Update on Falls Prevention Research

Jasmine Menant
NSW Falls Prevention Network Rural Forum
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Acknowledgments: Prof Stephen Lord

www.NeuRA.edu.au
Recent falls risk factor studies
Brain activation in older adults & prospective falls

Verghese et al. 2017. Neurology 88 (2)

- 166 high-functioning adults (75 ± 6 y; 51% women)
- Prefrontal cortex activity using functional near-infrared spectroscopy (fNIRS) –task-related changes in oxygenated hemoglobin levels
- Single and dual-walking tasks (verbal fluency)

- 116 falls over 34 ± 12 months
  - Higher levels of prefrontal cortical activation during the dual-task predicted falls (HR: 1.32 (95% CI: 1.03 to 1.70) after adjusting for confounders (cognition, slow gait, frailty).
  - Prefrontal cortex activation in single task, gait speed or letter rate did not predict falls

- Limitations: potential confounders of fNIRS: heart rate, movement
- Prefrontal brain activity levels while performing a cognitively demanding walking condition predicted falls in high-functioning seniors.
- Findings implicate: neurobiological processes early in the pathogenesis of falls.
Research
Risk factors for falls among older Aboriginal and Torres Strait Islander people in urban and regional communities

Lubaszy K, Radford, Delbaere et al; 2017

- Interviews with 336 aboriginal people aged 60+ in 5 communities.
- 22 fall predictors examined
- 80 fallers (24%) (past year recall) including 34 multiple fallers
- Fall risk factors:
  - Univariate analyses: female; used 3+ medications; had macular degeneration, depression, history of stroke;
  - Unable to do their own housework (relative risk: 1.9 (95%CI: 1.2 to 3.0))
  - Osteoarthritis / inflammatory arthritis (RR: 1.8 (95% CI: 1.0 – 3.2))

- Limitations: 1-year recall bias; cognitive screening not sensitive in this population;
- Fall risk factors identified for older Aboriginal people appear to be similar to those identified in the general population
To identify older people at high risk of falling and situations that cause near falls before fall-related injuries occur.

Near-falls: slips, trips, stumbles, missteps, incorrect weight transfer, temporary loss of balance

Inclusive: young, old, any clinical group

9 studies included: low to moderate quality (no real falls, no report of accuracy in adults only) but high sensitivity (≥85.7%) and specificity (≥90.0%) of the devices.

Wearable sensors used: accelerometers, gyroscopes, and insole force inducers – waist worn

Limitations:
- Mostly young participants
- Simulated falls in laboratory – no real falls

The use of a single lightweight sensor to distinguish between different types of near falls, actual falls, and activities of daily living promising low-cost technology and clinical tool for long-term continuous monitoring of older people and clinical populations at risk of falls.
Recent interventions

Linda A. M. Khong¹ • Richard G. Berlach² • Keith D. Hill³ • Anne-Marie Hill³

- 2 groups pre-test post-test study design
- Community-dwellers attending a peer-led presentation to raise awareness about falls prevention
  - Control (n=99) - 1-h presentation on falls (risk factors and strategies) by trained peer educators
  - Intervention (n=133): 1-h new falls prevention package presentation by educators trained in behaviour change and learning principles.
- 3 time-points: pre-presentation, post- and 1-month-post.
- Peer educators: 65- 85 years, retired; various professional backgrounds
- Intervention presentation:
  - self-belief that falls prevention strategies are useful;
  - knowledge about falls;
  - motivation and intention to engage in falls prevention strategies.
Peer education (Khong et al) - questionnaire

1. For me, taking measures to reduce my risk of falling would be useful
2. Most people whose opinion I value approve of me taking measures to reduce my risk of falling
3. I am aware of the measures needed to reduce my risk of falling
4. I feel positive about reducing my overall risk of falling
5. I am confident that if I wanted to, I could reduce my risk of falling
6. In the next month, I intend to take measures to reduce falls or my risk of falling
7. I have a clear plan of how I will take measures to reduce falls or my risk of falling

Qu. 8. “List up to 3 ways (measures) that you could take in the next month, which will help you avoid falling or the risk of falling”
Peer education (Khong et al) – results

- **Both groups**: increased levels of beliefs and knowledge about falls prevention, and intention to engage in falls prevention strategies **over time compared to baseline**
- **Intervention group**: more likely to report a clear action plan to which they intended to implement to reduce their risk of falling compared to control group. (OR= 1.69, 95%CI: 1.03 to 2.78)
- Gender bias: women – stronger beliefs, increased knowledge & intention
- People who previously discussed fall prevention with doctor

- Limitations
  - Motivated individuals (eg. need access to transport to attend meeting)
  - Recruitment, training and retention of new peer educators
- **Peer-led falls prevention education is an effective approach for raising older adults' beliefs, knowledge and intention to engage in falls prevention strategies.**
A multidisciplinary intervention to prevent subsequent falls and health service use following fall-related paramedic care: a randomised controlled trial

