CCAA: Research to Action

Brain Blood Flow
Memory, Mobility, & Falls

An introduction for older adults on understanding the connection between brain blood flow and maintaining memory and physical stability.

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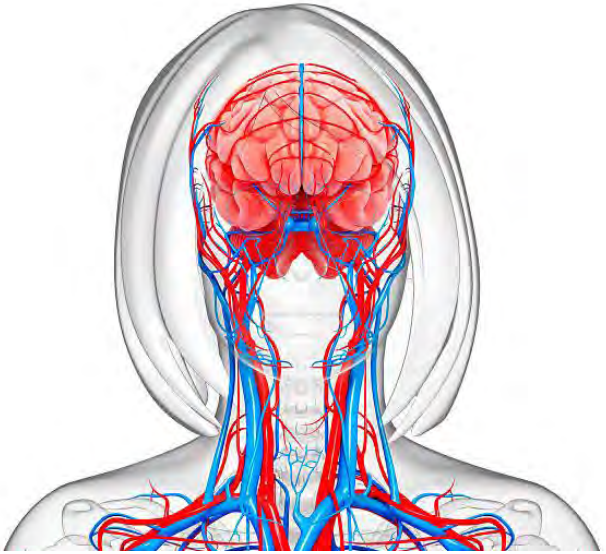
Your Amazing Brain

- Just 2% of your body weight – yet your brain runs everything
- Controls every thought, memory, movement, and heartbeat
- Uses **20%** of all your blood delivery
- Has no energy reserves → it needs continuous blood flow every single second
- Without good blood flow, brain cells begin to struggle within minutes

Blood flow IS brain health.

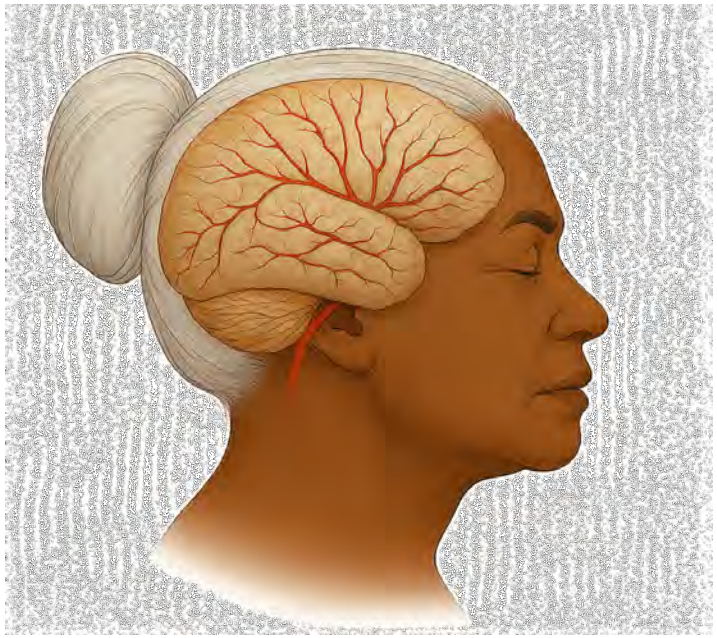
Protect your blood flow, protect your mind

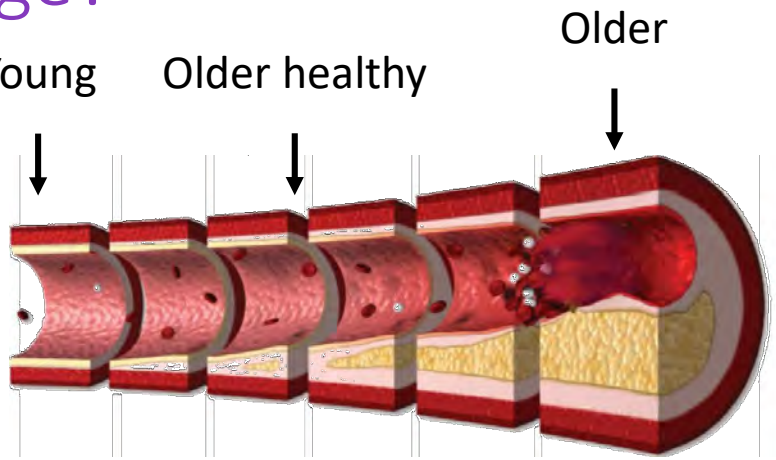
What is Brain Blood Flow?



- Brain blood flow is how much blood reaches your brain at a given moment
- A network of arteries and tiny capillaries delivers oxygen and nutrients and clears carbon dioxide
- In most healthy adults, blood flow stays steady – no matter what you are doing , (ex, activity, posture, and blood pressure)

What happens as we age?



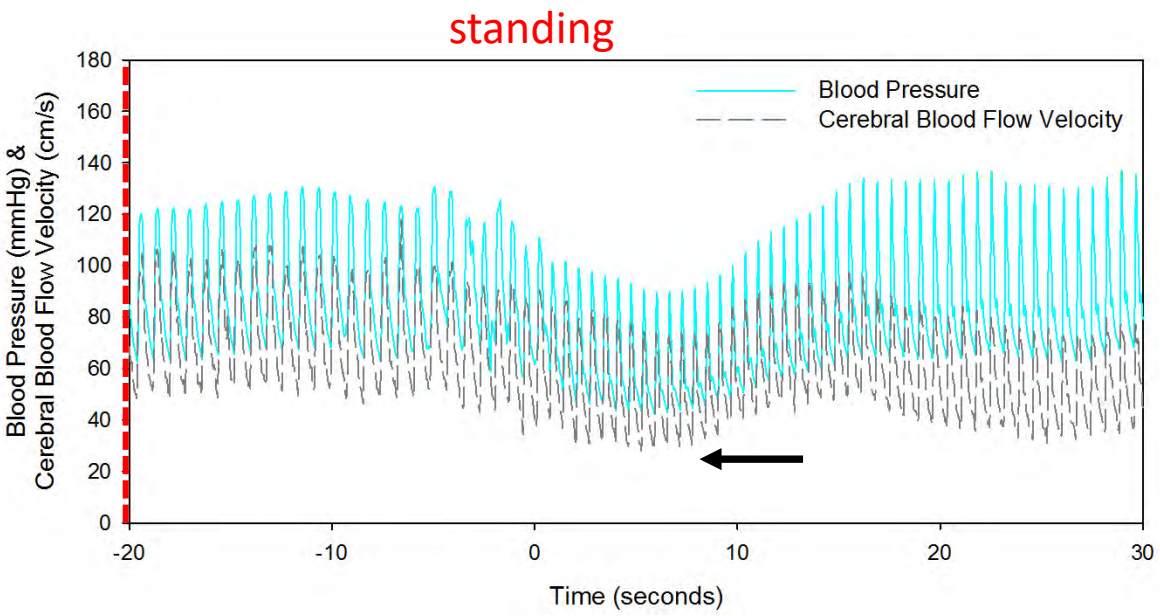


Stiffening and Narrowing of arteries
Reduced Blood flow

Blood pressure changes

In some people, the brain may get **less blood when standing or walking**

Blood pressure and brain blood flow temporarily drop when going from lying to standing



