



# Dizziness and Falls

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[www.NeuRA.edu.au](http://www.NeuRA.edu.au)

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# Seminar outline

- Dizziness and falls: summary of the evidence
- Our research
- Clinical implications

# Review of the evidence

# What is dizziness?

*"like the room is spinning"*

*"An earthquake inside me"*

*"Veering to one side"*

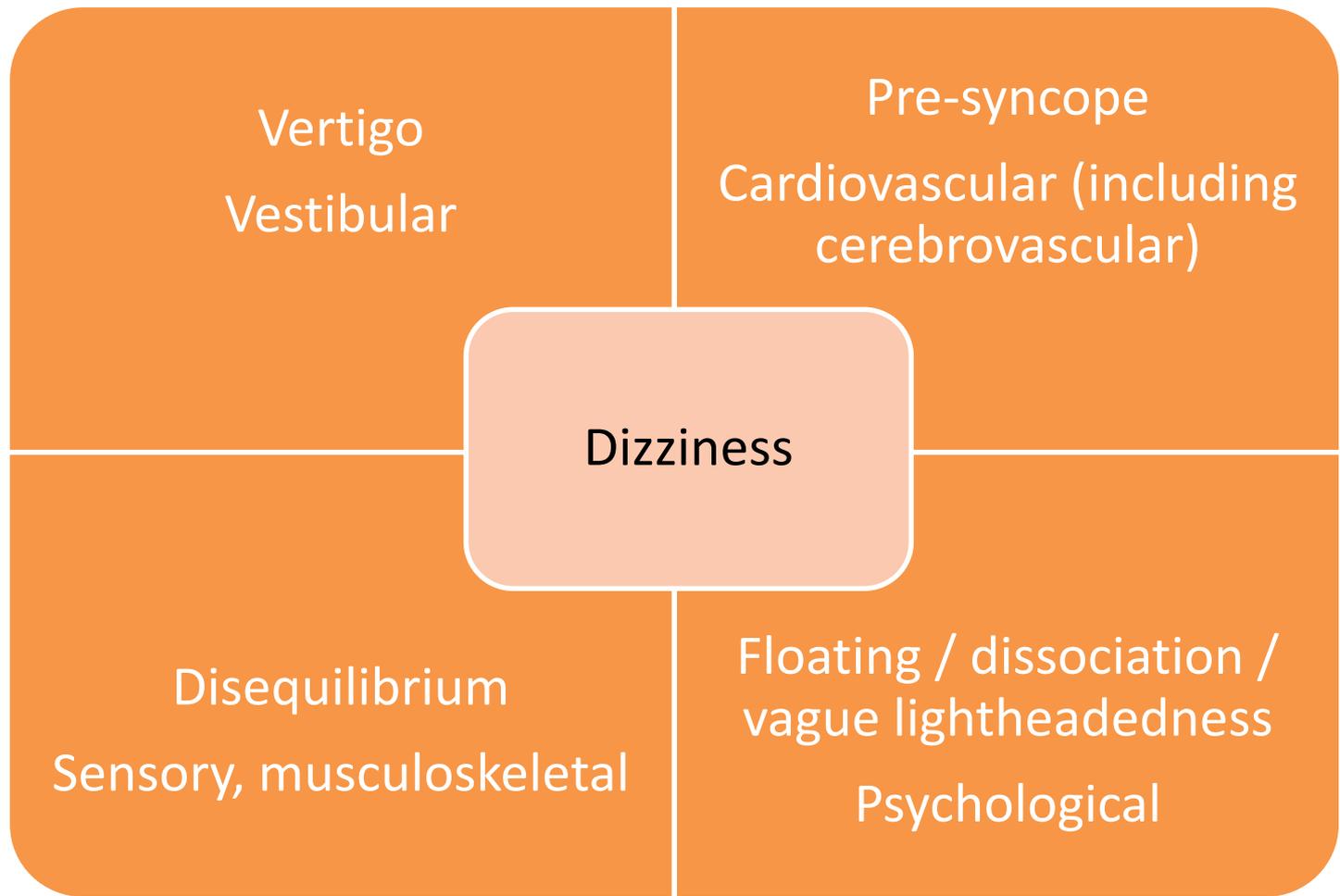
*"Frostbite in the brain "*

*"Electric shock"*

*"I feel disconnected – like I am floating on a wharf"*

*"Feeling faint"*

*"Electric blue jagged lines and multi-coloured rectangles"*



- Can also be also be related to medication side effects, neurological pathology...

# Dizziness prevalence

- 10-30% among those aged 50+years<sup>1-6</sup>
- Increases with older age<sup>1,3,5-6</sup>
- Higher in women vs. men<sup>1,3,5-6</sup>