A. Stefanie Mikolajczak¹, Stephen R. Lord¹, Anne Tiedemann², Paul Simpson³, Gideon A. Caplan⁴, Jason Bendall⁵, Kirsten Howard⁶, Lyndell Webster¹, Narelle Payne¹, Sarah Hamilton¹, Joanne Lo¹, Elisabeth Ramsay², Sandra O’Rourke¹, Linda Roylance¹, J. C. Close⁷,⁸

- **RCT of** 221 non-transported older fallers (mean age: 83 ± 7 y, 65% women)
  - Intervention: based on identified risk factors and used existing services to implement PT, OT, geriatric assessment, optometry and medication management
  - Control: individualized written fall prevention advice
- **No difference between groups in subsequent falls (12 months FU), injurious falls and health service use.**
- Intervention participants who adhered to the recommended interventions had significantly lower rates of falls compared to non-adherers (IRR: 0.53 (95% CI : 0.32-0.87)).
- A multidisciplinary intervention did not prevent falls in older people who received paramedic care but were not transported to ED. However the intervention was effective in those who adhered to the recommendations.
Tailored multifactorial intervention to improve dizziness symptoms and quality of life, balance and gait in dizziness sufferers aged over 50 years: protocol for a randomised controlled trial

Menant et al., BMC Geriatrics, 2017

- 6-month, single blind, RCT of 305 people aged 50-92 years (62% women) reporting significant dizziness in the past year but no current treatment

<table>
<thead>
<tr>
<th>Problem</th>
<th>Intervention</th>
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<tr>
<td>Poor balance / strength</td>
<td>Otago home exercise program</td>
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<tr>
<td>BPPV / vestibular hypofunction</td>
<td>Epley maneuver or vestibular rehabilitation (VR)</td>
</tr>
<tr>
<td>Severe Anxiety / depression</td>
<td>Internet-based Cognitive-Behavioural Therapy (CBT) (8 weeks)</td>
</tr>
<tr>
<td>Abnormal ECG, medication interactions, low blood pressure, orthostatic hypotension</td>
<td>Medical management: Letter to General Practitioner (single / simple issue) or hospital falls clinic visit (multiple complex issues)</td>
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Dizziness RCT – flow chart and primary outcomes

- **Dizziness handicap inventory** 25 questions: emotional, physical & functional burden of dizziness (low score → less burden)

- **Dizziness episodes frequency** prospectively recorded with monthly diaries for 6 months

- **Choice-stepping reaction time** (strength, balance, reaction time)

- **Step time variability** during usual gait speed

Baseline: 305 adults aged 50+ years (Mean (SD): 67.8 (8.3) years) 1+ dizzy episode in past year & not currently treated for it

Comprehensive baseline Assessment: Medical history, CV, vestibular, mental health, sensorimotor, balance

Consensus panel meeting

Randomisation - concealed allocation

Control group

Intervention group

Multifaceted tailored intervention

Blinded tester re-assessment

Participants’ report + recommendations to controls
% intervention group participants (n=146) assigned to the range of intervention combinations
At trial completion, the dizziness handicap inventory scores in the intervention group were significantly reduced when compared to the control group, when controlling for baseline scores (mean (95% CI) difference between groups (baseline adjusted): -3.7 (-6.2 to -1.2); p=0.003).
Dizziness RCT – results

Severe / moderate dizziness handicap

- Reduced % participants with severe handicap

\[ X^2 = 4.249, \ p = 0.039 \]
No significant between-group differences in other primary outcomes:

- Dizziness episodes frequency over 6-month FU
- choice-stepping reaction time performance
- step time variability during gait
Dizziness RCT – conclusions

- A multifactorial tailored approach for treating dizziness was effective in reducing dizziness handicap in community-living people aged 50+ years.

- Future translational research: development and implementation of a dizziness profile assessment, based on our empirical data and to assist clinicians in diagnosing pathologies contributing to dizziness, thereby offering the opportunity for effective intervention.
530 adults (mean age 78 y; 85% women) randomised by self-care retirement village clusters

- Control (n=251): usual care
- Dance classes (n=279): 2x 1h / week of folk or ballroom dancing (max 80h /y)

444 falls during the 12 months FU.

No significant difference in fall rates between the control group (0.80 per person-year) and the dance group (1.03 per person-year) - adjusted Incidence Rate Ratio : 1.19 (95% CI = 0.83, 1.71).

- Higher falls rates in dance participants with history of multiple falls and in the folk dance group
- No significant differences in: executive function, Physiological Profile Assessment, Short physical performance battery or quality of life questions.

Study limitations: Low adherence: 51%; Dancing style allocation based on logistics; No assessment of complex balance tasks that might have been more sensitive to change.

