## Session 3A Concurrent Risk factors and clinical conditions

**Dr Teresa Liu-Ambrose**, PhD is an Assistant Professor at the University of British Columbia. Her research focuses on the role of exercise in promoting healthy aging and preventing cognitive and functional decline among seniors.

**Lindsay Nagamatsu** is currently a second year PhD student in Psychology at the University of British Columbia. Her research focuses on cognitive factors contributing to falls risk in seniors. Her current work involves collaborations with researchers at the University of Illinois using virtual reality to examine falls in a real-world setting.

**Jacquie Zheng** is a PhD student, supervised by Prof. Stephen Lord, A/Prof Jacqueline Close and Dr Kim Delbaere in Falls and Balance Research Group, Neuroscience Research Australia. Her PhD project focuses on understanding of how structural changes in the ageing brain contribute to risk of falls in older people.

**A/Prof Brauer** leads the Neurology, Ageing and Balance Research Team at the Division of Physiotherapy, the University of Queensland. She is also the lead researcher of the Queensland Health Falls Prevention Collaborative. Her research encompasses preventing falls in hospitals, falls in the neurological population and understanding balance in older adults.

**Alex Black** (BAppSc, GradCertHlthSc) is falls researcher at Queensland University of Technology. He has been involved in a number of falls research projects since 2003, having worked on a number of falls injury projects, including his recent PhD research, and has recently worked with the Falls Injury Prevention Program at Queensland Health.

**Dr Kim Delbaere** is a Postdoctoral Researcher at Neuroscience Research Australia. She completed her PhD at the Ghent University in Belgium on falls risk factors. Since 2006, she has been working at the Falls and Balance Research Group lead by Prof. Stephen Lord, in the area of fear of falling.

**Morag Taylor** completed a BAppSc(Physiotherapy) in 1999. She joined the Falls Balance Research Group, Neuroscience Research Australia in 2005 working on a study investigating falls in rehabilitation patients for Dr Cathie Sherrington. She is currently investigating cognitive impairment and falls with A/Prof Jacqui Close. Morag enrolled in MSc (part-time) in 2008.

**Dr Jasmine Menant** completed her PhD on footwear and balance in older people at NeuRA in 2008 under Stephen Lord's supervision and is still working with him as a postdoctoral researcher. Her interests are in sensorimotor function, balance, gait and falls prevention.

## RESISTANCE TRAINING AND CORTICAL PLASTICITY OF THE AGEING CORTEX

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**Aim:**
Maintaining functional plasticity of the cortex is essential for healthy aging and aerobic exercise may be an effective behavioural intervention to promote cortical plasticity among seniors. Whether resistance training has similar benefits on cortical plasticity in seniors has received little investigation.

**Methods:**
In a 12-month randomized controlled trial of resistance training among 155 community-dwelling women aged 65 to 75 years old, a subset of participants (n= 52) completed both baseline and trial completion fMRI assessment.

**Results:**
Twelve months of twice-weekly resistance training led to increased hemodynamic activity in regions of the cortex previously associated with response inhibition processes, including left insular and left superior temporal areas. These hemodynamic effects co-occurred with improved task performance. The effect of resistance training was dose-dependent – participants of the once-weekly resistance training did not demonstrate comparable response profiles, either in behavioural performance or hemodynamic activity in the cortex.

**Conclusion:** Our findings suggest that twice-weekly resistance training in seniors can positively impact functional plasticity of response inhibition processes in the cortex, and that it does so in a manner that complements the effects on selective attention that have previously been ascribed to aerobic exercise.

## INCREASED COGNITIVE LOAD LEADS TO IMPAIRED MOBILITY DECISIONS IN SENIOR FALLERS

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**Aim:**
Decision-making contributes to our successful mobility through the environment. These judgments may be impeded by the performance of a secondary cognitive task due to our limited processing capacity, especially in those with reduced executive functioning – senior fallers. The extent to which mobility judgments play a role in successful navigation in senior fallers, however, has not been examined thus far.