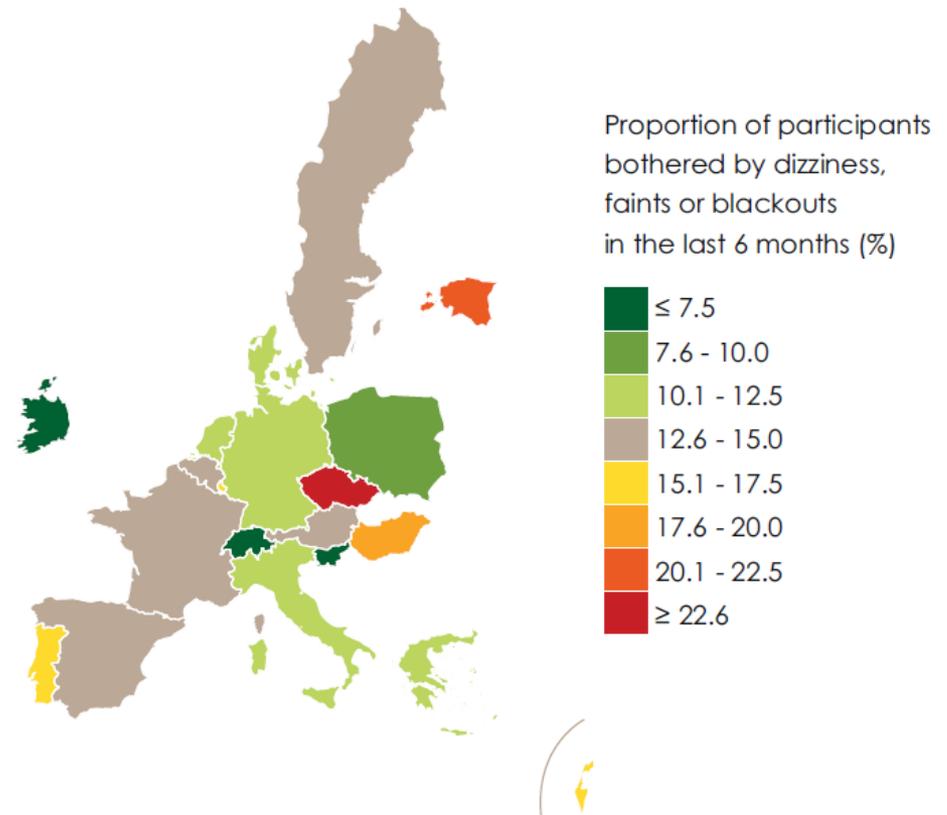
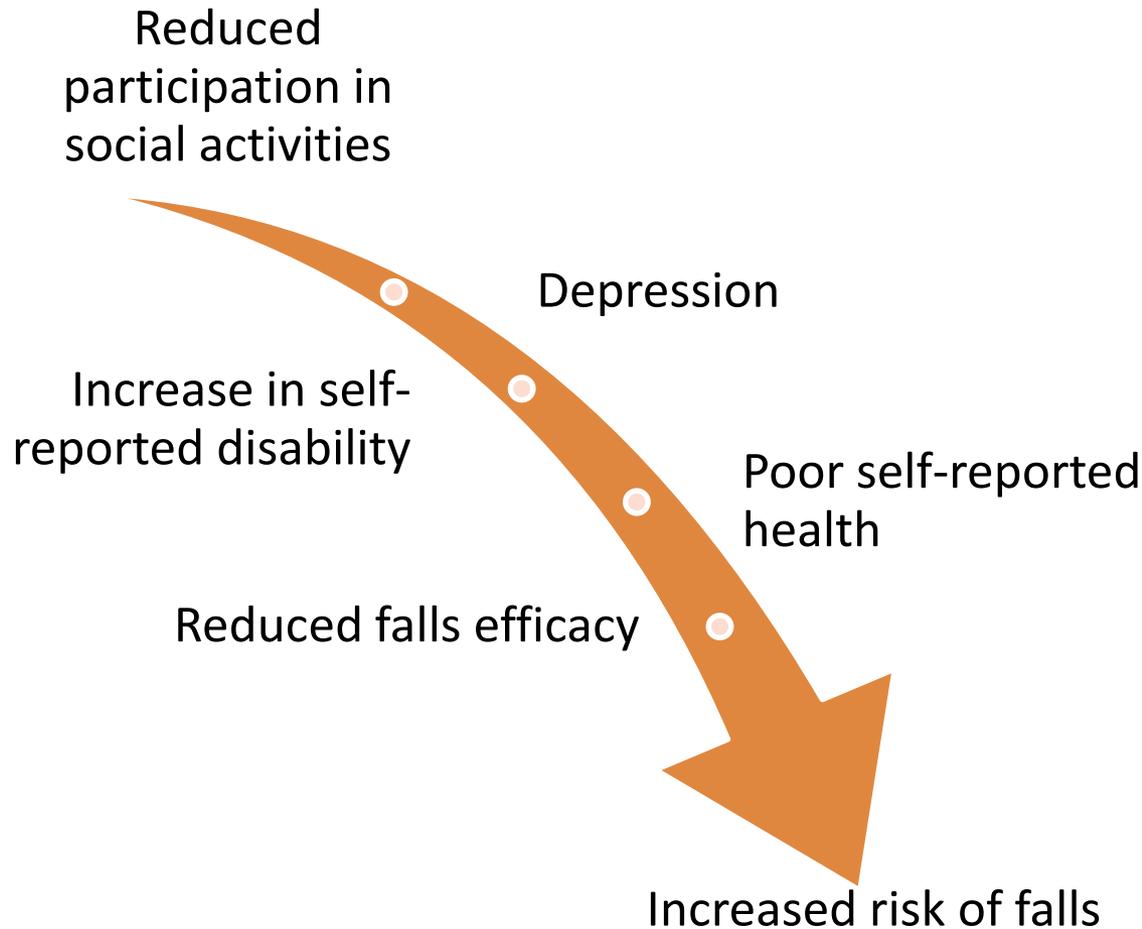


Fig. 1 – Map of weighted prevalence of dizziness across Europe aged 50+ years (n = 69,225).

1. Aggarwal., J Gerontol Med Sci, 2000;
2. Stevens et al., Age Ageing, 2008;
3. Colledge et al., Age Ageing, 1994
4. Tinetti et al., J Am Geriatr Soc, 2000
5. Penger et al., Public Health, 2017
6. Maarsingh et al., BMC Family Practice, 2010

Penger et al., Public Health, 2017

# Negative sequelae of untreated dizziness



1. Aggarwal., J Gerontol Med Sci, 2000
2. Stevens et al., Age Ageing, 2008
3. Tinetti et al., J Am Geriatr Soc, 2000
4. Meuller M et al., Eur J Public Health, 2014

# Dizziness & prospective falls

Study	Population	Dizziness definition	Falls data collection	Results
Deandra et al., Epidemiol, 2010	At least 80% community-dwellers and aged 65+y N>200	Dizziness and vertigo (yes/no)	Prospective	Systematic review and meta-analysis Pooled data (yes dizziness / vertigo) <b>All fallers: OR (95%CI)= 1.80 (1.39-2.33) (6 studies)</b> <b>Multiple fallers: OR (95%CI)=2.28 (1.90-2.75) (8 studies)</b>
Tinetti, JAGS, 2000	1087 community-dwellers aged 72+ y	Chronic dizziness – present for 1+ month in past 2 months	Monthly diaries for 1 year	261 (24%) with chronic dizziness Relative Hazard (95%CI) for falls: 1.35 (1.06-1.72) Disappears after adjusting to confounders
Graafmans et al., Am J Epidemiol, 1996	354 aged-care facilities residents 72-92y (median MMSE : 25, range 4-30)	Dizziness upon standing	weekly diaries for 6 months	36% fallers – 16% multiple fallers 22% of participants with dizziness 1+fall: OR(95%CI)=2.3 (1.3-3.8) Multiple falls (2+): OR = 2.8 (1.2 -4.3)
Menant et al., J Am Geriatr Soc, 2013	516 community-dwellers aged 73-92 y	History of dizziness, vertigo or light-headedness since age 60	Monthly diaries for 1 year	42% history of dizziness 18% multiple fallers Relative risk (RR) (95%CI)= 1.55 (1.08-2.23)

