launch of a re-engagement campaign

- Regular communications to participants during the pandemic and changes to ORIGINS protocol
- Monthly Coffee and Connect sessions
- Regular e-newsletters and updates to participants and stakeholders
- Nine visits and presentations to GP clinics
- Website development: addition of 'For Collaborators' tab
- Michael Mosley recruitment; Participant 'thank you ' videos were created
- ORIGINS Nutshell report on vaccine intention disseminated to our stakeholders
- Media: ORIGINS featured in The West Australian, Joondalup, Wanneroo and Stirling Times, Western Suburbs Weekly, Medical Forum, CH9 news, CH7 News, Telethon CH7 coverage, 6PR, 720, social media channels of Telethon Kids, JHC, CH9, National Treasurer, City of Wanneroo, WAHTN, and posts shared by many other collaborators. See Appendix Three for a full list of media publicity.

ORIGINS OF BEST FAMILY HEALTH

Telethon Kids Institute & 10,000 families are fortifying our future

EXCLUSIVE ANGELA POWNALL

A pioneering long-term study of Perth families has found that up to 30 per cent of young children have low iron levels, potentially leading to problems with their health and brain development.

The Origins project — a collaboration between Joondalup Health Campus and Telethon Kids Institute — has reached the major milestone of recruiting 1000 families in Perth's northern suburbs to monitor their health, wellbeing and development for five years.

Early data has also revealed high levels of anxiety and behavioural issues among very young children, that 70 per cent of fathers are overweight or obese and that a Mediterranean diet consumed by a pregnant woman is linked to lower body fat in her newborn baby.

Origins project director Desiree Silva said it was "phenomenal" to be halfway to recruiting the target of 10,000 pregnant women and their families to take part in the study.

"The goal is to improve the health of the next generation through giving them the best start in life. That is, if you identify something, you basically act on it," she said.

Origins is different to most longitudinal studies in that if researchers or clinicians come across a health issue affecting a participant, they intervene to help rather than just recording it for the study. Professor Silva, who is a paediatrician at Joondalup Health Campus, said children's iron levels were not routinely tested but had been at health check-ups for children in the Origins project.

"We're obviously worried that we're probably seeing up to 30 per cent of children with low iron ... which is very high," she said.

"That can affect your sleep. It can make you more fidgety and fussy eating as well."

Professor Silva, below with three-year-old Elias Candell, said children may not be eating enough iron-rich foods or were filling up on too much cow's milk, which is not high in iron.

The Origins project began in 2017, five years after a national study — the Australian Early Development Census — revealed that children in Perth's northern suburbs were falling behind on developmental targets.

"There were pockets in the Wanneroo area in particular where children were really struggling," Professor Silva said. "We thought, 'What can Joondalup hospital do to change this?'"

The Origins project was later born, thanks to a partnership with TKI and funding from the Federal Government through Telethon and the Paul Ramsay Foundation. Pregnant women in the Joondalup and Wanneroo areas have been recruited to the study, and usually their partner and later their baby. Data is collected from the parents-to-be women at antenatal appointments and at the birth of their child, as well as from regular online questionnaires.

The child then has check-ups with a paediatrician at the ages of one, three and five. Biological samples such as blood, saliva and house dust are taken from the family 10 times until the child's fifth birthday. Professor Silva said the biological samples were used to find out how our environment can be changed to improve our physical and mental health.

"The concern we've had is that there's been an increased burden of non-communicable diseases like obesity, allergies, mental illness, respiratory disease, behaviour and diabetes," she said. "All these things are happening earlier in childhood and more often. You cannot have something increase that fast and be genetic. Environmental factors play a big part."

There are 25 studies running within Origins using the data provided by families covering issues such as increased incidence of food allergies, eczema, neurodevelopmental disorders like autism and ADHD, and the impact of technology use on child development, mental health, dental health and eye health.

More than 1000 one-year health checks have been done on children and assessments of three-year-olds started in January.

Professor Silva said paediatricians picked up a problem in half of all the children they checked, issues that would most likely not have been diagnosed outside of the Origins project.

"What has surprised us is the level of anxiety and behaviour issues in children at the three-year checks," she said.

"The intensity of children's behaviour or neurodevelopmental issues is increasing."

Professor Silva said they were looking at ways to address the problems, such as the impact of spending more time outside and less time on electronic devices, and the food being eaten. "Sleep is another big problem with children that can affect anxiety as well," she said. "Falling asleep, delayed sleeping and that may be related to electronic use."

Elizabeth and Mark Roberts with their 18-month-old son Tate. Picture: Justin Benson-Cooper

BIG BENEFITS FOR LITTLE MAN TATE

ANGELA POWNALL

Elizabeth Roberts decided to join the Origins project because her first child, daughter Tiana, died at just 15 days old.

Pregnant with her second child, Mrs Roberts hoped the extra checks and testing they would both get by taking part in the research would help avoid another tragedy.

It was a wise decision by the Banksia Grove mother, who now has 18-month-old Tate with her husband Mark. At Tate's one-year assessment, a paediatrician picked up subtle signs that something was wrong and ordered further testing.

The tests revealed Tate has the genetic condition DiGeorge Syndrome, which can lead to congenital heart problems, developmental delay and trouble learning.

"When I heard the symptoms and problems that kids can get from this syndrome, I started worrying, of course," Mrs Roberts said. "But the doctor made us feel more comfortable and organised all the specialists from cardiology, dermatology, physiotherapy and audiology."

Tate has now been diagnosed with a heart problem that will need surgery and under-developed leg muscles which affects his walking. Mr Roberts suspects that he has DiGeorge Syndrome and unknowingly passed it on to his son. He is waiting for the results of genetic testing.

"Growing up was pretty hard," the 41-year-old said. "Back then there was no such thing as DiGeorge Syndrome, but I know that Tate doesn't have to grow up the same way that I did. He'll have all the support and everything like that."

Mrs Roberts said that if they had not been part of the Origins project, they would not have found out about Tate's condition.

She said when they previously took Tate to hospital when he started wheezing — which they now know was caused by his heart problem — he was simply given an inhaler.

ORIGINS Staff, Volunteers & Students

Crucial to ORIGINS are the staff, volunteers, and students. They are the drivers of the Project, led by the Project Directors and senior management team. The ORIGINS Project team members demonstrate passion and commitment generated from a strong belief in The ORIGINS Project's vision and aims.