During walking, the cardiovascular system is required to deliver adequate blood flow to both the working muscles and the brain

Modified Heart & Stroke image

Vascular, Brain, and Mobility (VBM) Lab

PhD

Michaela Nikpal

PhD Candidate

Integrative Biosciences

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MSc

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Two prevailing health concerns of our older adult population

Mobility

Falls

Cognition

Dementia

Transcranial Doppler Ultrasound
Middle Cerebral Artery Blood Velocity

Near-infrared Spectroscopy
Oxy- & deoxygenated hemoglobin

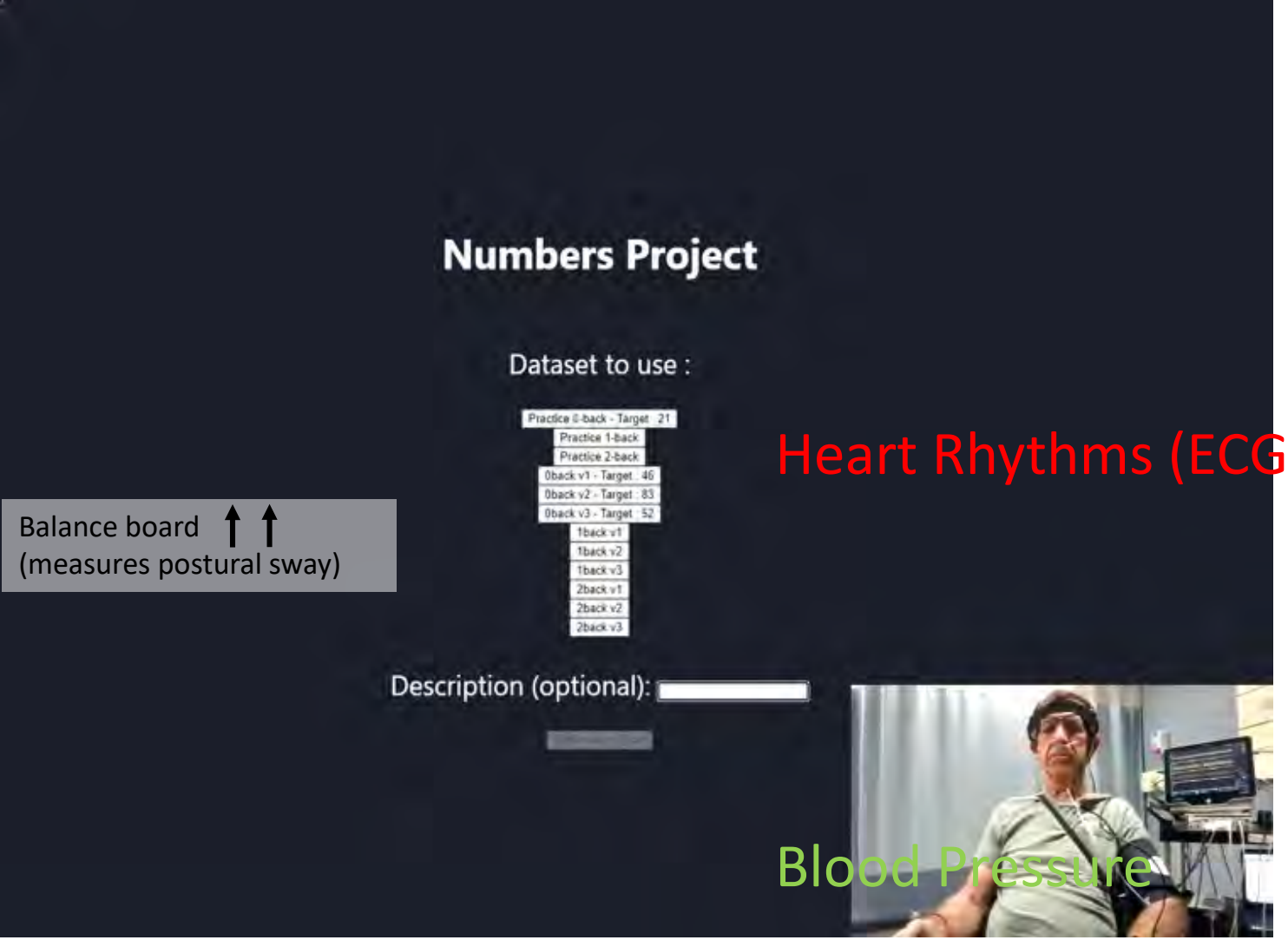
