brainWAVES

The Newsletter of the Brain Foundation

Winter 2022

Most people don't realise just how frequently the work of the Brain Foundation touches their own lives. To gain a greater appreciation I ask you to consider this statement: "Chances are; you or someone you love has been touched by a brain disorder, disease or injury".

I am sure you are thinking of someone right now… Perhaps you have a family member who suffers from migraine or dementia. Or maybe a close friend has had a stroke, or suffered a brain injury.

Over the past 50 years there are literally hundreds of research projects which the Brain Foundation has funded in an effort to find the answers into brain disorders, diseases or injuries. We have come a long way but our work will never end.

Did you know you can nominate which area of research you would like your donation to support? Jump on our website www.brainfoundation.org.au, then hold your mouse over 'Support Us' to find our donation page. Then just follow the easy steps to support a certain research category.

Researchers across Australia thank you.

Trevor Thompson
CEO

OVER **$9,000,000** HAS BEEN GIFTED TO OVER **470 RESEARCH PROJECTS** IN THE LAST **50 YEARS**

Celebrating over **50 YEARS** OF RESEARCH

• MAKING A DIFFERENCE SINCE 1970 •

$5,000,000 IN **GRANTS GIVEN** FROM 2010 TO 2019

WE CAN'T WAIT TO SEE WHAT THE COMING DECADES HAVE IN STORE

Brain Awareness Week 2022

Brain Awareness Week took place from March 14-18 this year and for the first time, we took everything online. We shared articles & resources about brain health, patient support, and different brain disorders.

"When the Brain Foundation began more than 50 years ago, there was no internet or social media," says Trevor Thompson, CEO.

"NOW WE CAN SHARE THE AWESOME WORK OF OUR RESEARCHERS WITH JUST A CLICK, GIVING YOU INSIGHT INTO THE LATEST FINDINGS AND HELPING YOU LEARN A LITTLE BIT MORE ABOUT THE DISEASES THAT AFFECT SO MANY AUSTRALIANS."

If you missed Brain Awareness Week this year, you can visit our website to catch up on the resources. You can learn about…

- Strategies to maintain your brain health
- How to access patient support services
- The latest updates on Alzheimer's Disease research
- New imaging technologies being used to detect concussion
- And other short videos about multiple sclerosis, stroke, and motor neurone disease.

Brain Awareness Week

Brain health | Researcher updates | Patient resources

Thank you to everyone who participated in Brain Awareness Week, and a special thanks to the neurologists who contributed their time & expertise to make these videos. If you missed out this year, make sure you're subscribed to our email list to stay in the loop for future events!

You can sign up & access this year's resources at brainfoundation.org.au/brain-awareness-week/

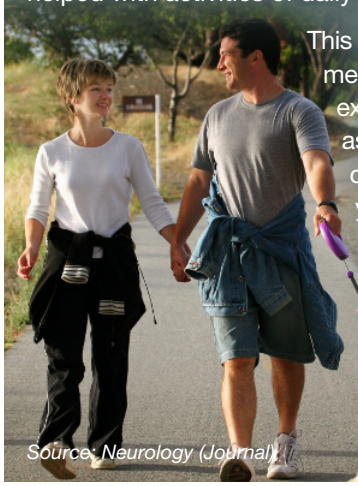
Contact the Brain Foundation
PO Box 579, Crows Nest NSW 1585
Telephone: 02 9437 5967 or 1300 886 660
Email: info@brainfoundation.org.au
Visit our websites **brainfoundation.org.au** and **headacheaustralia.org.au**

News

Regular exercise improves clinical outcomes in Parkinson's Disease

A new study has found that exercise and activity levels have a long-term impact on clinical outcomes for people with Parkinson's Disease. Certain types of exercise and physical activity led to slower decline of peoples' postural and gait dysfunction, processing speed, and activities of daily living.

Moderate to vigorous exercise improved outcomes for posture and gait dysfunction; work-related activity helped with processing speed; and household tasks helped with activities of daily living.



This was the first study to measure the effects of exercise in the long term, assessing motor and cognitive function for six years. Given that there is no disease modifying treatment for Parkinson's Disease, this research provides hope that exercise can improve patient outcomes.

Source: Neurology (Journal)

New brain study aims to diagnose & prevent neurological disease before symptoms appear

The Cleveland Clinic (USA) will collect data from up to 200,000 people over a 20-year period to identify disease biomarkers and targets for treatment.