→ Variations in settings, sample's age range, definition of dizziness

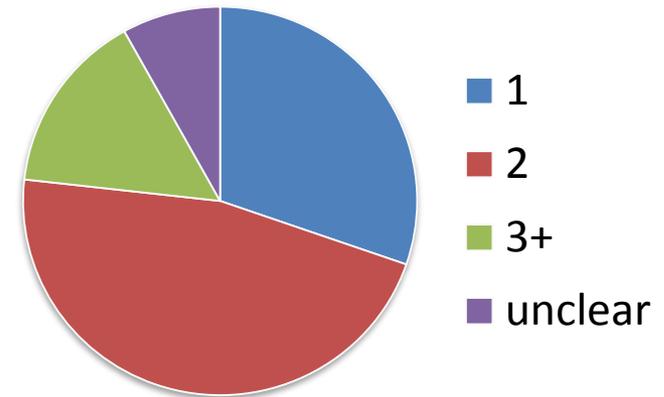
# Causes of Persistent Dizziness in Elderly Patients in Primary Care

ANNALS OF FAMILY MEDICINE + WWW.ANNFAMMED.ORG + VOL. 8, NO. 3 +

Maarsingh et al.,

- 417 primary care patients aged 65-95 y
- Dizziness present for at least 2 weeks
- Multidisciplinary assessment
  
- Major contributing causes
  - Cardiovascular disease 57% (n=237)
  - Peripheral vestibular disease 14% (n=60)
  - Psychiatric illness 10% (n=41)
  
- Minor contributing causes
  - Adverse drug effect
  - Locomotor disease

**Dizziness causes**



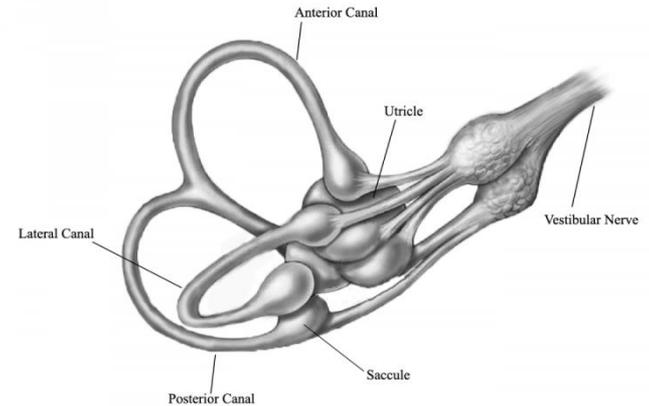
# Orthostatic hypotension (OH)

- Orthostatic Hypotension (OH): blood pressure recording <sup>1, 2</sup>
- **Versus.** Orthostatic Dizziness <sup>3</sup>: symptom
- ~10% prevalence of OH and OD <sup>1, 3</sup>
- Inconsistent relationships between OH, OD and falls <sup>1, 2</sup>

1. Angelousi et al., J Hypertension, 2014
2. Heitterachi et al., J Am Geriatr Soc, 2002
3. Radtke et al., Clin Auton Res 2011

# Vestibular dysfunction

- Prospective studies of falls
  - No relationship with Fukuda's stepping test and dynamic visual acuity <sup>1</sup>
  - Increased error and variability in perception of postural vertical associated with increased risk of falling <sup>2</sup>
- Retrospective studies – significant associations with falls <sup>3, 4</sup> and fractures <sup>5, 6</sup>
  - Deficit in vestibulo-ocular reflex suppression <sup>3</sup>
  - Benign Paroxysmal Positional Vertigo <sup>4</sup>
  - Positive head shaking test (vestibular asymmetry) <sup>5, 6</sup>



→ Conflicting and limited published evidence of clear association with falls

1. Lord et al., J Am Geriatr Soc, 1991
2. Menant et al., Gerontology, 2012
3. Di Fabio et al, Arch Phys Med Rehabil, 2002
4. Lawson et al., Age Ageing, 2008
5. Kristinsdottir et al., Scand J Rehabil Med 2000
6. Kristinsdottir et al., Acta Otolaryngol 2001

# Medications

## Medications often causing dizziness (Sloane et al., Ann Intern Med, 2001)

- $\alpha$ 1-Adrenergic
- Alcohol
- Aminoglycosides Ototoxicity (eg. Gentamicin)
- Anticonvulsants
- Antidepressants
- Anti-Parkinsonian medication
- Antipsychotics
- $\beta$ -Blockers
- Calcium-channel blockers
- Class Ia antiarrhythmics
- Digitalis glycosides
- Diuretics
- Narcotics
- Oral sulfonylureas
- Vasodilators

## Fall-risk inducing drugs (Seppala et al., and de Vries et al., JAMDA, 2018<sup>a, b, c</sup>)

- Antipsychotics
- Antidepressants
- tricyclic antidepressants
- selective serotonin reuptake inhibitors
- benzodiazepines
- long-acting benzodiazepines
- short-acting benzodiazepines
- Opioids
- anti-Parkinson drugs
- Antiepileptics
- polypharmacy
- Loop diuretics
- Digitalis
- Digoxin

→ Overlap between drugs leading to dizziness and also associated with falls

# Psychological / functional disorders

## Psychiatric comorbidity and psychosocial impairment among patients with vertigo and dizziness

Claas Lahmann,<sup>1,2</sup> Peter Henningsen,<sup>1,2</sup> Thomas Brandt,<sup>2,3</sup> Michael Strupp,<sup>2,4</sup>  
Klaus Jahn,<sup>2,4</sup> Marianne Dieterich,<sup>2,4,5</sup> Annegret Eckhardt-Henn,<sup>6</sup>  
Regina Feuerecker,<sup>2,4</sup> Andreas Dinkel,<sup>1</sup> Gabriele Schmid<sup>1,2</sup>

- 547 patients from a specialized interdisciplinary treatment centre for vertigo/dizziness
- ~ 50% psychiatric disorder identified by standardized test

# Our research



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

1. Relationship between dizziness and falls?
2. What are the risk factors for dizziness burden?
3. Effects of a multifactorial intervention on dizziness burden (main trial)?

