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Fall prevention in older people: an update of the evidence

Brain activity and fall risk; pain and social isolation; effective exercise programs; compliant flooring in nursing homes; gold bar fall prevention evidence

Stephen Lord

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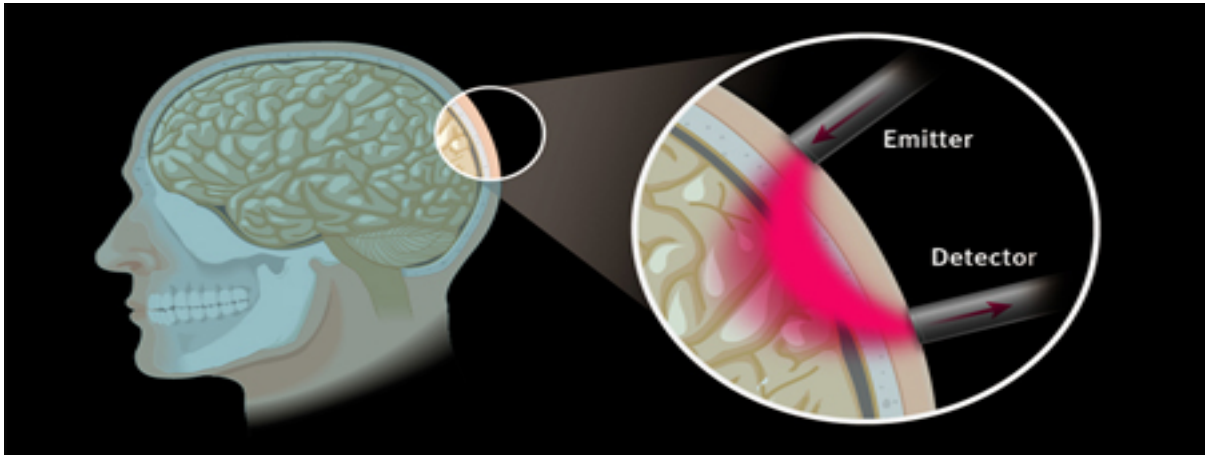
Brain activity

fNIRS

- Functional near-infrared Spectroscopy (fNIRS) is an optical neuroimaging technique for investigating cortical brain area activation while participants move freely (i.e. stepping tasks).
- fNIRS is particularly useful for monitoring haemodynamic changes in brain activation before and after a stimulus.



2019: DOI
10.7717/peerj.6833

Prefrontal cortical activation measured by fNIRS during walking: effects of age, disease and secondary task

Paulo H.S. Pelicioni[1,2], Mylou Tijsma[3], Stephen R. Lord[1,2] and Jasmine Menant[1,2]