Staff

- There are approximately 40 staff working within The ORIGINS Project, many of whom work in a part-time capacity. The ORIGINS team members bring a wealth of expertise and different skill sets to the Project. There are clinical, administrative, management, technical and research staff. Staff are employed through either TKI or JHC via Ramsay Health Care. Meet the Management team on The ORIGINS Project website
- We actively work to build ORIGINS Project Team members capacity, for example two staff members were chosen to participate in the 'Emerging Leaders Program' at Telethon Kids; Team Leads are involved in mentoring sessions with Prof Fiona Stanley.
- Staff undertook a range of internal and external training opportunities during the year.

Students & Volunteers

- 9 students are progressing manuscripts for publication.
- 5 students have presented their research project and/or results at conferences and other events and forums to report and share knowledge.
- 5 volunteers have gone on to become employed as paid team members on the project.

APPENDICES

Appendix One: ORIGINS Sub-Projects

Current & Completed ORIGINS Sub-Projects

Current & Completed Sub-Projects	Type	Impact/Focus	Status At 30 June 2021 (N)	Grant Value
The PLAN Project (pilot study): Pregnancy Lifestyle Activity and Nutrition	Randomised Controlled Trial	Overweight & obesity (mother and child)	Completed (57)	$24,821 (TKI Research Focus Area Seed Grant 2014)
A family's journey at JHC: Analyses of routinely collected data	Observational	JHC mother and father profiling	Ongoing	In-kind (JHC and TKI)
Screen ORIGINS: Longitudinal study of the multidimensional influences and impacts of contemporary screen technology use over the first 5 years of life (quantitative & qualitative)	Observational	Technology use (family)	Quantitative recruitment ongoing (as many as possible) Qualitative recruitment ongoing (57)	$6,100 (Curtin School of Physiotherapy and Exercise Science Early research Grant; Curtin PhD Candidate Research Support Fund)
The SYMBA Study: Improving gut health (symbiosis) for allergy prevention	Randomised Controlled Trial	Reducing infant allergies	Recruitment ongoing (604/652)	$1,681,512.40 for 2016-2020 (NHMRC Project grant 2015) $200,000 (Telethon Perth Children's Hospital Research Fund 2014)
Testosterone and Language in Kids (TALK) Study	Observational	Cerebral lateralisation and early language development	Recruitment completed (501)	$415,000 (ARC 2015)
Cardiovascular Risk Evaluation in Expectant Fathers (CARE-Dads)	Observational	Cardiovascular and mental health of fathers	Completed (503)	In-kind (JHC and TKI) $10,000 (CI contribution)
NewbOrn nasal Sampling Evaluation (NOSE) Study (Pilot study of AERIAL)	Observational	Asthma risk	Completed (145)	Under AERIAL funding
Airway Epithelium Respiratory Illnesses and Allergy (AERIAL)	Observational	Asthma	Recruitment ongoing (115/300)	$1,942,731 (NHMRC) $827,235 (NHMRC) $95,000 (Dept of Health WA Merit Award for NHMRC near-misses) $74,000 (WA Near-Miss Award (WANMA) $50,000 (Millennium Science and 10x Genomics)
BENEFIT: Breastfeeding and Eating Nuts and Eggs For Infant Tolerance	Randomised Controlled Trial	Reducing infant egg and peanut allergies	Recruitment Completed (108)	$68,616 (2017-2019) (The Financial Markets Foundation for Children) $110,290 (2018-2019) (Telethon Perth Children's Hospital Research Fund)
The Cashew Study: Introducing cashew nuts during infancy	Randomised Controlled Trial	Reducing infant cashew allergies	Recruitment completed (196)	$50,000 (2018-2019) (Australian Food Allergy Foundation)

The PrEggNut Study: A Maternal diet rich in eggs and peanuts to reduce food allergies	Randomised Controlled Trial	Reducing infant egg and peanut allergies	Recruitment ongoing (106/200-300)	$100,000 (2019-2023) (part of a larger multi-site NHMRC Project Grant)
The Engage Study: Discovering and delighting in your baby (pilot)	Single arm intervention trial	Parenting education	Recruitment completed (13)	$615,000 (2019-2022)
The SunPreg Study: Measuring sun exposure in pregnancy and its association with the development of early childhood allergies	Observational	Benefits of sunlight exposure in pregnancy on maternal skin	Recruitment completed (50)	Student project
ADAPTS: Antibiotic Dysbiosis and Probiotics Trial in infants	Randomised Controlled Trial	Gut health	Recruitment completed (60)	$111,700 (2019-2020)
TUMS: Water quality and the microbiome study	Randomised Controlled Trial	Microbiome	Recruitment completed (197)	$100,000 (BHP Blue Sky Awards)
Diabetes during pregnancy and subsequent child development: A 3-year follow-up study	Observational	Diabetes	Commencing data extraction	$69,033 (ECU strategic fund/ The SNM researcher support scheme)
The impact of a Mediterranean diet and physical activity in pregnancy on gestational weight gain and neonatal body composition at birth and weight at 1 year of age	Observational	Diet and body composition	Finalising analyses	$48,000 (2019-2021) Sceptics WA
ORIGINS Community Wellbeing during the COVID-19 Pandemic	Observational	Mental health during COVID-19	Ongoing	In kind (JHC and TKI)
Breastmilk Allergy Prevention	Observational	Food allergies, prebiotics	Breastmilk analyses commenced	$247,597 (WA Child Research Fund 2018)
Early Moves	Observational	Neurodevelopmental assessment of general movements in babies	Ongoing (1007/1,500)	$2,256,750.20 (2019-2024) $446,773 (2019-2020) (Perth Children's Hospital Foundation) $242,919 (WA Child Research Fund 2018) $250,000 (CP Alliance) $1,000,000 (Mineral Resources)
ACE Infant Feeding: Helping new mums to be better breastfeeders	Randomised Controlled Trial	Breastfeeding	Commencing recruitment	$75,000 (WA Department of Health)
Built Environments and Child Health in Wales and Australia (BEACHES)	Observational	Built environment, physical activity and childhood obesity	Commencing data extraction	$797,256 (NHMRC)
The BioMood study: A PILOT study assessing the association between Mediterranean diet, microbiome, metabolome, inflammation and mental health during pregnancy	Observational	Diet, microbiome, inflammation and mental health	Commencing sample extraction	$48,000 (Science Sceptics of WA)