Gas Analyzer
End-Tidal CO_2

Plethysmography
Continuous blood pressure

Accelerometers
Gait dynamics

Bluetooth balance board
Centre of Pressure Sway

Lying to standing transition



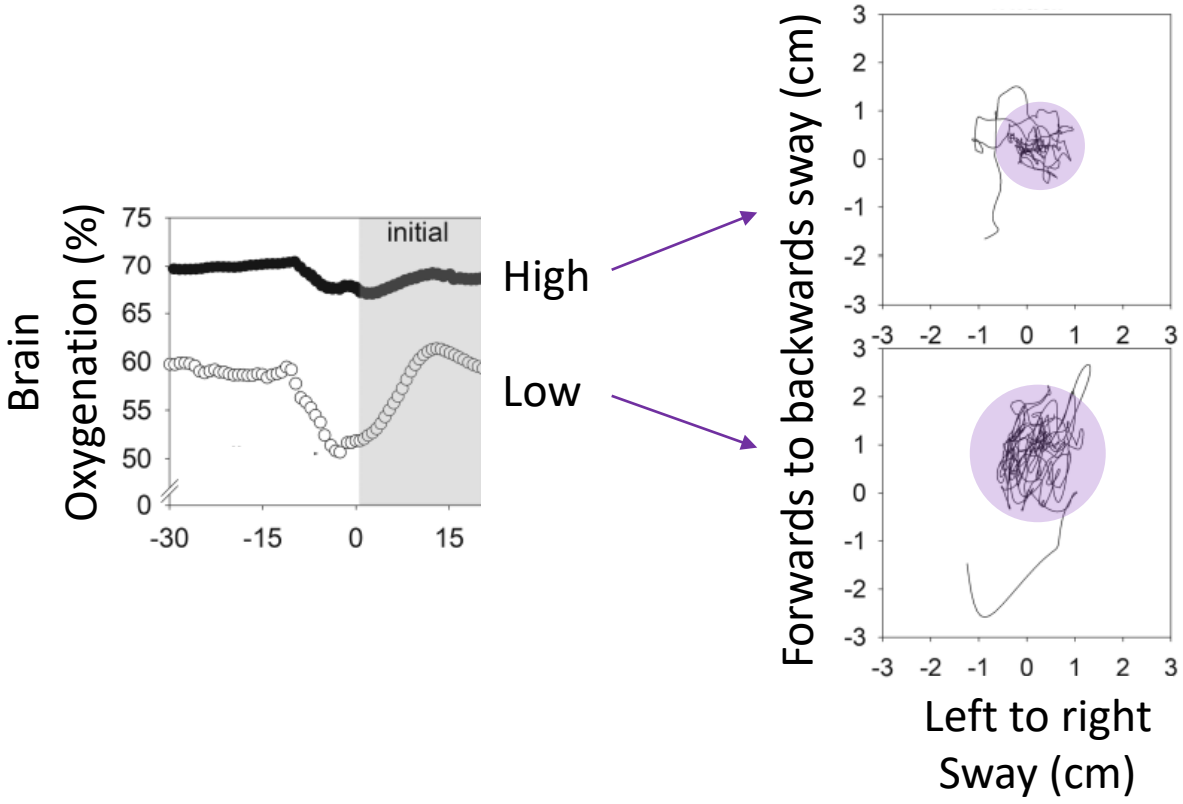
Heart Rhythms (ECG)

Balance board
(measures postural sway)

Blood Pressure

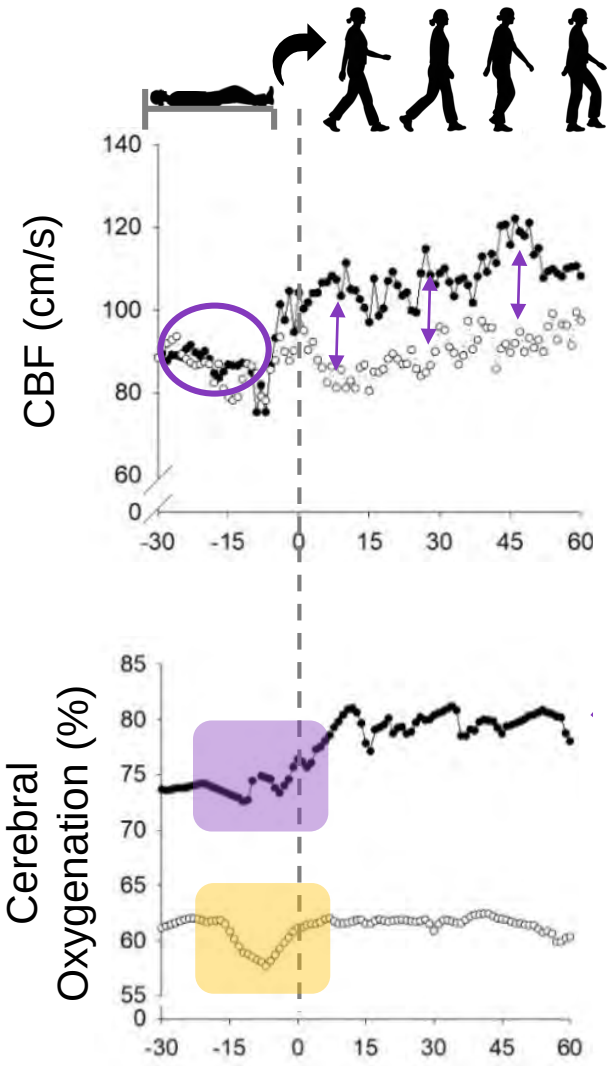
$\frac{120}{80} = \frac{\text{Systolic}}{\text{Diastolic}}$

Have you ever felt lightheaded or dizzy when getting up from lying or sitting down?



20% of older adults demonstrate a large enough **reduction in brain oxygenation** when getting which is **related to instability**

