# Physical Exercise

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## Centre for Healthy Brain Ageing (CHeBA)

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Published by:

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UNSW Medicine
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This educational booklet is one in a series of four booklets developed as a supplement to CHeBA's Better Brain. Better Life public forums. These educational booklets have been made possible through the support of Genworth Australia.



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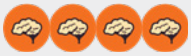
A recent analysis showed that physically inactive individuals had an 80% increased risk of dementia.

Better Brain. Better Life

# Physical Activity and Cognitive Functionality

| Research Rating | Research Message | Possible Strategies |
|---|---|---|
|  | Physical exercise reduces rates of mortality, heart disease, obesity, osteoporosis, arthritis, high blood pressure, stroke, diabetes, cancer, depression and falling, among other things. It is one of the best forms of preventive medicine. | Make exercise a regular feature of your daily life throughout the life span. |
|  | Physical exercise improves cardiovascular and muscle fitness and bone health and is important for maintaining optimal body function. | There is a type of exercise to suit everyone, even those with frailty or disability. Frail individuals often have a greater capacity to improve with exercise than healthy individuals. Tailored exercise regimens can be used even in those with severe disability or mobility impairment. |
|  | There are multiple mechanisms by which exercise improves body and brain health. | Combine the type(s) of exercise: aerobic, resistance (strengthening), balance, and/or flexibility that have effects on the health outcome you want to optimise. |
|  | Physical exercise improves cognitive function in healthy people and those with cognitive impairment. | Do regular physical exercise to improve cognitive function and possibly slow the rate of cognitive decline with age. |
|  | Physical exercise is beneficial for people with dementia, helping improve cognition and functional abilities. | People with dementia should have an exercise program tailored to their needs by a professional. |

Low quality evidence

Medium quality evidence

Good quality evidence

Excellent quality evidence

| Research Rating | Research Message | Possible Strategies |
|---|---|---|
|  | More exercise is better (except for prolonged periods of vigorous exercise) for most health outcomes. | Try to fit in as much exercise as possible in your daily routine. Aim for 40 minutes of moderate or vigorous exercise per day. If you do no exercise, start with low to moderate intensity, not vigorous intensity exercise. |
|  | Exercise does not have to be carried out in one session. | Aim to integrate your exercise in short bouts of aerobic, strength, power, balance, or flexibility exercises throughout the day at your convenience. |
|  | Excessive sitting is harmful for health and incidental physical activity is important. | Sit less and stand whenever possible to break up long bouts of sitting. Incorporate walking into your work schedule and avoid remote controls; think of ways to add activity rather than avoid it, such as using stairs instead of elevators. |

Low quality evidence

Medium quality evidence

Good quality evidence

Excellent quality evidence

Exercise is one of the best medicines available.

Exercise is one of the best medicines available. Its health benefits are indisputable. Physical exercise is associated with reduced risk of heart disease, diabetes, cancer, high blood pressure, obesity, osteoporosis, depression, and dementia and many other conditions. It helps improve your mood and quality of life and will also help you live longer. Everyone can benefit from exercise, irrespective of age, gender, ethnic background, health conditions, and the shape and size of your body.

Regular exercise is linked to improved cognitive performance (memory and thinking ability) and lowered dementia risk. Importantly, exercise can correct other risk factors associated with cognitive decline, by improving fitness and muscle mass, reducing obesity and blood pressure, and controlling diabetes. Like the heart, the brain is adversely affected by high levels of blood pressure, blood sugar and cholesterol. What is good for the heart is good for the brain.

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## What Counts as Exercise

The American College of Sports Medicine defines exercise as planned, structured and repetitive physical activity for the improvement or maintenance of physical fitness. Exercise is more than just routine physical activity such as doing housework or casually strolling - it must be challenging and involve some muscular effort or "huff and puff". This does not mean that routine, low intensity physical activity is not important. In fact, staying active throughout the day is good for your health, and sitting for long periods of time should be avoided.

Different forms of exercise have different benefits, so it is important to incorporate all of them into an exercise program.

There are many different forms of exercise for optimal health:

- Aerobic exercise gives the heart a workout, such as walking, running, cycling and playing tennis;
- Resistance or strength training engages and strengthens muscles, such as lifting weights, pilates, push-ups, lunges and squats;
- Balance training helps to improve stability and prevent falls, such as yoga and Tai Chi;
- Stretching helps to improve flexibility, increase blood flow and reduce muscle tension, such as yoga or specific stretch exercises targeting a muscle group (e.g. calf stretches or hip-flexor stretches).