# Inclusion / Exclusion criteria

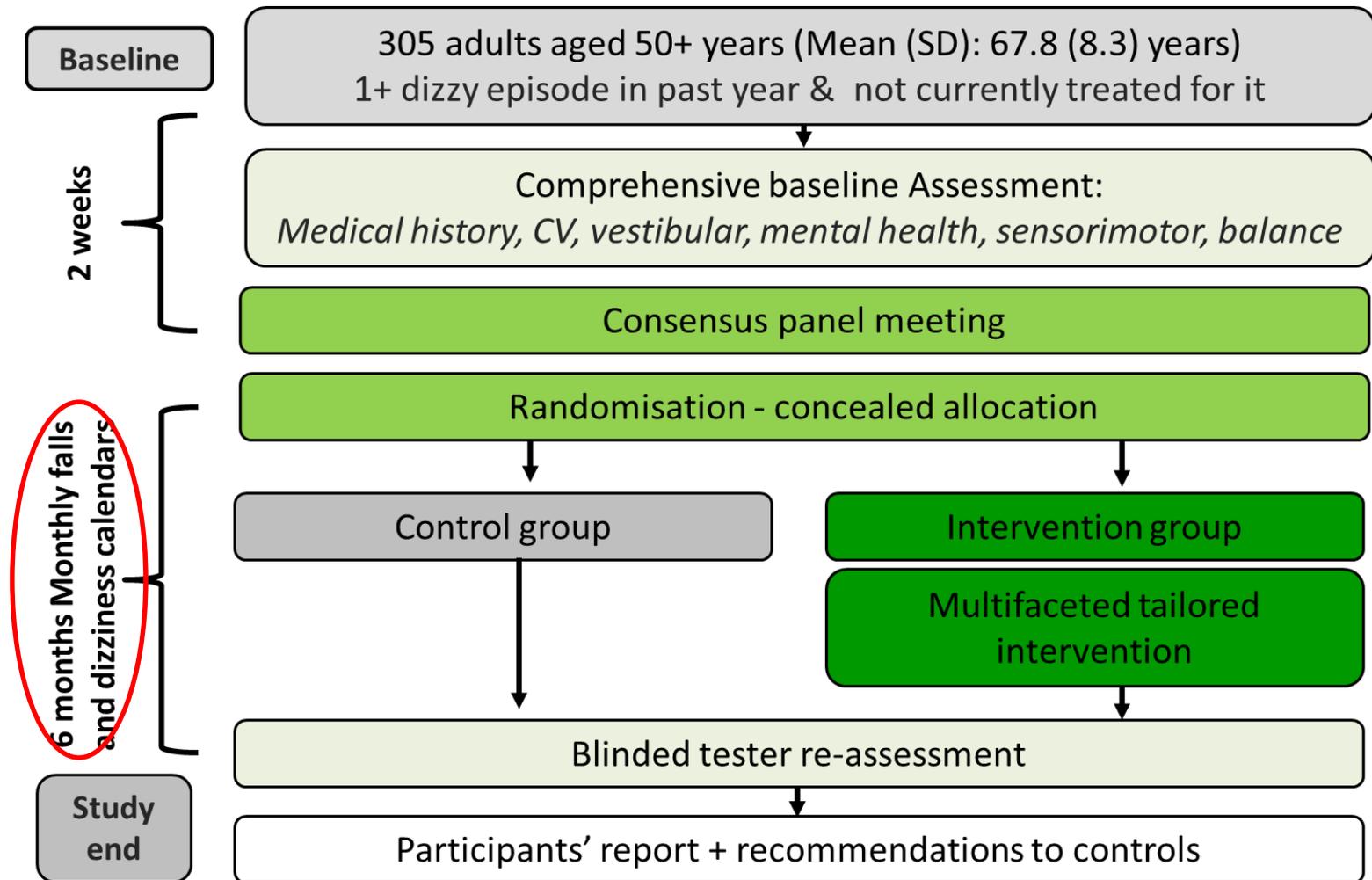
- Inclusion criteria

- age  $\geq 50$  years
- Dizziness symptoms in past year & not currently treated for them
- Living independently
- Understanding English

- Exclusion criteria

- Severe cognitive impairment (GPCOG  $< 5$ )
- Degenerative neurological condition (PD, MS, etc)
- Severe depressive symptoms (PHQ-9  $\geq 20$ ), severe anxiety symptoms (GAD-7  $\geq 20$ ), other conditions that require urgent treatment (Suspected stroke; TIA; Acute cardiovascular condition)

# Study timeline

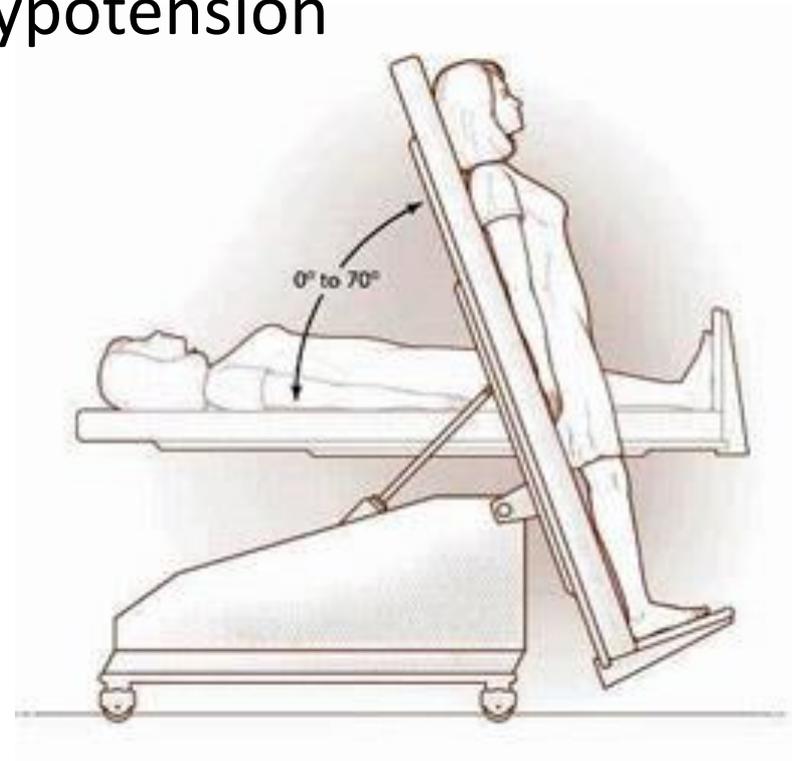


# Questionnaires

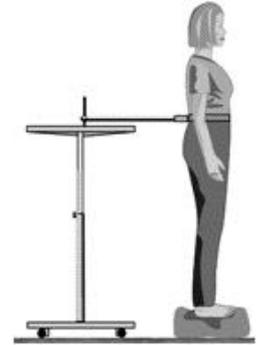
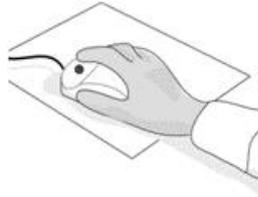
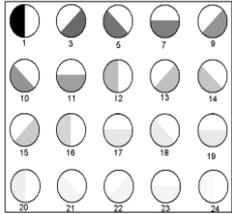
- Demographics
- Medical conditions
- Medications
- Physical activity (IPEQ)
- Depression (PHQ-9)
- Anxiety (GAD-7)
- Neuroticism (NEO-FFI)
- Quality of life (EuroQoL-5)
- Dizziness Handicap Inventory (DHI)- scale 0-100 which assesses functional, emotional and physical burden of dizziness <sup>1</sup>