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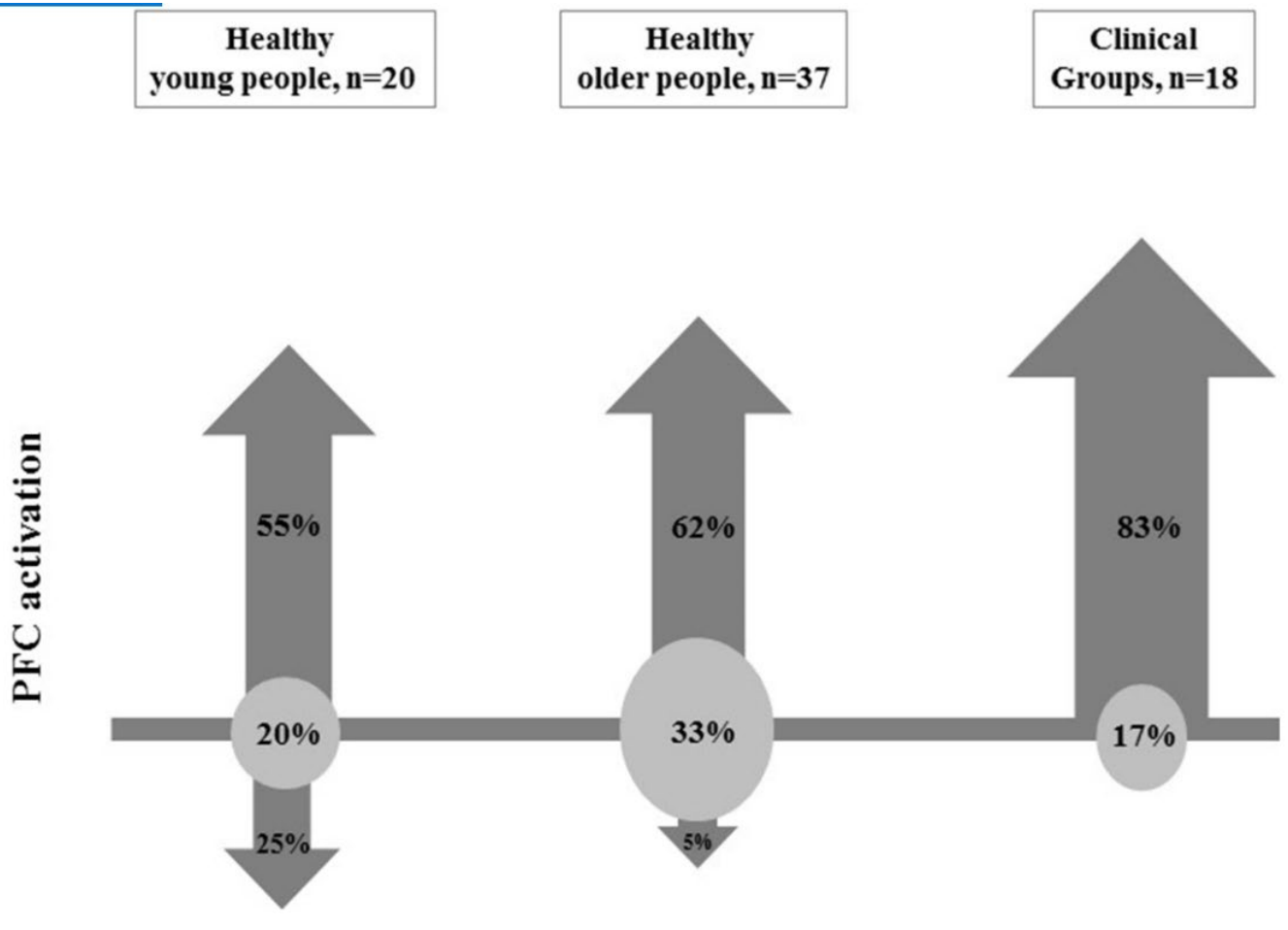
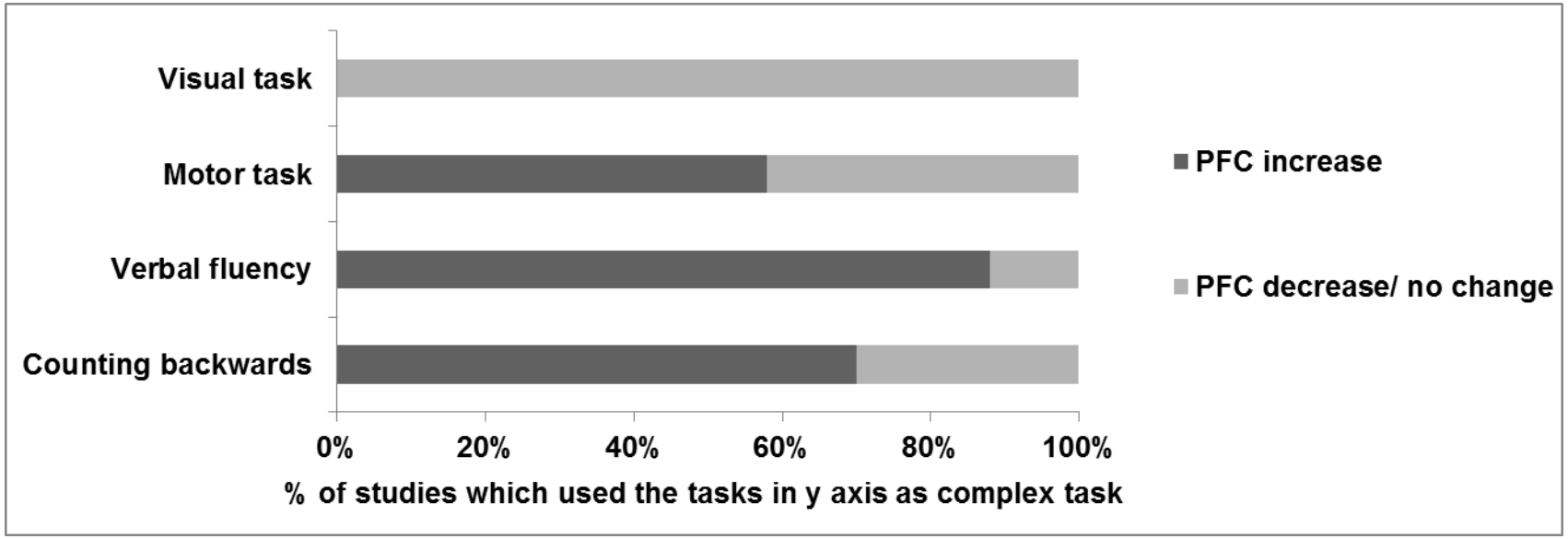
- Cognitive processes are required during walking to appropriately respond to environmental and task demands.
- Several studies that have used functional Near-Infrared Spectroscopy (fNIRS) to record brain activation to investigate neural bases of cognitive contributions in gait.
- The aim of this systematic review was to summarize the published research regarding Prefrontal cortical (PFC) activation patterns during simple and complex walking tasks in young adults, older adults and clinical groups with balance disorders using fNIRS.