The researchers will begin with 10,000 neurologically healthy volunteers, including some who have a first-degree relative diagnosed with multiple sclerosis. They will undergo yearly assessments for five years including neurological examination, bloodwork, MRIs, and more. Advanced computer analysis will then help identify genetic risk factors and detect changes occurring in the brain over time.

With one in six people worldwide living with a neurological disorder (i.e. dementia, stroke, Parkinson's, epilepsy), this research will provide hope for so many. We are looking forward to how this might guide future research into diagnostic and preventative medicines.

Source: The Cleveland Clinic

Simple DNA test could detect common neurological disorders

A new study has found that whole genome sequencing (WGS) can quickly and accurately detect the most common inherited neurological disorders.

For many years, it has been difficult to get a definitive diagnosis for conditions such as Huntington's Disease and some forms of amyotrophic lateral sclerosis (ALS). They are 'repeat expansion disorders', and it was thought that WGS could not detect these specific genetic anomalies. Instead, people with symptoms would undergo multiple tests which significantly delayed diagnosis.

However, a study in The Lancet Neurology has created a new algorithm that will allow these conditions to be detected with WGS. This finding will help people with neurological symptoms find answers in a matter of weeks, rather than years.

Source: The Guardian

Even mild COVID infection can affect the brain

After small imaging studies showed brain damage after severe COVID-19, researchers investigated the effects of milder infection. The University of Oxford team reported that adults aged 51 - 81 had slightly thinner grey matter and signs of tissue damage in their olfactory areas. Executive function also declined more rapidly after someone had COVID-19.

These structural and cognitive changes raised questions about dementia risk. The good news is that this doesn't appear to be a reason for panic - one researcher said that the brain returns to baseline a few months after infection, as far as they have observed. We also haven't seen a major spike in dementia cases. Research is ongoing in association with the UK Biobank, and we'll keep you updated on their findings.

Source: Alzforum

Fundraisers

Support from 'Brothers in Arms' author

Mosese Sikivou speaking at the Brothers in Arms book launch.

Books can change the world, and this book is making a difference in two ways. The contributing authors each selected a charity to support with the proceeds from Brothers in Arms, and we thank Mosese Sikivou for nominating us as his chosen charity. Brothers in Arms features the stories of twelve men speaking on a theme that is important to them. These messages of hope, inspiration and reflection are written by men, for men. We are glad we could be a part of such a beautiful project!

What is an aneurysm?

Cerebral aneurysm is a common disorder caused by weakness in the wall of a brain artery. An aneurysm can form for many reasons, and it is often asymptomatic. However, it can be quite dangerous if the aneurysm ruptures and causes haemorrhaging. You can learn more at brainfoundation.org.au/disorders/aneurysm/

Remembering Kobi

Thank you to Rhianna Hall who held a fundraiser in memory of her son, Kobi, earlier this year. Kobi was just 16 when he sadly passed away after a cerebral aneurysm. To celebrate his 18th birthday, Rhianna organised a fundraiser to help support research into this disease. We appreciate the support of his family, friends, and community who donated and helped to raise awareness about aneurysms. It is a testament to how loved he was, and these funds will help so many by advancing research into the diagnosis, treatment, and prevention of aneurysms.

Walking for brain research

Thank you Antra for taking us 'one step further' in aneurysm research. Antra created a walking challenge to celebrate her mother, Erika, and her incredible achievements after being diagnosed with multiple brain aneurysms in 2013. We are so thankful for your support and dedication.

A 'tee-riffic' fundraiser

We are so thankful to have the support of the Melbourne Business Golf Group, who held a fundraiser to support brain cancer research in early May. It was a fantastic day with over 100 people participating in a golf tournament followed by dinner and a silent auction. Plus, physical activity & socialising are both great ways to maintain your brain health! Thank you to Bernadette Looner for organising this event, and of course to everyone who attended.

How can I hold a fundraiser?

There are so many ways that you can fundraise to support brain research. You might want to participate in a fun run, take on a healthy brain challenge (such as giving up alcohol or sugar for a month), commemorate a loved one, celebrate a birthday or create your own fundraiser. You can find more information at brainfoundation.org.au/fundraising/

Regular Giving

Would it suit you to make smaller but more frequent donations?

We can help you. Either sign up using our online Donation form – see our web site, or you can make a direct debit. Ring us for our bank details. Regular donations can be made to a specific area of research.