The COvid COmmunity compassiON study (COCOON): Assessing virus transmission, immunity development and wellbeing of families during COVID-19	Observational	COVID-19	Recruitment ongoing (88/100 families)	$38,000 (RACGP) $113,594 (Respiratory Centre Funding Scheme)
CUB/Baby AICES - A randomised-controlled trial of a parent-mediated intervention for optimising social and communication development of newborns at increased familial risk of autism spectrum disorders	Randomised Controlled Trial	Parenting education and child development	(32/150)	$1.1million (NHMRC Investigator Grant)
Kindy Readiness: Preschool readiness in the ORIGINS cohort	Observational		Recruitment ongoing (41)	
Machine Learning: Personalised, machine learning based prediction of asthma and allergies in Western Australia	Observational	Asthma and allergy	Ongoing	$134,192 (WA Child Health Research Fund)
Mast Cell: Contribution of a novel mast cell subset to development of atopic disease	Observational	Allergies	Sample collection ongoing (9/60)	$100,000 (Telethon Kids BHP BlueSky)
Mums Minds Matter: A three-arm pilot study of mindfulness vs self-compassion vs relaxation training for reducing stress and promoting wellbeing among pregnant women	Interventional	Maternal mental health	Recruitment ongoing (45/75)	
Time Out for Wellbeing: an experimental study linked to the Mums Minds Matter Project	Observational	Maternal mental health	Recruitment ongoing (98/150)	$1,500 (UWA Faculty of Health & Medicine; TKI student support)
STORK: A pilot retrospective observational study to assess biomarkers of stress and serotonin pathways in pregnant women in The ORIGINS Project	Observational	Maternal mental health	Commencing sample extraction	Part funded by Science Sceptics of WA
Dental screening: Tele-screening for early childhood caries detection during COVID-19 pandemic	Observational	Oral health	Commencing recruitment	$50,000 (FHRI Focus Grant)
ORIGINS of Neurodevelopmental Risk and Resilience Project Amendments	Observational	Neurodevelopment	Commencing sample and data extraction	$230,842 (WA Child Research Fund)
TOTAL FUNDING				**$13,731,461.60**

Additional indirect funding is incorporated within The ORIGNS Project from PhD and other students. In total there are **12 PhD students** working on projects in ORIGINS which a combined current and projected funding of **$250,000.**

A further **10 new sub-projects** have been approved by the ORIGINS Scientific Committee and Project Management Group to be nested within ORIGINS. Some are due to commence in the coming months, while some are awaiting either ethics approval and/or funding success. A further **seven sub-projects are under review** and awaiting final approval from the Scientific Committee and Project Management Group.

ORIGINS "Live" Sub-Projects:

1. **The PLAN Project: (pilot study) Pregnancy Lifestyle Activity and Nutrition (PLAN)**
   The pilot study for the PLAN RCT tested whether a lifestyle intervention in early pregnancy can reduce offspring adiposity. This project used a smartphone web-based application to deliver diet, physical activity and wellbeing advice to women in early pregnancy (over the course of 6-20 weeks gestation) to optimise their gestational weight gain (weight gain during pregnancy) within the recommended medical guidelines. The feasibility of the web-based application proved successful with the potential for inclusion in routine clinical practice pathways aimed at providing a healthy start to life.

2. **A Family's Journey at JHC: Analyses of routinely collected data**
   This project aims to analyse routine data collected at JHC to better understand the demographics and journey from pregnancy to early childhood of all pregnant women, their partners and their newborn. It is anticipated that this will enable a better understanding of the care provided to inform improvements in routine care at JHC. Analysis of routinely collected data will also provide useful information for researchers wishing to apply for grants which may eventually result in Sub-Projects within the ORIGINS Project. An extract of the data from this project has been used to prepare a manuscript, 'Adverse pregnancy and neonatal outcomes associated with elevated maternal and paternal body mass index (BMI): a single-centre retrospective cohort study'.

3. **Screen ORIGINS: Longitudinal study of the multidimensional influences and impacts of contemporary screen technology use over the first 5 years of life (quantitative & qualitative)**
   The Screen ORIGINS study aims to understand family screen technology use, particularly mobile touchscreen devices (i.e. tablet computers and smartphones), including what influences family screen technology use and potential implications for child health and development. This study plans to use data routinely collected as part of the ORIGINS Project via web-questionnaire (quantitative component). A subset of approximately 30 ORIGINS participant families at different stages (before birth; between 6- and 12-months post-birth; 2, 3 and 5 years post-birth) will provide further in-depth information on their perspectives and practices related to screen technology use in interviews (qualitative component).

4. **The SYMBA Study: Improving gut health (symbiosis) for allergy prevention**
   The aim of the SYMBA Study is to examine if a high fibre prebiotic supplement, taken during pregnancy and while breastfeeding, will reduce the risk of allergic disease in children by improving the balance of 'healthy bacteria' in the gut. SYMBA is a placebo-controlled, single-blind study. Recruitment will include pregnant women at JHC that have a family history of allergic disease, as they are more likely to have children with allergies. Participants are randomly assigned to an intervention group (prebiotic powder) or a placebo group (carbohydrate powder) taken once a day from 20 weeks gestation until their baby is 6 months. Participants (mother and baby) are followed up at 4-, 6- and 12-months post birth. At present, 315 1-year old's have been seen, representing a 95% completion rate.

5. **Testosterone and Language in Kids (TALK) Study**
   The TALK study is seeking to understanding how testosterone exposure in the womb may relate to brain growth before birth and language development after birth. The development of language is complex and there is evidence for a relationship between language development and a wide range of positive health outcomes later in life. Data will be collected from 18 weeks pregnancy, and until the child is three years of age. The recruitment goal (500 participants) has been met and 370 children have been seen for their 6- to 9-month follow-up assessment. This study will help us to better understand how children acquire language and how we can best support children who have difficulties learning language.