Brain blood flow and walking in two older adults



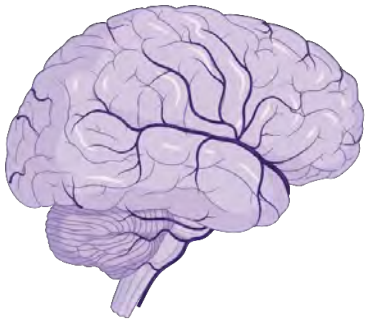
Faster walking
Consistent steps

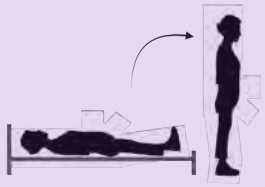
Slower walking
Inconsistent steps

Fitzgibbon-Collins, 2018

Western MEDICINE & DENTISTRY

Low brain flood flow is related to ….. **Loss of mobility**





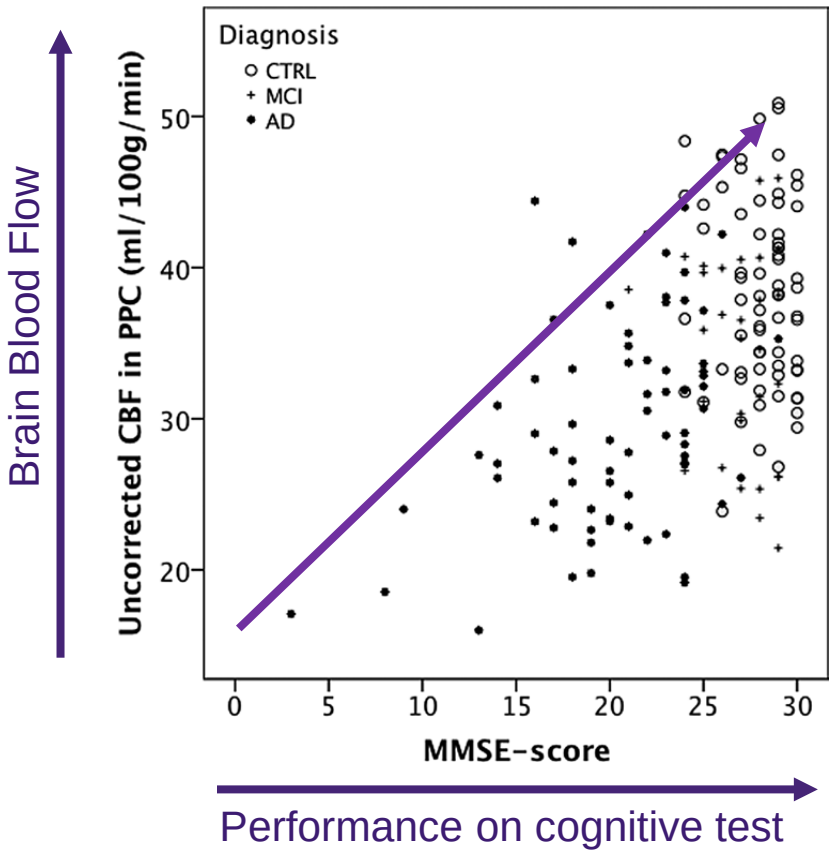
↑ sway

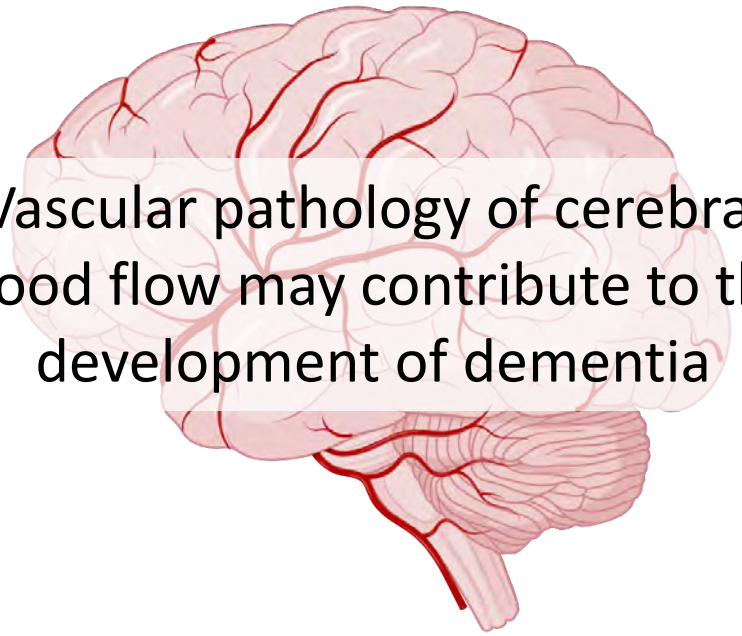
↑ future fall (tend)

