Psychological factors that influence fall risk: implications for prevention

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Psychological perspective on Injury prevention in late life

- Larger research theme of relating psychological wellbeing to functional outcomes

- Psychological wellbeing is a resource in later life that enables adaptation

- Psychological wellbeing has a role to play in self-management of chronic disease, managing risk

- Cognitive function enables self-management, health behaviour

- Common biological factors may lead to cognitive decline, depression and risk of injury eg. cortical atrophy, white matter changes, stroke, medication use, disease

Evidence Base on Predictors and Correlates of Falling

- Literature focuses on physical and health risk factors

- Failure of balance systems, integration of sensorimotor and cognitive function

- Evidence of depression associated with falling in short-term studies

- Depression may affect falling via psychotropic medication, lack of concentration, poor self care, low energy, slower responding to environment

- Evidence for cognitive impairment to increase fall risk but lack of information on normal cognitive decline prior to 2006

- No literature on positive aspects of wellbeing and fall risk prior to our study

Specific Research Questions in 2 Domains of Psychological Function

- **Does cognitive function predict falling prospectively in adults without dementia, and, is cognitive decline associated with increasing fall risk?**

- **Does psychological wellbeing (depression, morale, control) predict falling in adults without dementia, and is decline in psychological wellbeing associated with increasing fall risk?**

1. Why should cognitive function relate to injury?

Normal cognitive ageing:

- Slowing of information processing

- Slower reaction time

- Reduction in episodic memory

- Reduction in working memory

- Greater difficulty inhibiting irrelevant or distracting information

- Strong link between sensori-motor function and cognitive performance in later life

These changes affect the capacity to respond quickly to unexpected changes in the environment, especially when multiple things are happening at once

2. Why should wellbeing relate to injury?

- Wellbeing = positive and negative mood, life satisfaction, morale
- Psychological wellbeing associated with better self-care (glasses checked, engage in exercise, adapt physical environment, management of chronic disease, help seeking)
- Psychological wellbeing associated with stronger social networks
- Psychological wellbeing may be a consequence of more financial, cognitive and social resources, and of good health
- Common biological mechanisms influence late-life depression and cognitive decline, and personality and executive function

Australian Longitudinal Study of Ageing

- Random sample from electoral roll
- Stratified by age (70-74, 75-79, 80-84, 85 +) and sex
- Community and residential care
- 2087 participated in Wave 1 interview
- 8 waves of data collection
- Assessed at home by trained interviewer
- Informant interviews obtained at later waves
- State and National Death Registries annual update

Sample

Wave	Year	Type	Years since Baseline	Years since prev Wave	Resp Rates (Eligible %)	Response (N)
1	1992-1993	Full	-	-	100%	2087
2	1993	Tel	1	1	91.3%	1779
3	1994-1995	Full	2	1	93.1%	1679
4	1995	Tel	3	1	89.5%	1504
5	1998	Tel	6	3	85.5%	1171
6	2000	Full	8	2	74.13%	791
7	2003	Full	11	3	65.23%	486
8	2005	Tel	13	2	88.3%	348

Full = Face to face interview & full clinical assessment in residence; **Tel** = Telephone interview

Falls questions:

"Have you had any falls in the past year – including those falls that did not result in injury as well as those that did?"

"In the past 12 months, how many falls did you have with injuries that required medical attention or limited you in doing your usual activities for more than 2 days?"

Demographic

Age, Sex, Years of education, Co-resident status

Health Measures

Self-rated health (global)

Cardiovascular disease (binary)

Neurological condition (binary)