PFC activation changes



Proportion of studies showing increase (up arrows), decrease (down arrows) or no change (circle) in Prefrontal Cortex (PFC) activation when walking with while conducting a secondary task.

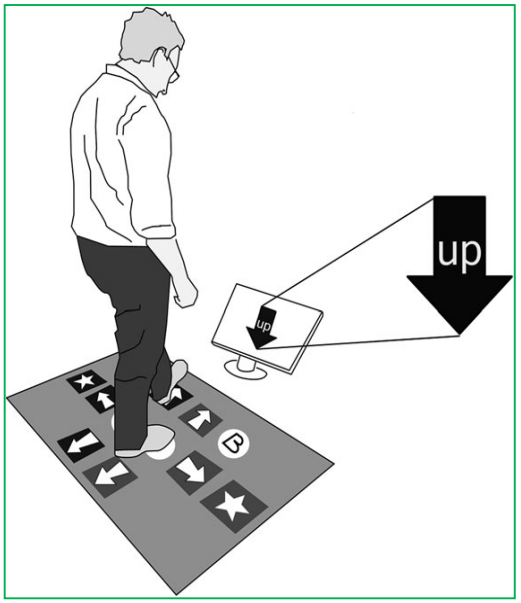
PFC response – secondary task type



Main findings

- Increased PFC activation was most common in studies that involved walks comprising secondary verbal fluency and arithmetic tasks.
- Clinical groups generally showed increased PFC activation irrespective of type of secondary task performed during walking which suggests these groups require more attentional resources for safe walking.