6. **Cardiovascular Risk Evaluation in Expectant Fathers (CARE-Dads)**
   The aim of the CARE-Dads Study is to assess the health of expectant fathers by providing a health check-up. Dads play an important role within the family as their involvement in child-rearing enhances the health of their children. Studies have shown that a father's involvement in his child's life can be associated with positive child outcomes. A healthy Dad is an important part of a nurturing early environment. Dads are seen antenatally and when their child is 1 year of age. A full health report is provided at both time points, including a mental health assessment by means of the DASS-21. Findings will provide insight into the ways in which the health of dads-to-be can be improved.

7. **Newborn Nasal Sampling Evaluation (NOSE) Study, pilot study for the Airway Epithelium Respiratory Illnesses and Allergy (AERIAL) Study**
   This pilot study assessed whether enough epithelial cells could be obtained from a nasal sample at birth to investigate gene patterns. Recruitment is now completed. At birth, a very small brush was used to obtain a sample of cells from inside baby's nose. The outcomes of the NOSE study were used to inform the development of a larger study (AERIAL) investigating epithelial cells in the nose to determine any gene signature patterns which may predict the development of wheeze, allergy and asthma later in childhood.

8. **Breastfeeding and Eating Nuts and Eggs For Infant Tolerance (BENEFIT) Trial**
   The aim of the BENEFIT Trial is to determine whether the amount of eggs and peanuts a mother eats during breastfeeding has an influence on her baby's food allergy development. By 1 year of age, 10% of babies will develop a food allergy. Regular consumption of allergenic foods in early life can help to reduce food allergies. However, this is too late for some babies, who have an allergic reaction to a food the first time it is consumed. It is hypothesised that during breastfeeding could be the ideal opportunity to prevent childhood food allergies since the food proteins in allergenic foods, like egg and peanut, can be detected in breast milk. However, research is needed to understand what amounts of eggs and peanuts eaten during breastfeeding will help to reduce the risk of childhood food allergies. Recruitment is now complete with mothers assigned to either group 1 (eggs and 60 peanuts per week) or group 2 (up to 2 eggs and up to 20 peanuts per week). Babies will be followed until 9 months of age. Lactation consultant support is offered to women who are part of the BENEFIT Trial.

9. **The Cashew Study: Introducing cashew nuts during infancy**
   The aim of this study is to pilot regular cashew nut spread intake by infants from 6 months to 1 year of age to determine dosage recommendations prior to a larger RCT. Recent Australian research has found that approximately 1 in 20 school students have a current food allergy. Furthermore, cashew nut allergy is the most common of the tree nut allergies in adolescents. The 2016 revised Australasian Society of Clinical Immunology and Allergy (ASCIA) infant feeding and allergy prevention guidelines recommend all infants should be given allergenic foods including peanut butter, cooked egg, dairy and wheat in the first year of life. However, there is no specific mention of tree nut foods. This is due to a lack of evidence for the effect of regularly eating tree nuts in early childhood on tree nut allergy prevention. Infants will be randomly assigned to Group 1 (1 teaspoon 3 times per week) Group 2 (increasing from 1 teaspoon to 3 teaspoons 3 times per week) or Group 3 (no specific recommendations to introduce cashew nut spread). Recruitment is ongoing with 173 infants having completed their 1-year assessment.

10. **The PrEggNut Study: A Maternal diet rich in eggs and peanuts to reduce food allergies**
    Recently, babies have been found to be at risk of developing a food allergy even before they start eating solid foods. Researchers have discovered that baby immune responses can be improved by mothers eating more eggs during the first weeks of breastfeeding. The aim of this trial is to determine whether mothers regularly eating more eggs and peanuts during pregnancy and breastfeeding (from 22 weeks gestation until 4 months post birth) will reduce food allergies in their babies. Mothers are assigned to either Group 1 (at least 6 eggs and 60 peanuts per week) or Group 2 (no more than 3 eggs and 30 peanuts per week). Babies will be followed up until 4 months of age.

11. **The Engage Study: Discovering and delighting in your baby (pilot)**
    The Engage Study was a pilot that investigated a behavioural intervention for increasing the quality of parent-baby social interactions in the first 6 months of life. The Engage Study commenced recruitment in April 2019 with a total of 14 families recruited into the study. The study involved 2 parent education sessions during the pregnancy period, and then up to 10 sessions with the parent and baby after the baby is born. Data analyses are now underway to provide the outcomes of the RCT.

12. **The SunPreg Study: Measuring sun exposure in pregnancy and its association with the development of early childhood allergies**
    This study aims to investigate the association of sun exposure in pregnancy on the development of conditions such as eczema. With our sunny climate throughout the year, safe and regular exposure to sunlight may be an inexpensive way to limit the development of non-communicable diseases. Women will attend an appointment at 28-week gestation to measure sun exposure, skin pH and skin barrier function. Findings from the SunPreg Study will inform future trials of safe sun exposure. The results will also be key in translation activities to develop better sun exposure policies with the Cancer Council WA that provide advice to pregnant women on the right balance of sun protection and exposure.

13. **ADAPTS: Antibiotic Dysbiosis and Probiotics Trial in infants**
    ADAPTS is an RCT involving full term infants who are exposed to antibiotics in the neonatal unit at JHC. It is well known that antibiotics exposure in neonates, at a time when the normal development of gut flora occurs, can have long term health impacts. ADAPTS uses supplemental probiotics to promote the normal development of gut flora and plans to study

its effect on short term outcomes such as infantile colic, maternal mental health, as well as long term immune responses in infants. Recruited babies will be followed up for 1 year.

14. **TUMS: Water Quality and the Microbiome Study**
This RCT will examine the effects of untreated tap water and filtered water on the development of the gut microbiome in infants. It seeks to understand if exposure to chlorine, heavy metals and pesticides in tap water is safe for microorganisms that colonise the gut and if gut dysbiosis leads to chronic disease. Children will be recruited at 6 months and assigned randomly to Group 1 (Filtered water group) or Group 2 (Control group) and followed up until 18 months of age. This study aims to ensure that the way we treat tap water is optimised for promoting a healthy tum in early childhood.

15. **Diabetes during pregnancy and subsequent child development: A 3-year follow-up study**
Risk for developmental delay in children is regarded as an interaction of genetic and environmental factors. Several hypotheses have been generated about the association between intrauterine environment and subsequent child development, but conclusions are yet to be reached. The aim of this study is to track a large participant cohort from prenatal life to 3 years of age to examine the association between exposure to maternal diabetes in utero and subsequent development in the offspring.