Number of medications
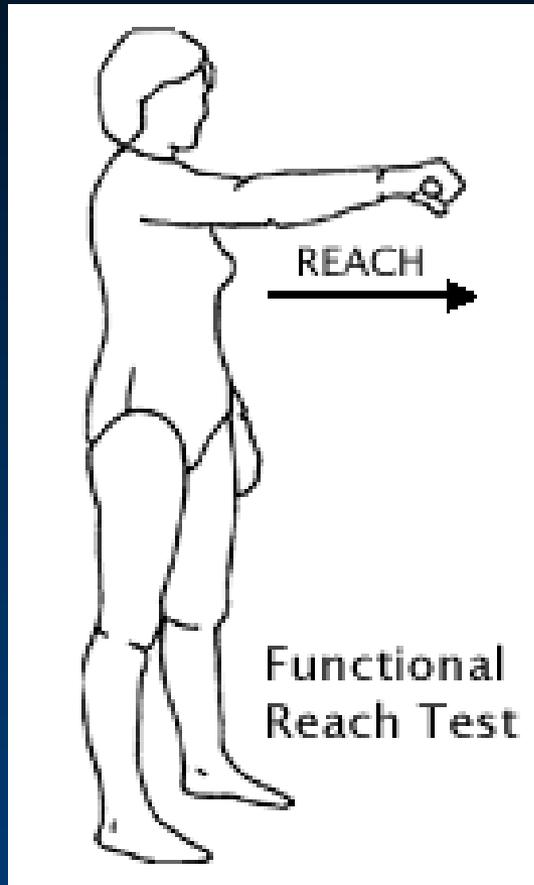
Function

Activities of Daily Living

Instrumental Activities of Daily Living

Grip strength (kilograms)

Distance Vision
Snellen Chart Best eye

Functional reach   Semi-Tandem stand

REACH →

Functional
Reach Test

Cognitive measures

- Mini-mental State Examination

- Digit symbol substitution test (WAIS-R)

- Similarities (WAIS-R) 3 items

- Immediate Picture Recall

Sample Naming Items
(Verbal & Memory)

Digit Symbol Substitution
(Speed)

Wellbeing measures

- **Morale** – Philadelphia Geriatric Centre Morale Scale (Lawton, 1975, Luszcz, 1992)

- **Control** – Expectancy of Control from the Desired Control Measure (Reid & Zeigler, 1981)

- **Centre for Epidemiological Studies – Depression Scale** (CES-D; Radloff, 1977)

Morale Scale

1. Little things bother you more than they used to.
2. Things keep getting worse as you get older.
3. You feel lonelier than you used to feel.
4. You have a lot to be happy about.
5. You are as happy now as when you were younger.
6. You get upset easily.
7. You have as much energy as you had last year.
8. You get angry more than you used to.
9. You sometimes feel life isn't worth living.
10. As you get older, you are less useful.
11. You take things to heart.
12. Life is difficult for you much of the time.
13. You are nervous about a lot of things.
14. You are satisfied with your life these days.
15. As you get older, things are better than you thought they would be.

Responses

1. Agree
2. Disagree

Expectancy of Control Scale

1. I find that I am able to arrange for friends to come and visit me regularly.
2. People tend to ignore my advice and suggestions.
3. Maintaining my level of health strongly depends on my own efforts.
4. It is difficult for me to get to know people.
5. I can usually arrange to go on outings that I'm interested in.
6. I spend my time usually doing what I want to do.
7. Although it is sometimes strenuous, I try to do some chores by myself.
8. I have quite a bit of influence on the degree to which I can be involved in activities.
9. I can rarely find people who will listen closely to me.
10. People generally do not allow me to help them.
11. Making people happy is something that I don't get much opportunity to do.
12. I am able to find privacy when I want it.

Responses

1. Strongly Agree
2. Agree
3. Neither Agree nor Disagree
4. Disagree
5. Strongly Disagree

Analyses addressed 2 main questions:

1. Did cognitive performance at baseline predict of falls over 8 years of follow-up

2. Did cognitive decline over 8 years predict of increasing fall risk over 8 years

Frequency of Self-Reported Falls in the Past Year
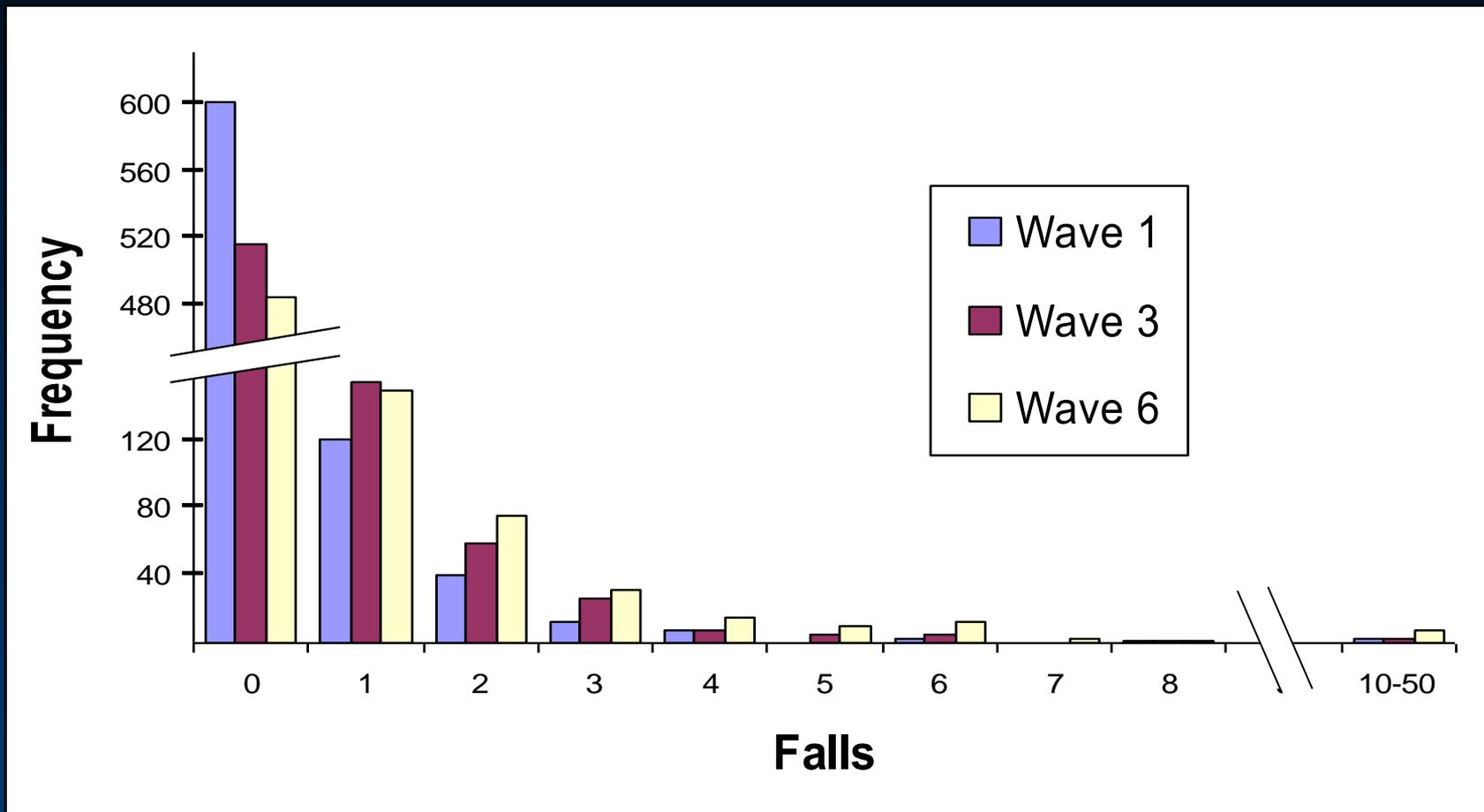
Poisson distribution

Table 2. Marginal Models Examining the Population-Specific Relationship Between Cognitive Performance at Baseline and Rate of Falls over the 8 Years