The evidence indicates that different forms of exercise have different benefits, so it is important to incorporate all of them into an exercise program.

"While you can combine different types of activities to achieve gains in aerobic function, resistance, muscle strengthening and balance, some activities serve multiple functions. For example, stair climbing is both an aerobic exercise and a form of resistance training. While biological mechanisms overlap, aerobic exercise stimulates more of a protein called brain-derived neurotrophic factor (or BDNF) that promotes the growth of new brain cells. Resistance training helps the body produce more of a hormone called insulin-like growth factor 1 (IGF-1) that's important for improving insulin sensitivity, forming new muscle cells and possibly brain cells."

– Professor Perminder Sachdev

| Intensity | Measure | Description |
|---|---|---|
| ***Sedentary*** | <16. METs<br><40%HRmax | Activities involving sitting and lying with little additional movement. |
| ***Light*** | 1.6 – 3 METs<br>40-55% HRmax | Aerobic activities with no noticeable change in breathing rate; can be sustained >60 min. |
| ***Moderate*** | 3-6 METs<br>55-70% HRmax | Aerobic activity than can be conducted while maintaining conversation; can do for 30-60 min. |
| ***Vigorous*** | 6-9 METs<br>70-90% HRmax | Aerobic activity not compatible with maintaining conversation; may last up to 30 min. |
| ***High*** | ≥ 9 METs<br>≥ 90% HRmax | Intensity that cannot be sustained for >10 min. |

Table 1: Categories of intensity of physical activity. *Source: Norton K, et al. (2010). Position statement on physical activity and exercise intensity terminology. J. Sci. Med. Sport 13(5): 496–502.*

## Intensity of Aerobic Physical Activity

The intensity of aerobic physical activity is usually measured in terms of energy expenditure (the unit used is metabolic equivalent or MET, with 1 MET = 3.5 mL O2/Kg/min) or as a relative measure such as percentage of maximal heart rate (%HRmax; when %HRmax is not known, it is estimated as 220 minus your age in years) or perception of exertion (see Borg scale in Figure 1, which can be used when HR is not measurable or valid due to the use of medications or diseases that alter heart rate response to exercise). There are five categories of intensity as shown in Table 1.

## How to Increase the Intensity of Exercise

Your exercise should be at the right intensity level to improve your health and fitness safely. Use the Borg scale in Figure 1 to measure how difficult your activity level should feel. For aerobic exercise, you should be working between 11 and 14; for strength training, between 15 and 18. As you become more fit, you need to increase the intensity of the exercise you are doing to stay within these training zones. For aerobic activities, move faster, add arm movements or include hills. For strength training, use heavier weights.

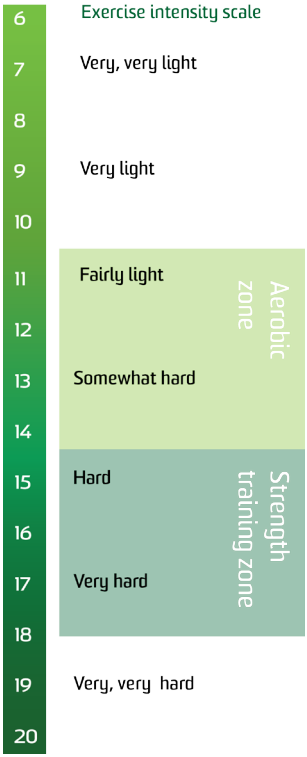
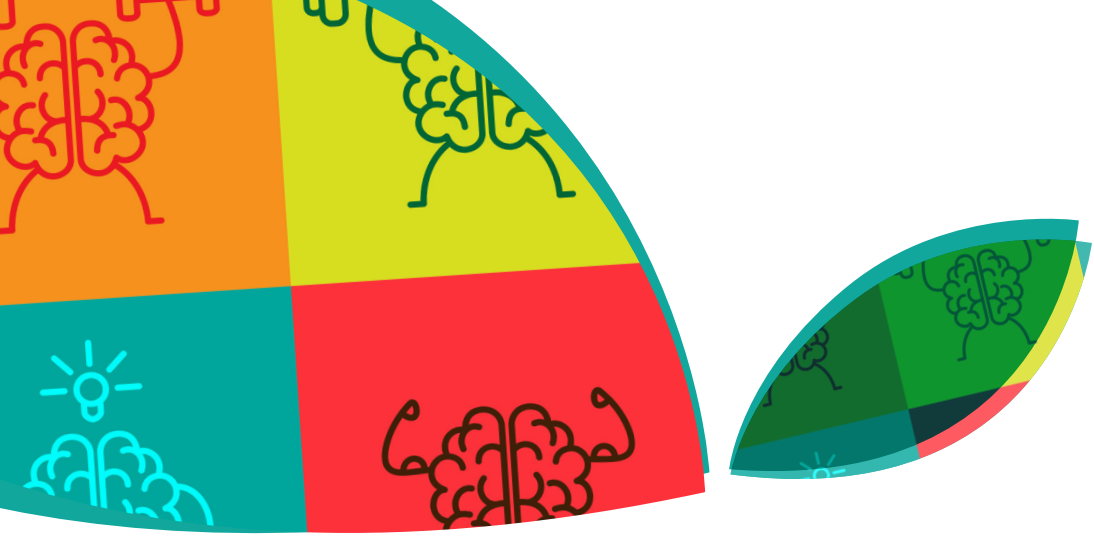