16. **The impact of a Mediterranean diet and physical activity in pregnancy on gestational weight gain and neonatal body composition at 1 year of age**
This study aims to examine how a Mediterranean diet and exercise in pregnancy influences neonatal body fat composition at birth and weight at one year of age. Mothers' exercise and Mediterranean dietary compliance will be assessed through antenatal web-based questionnaires. The questionnaires will be linked with the infants Air Displacement Plethysmography (PEA POD) measurements post-delivery and anthropometry at 1 year of age to directly assess if high or low adherence to exercise and/or Mediterranean diet in pregnancy affects infant body fat composition and weight at 1 year.

17. **ORIGINS Community Wellbeing during the COVID-19 Pandemic**
The COVID-19 pandemic has created forced isolation and increased financial pressures with families being confined together at home potentially creating stress and altered family dynamics. This study will investigate how ORIGINS families are coping during this time, and their experience of living through the pandemic. All ORIGINS participants, ORIGINS staff and collaborators, and JHC staff will complete voluntary monthly questionnaires to measure wellbeing, perceived stress, financial hardship, and family functioning during the COVID-19 pandemic.

18. **Breastmilk Allergy Prevention**
This study will investigate if modifying maternal diet with prebiotic fibre supplementation during pregnancy and breastfeeding creates breastmilk that is more likely to reduce food allergy in offspring. The project will contribute data to inform maternal dietary interventions for allergy prevention in breastfed children. This study will also potentially reinforce the importance of breastfeeding, by highlighting its role in allergy prevention.

19. **Early Moves**
The Early Moves study is investigating whether a baby's early movements can predict learning difficulties later in childhood. Participants are required to take short (3 minute) videos of their baby at several timepoints using a smartphone app. A developmental assessment is then carried out when baby is 2 years old. This study will help us to better understand how to recognise developmental difficulties early enough to provide support and intervention in the first year of life, a critical period of brain development.

20. **ACE Infant Feeding: Helping new mums to be better breastfeeders – before their babies are even born**
The ACE Infant Feeding study aims to determine whether breastfeeding outcomes can be improved by teaching pregnant women how to hand express colostrum using a novel online instructional video. As a pilot study, it aims to determine the feasibility of teaching antenatal colostrum expression (ACE) via video, which may increase support to mothers and lead to improved breastfeeding rates, ultimately leading to improved public health outcomes.

21. **Airway Epithelium Respiratory Illnesses and Allergy (AERIAL)**
Recurring viral infections and atopy in early childhood, and certain exposures during pregnancy, are strong predictors of persistent asthma and/or long-term lung disease in adulthood. The research team has previously examined the cells lining the airways in the nose and lungs (epithelial cells) and found that these cells among children with asthma/wheeze do not form a tight barrier and heal slowly from injury. AERIAL will examine epithelial cells in placental samples to determine how exposures leave specific gene fingerprints, and how these relate to breathing outcomes in early life.

22. **Built Environments and Child Health in Wales and Australia (BEACHES)**
BEACHES examines how the built environment impacts obesity among children. It will examine 5 cohort studies in the United Kingdom and Australia to understand how complex and interacting built environment factors influence modifiable risk factors (physical inactivity, sedentary time, unhealthy diet) throughout childhood. The study will help to inform evidence-based planning policy and practice strategies to prevent the increase of non-communicable diseases.

23. **The BioMood study: A PILOT study assessing the association between Mediterranean diet, microbiome, metabolome, inflammation and mental health during pregnancy**
BioMood will examine if maternal adherence to a Mediterranean diet will lead to beneficial microbiome and metabolome composition and reduced inflammatory markers. It will also examine if beneficial gut microbiota is associated with positive mental health. An association between diet and positive mental health would support the importance of optimising maternal diet during pregnancy and may improve health outcomes at a population level.

24. **The COvid COmmunity compassiON study (COCOON): Assessing virus transmission, immunity development and wellbeing of families during COVID-19**
COCOON will follow 250 families for a 6-month period to understand how COVID-19 is impacting the ORIGINS cohort. The study will use an app to help families record health information, including COVID-19 symptoms, and alert the research team if any follow-up testing for respiratory viruses is required. The study will provide information to help guide policy and increase understanding of SARS-COV-2, the virus that causes COVID-19.

25. **CUB/Baby AICES - A randomised-controlled trial of a parent-mediated intervention for optimising social and communication development of newborns at increased familial risk of autism spectrum disorders**
The first 3 years of life is an important time for a child's brain development, and this development can be influenced by the quality of 'back and forth' interactions children have with parents/carers. CUB will test a new program designed to support baby brain development by providing parents/carers with information and skills to optimise 'back and forth' interactions.

26. **Kindy Readiness: Preschool readiness in the ORIGINS cohort**
A positive start to life can have impacts that last well beyond childhood, influencing future health, development, learning and wellbeing. The Kindy Readiness study aims to assess the development and wellbeing of all non-active participants enrolled in The ORIGINS Project to enable early identification, timely feedback and early intervention to vulnerable children prior to commencing preschool, kindergarten and/or an alternate early learning environment.

27. **Machine Learning: Personalised, machine learning based prediction of asthma and allergies in Western Australia**
Asthma is the most common chronic lung disease in childhood and is hard to diagnose in young children. The Machine Learning study aims to show that asthma and allergies can be predicted before they occur, based on family history and information the early environment. Using machine learning, the study aims to create personalised prediction scores for developing this disease, ultimately helping to prevent and manage asthma.

28. **Mast Cell: Contribution of a novel mast cell subset to development of atopic disease**
Allergies affect 1 in 5 Australian children and can be apparent within the first months of life through signs such as skin rashes or eczema. Mast cells form part of the body's immune response and are involved in the release of histamines, leading to most allergic symptoms (runny nose, itchiness, swelling, etc.). These cells may be a suitable target for new allergy drugs. This study will compare how mast cells are 'programmed' in allergic and non-allergic children as they migrate through the body.