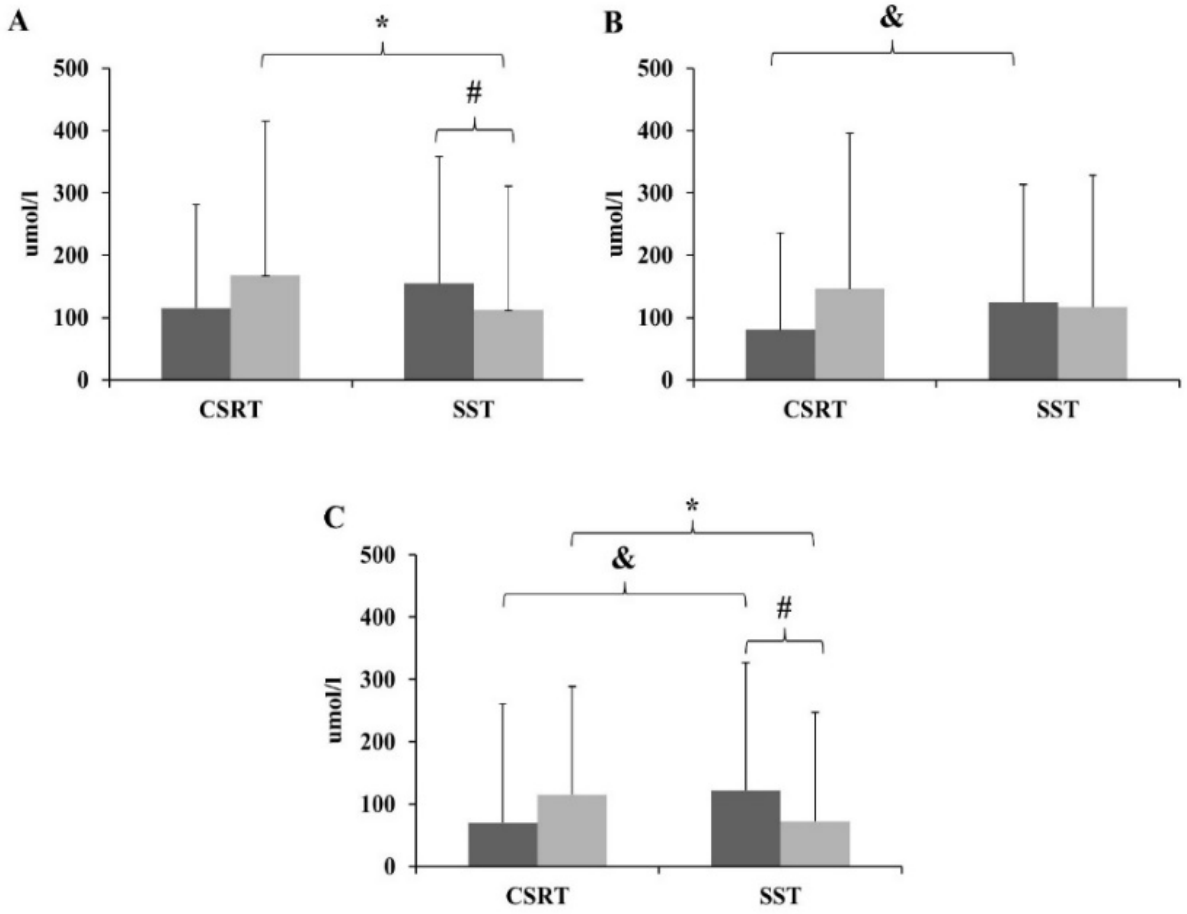
Brain activity in people with Parkinson's disease



- Fifty-two people with PD and 95 healthy older adults (HOA) performed a simple choice stepping reaction time test (CSRT) and a cognitively-demanding stepping test Stroop stepping task (SST)) on a computerized step mat.
- Cortical activation in the dorsolateral prefrontal cortex (DLPFC), Broca's area, supplementary motor area (SMA) and premotor cortex (PMC) regions were recorded using fNIRS.

Main findings

- The PD group was slower in both tasks and made more errors in the Stoop Stepping Task
- Reductions in cortical activity in DLPFC, SMA and PMC within the PD group during a complex stepping tasks requiring inhibitory control reflects sub-cortical and/or multiple pathway damage with subsequent deficient use of cognitive and motor resources



Dark grey – healthy older adults; Light grey - PD

Slow down and concentrate?

Parkinson's Disease
Volume 2013 (2013), Article ID 704237, 8 pages
http://dx.doi.org/10.1155/2013/704237

Research Article

Slow Down and Concentrate: Time for a Paradigm Shift in Fall Prevention among People with Parkinson's Disease?