# Cardiovascular assessment

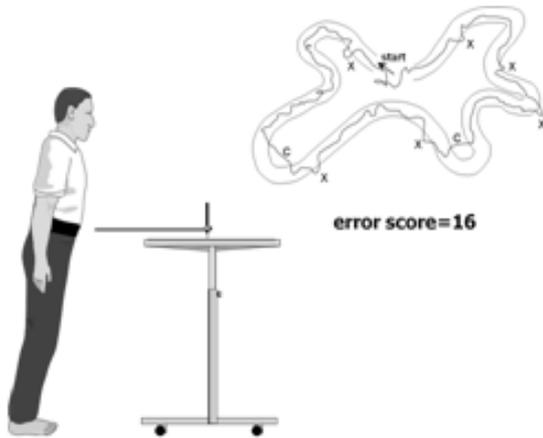
- Tilt-table test of Orthostatic hypotension (3min) / delayed (3min +)
  - Fall  $\geq 20$ mmHg in SBP
  - And/or fall  $\geq 10$ mmHg in DBP
  - Dizziness symptoms
- 12-lead ECG
- Lying and seated blood pressure



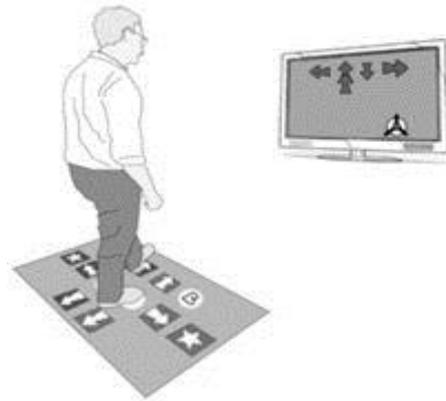
# Sensorimotor and balance assessment



Physiological Profile Assessment (PPA): composite fall risk score



Dynamic stability



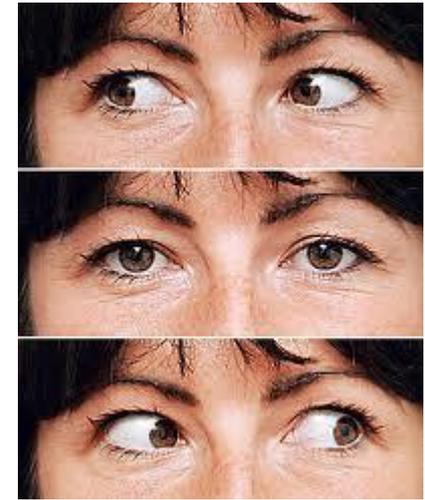
Choice-stepping reaction time



Gait

# Vestibular assessment

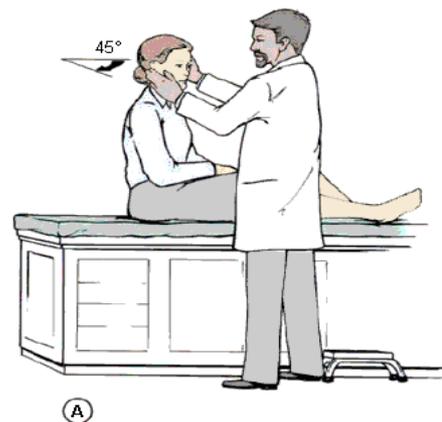
- Benign paroxysmal positional vertigo (BPPV)
- Vestibular hypofunction (head impulse test + head shake with Frenzel goggles)



Spontaneous ,  
gaze-directed and  
head-shaking  
nystagmus in light  
and darkness



Head impulse test  
+ head shake test in Frenzel goggles



(A)

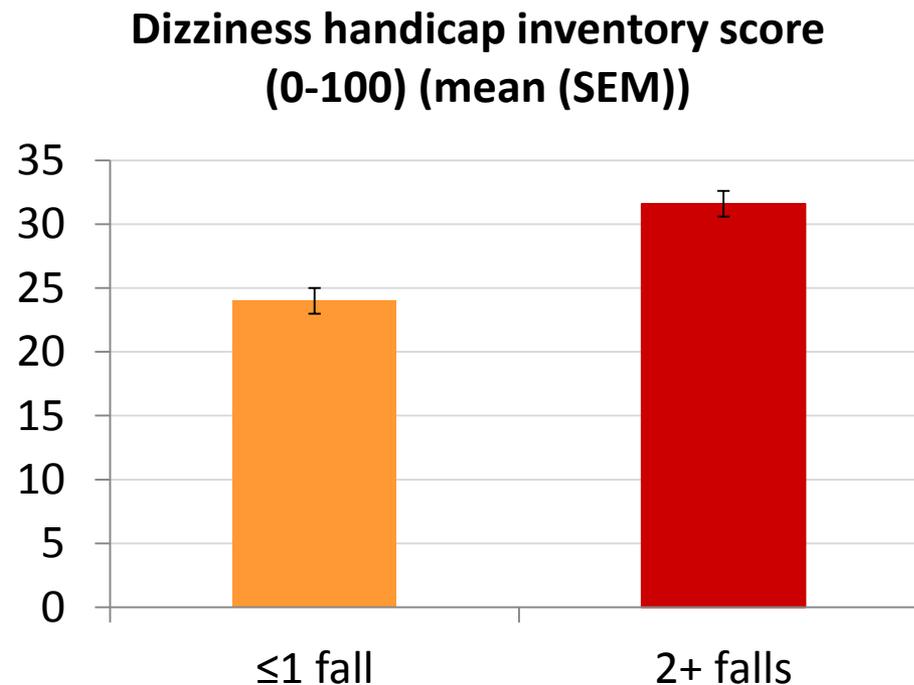


(B)

Dix-Hallpike and roll tests with Frenzel goggles

# 1/ Relationship between dizziness and falls

- N=294 with 6-month falls follow-up
- 32% (n=96) past fallers
- Total 215 falls (0.7 fall pp)
- 26% (n=77) fallers including 12% (n=36) multiple fallers



P=0.017

After adjusting for age: p=0.019

## 2/ Factors associated with dizziness burden

- Dizziness handicap inventory (DHI) score <sup>1</sup>
  - 0-30: Mild dizziness burden – n= 210
  - ≥ 31: Moderate / severe dizziness burden – n=95
- One variable from each domain considered to be causal factors for dizziness and significant discriminator in univariate analyses: vestibular, cardiovascular / medications, psychiatric, pain, sensorimotor/balance