*Figure 1: Borg scale of exercise intensity.*

*Source: Borg GA. (1973). Perceived exertion: A note on history and methods. Med. Sci. Sports 5(2): 90-93.*

"The evidence is that moderate-high intensity exercise regimens and greater improvements in fitness (both aerobic capacity and strength gain) are related to better cognitive outcomes."

– Professor Maria Fiatarone-Singh



## Research Findings

1. ***Incidental physical activity is helpful, and sitting too much is harmful.*** Light-intensity activity that people carry out for 6-7 hours a day, such as gardening, cooking, washing dishes, hanging clothes, playing a musical instrument, washing the car, walking the dog, playing with children / grandchildren and doing office duties, does increase the metabolic rate and may contribute to overall health. On the other hand, too much sitting has been linked with obesity, metabolic syndrome, increased risk of heart disease and death (from any cause). The relationship to cognitive function is not known.

   The recommendation is to sit less and stand whenever you have the chance, and to think of ways to incorporate walking into your work schedule. Some examples include: stand while talking on the phone; get up for a break or some other movement at least once an hour; and use a standing desk, or one that can be raised intermittently.

2. ***Physical exercise improves cognitive function.*** Physical exercise has a beneficial effect on the brain throughout the life span. Fit and active pre-adolescent children show greater brain volumes, more white matter integrity and more efficient patterns of brain activity, associated with better cognitive function and scholastic performance. Older individuals show the same relationship between exercise and the brain, and perform better in memory and executive function. Numerous studies have shown that physical exercise improves cognitive function, with very few negative studies. There is some evidence that this may be dose-related, with more exercise having a greater effect. For the effect to be maintained, the exercise must be continued. Most studies are small but the results are quite consistent.

Studies provide evidence that more physical activity and exercise, the greater the protective benefit.

3. ***Physical exercise can improve cognitive function in people with MCI and dementia.*** There is accumulating evidence that exercise can improve cognitive function in those with mild cognitive problems (often referred to as having mild cognitive impairment or MCI), who are at increased risk of dementia. This suggests that exercise may postpone the development of dementia in these individuals, although this has not been shown directly. According to one estimate, physical inactivity (not doing vigorous exercise for at least 20 minutes three times a week or moderate exercise for 30 minutes five time a week) increases the risk of dementia by about 80% (Norton et al, 2014). According to this research, 12.7% of all cases of dementia (roughly 4.3 million cases) world-wide could be attributed to physical inactivity.

   Exercise programs can also improve cognitive functioning of people with dementia and their ability to perform daily activities. Exercise programs for dementia should be tailored for the individual.

4. ***Exercise helps learning.*** When we're exercising, our brain is working hard coordinating movements, keeping us upright and balanced and possibly increasing reaction times. All of this increases our learning. Studies also show that after exercise we have heightened attention and are less distracted, so we concentrate on what we've learnt.

5. ***Exercise may promote neurogenesis.*** There are two regions in the brain where we know neurogenesis, the formation of new nerve cells, occurs in humans throughout the life span – the hippocampus and the subventricular zone. In rats, neurogenesis is promoted by physical exercise and being in a complex or cognitively stimulating environment. Although we do not know definitively if this is also true for people, it is likely to be.