Social dancing did not prevent falls or their associated fall risk factors in this population

Dance programs might need to include "training elements" to mimic structured programs.
Post-hospital home exercise program

Sherrington et al., PLOS One, 2014

- RCT of 340 people aged 60 + years recruited as inpatients
- Control (n=169): falls prevention education booklet
- Intervention group (n=171): tailored home exercise program (15-20min 3-6/week)
  - Improved performance-based mobility
  - Increased falls (177 vs. 123 falls in controls, IRR=1.43, 95%CI=1.07-1.93, p=0.017)

- Hypotheses re increase in falls
  - Sub-optimal adherence
  - Harmful effect of exercise
  - Increased exposure / confidence
  - Different time course of improvement in mobility vs falls

- Single home exercise training not appropriate to prevent falls in frail population
Step training improves reaction time, gait and balance and reduces falls in older people: a systematic review and meta-analysis

Yoshiro Okubo, Daniel Schoene, Stephen R Lord

Step training improves reaction time, gait and balance and reduces falls in older people: a systematic review and meta-analysis

Yoshiro Okubo,1,2 Daniel Schoene,3 Stephen R Lord1,4


- Effects of stepping interventions on fall risk factors and falls in people 60+
  - Volitional step training (eg. computerised stepping mat...)
  - Reactive stepping: unexpected perturbations delivered with treadmills, pulls...

- 7 randomised-controlled pooled- n= 660.

  - 52% reduction in falls rate (RR= 0.48, 95%CI= 0.36 to 0.65, p<0.01)
  - 49% reduction in proportion of fallers (RR= 0.51, 95% CI: 0.38 – 0.68, p<0.001)
  - Extra meta-analyses: improved simple and choice-stepping reaction time, single leg stance, timed up and go performance BUT NOT strength

- Both reactive and volitional stepping interventions reduce falls in ageing by ~ 50%

- Need for further high-quality studies adequately powered for falls
Treadmill walking + Virtual reality

THE LANCET

Addition of a non-immersive virtual reality component to treadmill training to reduce fall risk in older adults (V-TIME): a randomised controlled trial

Anat Mirelman, Lynn Rochester, Inbal Maidan, Silvia Del Din, Lisa Alcock, Freek Nieuwhof, Marcel Olde Rikkert, Bastiaan R Bloem, Elisa Pelosi, Laura Avanzino, Giovanni Abbruzzese, Kim Dockx, Esther Bekkers, Nir Giladi, Alice Nieuwboer, Jeffrey M Hausdorff


- N= 302 people aged 60-90 y
- 6-weeks program (3 x 45min/week):
  - Treadmill only
  - Treadmill + virtual reality
- Significantly reduced falls over 6-month FU in older adults and in people with Parkinson's disease
Cognitive-motor training – current work

Sturnieks et al., NeuRA, 2015-2019

Multidisciplinary assessment to uncover mechanisms of action
- Sensorimotor & balance function
- Executive function
- Brain structure (MRIs, n=105)
The slip and trip walkway

Yoshi Okubo, Daina Sturnieks, Matthew Brodie, Stephen Lord - NeuRA

- To train reactive step training
  - Ageing
  - Clinical groups: Multiple Sclerosis, Parkinson’s disease...
- To assess effects of stepping interventions on laboratory falls and behavioural outcomes

88 exercise trials (99 comparisons), 19,478 participants

Exercise effect relative risk (RR)
- 0.79, 95% CI=0.73-0.85, 21% reduction in community-dwellers (n=15773)
- 55% reduction in Parkinson’s disease (n=565)
- 45% reduction in cognitive impairment
Exercise to prevent falls in older adults: an updated systematic review and meta-analysis

Catherine Sherrington,¹ Zoe A Michaleff,¹,² Nicola Fairhall,¹ Serene S Paul,¹ Anne Tiedemann,¹ Julie Whitney,³ Robert G Cumming,⁴ Robert D Herbert,⁵ Jacqueline C T Close,⁵,⁶ Stephen R Lord⁵


- Non-significant 10% reduction in falls in residential care settings
- Non-significant 16% increase in falls in people recently discharged from hospitals

- Programs including: high challenge to balance + 3 hours /week of exercise: significant 39% decrease in rate of falls.

- Lack of fall prevention effect in residential care settings: dependent population might require additional interventions targeting multiple co-morbidities (e. vit D...)
Summary
Gold bar evidence scale

- One good quality RCT
- At least two good quality RCTs – little inconsistency
- Multiple RCTs and/or systematic reviews – little inconsistency
Falls prevention – what works

- High level balance exercise in group or home settings (functional balance exercises, Otago, Tai Chi)
- Occupational therapy interventions (home safety modifications in association with transfer training and education) in high risk populations
- Expedited first eye cataract surgery
- Restriction of multifocal glasses use in older people who take part in regular outdoor activity
- Pharmacist-led education and GP medication review
- Podiatry intervention in people with disabling foot pain
Falls prevention – what works

- Withdrawal of psychoactive medications
- Intensive multidisciplinary assessment of high risk populations
- Intensive interventions in hospitals
- Comprehensive geriatric assessment in residential aged care
- Vitamin D supplementation in residential aged care
- Medication review in residential aged care
What does not work?

  - 616 older community-dwellers aged ≥70 years
  - 32% of intervention group: updated glasses
  - Falls risk increase ≈ 50% & trend also for more fractures

- Brisk walking (see Sherrington et al., 2008)
- Gentle and seated exercise (see Sherrington et al., 2008)
- Sloppy slippers campaigns
- Stand alone home modifications
- Single exercise training in frail older people, dancing in retirement village residents
Thank you!