Migraine & Headache Australia Updates

Migraine & Headache Awareness Week 2022

Migraine & Headache Awareness Week is returning in 2022 from the 19th - 23rd of September. Over 4,000 of you joined our expert webinars last year featuring leading specialists to learn all about the latest research and treatment updates - and we're looking forward to an even bigger year ahead. Make sure you're signed up to the Migraine & Headache newsletter or our social media to receive updates about the speakers, topics, and session times.

Migraine & Headache Awareness Week

Shades for Migraine

Coming up soon is the 2022 Shades for Migraine awareness initiative and competition in June. Migraine & Headache Australia is joining forces with global advocacy groups to generate awareness and raise funds for migraine research.

Here's how you can participate in the event and be in the running to win some exciting prizes:

- Put on your shades on (or around) June 21st to show you care for people living with migraine.
- Take a photo of yourself in your sunglasses and don't forget to get your friends, family and co-workers in on the fun.
- Post your photo with the hashtag #ShadesForMigraine #MHA and challenge 3 friends to take part!

Getting involved will help raise much-needed awareness for migraine. Plus, all entries will go into a draw to win one of five prize packs. Stay tuned for more details!

New Treatment Update: Vyepti approved

In early April, a new preventive migraine treatment was approved in Australia. Vyepti® (eptinezumab) is available via private prescription for the prevention of migraine in adults. It is administered as a 30 minute infusion every 3 months.

Vyepti® is a calcitonin gene-related peptide monoclonal antibody (CGRP), joining the three other CGRP medications available in Australia. Emgality® and AjovyTM are subsidised on the pharmaceutical benefits scheme (PBS), and Aimovig® is available with a private prescription.

Studies have found that these medications are generally more effective and have fewer side effects than older preventive treatments (which are borrowed from other conditions).

Unfortunately, these potentially life-changing treatments are expensive without PBS coverage. The price of Vyepti® starts at $1,800 per quarter, which is unaffordable for many people.

We are advocating for this to change. In April we encouraged members of the community to join us in making a submission to the Pharmaceutical Benefits Advisory Committee, calling for this treatment to be added to the PBS. While we wait to see the outcome of these submissions, you can ask your neurologist about accessing Vyepti® privately.

Migraine World Summit

2022 brought us another incredible Migraine World Summit. Tens of thousands of people tuned in from all over the world to learn from top doctors, researchers and specialists in the field of migraine & headache.

Thank you for your support and participation in this event, which has raised over $3,000 in donations to Migraine & Headache Australia.

If you missed the live event in March, you can access 8 of the recordings online for free.

What is migraine aura?

Almost everyone experiences some warning symptoms before a migraine attack, known as a prodromal phase. You might feel fatigued, have difficulty concentrating, or develop neck stiffness. But some people experience something a little bit different, called migraine aura.

Aura symptoms can temporarily affect your vision, senses, or neurological function. They last between 5 minutes and one hour, and usually occur just before or alongside the headache.

Visual aura is the most common type of aura, and it can look like:

- 'Seeing stars', with flashes of light or bright spots
- Zig-zag lines moving across your field of vision
- Blind spots or partial vision loss

Sensory symptoms (i.e. numbness or tingling) and neurological symptoms (i.e. speech disturbances) are less common.

These disturbances can be quite scary the first few times they happen, even if they subside relatively quickly. You might think you're experiencing a serious neurological disease like a stroke or blindness. You should always seek medical advice to rule this out, but if it is aura, it does not cause lasting neurological damage.

Thankfully, the treatment for migraine with aura is no more complicated than standard migraine treatment. In fact, a preventive medication (lamotrigine or even low dose daily aspirin) is sometimes specifically recommended for people with visual aura. Other treatments are equally likely to work for patients with and without aura.

What causes aura?

One of the mysteries in migraine research is understanding what causes these unusual symptoms, and how are they connected to migraine overall?

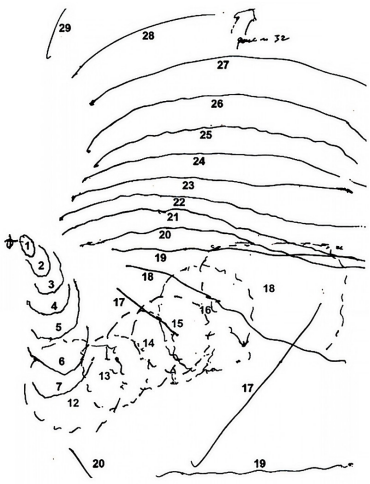
The most commonly accepted theory of aura points towards cortical spreading depression (CSD), although this is difficult to confirm with current imaging technology. CSD is a wave of atypical activity that travels across the brain, altering the function of brain cells and blood vessels. As this activity moves it can shut down parts of the brain, explaining why visual aura may appear to travel across the visual cortex.