Cognitive Measure	Model 1*	Model 2[†]	Model 3[‡]
	Incidence Rate Ratio (95% Confidence Interval)		
Falls (N = 539)			
MMSE	0.91 (0.89–0.93)[§]	0.93 (0.91–0.95)[§]	0.93 (0.91–0.96)[§]
Immediate picture recall	0.95 (0.93–0.98)[§]	0.97 (0.94–1.00)[‖]	0.98 (0.95–1.01)
Similarities	0.76 (0.71–0.83)[§]	0.78 (0.72–0.84)[§]	0.81 (0.74–0.87)[§]
NART errors	1.01 (1.01–1.02)[§]	1.01 (1.00–1.02)[‖]	1.01 (1.00–1.02)
Processing speed	0.99 (0.98–1.00)[§]	0.99 (0.99–1.00)	¶
Symbol recall	0.95 (0.92–0.98)[§]	0.97 (0.93–1.00)	¶
Falls (MMSE >24; n = 455)			
MMSE	0.95 (0.90–0.99)[‖]	0.95 (0.91–1.00)	¶
Immediate picture recall	1.03 (0.99–1.06)	¶	¶
Similarities	0.88 (0.79–0.98)[‖]	0.89 (0.80–0.99)[‖]	0.90 (0.80–1.00)
NART errors	0.99 (0.98–1.00)	¶	¶
Processing speed	1.00 (0.99–1.01)	¶	¶
Symbol recall	1.04 (0.99–1.09)	¶	¶
Injurious falls (n = 496)			
MMSE	0.94 (0.89–0.98)[§]	0.94 (0.89–0.98)[§]	0.93 (0.89–0.98)[§]
Immediate picture recall	0.98 (0.93–1.04)	¶	¶
Similarities	0.98 (0.83–1.17)	¶	¶
NART errors	1.00 (0.98–1.01)	¶	¶
Processing speed	0.98 (0.97–1.00)[§]	0.98 (0.97–0.99)[§]	0.98 (0.96–0.99)[§]
Symbol recall	0.98 (0.92–1.06)	¶	¶

* Adjusted for time, sex, age, years of education.
[†] Adjusted for factors in Model 1 plus self-rated health, heart condition/attack, hypertension, stroke/transient ischemic attack, diabetes mellitus, psychotropic medication, smoker, alcohol frequency.
[‡] Adjusted for factors in Model 2 plus semitandem balance, visual acuity, functional reach, grip strength.
$P <$ [§].01, [‖].05.
¶ Models were not evaluated because of nonsignificance in Model 1 or 2.
MMSE = Mini-Mental State Examination; NART = National Adult Reading Test.

Table 3. Random-Effects Models Examining the Subject-Specific Relationship Between Cognitive Performance and Rate of Falls over the 8 Years

Cognitive Measure	Model 1*	Model 2[†]	Model 3[‡]
	Incidence Rate Ratio (95% Confidence Interval)		
Falls (N = 539)			
MMSE	0.92 (0.88–0.95)[§]	0.93 (0.90–0.97)[§]	0.95 (0.92–0.99)[‖]
Immediate picture recall	0.86 (0.83–0.89)[§]	0.88 (0.83–0.90)[§]	0.89 (0.86–0.96)[§]
Similarities	1.02 (0.91–1.13)	¶	¶
NART errors	1.02 (1.01–1.03)[§]	1.02 (1.01–1.03)[§]	1.02 (1.01–1.03)[§]
Processing speed	0.97 (0.96–0.98)[§]	0.98 (0.97–0.99)[§]	0.98 (0.97–0.99)[§]
Symbol recall	0.92 (0.88–0.96)[§]	0.94 (0.90–0.98)[§]	0.94 (0.90–0.99)[‖]
Falls (MMSE > 24; n = 455)			
MMSE	0.92 (0.86–0.99)[‖]	0.94 (0.87–1.01)	¶
Immediate picture recall	0.87 (0.83–0.92)[§]	0.90 (0.86–0.95)[§]	0.88 (0.84–0.92)[§]
Similarities	1.13 (0.97–1.31)	¶	¶
NART errors	1.01 (1.00–1.02)	¶	¶
Processing speed	0.98 (0.97–0.99)[§]	0.99 (0.97–1.00)[‖]	0.99 (0.98–1.01)
Symbol recall	0.98 (0.92–1.04)	¶	¶
Injurious falls (n = 496)			
MMSE	0.98 (0.92–1.03)	¶	¶
Immediate picture recall	0.93 (0.88–0.99)[‖]	0.93 (0.88–0.99)[‖]	0.93 (0.87–0.99)[‖]
Similarities	1.05 (0.83–1.34)	¶	¶
NART errors	1.01 (0.99–1.03)	¶	¶
Processing speed	0.98 (0.97–0.99)[§]	0.98 (0.96–0.99)[§]	0.97 (0.95–0.98)[§]
Symbol recall	0.94 (0.87–1.01)	¶	¶

* Adjusted for time, sex, age, years of education.

[†] Adjusted for factors in Model 1 plus self-rated health, heart condition/attack, hypertension, stroke/transient ischemic attack, diabetes mellitus, psychotropic medication, smoker, alcohol frequency.