Slower walking

Inconsistent steps

Cerebral blood flow and cognition

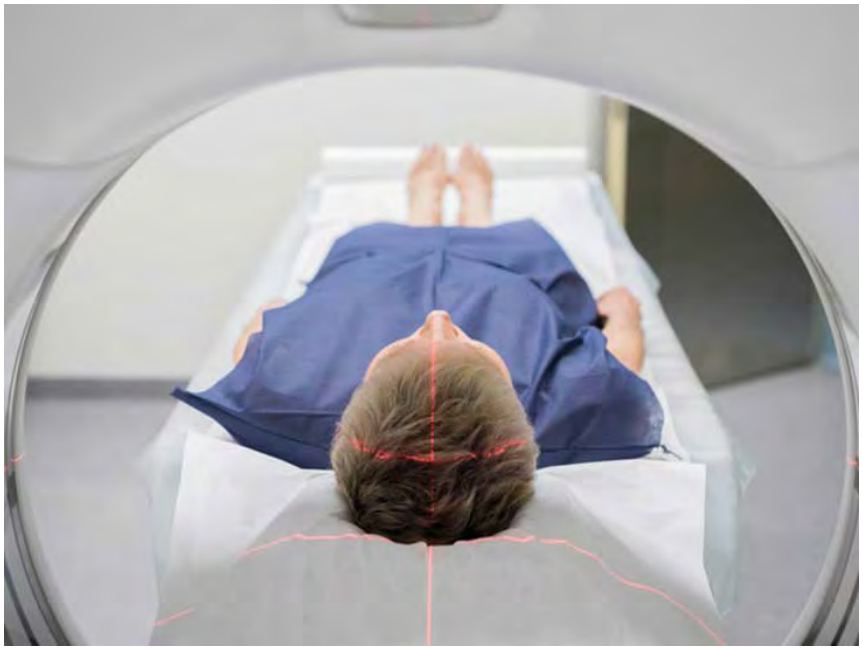




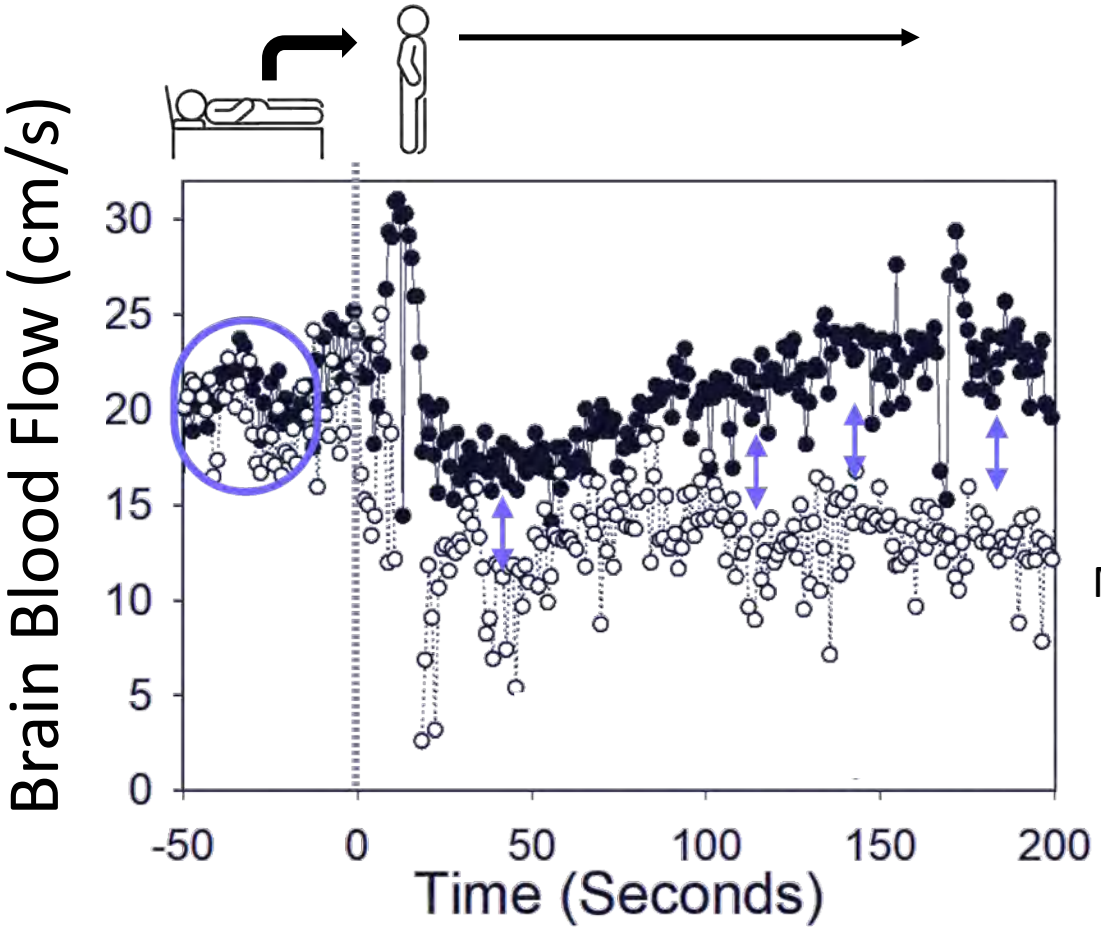
Vascular pathology of cerebral blood flow may contribute to the development of dementia

Binnewijzend et al. 2013 *image: physio-pedia.com*

Cerebral blood flow in the supine position



Standing (not lying down) brain blood flow contributes to Memory and thinking ability



Cognitively Intact Control
(76-year-old male)

Mild Cognitive Impairment
(76-year-old male)