## How Does Exercise Help Cognitive Function?

There are many mechanisms by which exercise may help cognitive function:

| Mechanism | Impacts of Exercise |
|---|---|
| Vascular damage | Vascular damage affects cognitive function and is also thought to play a role in the development of amyloid plaques, found in people with Alzheimer's disease. High blood pressure plays a major role in this. With ageing, the blood vessel walls stiffen and thicken due to a change from elastin to collagen, which is a less supple material. Physical exercise reduces blood pressure and the rate of stiffening of the arteries with age, and also slows the build-up of 'atherosclerotic' plaque in the arteries - the cause of heart attacks and stroke. Not only does exercise ensure a good blood supply to our brains, it reduces the risk of stroke and therefore the risk of vascular dementia. |
| Glucose levels | Exercise leads to lower glucose levels, increased sensitivity to insulin and better control or prevention of type 2 diabetes. It also leads to lower BMI and especially abdominal obesity. All of these are beneficial for heart and brain health. |
| Inflammation | Regular exercise reduces markers of inflammation, a process important in the development of heart disease and arthritis, as well as dementia. |
| Neuronal growth | Exercise leads to the release of a number of so-called 'neurotrophic' factors, i.e. molecules that promote neuronal or nerve cell growth. Prominent amongst these are the Brain Derived Neurotrophic Factor (BDNF) and the Insulin-like Growth Factor -1 (IGF-1). Exercise leading to the growth of new brain cells has been convincingly shown in rodent studies. This, along with more efficient brain networks, leads to improved neuroplasticity. |
| Neurotransmitters | Animal studies have shown that exercise affects the levels of neurotransamitters such as dopamine, noradrenaline and serotonin, chemicals important for cognitive and emotional regulation of the brain. |
| Stress | Regular exercise counteracts several harmful effects of stress by producing better hormonal and immunological regulation. |


## How Much Exercise?

There is considerable dispute in the scientific literature about the minimum amount of exercise required to protect the brain against age-related effects and dementia. A general recommendation is that 150 minutes (5x 30 minutes) of moderate exercise (e.g. brisk walking, dancing and gardening) or 75 minutes of vigorous exercise (e.g. running, fast cycling, competitive sports) per week can improve fitness significantly, and should be the minimum target. Our recommendation is to average at least 40 minutes every day (60 min for children), including aerobic exercise (such as walking, running, cycling, swimming or tennis playing) on five occasions and two sessions of resistance training per week. However, for those who have an inactive lifestyle, more exercise and incidental activity may be needed, with some research indicating more than 5 hours per week.

There is evidence that short bursts of vigorous exercise, e.g. running for 4 minutes, can have beneficial effects on the heart and reduce mortality. The minimum effective levels of exercise appear to be 4 to 16 minutes per day of vigorous activity (in bursts of 4 minutes), repeated 3 times a week; even the busiest individual should be able to achieve this.

Our recommendation is to aim for 40 minutes of exercise every day, combining aerobic (such as walking, running, cycling, swimming or tennis playing) on 5 occasions with 2 sessions of resistance training per week.

## It is never too early or too late to start an exercise program

There is evidence that most adults do not achieve the recommended level of exercise. Moreover, people often over-estimate the amount of exercise they do. It is never too early or too late to start an exercise program.

There are very few medical reasons that prevent vigorous exercise, however inactive individuals or people with acute illness or a heart condition should consult a medical practitioner for advice first. Some people need external motivating factors to begin or maintain an exercise program, such as a personal trainer or a friend. Find out what works for you, but remember that fitting an exercise schedule into your life may necessitate other changes to your lifestyle; the benefits are worth it.

"With general consensus among researchers that genetic makeup contributes to longevity and health at a rate of only 30 percent, there is a great deal that we can do to improve our behavioural and lifestyle habits to strive for a better future for ourselves."

– Professor Perminder Sachdev

## Planning an Exercise Program

### Getting started

- It is not generally necessary to see a GP before beginning everyday light to moderate intensity exercises, but we encourage you to talk to your GP about your health and exercise on your regular visits. If you are starting an exercise program for the first time, we recommend you answer 6 simple questions on the EASY (Exercise And Screening for Your) Tool.
  Visit http://www.easyforyou.info. It will guide you in finding the best activities and when to see a health care provider.

- Identify your exercise needs and limitations – what are your priority areas for improvement and if you have an injury or medical condition, what alternative forms of exercise can you do? Ideally, use a combination of aerobic, resistance, stretching, and balance exercises. The EASY website also gives you some safety tips.