[‡] Adjusted for factors in Model 2 plus semitandem balance, visual acuity, functional reach, grip strength.
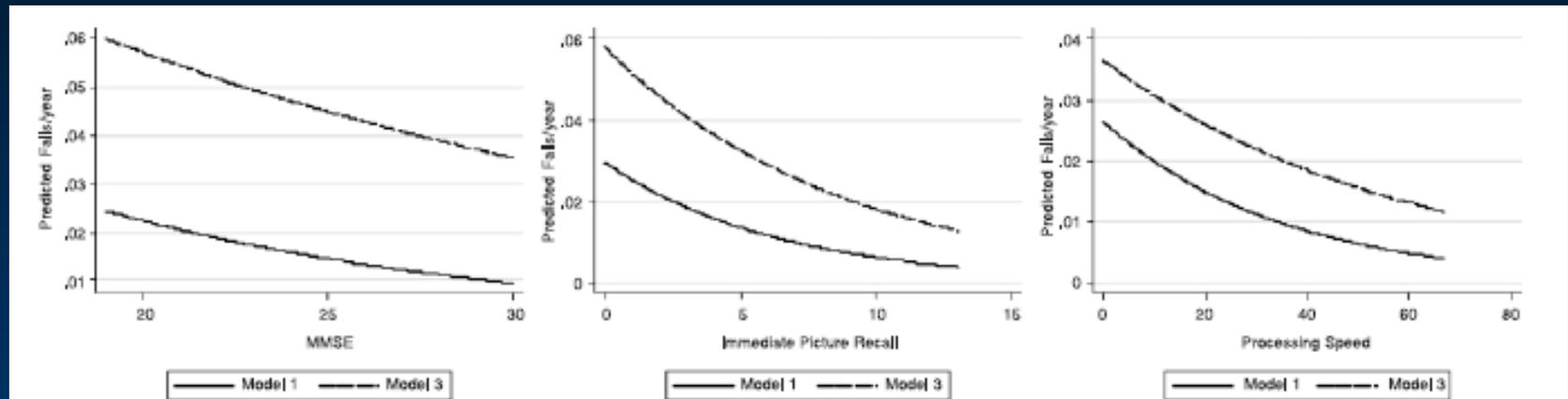
$P <$ [§] .01, [‖] .05.

Figure 1. Relationship between subject-specific scores on the Mini-Mental State Examination (MMSE), immediate recall, and processing speed and predicted rate of falls adjusted for sociodemographic variables (Model 1) and sociodemographic, health, and sensorimotor variables (Model 3).