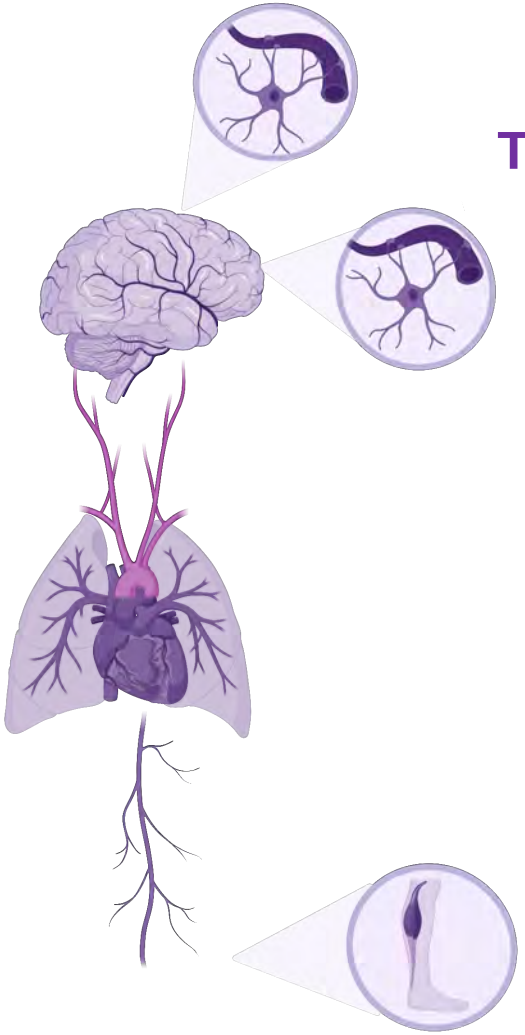
Fitzgibbon-Collins et al. 2024, CCCB

Mobility + Cognition

Stress test for the brain

Early indicator of cognitive change

A stress test for the brain: Dual-task paradigm

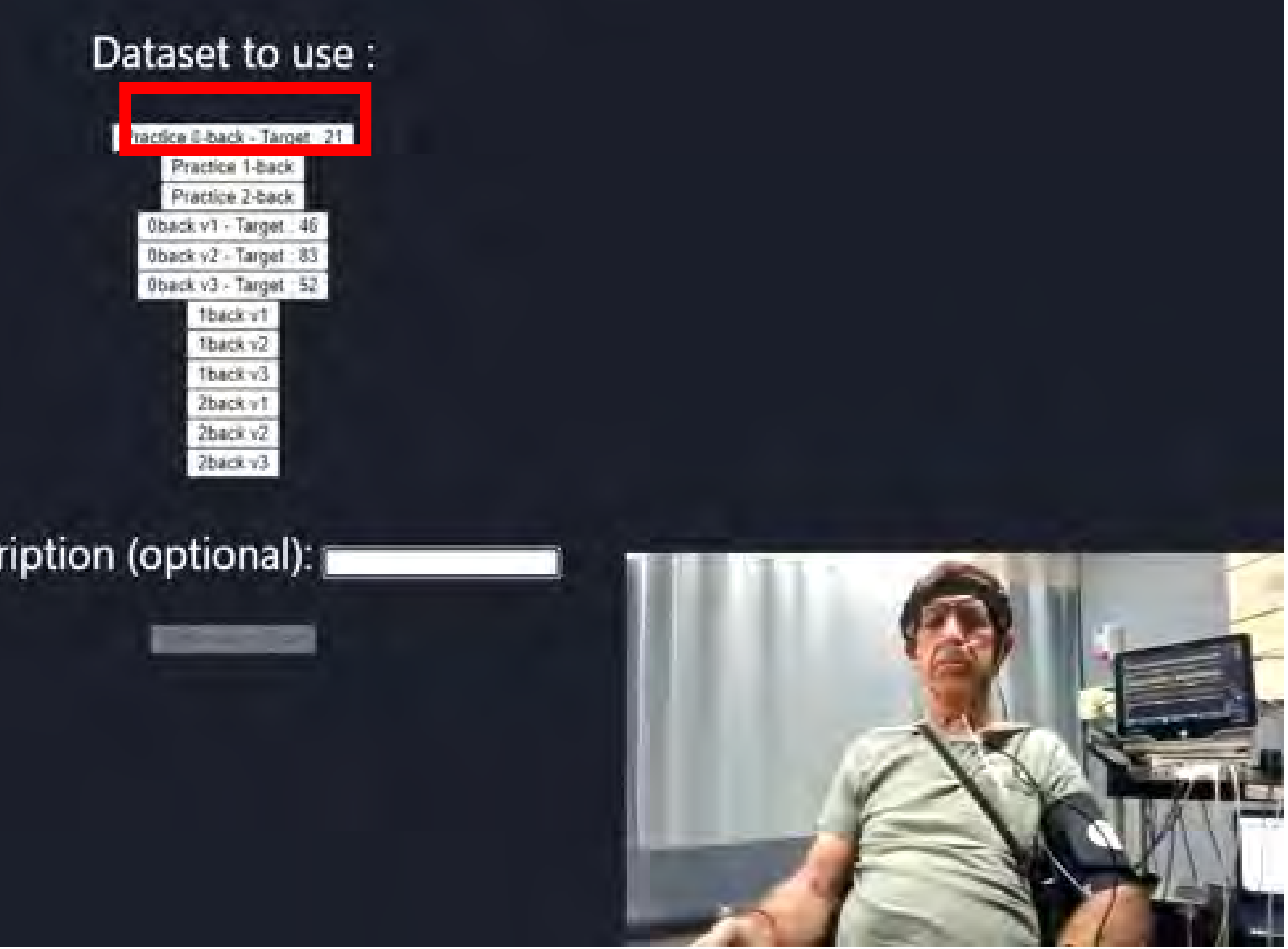


Two brain networks compete for shared resources

Sitting Cognitive

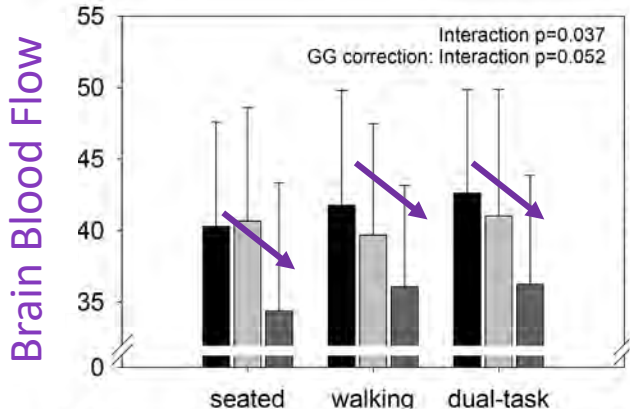
+

Walking Motor



Fitzgibbon-Collins et al. 2024, under review PLosOne

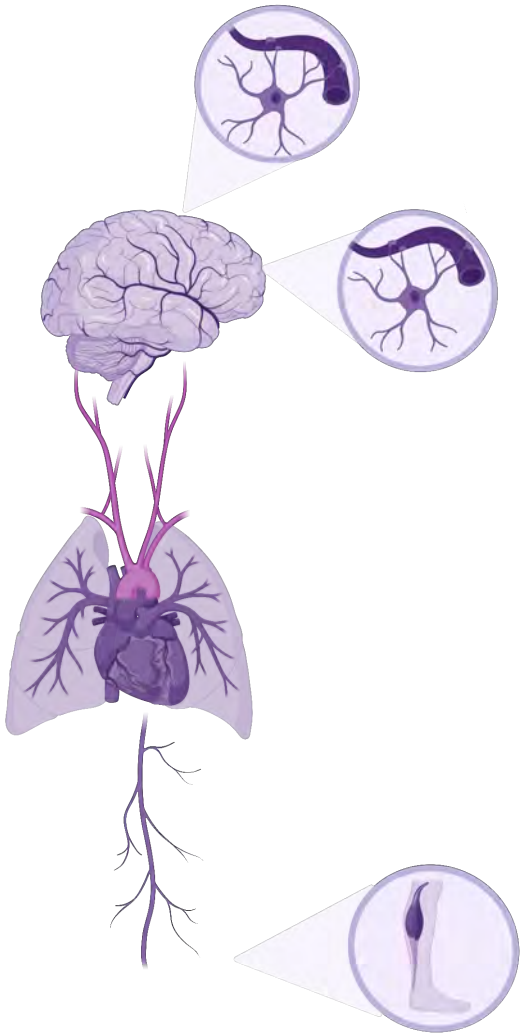
Dual-task & differences between groups



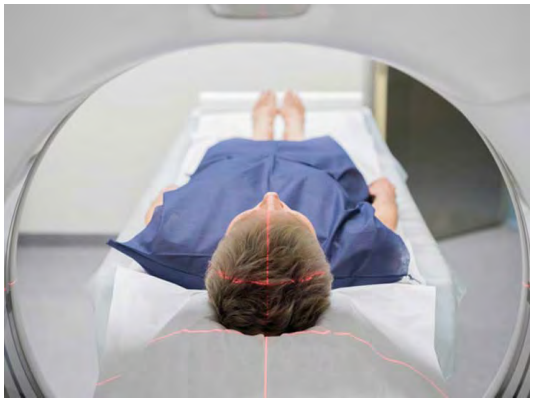
Participants who are controls (CNT), n=13
Participants with Mild Cognitive Impairment (MCI), n= 34
Participants with dementia (DEM), n=9

GG Greenhouse Geisser

Biological Biomarker



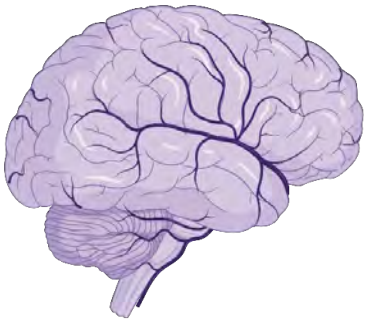
Can we use the dual-task paradigm as an assessment to detect early changes in the brain?