Emma L. Stack and Helen C. Roberts

Pain, social isolation, instability and falls

JAMDA 21 (2020) 597–603

JAMDA

journal homepage: www.jamda.com

Review Article

Pain Is Associated With Poor Balance in Community-Dwelling Older Adults: A Systematic Review and Meta-analysis

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[c] *Faculty of Medicine, University of New South Wales, Sydney, Australia*

Methods and Results

- Cross-sectional and case-control studies that compared objective balance measures between older (minimum age 60 years) adults with and without pain were included.
- Thirty-nine eligible studies (n = 17,626) were identified. All balance modalities (static, dynamic, multicomponent, and reactive) were significantly poorer in participants with pain compared to those without pain.
- Subgroup analyses revealed that chronic pain (pain persisting 3 months) impaired balance more than pain of unspecified duration.
- The effects of pain at specific sites (neck, lower back, hip, knee, and foot) on balance were not significantly different.

Conclusions and Implications

- Pain is associated with poor static, dynamic, multicomponent, and reactive balance in community-dwelling older adults
- Pain in the neck, lower back, hip, knee, and foot all contribute to poor balance, and this is even more pronounced for chronic pain
- Comprehensive balance and pain assessments may reveal mechanisms underlying the contribution of pain to instability and fall risk in older people

DOI: 10.1111/ggi.13785

ORIGINAL ARTICLE

EPIDEMIOLOGY, CLINICAL PRACTICE AND HEALTH

Chronic pain is independently associated with social frailty in community-dwelling older adults

Tatsuya Hirase,[1,2] Hyuma Makizako,[3] Yoshiro Okubo,[2,4] Stephen R Lord,[2,4] Shigeru Inokuchi[1] and Minoru Okita[1]

Methods

- Participants comprised 248 older adults who enrolled for community-based exercise classes
- Chronic pain was defined as the presence of significant pain-related symptoms within the past month that had continued for at least 6 months
- Social frailty was defined as positive responses to 2 of the following 5 questions (going out less frequently, rarely visiting friends, feeling unhelpful to friends or family, living alone and not talking with someone every day)
- Physical function as assessed using the chair stand and timed up and go tests.

Results

- Fifty five participants (22.2%) met the criteria for social frailty
- Twenty eight socially frail participants (50.9%) and 56 of the socially integrated participants (29.0%) reported chronic pain
- The presence of chronic pain was significantly associated with social frailty after adjusting for age, sex and physical function measures (odds ratio 2.13, 95% confidence interval = 1.01–4.48)
- Chronic pain was also significantly associated with three social frailty items: going out less frequently, rarely visiting friends and feeling unhelpful to friends or family.

Conclusions

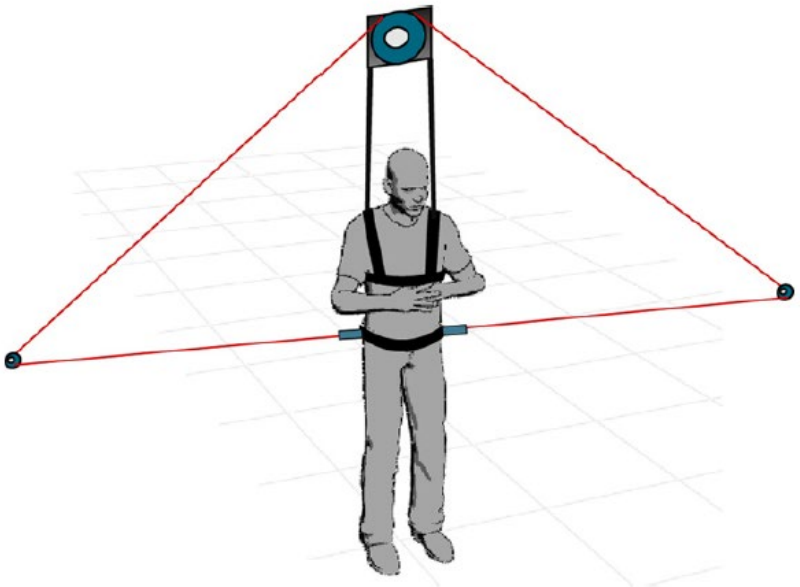
- Chronic pain was independently associated with social frailty in community dwelling older adults. Simple assessments of chronic pain and subsequent pain management interventions may be beneficial for older people with socially frailty