Healthy and unhealthy 80-year old women annual fall risk according to DSST score
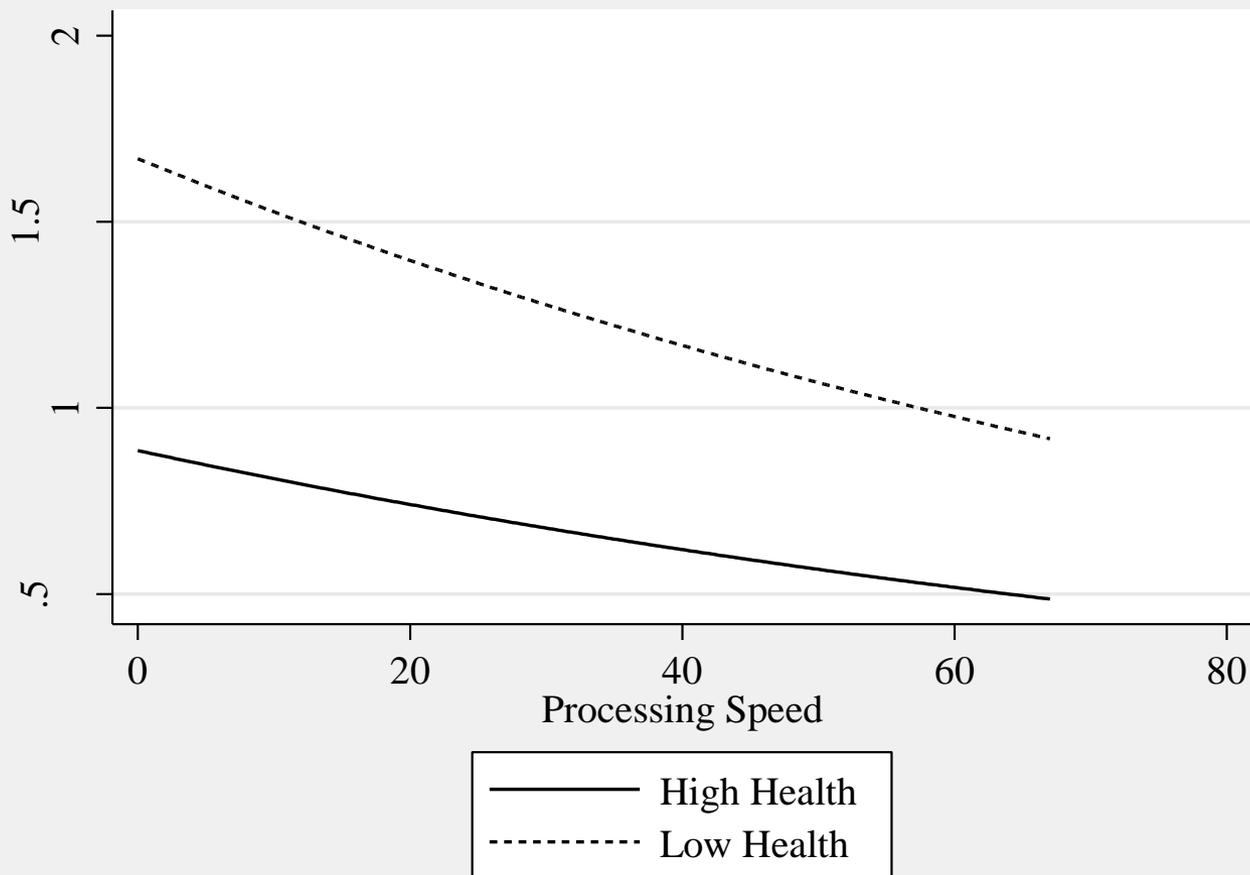
Population average effects plotted at Time = 2 years. High health = no hypertension, no psychotropic medication, non-smoker;

Anstey, K. J., von Sanden, C., Luszcz, M. A. (2006), JAGS, 54, 1169-1176.

Wellbeing and Falls ALSA Study

- Measures were depression, morale and control

- Examined types of depressive symptoms – predicted that poor concentration, and apathy associated with higher falls risk

- Statistically controlled for age, sex, education, visual acuity, tandem balance, grip strength, psychotropic medication use, medical conditions

Baseline wellbeing as a predictor of falling

	Model 1 IRR (95% CI)	Model 2 IRR (95% CI)	Model 3 IRR (95% CI)
Time	1.05† (1.04-1.07)	1.05† (1.04-1.07)	1.05† (1.04-1.07)
Age	1.04† (1.03-1.05)	1.04† (1.03-1.05)	1.04† (1.03-1.05)
CES-D Total	1.03† (1.02-1.04)	1.02† (1.01-1.03)	1.02† (1.01-1.03)
Morale	0.92† (0.90-0.93)	1.01ns (1.00-1.03)	0.95† (0.93-0.97)
Control	1.02† (1.01-1.04)	1.02† (1.01-1.03)	1.01 (.99-1.02)ns

Model 1 adjusts for for time, sex, age, years of education; **Model 2** adjusts for Model 1 + self-rated health, heart condition/attack, hypertension, stroke/TIA, diabetes, psychotropic medication, smoker, alcohol frequency; **Model 3** adjusts for Model 2 + semi-tandem balance, visual acuity, functional reach, grip strength, MMSE

* = $p < 0.05$; † = $p < .01$

Change in wellbeing as a predictor of falling

	Model 1 IRR (95% CI)	Model 2 IRR (95% CI)	Model 3 IRR (95% CI)
Time	1.07† (1.04-1.10)	1.07† (1.04-1.10)	1.07† (1.04-1.10)
Age	1.05† (1.04-1.07)	1.05† (1.03-1.07)	1.05† (1.03-1.07)
CES-D Total	1.02† (1.01-1.04)	1.02† (1.00-1.03)	1.02* (1.00-1.03)
Morale	0.94† (0.91-.97)	0.95† (0.92-0.98)†	0.95† (0.93-0.98)
Control	1.00ns (0.98-1.02)	1.00 (.99-1.02)	1.00 (.98-1.01)