The relationship between aura and migraine pain is more complicated. Aura is inconsistent - only 20-40% of people with migraine experience aura. And even then, they won't always have aura alongside every migraine attack. Other people get aura without any head pain at all. This makes it hard to say for sure what the connection might be.

A number of mechanisms are involved in migraine pain, such as inflammation of certain nerves and altered neurotransmitter function. However, we haven't identified one 'magic key' that unlocks the mystery of migraine. Hopefully, through continued research we can come closer to finding the answers, and maybe even finding a cure for this debilitating disease.

Read the full article on our website **at** headacheaustralia.org.au/migraine-aura/

Credit: Priya Rama



A drawing by a migraine patient showing the progression of an aura at one-minute intervals

Join the support group on Facebook & follow us on social media to connect with other patients, keep up to date with news, and discover upcoming events

Facebook.com/groups/headacheaustraliasupportgroup/

@migraineandheadacheaustralia

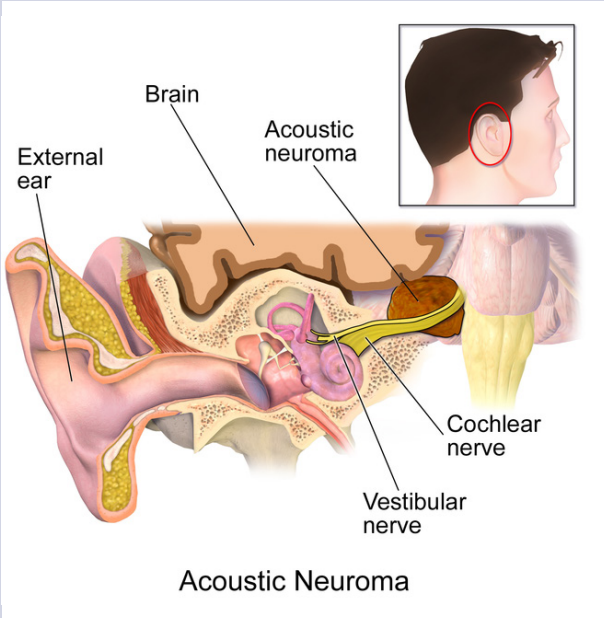
Disclaimer: Migraine & Headache Australia is not a medical office and cannot offer medical advice. We encourage you to discuss any issues you have with your medical practitioner.

Acoustic Neuroma

An acoustic neuroma is a benign (non-cancerous) tumour that can affect hearing and balance. It develops when the specialised cells (Schwann cells) surrounding the eighth cranial nerve grow at an abnormal rate in the internal auditory canal.

The eighth cranial nerve connects the inner ear to the brain and it is known as the vestibulocochlear nerve. When the tumour presses on this nerve, it causes symptoms including dizziness, hearing loss and ringing in the ears.

However, acoustic neuromas grow quite slowly, so these symptoms develop gradually. It might take years for someone to notice that something is wrong. If left untreated, the tumour can grow through to the brain and cause symptoms like facial paralysis.



SANDY RICHARDS WAS DIAGNOSED WITH ACOUSTIC NEUROMA IN 1964. WE HOPE THAT SHARING HER STORY CAN RAISE AWARENESS FOR THIS RARE DISORDER.

Searching for a diagnosis

It was 1964 and I had begun to notice that, through a combination of insignificant occurrences, my balance did not seem quite as it should be. For instance, I was making mistakes while typing, even though I had trained as a touch typist.

Eventually I went to a local doctor, a highly respected surgeon in our country town. His opinion was that I was having marital problems! He suggested a holiday away from Rick, my husband. Even though we were happily married, Rick said I should go, so I took a bus tour of Tasmania. It was good, but would have been more fun if he'd been there, and on returning my balance was no better.

A year went by and I returned to Tasmania, this time with Rick. At one point we went for a walk on a beach. The area was scattered with large rocks and though we tried to climb over them, I was finding this difficult and we walked around instead. The following day we wrote postcards to our family. However Rick wrote nine in the same time it took me to complete one. He did not say anything but when we returned home he suggested I get another opinion.