**Methods:**
We conducted a cross-sectional analysis of 33 senior men and women. Participants were divided into “At-Risk” for falls and “Not-At-Risk” for falls based on a Physiological Profile Assessment cut-off score of 0.6. Dual-task performance was tested in an immersive virtual reality environment where participants were required to cross a simulated busy street by walking on a manual treadmill, and simultaneously either listening to music on an iPod or converse on a hands-free phone. Both number of successful trials (i.e., no collisions with oncoming traffic) and length of time to cross the street were recorded.

**Results:**
Seniors “At-Risk” for falling experienced collisions with oncoming cars more often and were slower to cross the street while conversing on a cell phone compared with their “Not-At-Risk” counterparts. These results are above and beyond mobility differences between the two groups, as there were no between-group differences in current physical activity and measures of balance and mobility.

**Conclusion:**
We conclude that poor mobility judgments while performing a dual-task leads to reduced street-crossing performance in those “At-Risk” for falls. Our study highlights the importance of using real-

world paradigms to examine cognitive contributors to falls.

## BRAIN WHITE MATTER LESIONS ARE ASSOCIATED WITH FALL RISK IN OLDER PEOPLE: A PROSPECTIVE STUDY

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**Aim:**
White matter hyperintensities (WMHs) are frequently observed on brain magnetic resonance imaging (MRI) in older adults. Severe degree of WMHs can affect a person's physical and cognitive performance and subsequent falls risk. This prospective study aimed to assess the effect of WMHs on falls.

**Methods:**
At baseline, 202 community-dwelling people, aged 70 to 90 years, underwent structural MRI, and physical, cognitive, and neuropsychological assessments. Periventricular and deep WMHs volumes were quantified using an automated method and classified into two severity groups based on the volume: mild to moderate group (≤ 75$^{th}$ percentile), and severe group ( > 75$^{th}$ percentile). 'Fallers' were defined as people who had at least one injurious or two non-injurious falls during the 12-month follow-up period.

**Results:**
Individuals with severe deep WMHs performed significantly worse on speed processing and executive function assessments compared with individuals with mild to moderate WMHs (p = 0.02) after controlling for age, sex, and cerebrovascular risk factors. Severe total WMHs were also independently associated with worse physiological function (p = 0.05). Risk of 'falling' was significantly higher in individuals with severe WMHs compared with individuals with mild to moderate WMHs (odds ratio (OR) 2.32 [95% CI 1.09 to 4.93]). In addition, a falls risk model incorporating WMHs, physiological function, fear of falling, word-finding ability, information processing speed and body mass index correctly classified 66% of the 'fallers'.

**Conclusion:**
These findings suggest that severe degree of WMHs is an independent predictor of injurious and recurrent falls in older people. Poorer physiological and cognitive performances are also related to WMHs and increase falls risk. Thus, WMHs should be included in the falls-risk profile assessment, and may provide a surrogate marker in falls prevention trials.

## COMMUNITY BASED FALLS IN PEOPLE WITH PD: A PROSPECTIVE STUDY

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**Background:**
Falls are very common in people with Parkinson's Disease (PD). Falls in the community (outside the home environment) may cause people to restrict their community activity, contributing to isolation and reduced quality of life. Little is known about how many people with PD experience community falls and what factors contribute to these falls.

**Aim:**
This study aimed to investigate the personal and environmental characteristics associated with community falls in people with PD.

**Methods:**
One hundred people with idiopathic PD who were able to walk independently and were not cognitively impaired were included in the study. Number and circumstances of the first fall reported over a 12 month period were collected using a falls diary and hotline. Personal characteristics of community vs non community fallers were compared using the two tailed t-test. Environmental characteristics associated with falls were classified using the framework provided by the Environmental Aspects of Mobility Questionnaire and compared using the Mann-Whitney U test.

**Results:**
Fifty-seven people (57%) reported falls. Of those who fell, 16% were classified as community fallers. No significant differences were detected in personal characteristics of the community fallers compared with non community fallers. Falls that occurred in the community were more likely to result in injury than non community falls (55.6% vs 32.3%; p < 0.001). Community falls occurred more frequently outdoors than non community

falls (44.4% vs 22.6%) and were more commonly attributed to terrain (66.7% vs 12.5%), ambience (22.2% vs 2.1%) and attention (22.2% vs 10.4%).