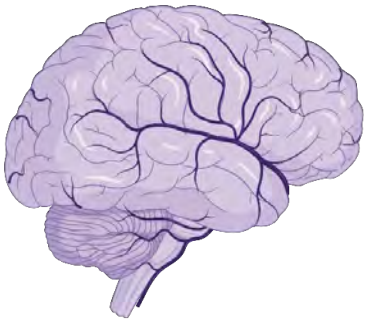
Move from the scanner

To the Clinic or Community

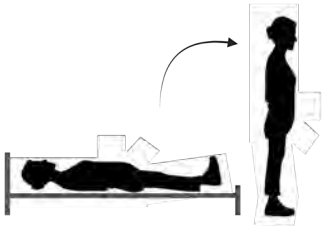
A Pillar of Research



Mobility + Cognition

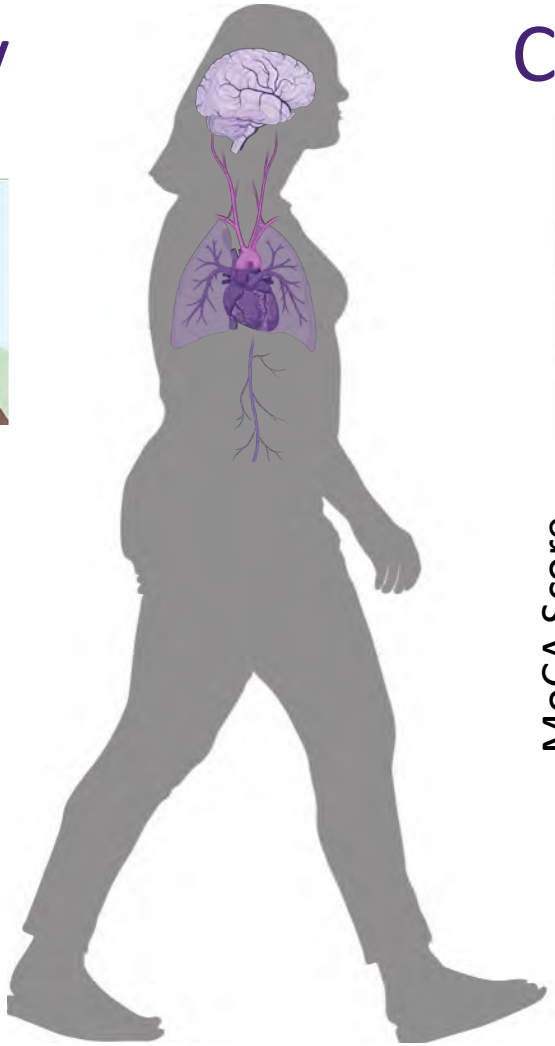


Mobility



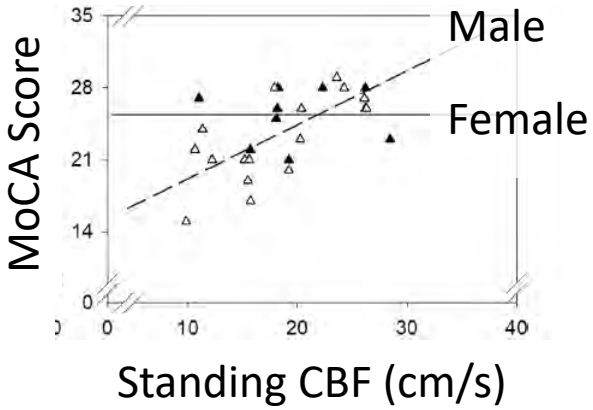
Postural Orthostatic Tachycardia Syndrome (POTS) in women

Brain activation changes in females with subcortical stroke

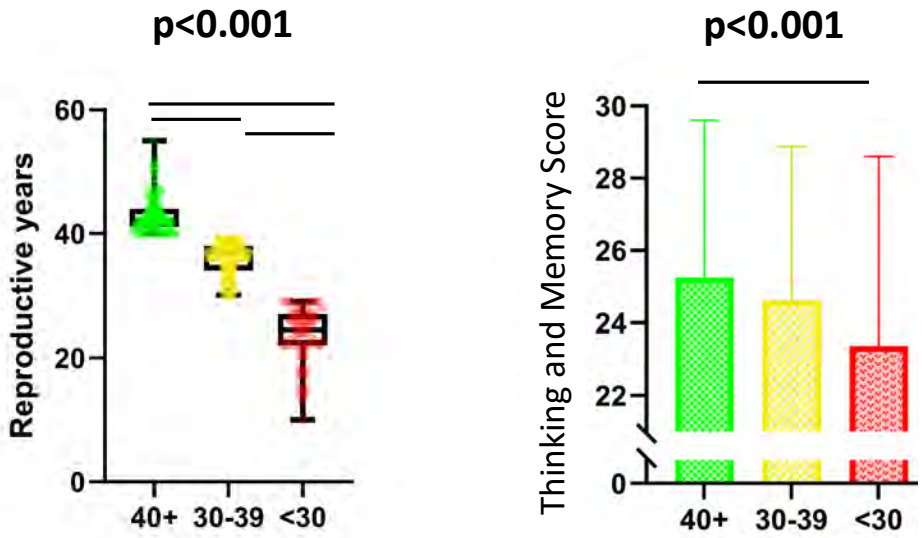


Cognition

70% are women



Duration of Hormone Exposure



- Females with 40+ years of hormone exposure: Long (n=141)
- Females with 30-39 years of hormone exposure: Moderate (n=193)
- Females with <30 years of hormone exposure: Short (n=71)

Upcoming Plans

- Effect of exercise before and after 6-months
- Longitudinal tracking (chicken or egg)
- Sex-differences
- Effects of estrogen on brain blood flow

Brain blood flow and physical activity

Regular exercise has a positive effect on vascular function and increases brain blood flow

Exercise has been shown to protect against cognitive decline

Regular exercise has been shown to improve cognitive function

Foster a positive perspective on aging

Lens on healthy aging

Thank you for listening!