29. **Mums Minds Matter: A three-arm pilot study of mindfulness vs self-compassion vs relaxation training for reducing stress and promoting wellbeing among pregnant women**
Mums Minds Matter is a pilot study comparing 3 8-week interventions and measuring the effects on maternal distress, self-compassion, mindfulness and emotion regulation. The 3 intervention types will be mindfulness-based training, self-compassion-based training, and a relaxation intervention; all intervention types will be home-based and provide resources in hardcopy and digital form. Improving mental health for pregnant women may improve maternal and child health.

30. **Time Out for Wellbeing: an experimental study linked to the Mums Minds Matter Project**
The perinatal period can be a stressful period, with many women experiencing depression during and/or after pregnancy. Evidence suggests that stress during this period can have negative health impacts on the mother and the mother-infant relationship. Time Out for Wellbeing aims to determine if pregnant women's willingness to engage in online wellbeing programs varies by program type. It will assess barriers and facilitators described by pregnant women that influence their willingness to engage in different types of online well-being antenatal programs.

31. **STORK: A pilot retrospective observational study to assess biomarkers of stress and serotonin pathways in pregnant women in The ORIGINS Project**
Traditionally, stress levels have been assessed through clinical assessments, which can be costly and inaccessible for some people, or self-reported questionnaires, which may be inaccurate and rely on participant literacy. Establishing a consistent, reliable measure of stress using biological markers could enable prevention and early intervention. Analysing hair is a relatively new strategy for measuring long-term cumulative cortisol levels. The STORK pilot study will analyse biomarkers in the hair of a sample of pregnant women, separated between those who score high and low on self-reported psychological scales, to determine if there is a correlation between self-reported measures and biological markers.

32. **Dental screening: Tele-screening for early childhood caries detection during COVID-19 pandemic**
Dental decay is one of the most common causes of hospitalisation for children in Western Australia. Dental Screening aims to implement and validate a potentially cost-saving photographic method in remote dental screening for tooth decay in preschool children using a smartphone camera and store-and-forward telehealth as an alternative to a traditional visual dental inspection. This study may contribute to the prevention and early intervention of dental decay, leading to fewer dental-related hospitalisations for children and improved dental health.

33. **ORIGINS of Neurodevelopmental Risk and Resilience Project Amendments**
Neurodevelopmental disorders, such as Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder, often go undetected until later infancy or early childhood and have lifelong impacts. This study aims to analyse whether different classes of neurodevelopmental trajectories emerge in the first two years of life and examine various risk factors. The identification of risk factors and early intervention have the best chance of improving impairments by capitalising on the neuroplasticity of infants' brains.

Appendix Two: ORIGINS Research Dissemination: Publications, Papers and Presentations

Publications

1. Batty, G. D., & Kivimaki, M. (2021). Adverse childhood experiences and adult health: The need for stronger study designs to evaluate impact. *Journal of Epidemiology and Community Health, 75,* 485-488. Advance online publication. DOI: 10.1136/jech-2020-215870.

2. Baughman, N., Prescott, S. L., & Rooney, R. (2020). The prevention of anxiety and depression in early childhood. *Frontiers in Psychology, 11*(2333). DOI: 10.3389/fpsyg.2020.517896

3. Chebar Lozinsky, A., Loke, P., Orsini, F., O'Sullivan, M., L Prescott, S., Gold, M. S., Quinn, P., DunnGalvin, A., LK Tang, M., & PPOIT study team. (2020). Study protocol of a multicentre, randomised, controlled trial evaluating the effectiveness of probiotic and peanut oral immunotherapy (PPOIT) in inducing desensitisation or tolerance in children with peanut allergy compared with oral immunotherapy (OIT) alone and with placebo (the PPOIT-003 study). *BMJ Open, 10*(9), e035871. DOI: 10.1136/bmjopen-2019-035871

4. Elliott, C., Alexander, C., Salt, A., Spittle, A., Boyd, R. N., Badawi, N., Morgan, C., Silva, D., Geelhoed, E., Ware, R. S., Ali, A., McKenzie, A., Bloom, D., Sharp, M., Ward, R., Bora, S., Prescott, S., Woolfenden, S., Le, V., . . . Valentine, J. (2021). Early Moves: A protocol for a population-based prospective cohort study to establish General Movements as an early biomarker of cognitive impairment in infants. *BMJ Open, 11*(4), e041695. DOI: 10.1136/bmjopen-2020-041695

5. Finlay-Jones, A. L., Davis, J. A., O'Donovan, A., Kottampally, K., Ashley, R. A., Silva, D., Ohan, J. L., Prescott, S. L., & Downs, J. (2020). Comparing web-based mindfulness with loving-kindness and compassion training for promoting well-being in pregnancy: Protocol for a three-arm pilot randomized controlled trial. *JMIR Research Protocols, 9*(10), e19803. DOI: 10.2196/19803

6. Gamez, C., Metcalfe, J., Prescott, S. L., & Palmer, D. J. (2021). Lower cord blood IL-17 and IL-25, but not other epithelial Cell-derived cytokines are associated with atopic dermatitis in infancy. *International Archives of Allergy Immunology, 182*(6),474-478. DOI: 10.1159/000512919.

7. Hagemann, E., Silva, D. T., Davis, J. A., Gibson, L. Y., & Prescott, S. L. (2021). Developmental Origins of Health and Disease (DOHaD): The importance of life-course and transgenerational approaches. *Paediatric Respiratory Reviews*. DOI: 10.1016/j.prrv.2021.05.005

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Conference presentations

1. Ashwin, D., Gibson, L., Hagemann, E., D'Vaz, N., Bear, N., & Silva, D. (2020, September). The impact a Mediterranean Diet in pregnancy on neonatal body fat composition: The ORIGINS cohort [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

2. Dallimore, L., Aniba, R., Doyle, S., Silva, D., Blyth, C., & Bellini, C. (2020, September). Towards a digital health vision for Western Australia [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

3. Davis, J. (2020, 1-8 December). Exploring the experience and engagement of perinatal women in online emotional wellbeing training [Conference presentation]. 2020 inVIVO Planetary Health, Amsterdam, Netherlands (changed to online).