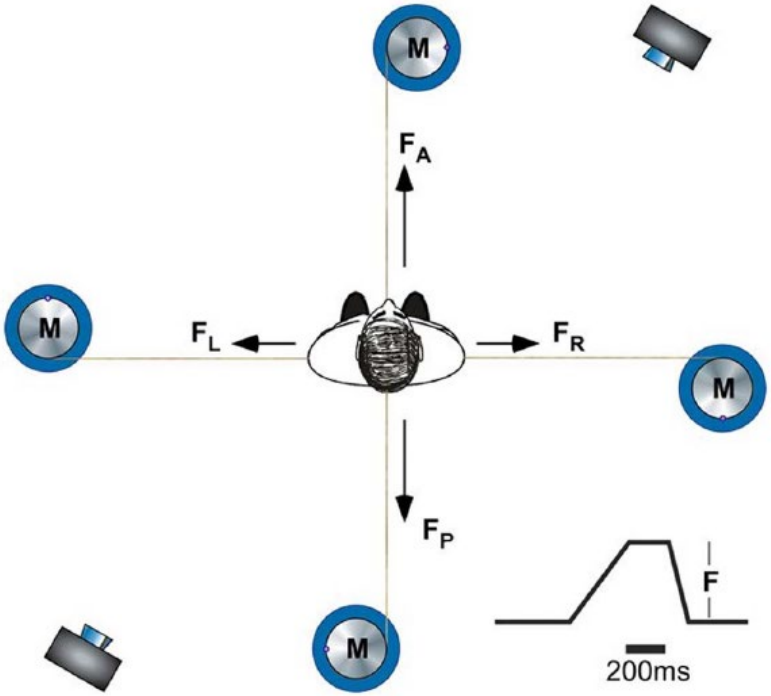
Impact of pain on reactive balance and falls in community-dwelling older adults

- *Objective*: To investigate whether any pain, back/neck and lower limb pain are associated with poor reactive balance and prospective fall outcomes in older adults
- *Methods*: 242 participants completed a questionnaire on the presence of pain and underwent force-controlled waist-pull postural perturbations while standing. Force thresholds for stepping, step initiation time, step velocity and step length were quantified. Falls were monitored with monthly falls calendars for 12-months

Hirase T et al, Age and Ageing. In Press.

The waist pull device





Main findings

- Participants with lower limb pain had significantly lower force thresholds for stepping.
- Those with any pain or pain in the back/neck had longer step initiation time, slower step velocity and shorter step length.
- The three pain measures (any pain, back/neck pain, lower limb pain) were significantly associated with multiple falls when adjusted for age, sex, body mass index, use of polypharmacy, strength and walking speed.
- Reactive balance partially mediated the association between pain and fall-related fractures.

Effective exercise programs

Open access Review

BMJ Open Sport & Exercise Medicine

Exercise for falls prevention in community-dwelling older adults: trial and participant characteristics, interventions and bias in clinical trials from a systematic review

Christopher A C M Ng ,[1,2] Nicola Fairhall,[3] Geraldine Wallbank,[3] Anne Tiedemann,[3] Zoe A Michaleff,[3,4] Catherine Sherrington[3]

Background and methods

- Systematic review summarises trial and participant characteristics, intervention contents and study quality of 108 randomized trials evaluating exercise interventions for falls prevention in community-dwelling older adults.
- Methods MEDLINE, EMBASE, CENTRAL and three other databases sourced randomised controlled trials of exercise as a single intervention to prevent falls in community-dwelling adults aged 60+ years to May 2018.
- 108 trials with 146 intervention arms and 23,407 participants were included.
- Trials were undertaken in 25 countries, 90% of trials had predominantly female participants and 56% had elevated falls risk as an inclusion criterion

Main findings

- In 72% of trial interventions attendance rates exceeded 50% and/or 75% of participants attended 50% or more sessions.
- Characteristics of the intervention programs that reduced falls were:
  - balance and functional training interventions lasting on average 25 weeks (IQR 16–52), 39% group based, 63% individually tailored;
  - Tai Chi interventions lasting on average 20 weeks (IQR 15–43), 71% group based, 7% tailored;
  - multiple types of exercise programs lasting on average 26 weeks (IQR 12–52), 54% group based, 75% tailored
- Strength / resistance training, flexibility training and general physical activity programs did not reduce falls.