Once more I went to my doctor and he suggested I see Dr Aldons, a neurologist who was new to the region. I probably had to go home and look up what a neurologist was! I arranged an appointment and expected him to syringe my ears and send me home fixed.

Instead, he asked me to do some simple tests (such as finger to nose), and then told me he thought I had a type of brain tumour. It turns out his wife, Sheila, had been diagnosed with acoustic neuroma as well. He had been looking out for similar problems ever since, and in 13 years I was the first he had seen.

Acoustic Neuroma cont.

The treatment journey

Once we confirmed the diagnosis I was admitted to the Royal Melbourne Hospital. The hardest part had been telling my friends. I felt like I was a leper. Who would look after Rick? Who would look after my babies? I couldn't see a future for myself, because my mother had died of a brain tumour when I was four.

The treatment process started with 2-3 weeks of intensive testing - burr holes, lumbar punctures - to prepare for surgery. My surgeon, Reg Hooper, was able to remove most of the tumour, which was the size of an orange. He hoped that the blood supply was cut off and the tumour could not grow again. Unfortunately, this wasn't the case and I've had three subsequent acoustic neuromas (in 1972, 1974, and 1979).

After the surgery I was taken to intensive care to recover. I don't remember much because of the medication, but I remember it was freezing! I had such a high fever that they had to keep the windows open in my room, even though it was the middle of winter.

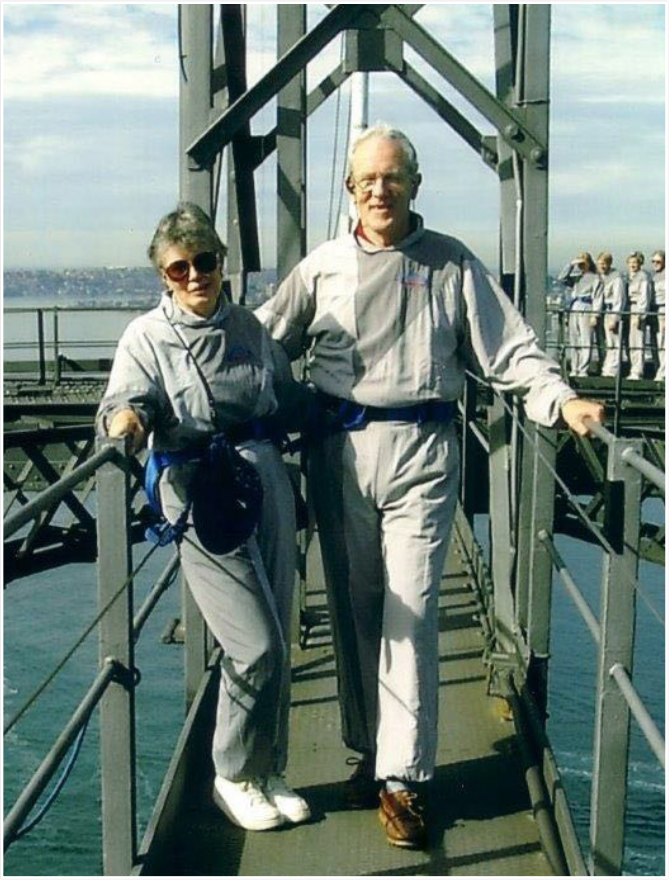
Life after acoustic neuroma

The surgery left me with severely depleted hearing, spasticity down my right side, and a badly twisted face (although this is fixed with a wire inserted between my chin and right eye). I now write with my left hand and find it extremely difficult to keep a shoe on my right foot. I have no feeling on the right side of my face and the nerves to my eye have been severed. I've had so many procedures in attempts to keep my eye moist and able to close; from punctal occlusions to gold eyelid weights.

As well as that, I still have no balance and find walking quite difficult. Thankfully I now walk with a frame, which has done wonders for my independence.

Despite these challenges there are blessings that far outweigh the disadvantages. I have a darling, patient husband, a wonderful family and great friends. I have everything I could need and most important of all, I have my faith.

MEDICINE IS ADVANCING ALL THE TIME SO THAT I WAS ABLE TO HAVE A BETTER CHANCE THAN MY MOTHER DID, AND LIKEWISE FUTURE PATIENTS WILL HAVE A BETTER DEAL THAN I DID. THE SUPPORT OF PATIENT ORGANISATIONS AND RESEARCHERS IS SO IMPORTANT TO ANYONE WHO HAS A MEDICAL PROBLEM A LITTLE OUT OF THE ORDINARY. THANK YOU.