**Conclusion**:
A high proportion of people with PD experience community falls, and these falls are more likely to result in injury. The circumstances associated with community falls appear to differ from those associated with non community falls. Greater understanding of the personal and environmental characteristics associated with community falls in people with PD may direct treatment planning.

## VISUAL FIELD LOSS AND FALLS AMONG OLDER ADULTS WITH GLAUCOMA

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**Aim:**
Visual field loss is regarded as an important visual risk factor for falls and fractures among older adults, more so than loss of central visual acuity or contrast sensitivity.[1,2] Glaucoma is the leading cause of irreversible visual field loss, affecting around 3% of adults aged over 60 years. We investigated the role of severity and location of visual field loss on the rate of prospective falls among older adults with glaucoma.

**Methods:**
A total of 71 community-dwelling adults (37 men, 34 women; mean age, 74 ± 6 years) were followed for the occurrence of falls for 12 months, using monthly falls diaries. Baseline visual assessment comprised measures of central (visual acuity and contrast sensitivity) and peripheral (96-point binocular 120 degree visual field) visual function.

**Results:**
During the 12 month study, 44% of participants experienced one or more falls, with a total of 75 falls reported. Every 10 points missed in the binocular visual field increased the rate of falls by 25% (rate ratio 1.25, 95% confidence interval 1.08 to 1.44), adjusted for age and gender. Inferior visual field loss was a significant predictor of falls, more so than superior field loss, highlighting the importance of this visual area for safe navigation.

**Conclusions:**
Visual field loss was associated with an increased rate of falls among older adults with glaucoma, particularly inferior visual field loss. This work reinforces the importance of visual field evaluation as part of falls risk assessments for older adults, particularly among those with eye diseases leading to visual field loss. Further work is required to educate the healthcare workforce and identify strategies to reduce the risk of falls among older adult with visual field loss.

**References:**
1. Freeman EE, Munoz B, Rubin G et al. Visual field loss increases the risk of falls in older adults: the Salisbury eye evaluation. Invest Ophthalmol Vis Sci 2007;48(10):4445-50.
2. Coleman AL, Cummings SR, Ensrud KE et al. Visual field loss and risk of fractures in older women. J Am Geriatr Soc 2009;57(10):1825-32.

## DEVELOPMENT AND INITIAL VALIDATION OF THE ICONOGRAPHICAL FALLS EFFICACY SCALE – ICON-FES

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**Aim:**
Fear of falling scales typically have a strong floor effect in active older people and use short, verbal phrases to state the overall context of a fear-related activity. We developed the Iconographical Falls Efficacy Scale (Icon-FES), which includes more demanding activities and uses pictures to provide a more complete environmental context.

**Methods:**
One hundred and seventy cognitively intact and 42 cognitively impaired older people (70–90 years) were assessed on the Icon-FES in conjunction with the Falls Efficacy Scale International (FES-I).

**Results:**
The overall structure and measurement properties of the 30-item Icon-FES, as evaluated with item response theory, were good. It measured a single factor with two dimensions assessing concern about lower demanding and higher demanding daily activities. It had high internal consistency (Cronbach's alpha = 0.96) and excellent test-retest reliability over a 1-week time-interval. The Icon-FES distribution was considerably closer to normal compared with the FES-I in the general population and normal in the frailer subsample (n = 67) and cognitively impaired group, indicating absence of floor and ceiling effects. Construct validity of the Icon-FES was supported by its relation with the FES-I ($r = 0.716$, $p < 0.001$) and its ability to discriminate between groups relating to demographic characteristics and fall risk factors. A shortened 10-item Icon-FES showed similar psychometric properties to the 30-item Icon-FES.

**Conclusions:**
The Icon-FES is an innovative way of assessing fear of falling using pictures to describe a range of activities and situations. This initial validation study showed that the Icon-FES has excellent psychometric properties and showed close continuity with the FES-I. Main advantages of the Icon-FES over the FES-I are its normal distribution and its ability to assess fear of falling in both high functioning older people and people with cognitive impairment.

**Reference:**
Delbaere K, Close JC, Mikolaizak AS et al. The falls efficacy scale international (FES-I). A comprehensive longitudinal validation study. Age Ageing 2010;39(2):210-6.