Compliant flooring in nursing homes

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PLoS Med. 2019 Jun; 16(6): e1002843.
Published online 2019 Jun 24. doi: 10.1371/journal.pmed.1002843

PMCID: PMC6590787
PMID: 31233541

The Flooring for Injury Prevention (FLIP) Study of compliant flooring for the prevention of fall-related injuries in long-term care: A randomized trial

Mackey DC, Lachance CC, Wang PT, Feldman F, Laing AC, Leung PM, Hu XJ, Robinovitch SN. PLoS Med. 2019 Jun 24;16(6):e1002843. doi: 10.1371/journal.pmed.1002843. PMID: 31233541; PMCID: PMC6590787.

Background an Methods

- Softer landing surfaces, such as those provided by low-stiffness “compliant” flooring, may prevent fall-related injuries by decreasing the forces applied to the body during fall impact
- The Flooring for Injury Prevention (FLIP) Study was a 4-year, randomized superiority trial in 150 single-occupancy resident rooms at a single Canadian LTC site. Resident rooms were block randomized (1:1) to installation of intervention compliant flooring (2.54 cm SmartCells) or rigid control flooring (2.54 cm plywood) covered with identical hospital-grade vinyl.

Compliant flooring

Main findings

- During follow-up, 184 residents occupied 74 intervention rooms, and 173 residents occupied 76 control rooms
- 1,907 falls were reported; 23 intervention residents experienced 38 serious injuries (from 29 falls in 22 rooms), while 23 control residents experienced 47 serious injuries (from 34 falls in 23 rooms).
- Compliant flooring did not affect the odds of:

  ≥1 serious fall-related injury (12.5% intervention versus 13.3% control, OR: 0.98, 95% CI: 0.52 to 1.84)
- ≥2 serious fall-related injuries (5.4% versus 7.5%, OR: 0.74, 95% CI: 0.31 to 1.75).
- Compliant flooring did not affect the risk of residents sustaining ≥1 falls (69.9% intervention versus 67.9% control, base model (OR: 1.18, 95% CI: 0.74 to 1.89)

Fall Prevention: what works

Falls prevention – what works

- Highest level of evidence given by meta-analyses of RCTs

- Gillespie LD et al. Interventions for preventing falls in older people living in **the community**. Cochrane Database Syst Rev. 2012 Sep 12;9
- Sherrington C et al. **Exercise for preventing falls in older people living in the community.** Cochrane Database Syst Rev 2019, Issue 1. Art. No.: CD012424. DOI: 10.1002/14651858
- Hopewell S et al. **Interventions based on individual assessment of falls risk and multiple component interventions for preventing falls in older people in the community.** Cochrane Database Syst Rev. 2018, Issue 7. Art. No.: CD012221. DOI: 10.1002/14651858.CD012221.pub2
- Cameron ID et al. **Interventions for preventing falls in older people in care facilities and hospitals**. Cochrane Database Syst Rev. 2018, Issue 9. Art. No.: CD005465. DOI: 10.1002/14651858.CD005465.pub4.

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: community

- High level balance exercise in group or home settings (functional balance exercises, Otago, Tai Chi)
- Voluntary and reactive step training
- 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: community

- Withdrawal of psychoactive medications
- Multicomponent and multifactorial interventions in higher risk populations [*Likely better effects if intervention put in place directly as opposed to relying on referrals*]

Falls prevention – what works: hospital

- Intensive interventions in sub-acute hospitals

Falls prevention – what works: residential care

- Multicomponent and multifactorial interventions [*Likely greater effects with more resources*]
- Vitamin D supplementation (excluding mega-doses)
- Medication review
- Physiotherapy exercises
- **Compliant flooring**

Thank you

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