Sandy Richards

Exploring early changes in brain morphology in frontotemporal dementia

RESEARCH TEAM:

Chief Investigator:

Professor Muireann Irish
School of Psychology, Brain and Mind Centre,
The University of Sydney

Co-investigator:
Dr. Christopher Madan
School of Psychology, The University of Nottingham

Research

Frontotemporal dementia (FTD) refers to a collection of younger-onset dementia syndromes which strike individuals in their 50-60's, producing stark changes in behaviour and personality, language and/or motor skills. These changes reflect the progressive degeneration of frontal and/or temporal regions in the brain that support complex functions such as decision-making, personality, social cognition, and language. With no treatments to halt or slow the progression of FTD, individuals become severely impaired in everyday functioning and increasingly dependent on family members.

A major barrier to the accurate diagnosis and management of FTD is its misdiagnosis as a psychiatric problem or as an atypical variant of Alzheimer's disease (AD). In this light, neuroimaging techniques are becoming increasingly important for the early diagnosis of FTD. Current imaging metrics, however, only partially capture the structural complexity of the cerebral cortex and show poor sensitivity to detect subtle brain changes in early stages of the disease course.

With the support of the Brain Foundation, we sought to use new developments in neuroimaging to improve the diagnosis of FTD. We proposed that the natural folding of the cerebral cortex represents a clinically useful biomarker for the early detection of FTD. Specifically, we sought to establish whether a measure of cortical folding complexity (fractal dimensionality) could serve as a new biomarker for structural brain changes in FTD. We predicted that overall fractal dimensionality would be significantly lower in FTD and Alzheimer's disease versus Controls, but that disease-specific differences would be evident in distinct regions of interest. Specifically, we predicted that alterations in cortical folding would be most pronounced in frontal and insular cortices in the FTD group.

Outcome

We recruited 30 behavioural variant FTD (bvFTD), 30 Alzheimer's disease (AD) and 30 healthy older Control participants for this study. Participants were matched for age, sex, and years in formal education. Patient groups were matched for level of cognitive and functional impairment. Using Madan's fractal dimensionality analysis methods, we found significant differences in the surface topology of the two types of dementia. A predominantly right-sided frontoinsular profile was found in bvFTD relative to AD, while the reverse contrast implicated a largely posterior parietal and temporo-occipital network. Importantly, we found a robust association between fractal dimensionality of the insula and emotion processing disturbances in bvFTD. This finding converges with a large body of evidence to implicate the insula as one of the key early drivers in the social and emotional symptoms that typify the bvFTD syndrome.

This work is ongoing, and we are currently exploring new exciting applications of this technique. One such avenue is to determine how changes in cortical complexity differ across FTD patients with different underlying genetic mutations (e.g., *C9orf72*, MAPT, GRN). Given the intense global effort to discover clinically sensitive imaging biomarkers, our findings represent an important step forward in improving the early and accurate diagnosis of FTD.

Improving Brain Tumour Care Online

RESEARCH TEAM:

Chief Investigator:

Professor Katharine J Drummond AM, MBBS, MD, FRACS
Department of Neurosurgery, The Royal Melbourne Hospital, Parkville, Australia.
Department of Surgery, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne, Parkville, Australia.

Co-investigators:

Dr Heidi McAlpine BSc(Hons), MBBS, DipSurgAnat
Department of Neurosurgery, The Royal Melbourne Hospital, Parkville, Australia.

Dr Magdalena Sejka BMedSci MD MTrauma DipSurgAnat
Department of Neurosurgery, The Royal Melbourne Hospital, Parkville, Australia.

Research

Patients with brain tumours are cared for primarily through neurosurgery departments and outpatient clinics at tertiary hospitals in capital cities, by specialist doctors, nurses and allied health staff at appointments that occur every few weeks or months. This model of care is extremely difficult for patients who live any distance from the hospital (particularly rural or regional patients), and for those with disabilities due to their brain tumour, particularly those who can't drive or use public transport due to epilepsy or physical or cognitive disability. Patients can become extremely isolated, and as brain cancer is a relatively rare disease, it can be difficult for patients and their carers to access support groups or other avenues to share experiences and ease the burden of this terrible disease.

We aim to build an online community to help overcome these physical and geographical barriers, allowing people with brain tumours to connect with their treating team, and with each other, for support, education and care.