## PHYSIOLOGICAL RISK FACTORS FOR FALLS IN OLDER PEOPLE WITH COGNITIVE IMPAIRMENT

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**Aim:**
To investigate physiological risk factors for falls in people with cognitive impairment.

**Methods:**
One hundred and seventy-six community-dwelling men and women with cognitive impairment aged 61-99 years (mean 82.8, SD 6.7) underwent tests of muscle strength, proprioception, vision, reaction time and postural sway. Falls in the previous 12 months were recorded. The total Falls Risk Score was calculated using the Physiological Profile Assessment (PPA). This sample was age and sex matched 1:2 with cognitively intact older people (n = 352, mean age 82.6, SD 6.0).

**Results:**
Cognitively impaired people performed significantly worse on tests of reaction time ($p < 0.001$), quadriceps strength ($p < 0.001$) and postural sway ($p < 0.001$), as well as Falls Risk Score ($p < 0.001$). The cognitively impaired group also suffered significantly more falls in the previous 12 months than the cognitively intact group: 63% (n = 111) reporting one or more falls as opposed to 36% (n = 126), and 34% (n = 60) reporting two or more falls as opposed to 16% (n = 55) ($p < 0.001$). Within the cognitively impaired group, slow reaction time ($p = 0.002$), poor proprioception ($p = 0.012$), increased postural sway ($p = 0.037$) and increased Falls Risk Score ($p = 0.003$) were significantly associated with multiple previous falls.

**Conclusion:**
Older people with cognitive impairment are at increased risk of falling due to deficits in their sensorimotor systems. When compared with cognitively intact people, cognitively impaired people perform worse on reaction time, quadriceps strength, postural sway and overall Falls Risk Score. Future planned analysis will determine impairments in specific physiological domains and overall falls risk in relation to prospective falls in cognitively impaired older people. This will assist in the design of future falls prevention trials in this population.

## VITAMIN D INSUFFICIENCY, PHYSIOLOGICAL AND COGNITIVE FUNCTIONING AND FALLS IN OLDER PEOPLE

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**Aim:**
Vitamin D insufficiency is common in older people and has been repeatedly associated with muscle weakness.[1] Although a recent meta-analysis confirmed the benefits of vitamin D supplementation on falls reduction in older people,[2] the underlying mechanism by which circulating vitamin D (serum 25OHD) influences fall risk in community-dwellers is still poorly understood. The aim of this study was therefore to investigate the relationship between serum 25OHD levels, neuromuscular and neuropsychological function, balance and stepping performance in community-dwelling older people; and to examine the relationship between serum 25OHD and prospective falls.

**Methods:**
Four hundred and sixty-four community-living older people (248 women), from eastern Sydney, aged 68-91 years underwent assessments of reaction time, muscle strength, balance, gait speed and executive function (attention, processing speed, task switching ability). Their serum 25OHD levels were determined from blood sample analysis. Significant fallers were defined as people who had at least one injurious fall or at least two non-injurious falls during a 12-month follow-up period.

**Results:**
Participants with vitamin D insufficiency (n = 154; serum 25OHD < 50 nmol/L) had weaker upper and lower limb strength, slower simple finger press and choice stepping reaction time, poorer leaning balance, slower gait, increased composite fall risk scores as assessed with the Physiological Profile Assessment and poorer executive function. In the men, vitamin D insufficiency was associated with a higher incidence of significant falls in the follow-up year: 48.9% and 30.2% for the insufficient and sufficient groups respectively (p = 0.02).

**Conclusion:**
In a region of high ambient UV rays, vitamin D insufficiency was surprisingly prevalent in older community-dwellers, and associated with poorer neuromuscular, physical and cognitive functioning. Older men with vitamin D insufficiency experienced more significant falls than their counterparts with higher levels of vitamin D. These findings further support the need for interventions for increasing vitamin D levels in older people.

**References:**
1. Campbell PM, Allain TJ. Muscle strength and vitamin D in older people. Gerontology 2006;52(6):335-8.
2. Bischoff-Ferrari HA, Dawson-Hughes B, Staehelin HB et al. Fall prevention with supplemental and active forms of vitamin D: a meta-analysis of randomised controlled trials. BMJ 2009;339:b3692.