Model 1 adjusts for for time, sex, age, years of education; **Model 2** adjusts for Model 1 + self-rated health, heart condition/attack, hypertension, stroke/TIA, diabetes, psychotropic medication, smoker, alcohol frequency; Model 3 adjusts for Model 2 + semi-tandem balance, visual acuity, functional reach, grip strength, MMSE

* = $p < 0.05$; † = $p < .01$. **Falls** N = 787

Depression & Falling – Example of three 80-year old women
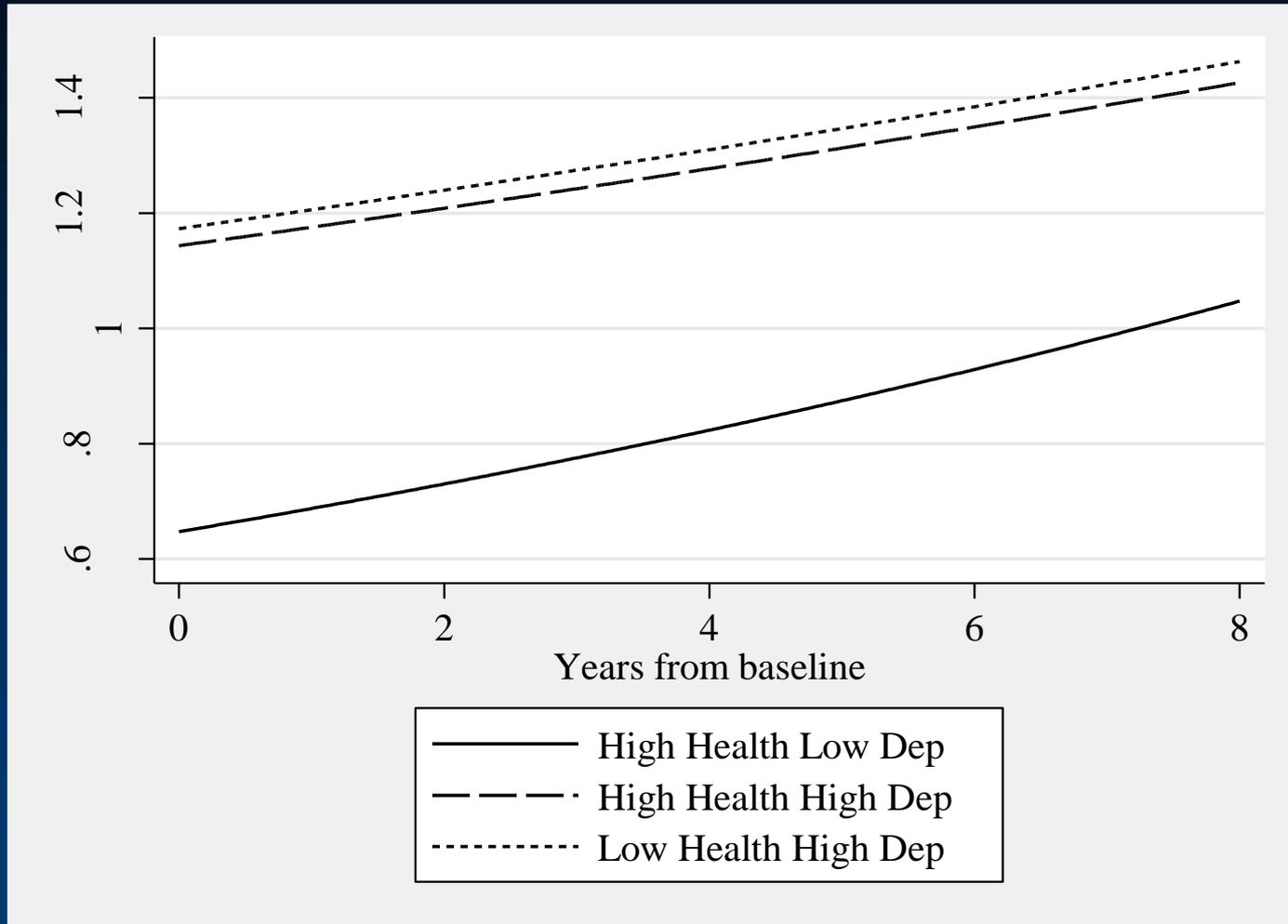
Predicted number of falls per year over time: displaying **Population Average Effect x Time for Depression**. (High Health = no hypertension, not on psychotropic med, non-smoker; Low Dep = CES-D Wave1 score 5; High Dep = CES-D Wave1 score 20)