4. Gibson, L., Davis, J., Bear, N., Whalan, S., Hagemann, E., Bivoltsis, A., Silva, D., & Prescott, S. (2020, September). Community wellbeing during the COVID-19 pandemic: The ORIGINS Cohort [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

5. Hood, R., Zabatiero, J., Silva, D., Zubrick, S., & Straker, L. (2020, September). Expecting a baby in a digital era: Device use and prenatal attachment [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

6. Hood, R. (2020, 1-8 December). Parent use of smartphones and tablet computers and prenatal attachment [Conference presentation]. 2020 inVIVO Planetary Health, Amsterdam, Netherlands (changed to online).

7. O'Sullivan, T. (2021, 17 May). Applying a child-centered, respectful approach in paediatric trials [Conference presentation]. Science on the Swan, Perth, Western Australia.

8. Prescott, S.L. (2020, deferred). Mental health and the health of our planet – why mindsets matter. Congress of the Royal Australian NZ and Australian College of Psychiatrists, Hobart, Tasmania (Keynote speaker).

9. Parkin, K., Martino, D., Christophersen, C., Prescott, S., Palmer, D., Silva, D. (2020, September). Investigating the effect of chlorinated drinking water on the infant gut microbiome. [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

10. Parkin, K. (2020, 1-8 December). Investigating the effect of chlorinated drinking water on the assembly of the infant gut microbiome [Conference presentation]. 2020 inVIVO Planetary Health, Amsterdam, Netherlands (changed to online).

11. Prescott, S.L. (2020, 3-4 February). Dysbiotic drift and the modern health crisis. The Institute for Integrative Health, Baltimore, United States of America.

12. Prescott, S.L. (2020, May). Dysbiotic drift and the modern health crisis: Ecological approaches for People, Place and Planet. Institute of Functional Medicine, Phoenix, United States of America (Keynote speaker - changed to online).

13. Prescott, S.L. (2020, 9-10 October). Immune resilience on all scales: From personal to planetary ecology. Eighth Annual Personalized Lifestyle Medicine Thought Leaders Consortium, Seattle, United States of America (Plenary Speaker - changed to online).

14. Prescott, S.L. (2020, 20-24 October). A world of inflammation-pandemics and planetary health. 9th World Congress of Veterinary Dermatology, Sydney, New South Wales (Keynote speaker).

15. Prescott, S.L. (2020, November). Building resilience on all scales - for People, Places and Planet. International Lifestyle and Personalized Medicine Summit, Brazil (Keynote speaker - changed to online).

16. Prescott, S.L. (2020, December). Inspiring personal and planetary change for resilience on all scales. Australian Lifestyle Medicine Conference, Melbourne, Victoria (Keynote speaker - changed to online).

17. Prescott, S.L. (2020, 1-8 December). Project Earthrise. 2020 inVIVO Planetary Health, Amsterdam, Netherlands (Congress Chair - changed to online).

18. Renouf, B. (2020, November). AERIAL: Invited Young Investigator speaker. Wal-yan Respiratory Scientific Meeting, Rottnest, Western Australia.

19. Silva, D. (2021, 30 March). Pregnancy risk factors on body fat composition: Mediterranean diet [Conference presentation]. 2021 Perinatal Society of Australia and New Zealand Annual Congress, online.

20. Silva, D. (2021, 17 May). The ORIGINS Project: Creating a platform to increase research capacity to better understand non-communicable disease [Conference presentation]. Science on the Swan, Perth, Western Australia.

21. Silva, D. (2021, 28 May). Digital technology vs nature: Effects on child development and mental health [Conference presentation]. Friends of Ngala Annual Fundraising Luncheon, Perth, Western Australia.

22. Silva, D. (2021, 10 June). Update on The ORIGINS Project. Gen V Scientific Meeting, Perth, Western Australia.

23. Silva, D. (2021, 23 June). The ORIGINS Project. Presentation to the Commission for Children and Young People, Perth, Western Australia.

24. Silva, D. (2020, 1-8 December). Managing the digital environment for our children: Physical, mental and social implications for a post COVID generation [Conference presentation]. 2020 inVIVO Planetary Health, Amsterdam, Netherlands (changed to online).

25. Silva, D., Davis, J., Hagemann, E., Gibson, L., D'Vaz, N., Ong, M., Downie, E., Giggs, L., Whalan, S., Tan, J., Smit, A. Bell, L., Srinivasjois, R., & Prescott, S. (2020, September). The ORIGINS Project: Creating a platform to increase research capacity [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

26. Starcevich, L., Chong, N., Palmer, E., White, J., Kidd, C., Amin, M., Ling K-M., Iqbal, M., Agudelo-Romero, P., & Stick, S. (2020, September). NOSE - A pilot study to determine feasibility of newborn nasal sampling [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

27. Starcevich, L. (2020, November). COCOON study update, Inaugral Award Presentation. Wal-yan Respiratory Scientific Meeting, Rottnest, Western Australia.

28. Stick, S. (2020). AERIAL presentation. 2020 Child Health Symposium, Perth, Western Australia.

29. Stick, S. (2020). COCOON presentation. Wal-yan Respiratory Scientific Meeting, Rottnest, Western Australia.

30. Valentine, J. (2021, 17 May). The role of general movements in the early diagnosis of neurodevelopmental impairment [Conference presentation]. Science on the Swan, Perth, Western Australia.

31. Valentine, J., Alexander, C., Salt, A., Amery, T., Coenen, A., Moore, J., Thornton, A., Davidson, S., Adams, M., & Elliott, C. (2020, September). Identifying cognitive impairment through Early Moves. [Conference presentation]. 2020 Child Health Symposium, Perth, Western Australia.

Presentations

1. Ashwin, D. (2020, October). The impact a Mediterranean Diet in pregnancy has on neonatal body fat composition. Joondalup Health Campus Research Week, Perth, Western Australia.

2. Davis, J. (2020, October). The ORIGINS Project: Making inclusive positive change. Joondalup Health Campus Research Week, Perth, Western Australia.

3. Davis, J. (2020, October). The ORIGINS Project: Phase 2 of a decade long pregnancy intervention cohort. Joondalup Health Campus Research Week, Perth, Western Australia.

4. D'Vaz, N. (2020, October). The ORIGINS Project Biobank. Joondalup Health Campus Research Week, Perth, Western Australia.

5. Gibson, L. (2020, October). Community wellbeing during the COVID-19 pandemic: The ORIGINS Cohort. Joondalup Health Campus Research Week, Perth, Western Australia.