Alzheimer Society

If you are interested in this type of research please contact me

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VBMLab.ca

VAST

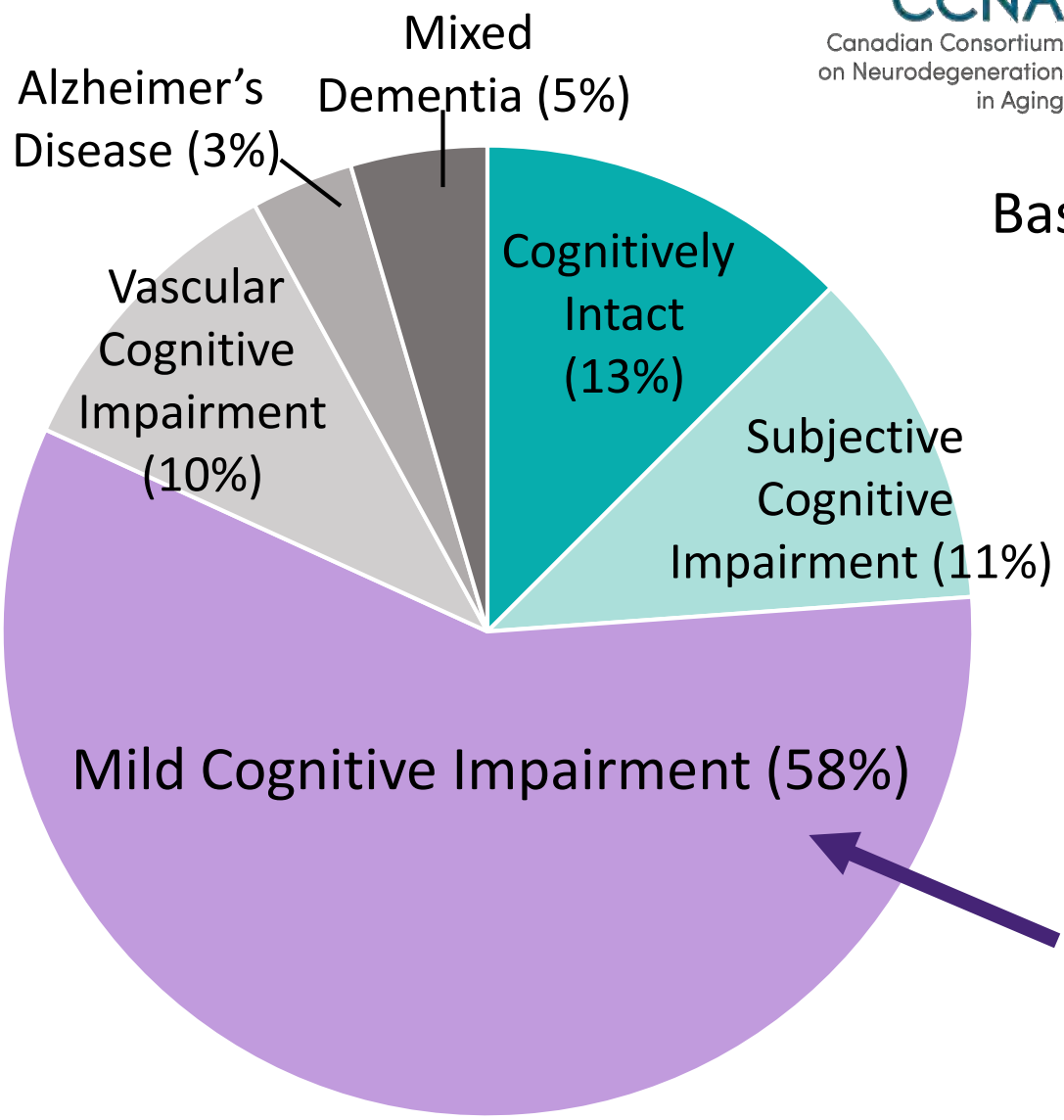
Parkwood Institute Research

Clinical Trials Group

Canadian Centre for Activity and Aging

CCNA
Canadian Consortium on Neurodegeneration in Aging

CCNV
Consortium canadien en neurodégénérescence associée au vieillissement



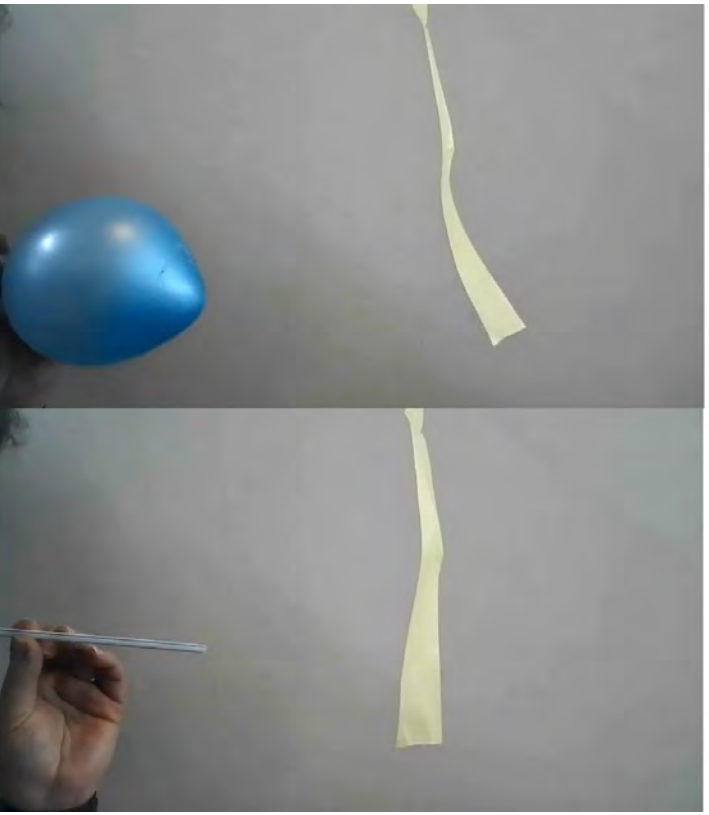
Based on expert consensus diagnosis

Potential clinical cohort to target prior to the overt progression to dementia

Vascular function

High pulse pressure particularly dangerous to the brain

Exercise is positively associated with compliant arteries



Large compliant artery

Large stiffer artery

Fitzgibbon-Collins et al. 2018, PhD Thesis
Hughson…..Shoemaker et al. 2016