- Identify what forms of exercise are practical for your schedule and match your goals: it may be alone or in a group; it may be a sport in which case joining a team might be helpful; it could be joining the gym or arranging a personal trainer; or it could involve simply walking in a park or around the block. Remember you can use your own body for resistance work, and initially household items can be used for weights (e.g. a bottle of water or can of food) until you gain strength. If you are going to manage your own home program and plan to engage in vigorous exercise, it is essential that you learn the appropriate techniques first so you don't injure yourself; you may wish to consult a physiotherapist, accredited exercise physiologist, or a qualified personal trainer. Web based materials are also available.

- Work out your exercise plan, and the daily schedule to go with it. Aim for 40 minutes of some form of moderate intensity exercise per day, but begin slowly and gradually build up your capacity.

| | |
|---|---|
| Making gains | • Increase your incidental activity; for example if working, stand to answer the phone, change television channels directly rather than using the remote, stand up during commercial breaks, take the stairs rather than lifts where practical, walk up escalators, and use other strategies to stand more often and not sit for prolonged periods at a time.<br><br>• Increase the exercise component of your daily household and garden chores by increasing your reach and extension: squat to pick things up, reach to high spots, tandem walking to the bathroom, etc. You can also get your heart rate up by increasing the pace at which you work.<br><br>• Get off at an earlier bus stop, or park your car further from your destination so you add some extra walking.<br><br>• Include "huff and puff" and lift things that feel hard to lift.<br><br>• Make exercise a habit. It is vital to keep your exercise routine; so set yourself some goals and reward yourself when you achieve them, such as buying some new exercise clothes, getting a new bicycle, or trying something new like kayaking.<br><br>• Telling someone your goals will increase the chances that you reach them too!<br><br>• Expect hard days and feeling tired so when they happen you do not get despondent. Knowing how to cope and remembering how well you feel after exercising will help you stay motivated.<br><br>• Find an exercise buddy. Invite a friend to join you on your exercise regime, and start talking to people in gym classes or teams because seeing them will help keep you motivated and provide social connection as well. |
| Topping up | • Think about joining an exercise or training group such as bushwalking clubs, cycle groups, run teams and swim groups.<br><br>• Start a new exercise activity to develop different physical abilities. For example, if you have been focusing on strength, try stretching through yoga.<br><br>• For some people, dual task training (performing a complex mental activity while exercising for balance, etc.) may be helpful.<br><br>• Continue to extend the time / activity range / weight range of your program. |

## Case studies

**Alice,** was 83 when she joined a local gym. She had never had a regular exercise routine before but when she retired from her duties as a nun, she committed to looking after her health and wellbeing. At the gym, she had an assessment and an individual exercise program was made for her which she completed several times each week on her own. Just proves you are never too old to start!

**John,** at 58 was over-weight and unfit. He decided to start exercise when he was told he was at risk of developing diabetes. He started with a simple stretch routine based on several exercise and yoga books at the local library, and enjoyed feeling his stiff joints loosen up. He also began walking around the block, initially slowly because of weight difficulty but as he gradually lost weight and increased his muscle strength, he increased his speed and the duration of the walk. He is now up to walking 40 minutes nearly every day, and has lost 15 kilograms. His risk of diabetes is substantially reduced.

# Physical Activity Checklist

Regular exercise is linked to improved cognitive performance and lowered dementia risk, as well as correction of other risk factors for cognitive decline (such as obesity and high blood pressure). Learning some new physical activities, such as dancing and tai chi, also counts as a complex mental activity (see CHeBA's booklet: Complex Mental Activity), which improves neuroplasticity and cognitive performance.

**Aim for 40 minutes of exercise every day: with five sessions of aerobic exercise and two sessions of resistance training per week. Combine it with balance exercises and stretching.**

**Aim to choose 1 new physical activity from each category every 12 months:**

### AEROBIC

- [ ] Brisk walking or hiking
- [ ] Running
- [ ] Swimming
- [ ] Water aerobics
- [ ] Cycling
- [ ] Dancing
- [ ] Tennis

### RESISTANCE TRAINING/MUSCLE STRENGTHENING

- [ ] Exercises that use your body weight as resistance, such as push-ups, sit-ups, abdominal crunches, pull-ups and leg squats
- [ ] Lifting weights (can be either free-weights such as dumbbells or weight machines in a gym or fitness centre)
- [ ] Working with resistance bands
- [ ] Climbing stairs
- [ ] Digging in the garden
- [ ] Pilates
- [ ] Tennis

### STRETCHING

- [ ] Touching your toes
- [ ] Doing side stretches, child's pose, back and chest stretches
- [ ] Yoga

### BALANCE

- [ ] Dancing
- [ ] Yoga
- [ ] Tai Chi
- [ ] Use of balance boards, cushions, or platforms
- [ ] Other balance exercises – heel-to-toe walking, one foot balance, leg raises

# Glossary of Research Terms

**Aerobic exercise:** Aerobic exercise (also known as **cardio**) is physical exercise of low to high intensity that depends primarily on the aerobic energy-generating process.