The first part of this project was a review of the literature to assess other online management tools designed for cancer patients. Our published review found that despite a large number of publications describing online resources for cancer patients, few were properly tested to ensure they were actually beneficial. Furthermore, we found that existing online platforms were often developed based on researchers' understanding of patient's needs, without engaging with patients or considering their preferences. Using funding from our Brain Foundation Grant we have undertaken the second part of this project, and surveyed brain tumour patients at the Royal Melbourne Hospital to assess their needs and preferences for online resources. This needs analysis will help to tailor future platforms specific to the needs of brain tumour patients with the ultimate aim of improving their quality of life.

Outcome

We surveyed 201 brain tumour patients at the Royal Melbourne Hospital. We found that our population was isolated, both by distance, (34% lived >50km from the hospital), and functionally, with 46% of patients unable to drive, 36% not partnered and 58% not working, making this group ideal for online resources. We found that most patients used the Internet (86%), and many of those (72%) used social media. Importantly, 43% of Internet users were turning to social media specifically for information, communication, interaction or problem solving related to their brain tumour. The majority of patients used social networking sites (33%), wikis (28%) and blogs (13%) for this purpose. Patients preferred privacy and flexibility, and valued when a health professional contributed to the social media site. They reported subjective benefits to daily functioning and activities from social media use, however no difference in objective quality of life measures was found between social media users and non-users.

This study is the first to examine Internet and social media use in disease management for brain tumour patients. By examining the preferences of our patients, we have created recommendations to direct design of future online communities and interventions for this vulnerable population.

Healthy Brain

How does the brain work?

The human brain is the centre of the body's nervous system and the locus of your cognition. It is responsible for everything that you do, feel, and perceive. So when you are diagnosed with a brain disease, disorder, or injury, it can be quite distressing news.

We talk about these conditions quite a lot at the Brain Foundation. But have you ever wondered how the brain works in the first place? Maybe you have questions like…

- How do I learn & process information?
- What is the difference between white matter & grey matter?
- How is the physical & biological structure of the brain connected to different brain diseases, disorders, and injuries?

Learning these brain basics can help you understand more about neurological conditions, and help you decode some of the scientific jargon you might see in medical articles. We hope this brief introduction will help make neuroscience seem a little bit less intimidating!

Keep an eye out for our next newsletter, where we will dive deeper into the different parts of the brain and what they do.

What is a neuron?

The central nervous system (CNS) is made up of two types of cells - neurons (or nerve cells) and glia. Neurons are the key players in the brain. They are the information messengers that allow us to think, learn, move, and feel; while glial cells primarily support and protect neurons.

There are many different types of neurons, but they all consist of three key parts.

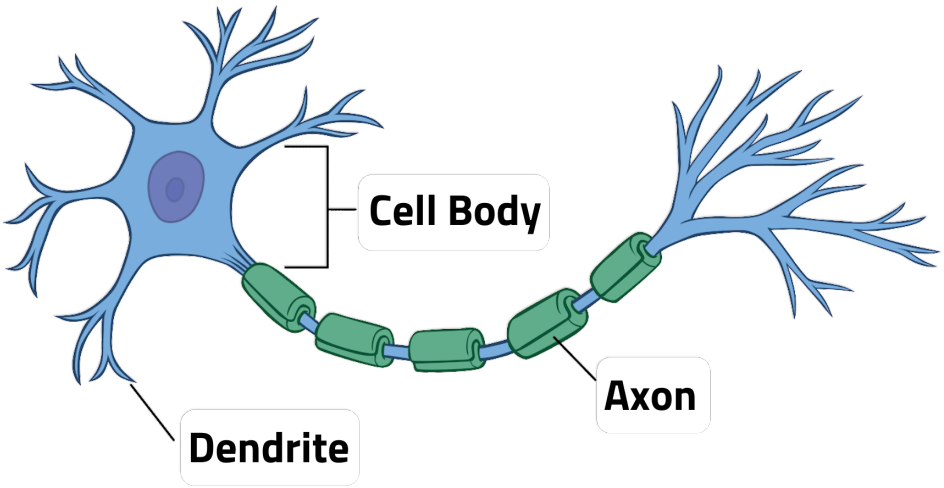
1. The cell body (soma). This receives information & controls the function of the neuron.

2. Dendrites. These are thin filaments that receive information input from other neurons to the cell body.

3. Axons. This is the 'output' of the neuron. It is a longer tail that sends information out to other cells, and it is covered in a protective coating called myelin. There are usually synapses on the end of the axon, which connect to the dendrites of other neurons.

