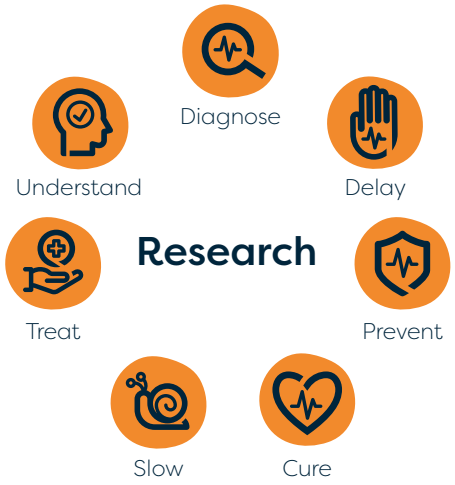
Research Project
By Dr Andrew McKinnon

Dementia Australia™ Research Foundation

RACE AGAINST DEMENTIA

Delineating relationships between sleep-wake disturbances, brain changes, dementia risk factors and the accumulation of dementia pathology



What is the focus of the research?

Determining the relationship between sleep-wake disturbances and brain structure, cognition and dementia risk factors (both pathological and modifiable).

What is an MRI?

MRI stands for Magnetic Resonance Imaging. It is a medical scan used to take images of softer parts of the body (like the brain!) that don't show up on an x-ray. This is because it is designed to target water molecules, not calcium in bones.

Patients are put inside a large magnetic field. Protons in the water molecules in their bodies send out an "echo" to a radio wave. This echo is used by a computer to create an image of a 'slice' of the inside of the body. For a clearer image, a patient can be injected with a contrast dye that reacts to the magnetic field and helps the important parts stand out.

How will this happen?

Stage 1: Use PET and MRI imaging to analyse the medical signs of brain health for older adults at risk of or in the early stages of dementia.

Stage 2: Assess participant modifiable risk factors via blood tests, neuropsychological evaluations, mood and medical assessments, and vascular risk ratings.

Stage 3: Investigate participant sleep-wake disturbances over one week using wrist- and finger-worn monitors to measure the number of wakes and the amount of oxygenated blood reaching the brain throughout the night. Have them keep a sleep journal during this time.

Stage 4: Take all Stage 1-3 measures again two years later and map the results to see how sleep-wake disturbances change over time and how they are associated with changes in pathological and modifiable risk factors of dementia.

Stage 5: Use weightings in the relationships identified in Stages 1-4 to build machine learning models to inform individualised risk assessments and dementia predictions.

What is a PET scan?

PET stands for positron emission tomography. A PET scan takes images of your body to help doctors check for disease.

A special radioactive dye is put inside a patient. The dye gathers in the body where chemical activity is high, and because disease (amongst other things) has high chemical activity, it allows doctors to see bright spots on the scan where disease is.

The PET scan can also measure things like blood flow, oxygen use and how your body metabolises things, which allows doctors to see how well your organs and tissues are working.

Why is it important?

Dementia is the single leading cause of disability in persons over the age of 65 in Australia. With Australia's population ageing, the rates of dementia are increasing significantly. 3.6 million Australians are now older than 65 and this is projected to increase to 9.6 million in the next 50 years.

Dementia has a huge impact on people's lives. They can have difficulty remembering, processing information, recognising faces, performing everyday tasks and communicating. Dementia is also fatal, with no cure, so currently there feels like there is no light at the end of the tunnel for people who have been diagnosed, or their families.

In the absence of curative treatments, identifying and addressing factors that contribute to dementia risk is paramount. By doing so it is thought that one-third of Alzheimer's disease cases and up to 40% of all dementia cases may be preventable. Sleep disturbances including poor sleep quality and shorter sleep duration, as well as sleep disorders such as sleep apnoea, are present in up to 60% of people over the age of 60, and in up to 70% of those with dementia. These types of sleep problems are being increasingly noticed as a significant risk factor for dementia – and one that with the right research, we can modify.

What will this mean for older Australians?

- A tangible route towards reducing their risk of cognitive decline and dementia.
- Their physicians routinely screening them for this type of disorder, meaning a lower risk of dementia in the future.

What will this mean for physicians?

- Guidance for targeted and early interventions.
- Access to clinical diagnostics at varying stages of cognitive decline.
- Tools that will provide personalised risk profile reports that can be implemented to guide strategies for dementia management and prevention.

What are sleep-wake disturbances?

Sleep-wake disturbances are changes in night-time sleep that result in daytime distress or impairment in functioning.

Measuring sleep-wake disturbances looks at sleep efficiency (sleep vs time in bed), sleep fragmentations (how many times you wake up during the night), sleep latency (how long it takes you to get to sleep) and shifts in circadian rhythms.

There is a worrying relationship between sleep-wake disturbances and neurodegeneration, whereby neurodegeneration contributes to sleep-wake disturbances, and sleep-wake disturbances also cause neurodegeneration.

Sleep is vital for maintaining key brain processes, including the clearance of neurotoxic waste. Sleep-wake disturbances can impair the formation of new brain cells in the hippocampus - a critical part of the brain for memory formation.

What will this mean for dementia researchers?

- Guidance for targeted and early interventions.
- Access to clinical diagnostics at varying stages of cognitive decline.
- Tools that will provide personalised risk profile reports that can be implemented to guide strategies for dementia management and prevention.

Who's undertaking the research?

Dr Andrew McKinnon, The University of Sydney

Dr McKinnon is CRE fellow and neuropsychologist in the Healthy Brain Ageing team at the University of Sydney where he has been since 2013. His work has focused on sleep-wake disorders, cognition, and functional and structural MRI. Dr McKinnon will soon be undertaking a 14-month secondment at CSIRO in Brisbane with the Bioinformatics Information team, between the end of the first data collection period and the start of the follow-up collection.

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