**Amyloid plaques:** A hallmark of Alzheimer's disease due to the sticky buildup of the protein called beta- amyloid in between nerve cells in the brain.

**Cognitive decline:** Refers to reduced ability in cognitive functions such as memory, language ability, etc. When this is severe and affects the ability to function independently, it is referred to as **dementia.**

**Cognitive function (or cognition):** The set of mental abilities and processes related to thinking and knowledge. The various abilities (or **domains**) commonly referred to are attention, memory, language, spatial ability, executive ability (problem solving, decision making, task switching) and regulating social behaviour. A sum of these abilities is usually referred to as **global cognitive ability.**

**Inflammation:** Inflammation is a complex response of the body to harmful agents from outside (infections, pollutants) or inside (damaged cells) factors. It acts as a protective response and involves immune cells, blood vessels and many molecules that mediate the process. Inflammation is regulated by the body, and if too intense or allowed to persist, it can be harmful to the body, including the brain.

**Metabolic Syndrome:** Metabolic syndrome is a cluster of biochemical and physiological abnormalities associated with the development of cardiovascular disease and type 2 diabetes. It is a group of risk factors that raises the risk for heart disease, diabetes and stroke.

**Mild Cognitive Impairment (MCI):** A modest but measurable decline in memory and/or other cognitive abilities not severe enough to impair a person's abilities to function independently. An individual with MCI is at increased risk of progressing to dementia.

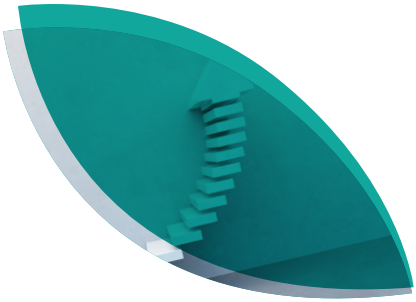
**Neurogenesis:** The formation of new brain cells. It is now known that the brain continues to develop new cells even in adulthood, although in a few special 'neurogenic' regions.

**Neuroplasticity:** Neuroplasticity, or brain plasticity, refers to the brain's capacity to adapt and change its structure and function in response to new experiences, such as making new connections, integrating new neurons, or changing brain metabolism.

**Osteoporosis:** Osteoporosis is a medical condition in which bones become brittle and fragile from loss of tissue, typically as a result of hormonal changes, or deficiency of calcium or vitamin D.

**Vascular Dementia:** Dementia, or significant cognitive decline, due to disturbance in the blood supply to the brain caused by disease of the small or large blood vessels.

**White matter/white matter integrity:** The brain consists of grey and white matter; the former comprises nerve cell bodies and the latter bundles of fibres that carry nerve impulses and connect brain cells so that they can communicate with each other. Integrity of these bundles is important for the brain to function as a network.



## Further Reading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## The Dementia Momentum

**An initiative to change the future of dementia incidence**

**Spokesman: Richard Grellman AM**

The Dementia Momentum is an important social initiative to bring the right researchers and community donors together to materially increase the pace of clear, clever and relevant work in confronting dementia.

My wife Suellen has advanced young-onset Alzheimer's disease having been formally diagnosed in 2011 at the age of just 61. She has been in High Care since late December 2015. For me, our children, her family and close friends, have all had to learn to walk this journey with Suellen, all sharing the desolate sense of helplessness, frustration and sadness that comes with knowing that there is currently no known cure.

Any advances in understanding the causes, preventative measures, treatment and care can start the process of confronting this terrible disease and hopefully reduce the number of families that have to endure what Suellen and we are experiencing.

Treating Alzheimer's and other forms of dementia is the biggest healthcare challenge for our society and The Dementia Momentum is worthy of our support. I commend this initiative to you and encourage you to do what you can to assist.

**Richard Grellman AM - Chairman, Genworth Mortgage Insurance Ltd, IPH Ltd & AMP Foundation**

To find out more or to make your contribution to The Dementia Momentum go to: www.thedementiamomentum.org

the dementia momentum

# Better Brain. Better Life Notes

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Published by CHeBA, UNSW Medicine
CRICOS Provider Code 00098G

ABN 57 195 873 179

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