After controlling for age	Moderate-severe handicap Odds Ratio (95%CI)
Cardiovascular medication use	1.93(1.09-3.45), p=0.025
Generalized anxiety disorder score	1.18 (1.09-1.28), p<0.001
Positive Dix-Hallpike test of BPPV	2.93 (1.52-5.81), p=0.001
Physiological Profile Assessment score	2.56 (1.73-3.80), p<0.001

# 3/ Intervention to reduce dizziness burden

RESEARCH ARTICLE

## Reducing the burden of dizziness in middle-aged and older people: A multifactorial, tailored, single-blind randomized controlled trial

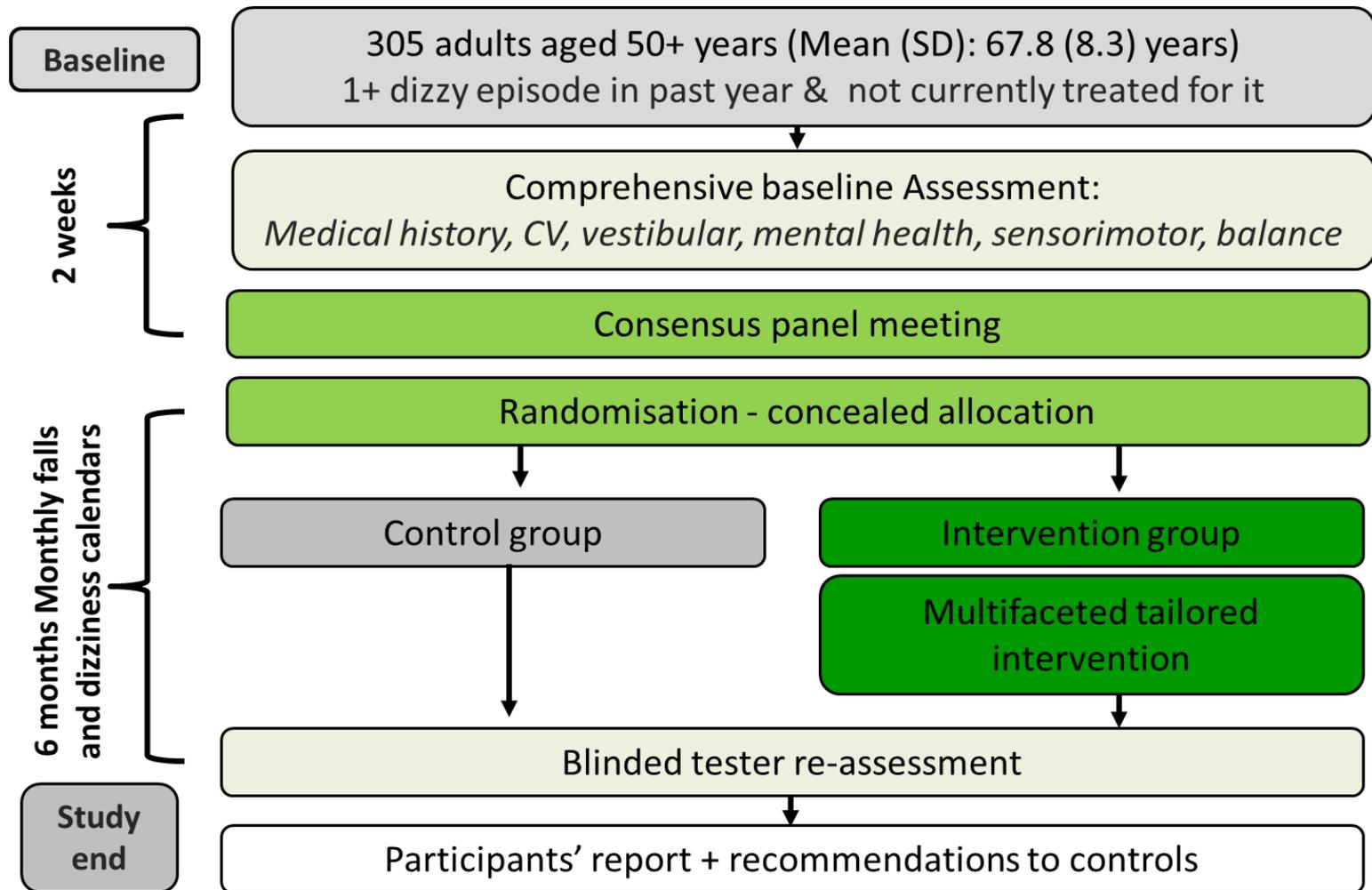
Jasmine C. Menant<sup>1,2</sup>, Americo A. Migliaccio<sup>1,3</sup>, Daina L. Sturnieks<sup>1,4</sup>, Cameron Hicks<sup>1</sup>, Joanne Lo<sup>1</sup>, Mayna Ratanapongleka<sup>1</sup>, Jessica Turner<sup>1</sup>, Kim Delbaere<sup>1,2</sup>, Nikolai Titov<sup>5</sup>, Daniela Meinrath<sup>6</sup>, Catherine McVeigh<sup>7</sup>, Jacqueline C. T. Close<sup>1,7</sup>, Stephen R. Lord<sup>1,2\*</sup>

In press - online open access 24<sup>th</sup> July

Access at:

<http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002620>

# Study timeline



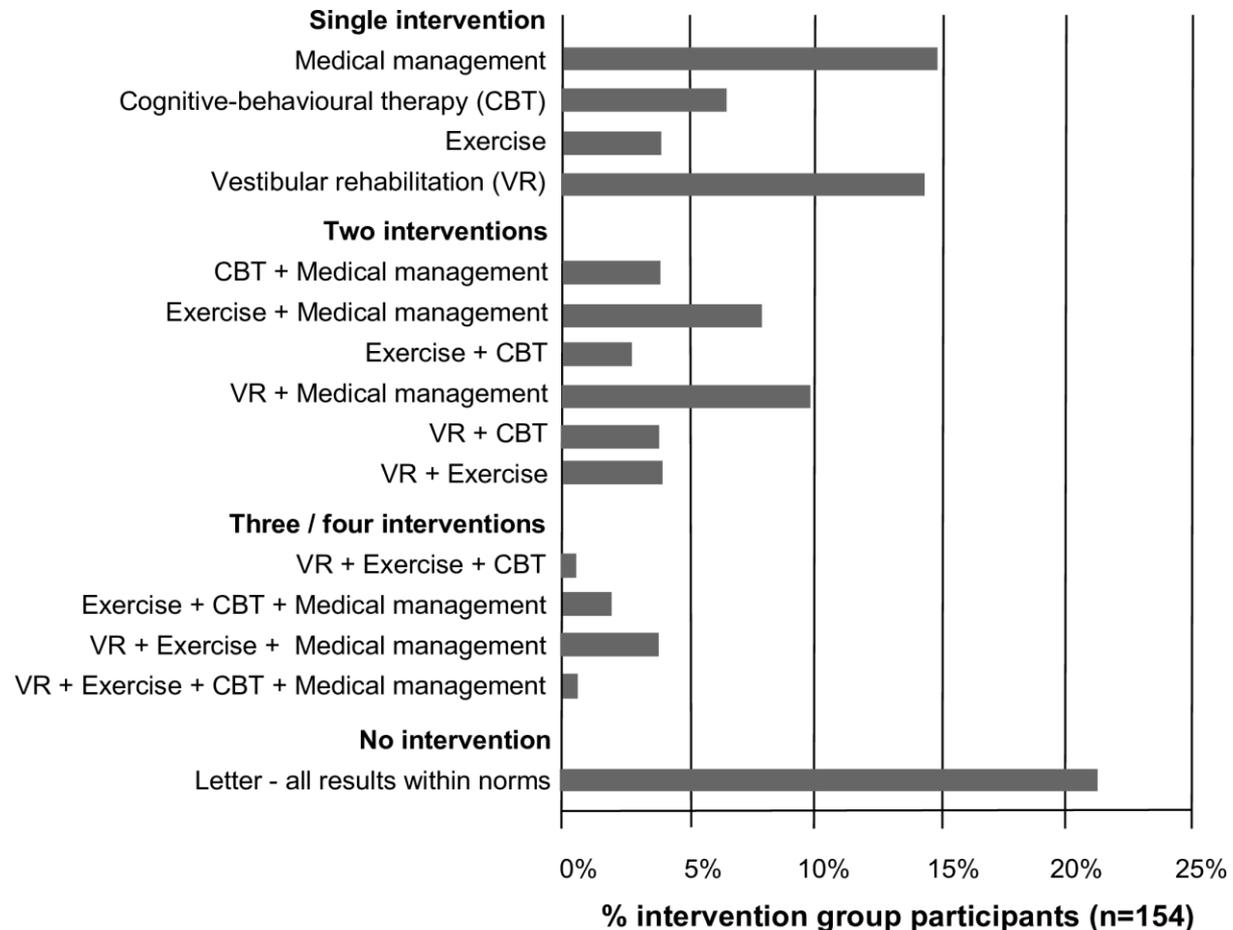
# Interventions

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

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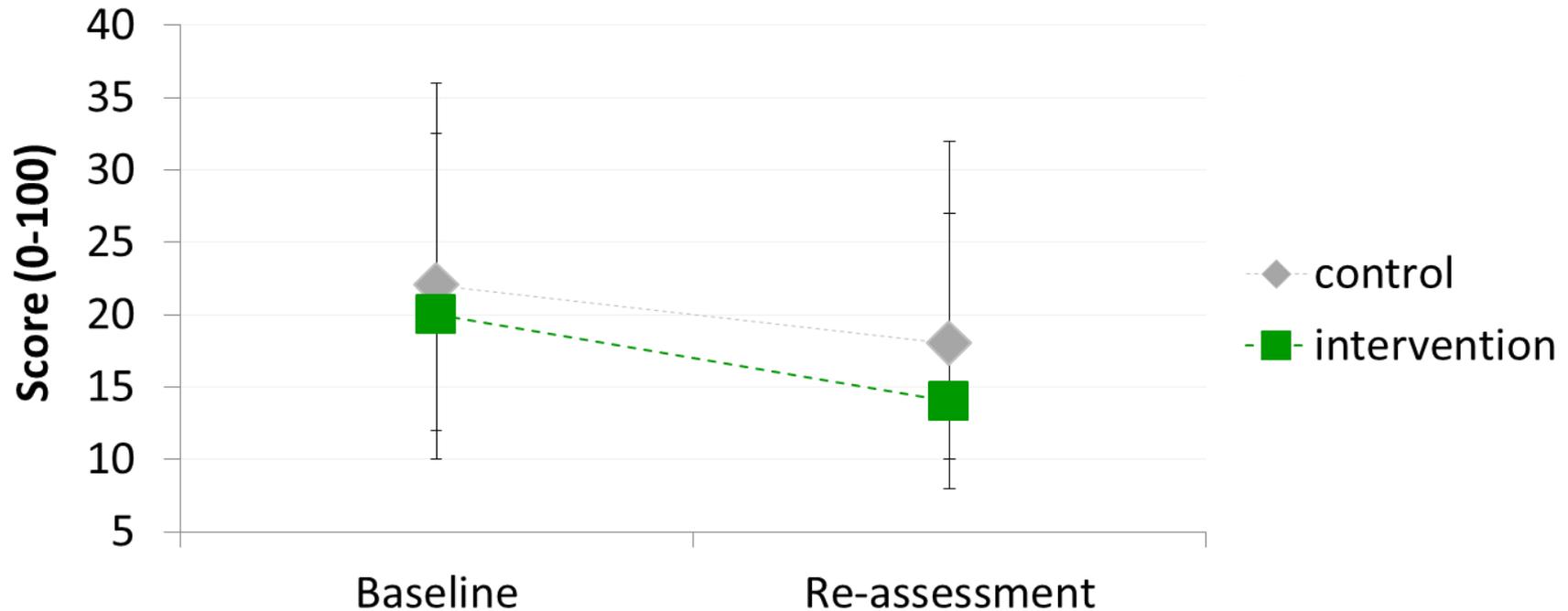
# Dizziness RCT– Results