These cell functions (input, output, and processing) are controlled by electrical and chemical signals. If a neuron is receiving enough information through its dendrites, it will respond by sending an impulse down the axon.

At the end of the axon, the cell will emit neurotransmitters or electrical signals through the synapse to be received by another neuron. These messages are being passed around constantly, allowing you to experience, understand, and react to the world.



White matter & grey matter

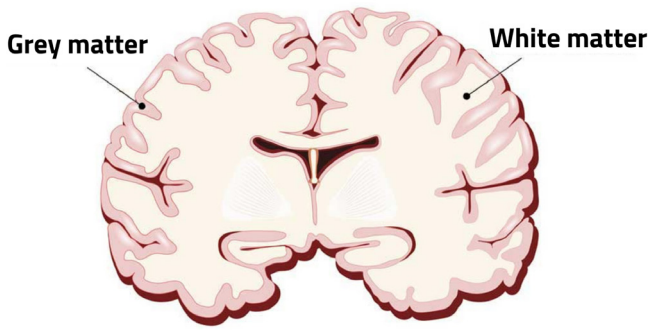
Grey and white matter are the two regions of the central nervous system. They are made up of different cells, and serve different purposes.

Grey matter is the part of your brain that does most of the actual processing, thinking, and interpreting information. It is mostly made up of neuronal cell bodies with shorter axons.

White matter, on the other hand, is the connective tissue of your nervous system. It is composed mostly of myelinated axons, which transport messages between different parts of your brain and body. The neurons in white matter still have cell bodies, but they have much longer axons. The longest axons are in the dorsal root ganglion, and they stretch from your toes to your brainstem (up to two metres in a tall person)!

These regions are relevant when talking about specific brain diseases. Neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease are caused by neuron loss in the grey matter. White matter might also be altered, but the main disease markers (such as amyloid plaques) are located in the grey matter.

White matter diseases affect nerve signal transmission, which can cause serious issues. Multiple sclerosis is one example of white matter disease. It occurs when the myelin that coats your axons is destroyed, leading to motor or sensory disruption.



Brain Games

Sudoku

Medium

		4		6	8	9		
5				4			7	8
			1	9	7	2		
8				3	4		2	6
2		1					9	7
	7		9	2			5	
								2
6	5	2	4					

Hard

9				2	7		5	
	5					9		4
8				7	5	6	4	9
1				4				
					9	8		
			4					
				3			1	
5		1			2		3	7

Target

Can you unscramble the letters to find the nine letter word?

For extra points, find as many other words as possible. Other words must be four or more letters and they must use the middle letter.

15 words - good;
25 words - great;
35+ words - terrific!

D	N	R
E	N	A
O	M	T

Solutions on back page

Get Involved

Leave a lasting gift

Have you written your will yet? Making your will for the first time or changing it to include a gift to the Brain Foundation could be as simple as contacting your legal advisor.

Alternatively, you can now use an online option to create a simple will. We've partnered with **Gathered Here**, an online Wills and Estates firm, to offer you a free and easy will writing service. The step-by-step form can be completed online in less than ten minutes, and all you have to do is print it out and sign it.

No matter how much you have, large or small, it can make a difference. Please consider making a bequest in your will to the Brain Foundation.

Write your free will now at
wills.gatheredhere.com.au/c/brain-foundation/

gatheredhere

IN MEMORIAM

A big thank you to the families and friends of the following who donated in memory of their loved ones.

Kobi Hall

David Yunghanns

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Healthy Brain Solutions

medium

7	2	4	5	6	8	9	3	1
5	1	9	3	4	2	6	7	8
3	8	6	1	9	7	2	4	5
4	6	7	2	1	9	5	8	3
8	9	5	7	3	4	1	2	6
2	3	1	6	8	5	4	9	7
1	7	8	9	2	6	3	5	4
9	4	3	8	5	1	7	6	2
6	5	2	4	7	3	8	1	9

hard

9	8	4	6	2	7	1	5	3
2	5	7	8	1	3	9	6	4
6	1	3	5	9	4	7	8	2
8	3	2	1	7	5	6	4	9
1	9	6	2	4	8	3	7	5
7	4	5	3	6	9	8	2	1
3	7	8	4	5	1	2	9	6
4	2	9	7	3	6	5	1	8
5	6	1	9	8	2	4	3	7

Target:
ADORNMENT, plus 111 possible words with 4 to 8 letters.

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