6. Gibson, L. (2020, October). Nature Play & Grow: Promoting healthy eating, unstructured play and planetary responsibility by connecting preschool children to nature. Joondalup Health Campus Research Week, Perth, Western Australia.

7. Gibson, L. (2020, October). The ORIGINS Project: Involving consumers in a cohort study. Joondalup Health Campus Research Week, Perth, Western Australia.

8. Gibson, L. (2020). The ORIGINS Project: Community engagement. TKI Connect, Perth, Western Australia.

9. Gibson, L. (2020). The ORIGINS Project: Community Wellbeing Project. TKI Connect, Perth, Western Australia.

10. Gibson, L. (2020). The ORIGINS Project: Community Wellbeing Project. TKI Re-Connect, Perth, Western Australia.

11. Gibson, L. (2021, July). The ORIGINS Project: Community Wellbeing Project. TKI Connect, Perth, Western Australia.

12. Gibson, L. (2021, July). The ORIGINS Project: Community Wellbeing Project. WASEY Network Meeting, Perth, Western Australia.

13. Hagemann, E. (2020, October). The ORIGINS Project: Leading a new generation of interventional birth cohorts. The ORIGINS Cohort. Joondalup Health Campus Research Week, Perth, Western Australia.

14. Hood, R. (2020, October). Mobile touch screen device use during pregnancy and prenatal attachment. The ORIGINS Cohort. Joondalup Health Campus Research Week, Perth, Western Australia.

15. Lichtenberg, N. (2020, October). Adverse pregnancy and neonatal outcomes associated with elevated maternal and paternal body mass index (BMI): A single-centre retrospective cohort study. Joondalup Health Campus Research Week, Perth, Western Australia.

16. O'Sullivan, T. (2020, October). Helping new mums with breastfeeding before their babies are born: The ACE Study. Joondalup Health Campus Research Week, Perth, Western Australia.

17. Parkin, K. (2020, October). Investigating the effect of chlorinated drinking water on the assembly of the infant gut microbiome. Joondalup Health Campus Research Week, Perth, Western Australia.

18. Silva, D. (2021, 24 February). Early life opportunities for health. UWA Student Presentation, Perth, Western Australia.

19. Starcevich, L. (2020, October). Are babies born with a vulnerable airway epithelium? NOSE: A pilot study to determine feasibility of newborn nasal sampling. Joondalup Health Campus Research Week, Perth, Western Australia.

20. Stick, S. (2020). AERIAL presentation. Joondalup Health Campus Research Week, Perth, Western Australia.

21. Whitehouse, A. (2021). CUBS presentation. CliniKids Connect Public Event, Perth, Western Australia.

22. Yeap, B. (2020, October). Cardiovascular Risk Evaluation in Expectant Fathers (CARE-Dads): Investigating the health of fathers in the ORIGINS Project. Joondalup Health Campus Research Week, Perth, Western Australia.

Appendix Three: ORIGINS media report July 2020-June 2021

June/July 2020	
The West Australian: Allergies – front page and double spread on ORIGINS and its allergy studies and families	LINK to article
6PR: Interview with Dr Debbie Palmer on allergies and ORIGINS	Link to listen
ABC Radio Perth: 45min feature – ORIGINS and allergies Prof Silva and Dr Debbie Palmer	Link to listen
JHC Facebook: ORIGINS screen time sub-project	Link to post
Telethon Kids website: BEACHES study: sub-project	Link to article
November 2020	
Telethon Kids Telescope internal: PrEggNut at sponsored event on allergies	Link to article
ABC Dr Norman Swan's Health Report radio program and podcast: Debbie Palmer on cow's milk allergy overdiagnosis.	Link to listen
The Daily Mail: Dr Michael Mosley speaks on ORIGINS	Link to article
JHC Facebook: Desi and Ravisha World Prematurity Day	Link to post
Telethon Kids Facebook: ORIGINS hits the Daily Mail	Link to post
December 2020	
Stirling Times, Joondalup Times and Wanneroo Times: (page 2) Perth Pregnancy Clinic and ORIGINS	Link to article
February 2021	
Telethon Kids Twitter and Facebook: Nina D'Vaz, Biobank Manager – International Day of Women and Girls in Science	Link to post
JHC Facebook: Michael Mosley/ORIGINS recruitment video	Link to post
Telescope internal: Meet the ORIGINS Team	
Telescope internal: Michael Mosley recruitment video	View the video on ORIGINS website
March 2021	
The West Australian: Wrap centre double spread: ORIGINS and Best Family Health: 10,000 families	Link unavailable See image in report
City of Wanneroo Facebook: Michael Mosley recruitment video	Link to post
City of Wanneroo family contacts database share - approximately 1000+ contacts from across the City from Girrawheen to Two Rocks: Michael Mosley recruitment video	
Telethon Beneficiaries Event: photos, stats and project outline for beneficiary event screens and program.	
Together Magazine: ORIGINS feature	
Telescope: ORIGINS' 5,000 families	
April 2021	
Joondalup and Wanneroo Times: ORIGINS Family Fun Day	Link unavailable
The West Australian: Josh Frydenberg Treasurer visit to Telethon Kids, ORIGINS feature and pic	Link unavailable
Josh Frydenberg Instagram account: Treasurer's visit, ORIGINS feature and pic	Link to post
Josh Frydenberg Facebook account: Treasurer's visit	Link to post
- shared to all Telethon Kids socials, including internal channels	

May 2021	
WA Health Translation Network Twitter: Science on the Swan Desi presentation	Link to post
Channel 9 News Perth, also shared on Facebook: Early Moves additional funding	Link to post
WA Business News – Ramsay Health Care article: ORIGINS image and outline	Link to article
June/July 2021	
Perth Now online / Joondalup Times / Wanneroo Times: Launch of PLAN app – Desi and ORIGINS	Link to article
ABC Radio Drive program: Jackie Davis speaks on ORIGINS	Link to listen
CliniKids Facebook page: ORIGINS family - TALK study	Link to post
Curing Homesickness socials: Early Moves and ORIGINS	Link to post
Perth Children's Hospital Foundation socials: Early Moves and ORIGINS	Link to post
- JHC & Telethon Kids Facebook shares: Early Moves and ORIGINS	