**% intervention group participants (n=146) assigned to the range of intervention combinations**

# Dizziness RCT – primary outcome measures results

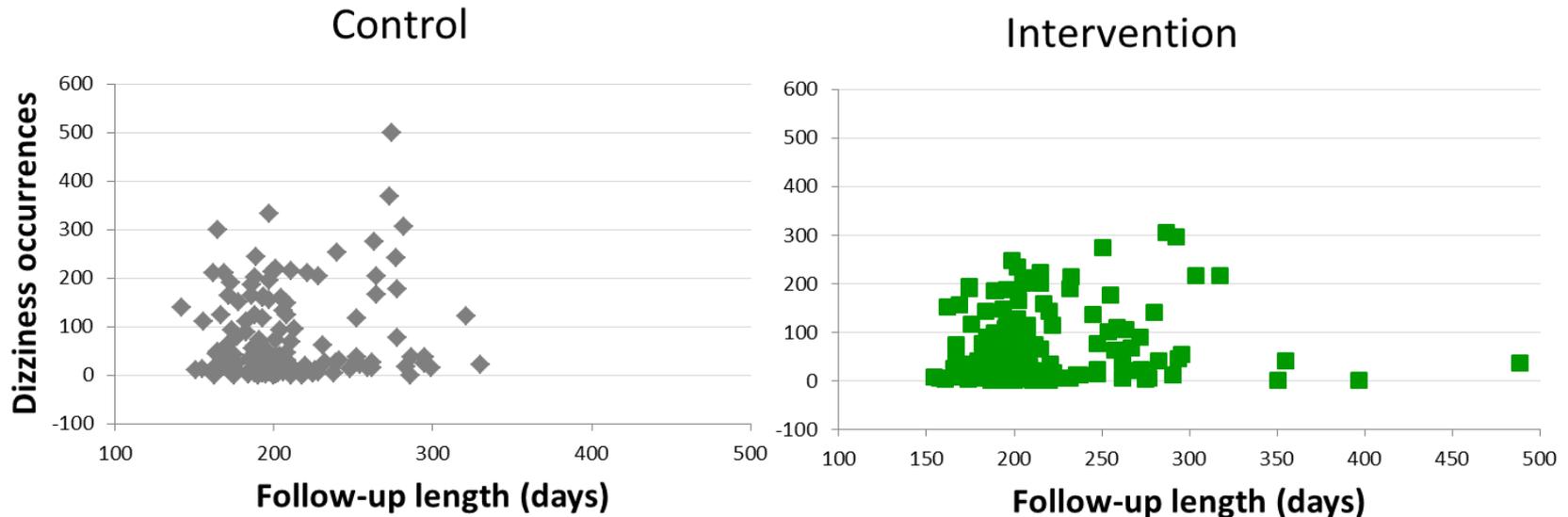
## Dizziness handicap inventory (median IQR)



- 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 – primary outcome measures results

## Dizziness frequency during 6 months follow-up



Relative Risk (95% CI)=0.87 (0.65 – 1.17), p=0.360

- 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 results

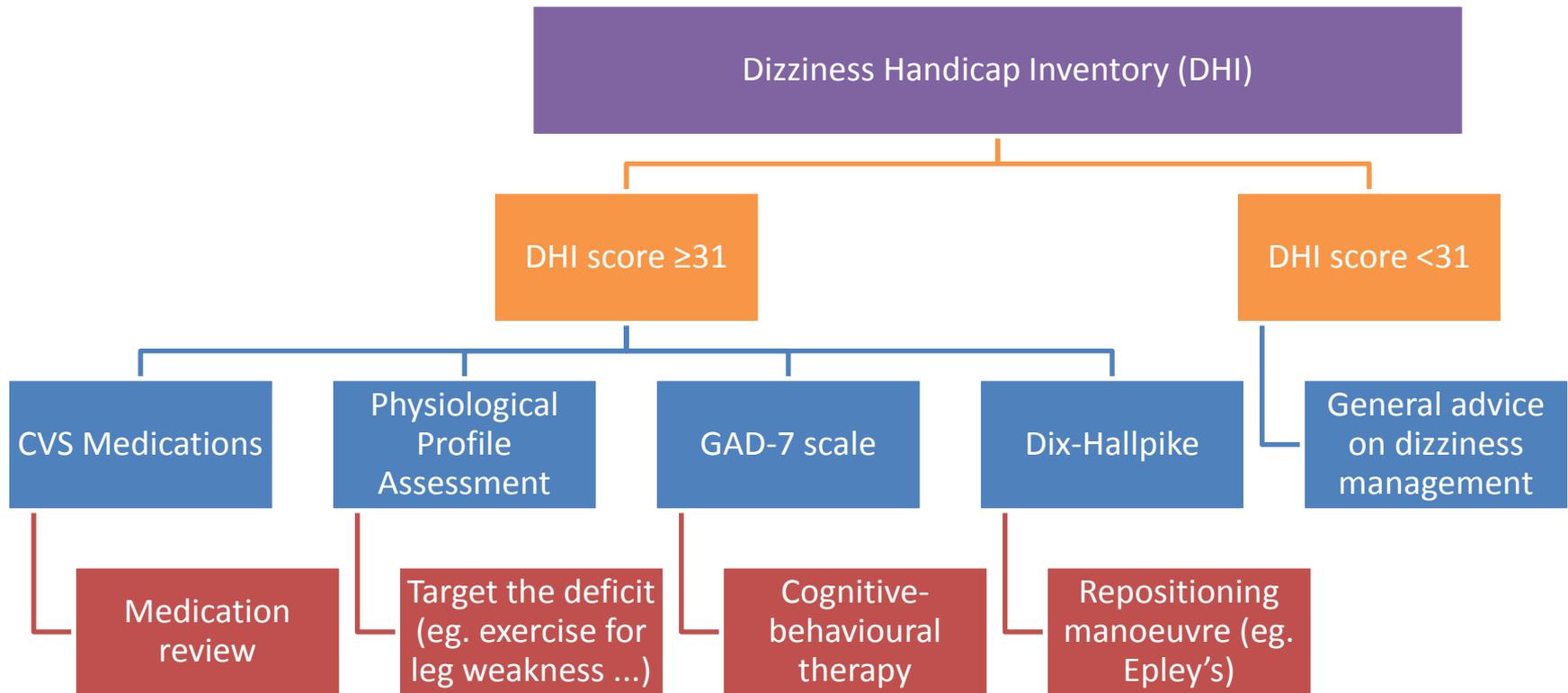
- Trend for reduction in composite fall risk (PPA) in the intervention,  $p=0.085$
- Intervention-specific effects on secondary outcomes:
  - Vestibular rehabilitation: choice-stepping reaction time
  - Otago exercise program: reduced composite falls risk
  - Cognitive-behavioural therapy: reduced anxiety symptoms

## 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.

# Clinical implications

# The MPA-D: multiple profile assessment of dizziness



# Take home messages

- Dizziness independent falls risk factor thus fall risk screen is indicated
- Do not overlook those aged < 65 years
- Multifactorial nature of dizziness therefore requires multidisciplinary approach
- Most evidence-based therapies to address the dizziness contributing factors exist in current health services

# Acknowledgements

- Co-Chief Investigators: Stephen Lord, Americo Migliaccio, Nick Titov, Jacqueline Close, Kim Delbaere, Daina Sturnieks, Catherine McVeigh
  - Research staff and students: Mayna Ratanapongleka, Joanne Lo, Jessica Turner, Cameron Hicks, Daniela Meinrath , Holly Hawtin, George Poller, William Figtree
  - Statistical advice: Barbara Toson, Rob Herbert
  - Randomisation: Esther Vance
  
  - NHMRC project grant funding: 1026726
  - ANZ Clinical trial registry: 12612000379819
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*Thank you!*

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