General Conclusion

- Psychological wellbeing and cognitive function predict falling independent of demographic, medical conditions, psychotropic medication, balance, vision, grip strength – overall contribution to risk is similar as that of individual medical conditions

- Possible shared biological factors underlying psychological factors and fall risk include ageing of prefrontal cortex, and general brain ageing

- Psychological resources enable individuals to adapt to their physical and social environment, manage their health, avoid injury

- Validated screening measures can be incorporated into falls risk assessments to assess psychological resources and augment falls risk profiels. Eg. depression scales, morale, processing speed, executive function (Trails A & B)

More information

- Anstey, K. J., Burns, R., von Sanden C. & Luszcz, M. A. (2008). Psychological wellbeing is an independent predictor of falling in an 8-year follow-up of older adults, *Journal of Gerontology: Psychological Sciences*, Jul;63(4):P249-P257.

- Anstey, K. J., von Sanden, C., & Luszcz, M. A. (2006). An 8-year prospective study of the relationship between cognitive performance and falling among very old adults. *Journal of the American Geriatrics Society*, *54*, 1169-1176.

- Anstey, K.J., Wood, J., Kerry, G. & Lord, S.R. (2009). Different Cognitive Profiles for Single Compared to Recurrent Fallers Without Dementia, in press, *Neuropsychology*

Acknowledgements

Table 4. Marginal and Random Effects Models of Well-Being Measures Predicting Falls, Adjusted for Demographic, Health, and Sensorimotor Variables

	IRR (95% CI)		IRR (95% CI)		IRR (95% CI)	
	Marginal Model	Random Effects Model	Marginal Model	Random Effects Model	Marginal Model	Random Effects Model
Time	1.05 (1.04–1.07)**	1.04 (1.01–1.06)*	1.05 (1.04–1.07)***	1.07 (1.04–1.10)***	1.05 (1.04–1.07)***	1.07 (1.04–1.10)***
Age	1.03 (1.02–1.04)**	1.04 (1.03–1.06)***	1.03 (1.02–1.04)***	1.04 (1.02–1.05)***	1.03 (1.02–1.04)***	1.05 (1.04–1.07)***
Gender	0.77 (0.65–0.90)**	0.69 (0.51–0.92)*	0.78 (0.66–0.91)**	0.75 (0.58–0.98)*	0.77 (0.65–0.90)**	0.73 (0.56–0.94)*
Years of education	1.03 (1.01–1.05)**	1.01 (0.98–1.05)	1.03 (1.01–1.05)**	1.02 (0.98–1.05)	1.03 (1.01–1.05)**	1.02 (0.98–1.05)
Self-rated health	1.16 (1.10–1.23)**	1.13 (1.04–1.24)**	1.24 (1.17–1.31)***	1.11 (1.02–1.21)*	1.19 (1.12–1.26)***	1.10 (1.01–1.20)*
Heart condition	0.89 (0.78–1.01)	1.04 (0.84–1.30)	0.90 (0.80–1.03)	1.01 (0.82–1.26)	0.89 (0.78–1.01)	1.02 (0.83–1.26)
Hypertension	1.25 (1.12–1.40)**	0.90 (0.75–1.08)	1.24 (1.11–1.38)***	1.14 (0.96–1.36)	1.23 (1.10–1.37)***	1.04 (0.87–1.25)
Stroke or TIA	1.10 (0.92–1.32)	1.70 (1.22–2.37)**	1.19 (0.99–1.42)	1.35 (0.97–1.89)	1.12 (0.93–1.34)	1.16 (0.88–1.54)
Diabetes	0.63 (0.49–0.82)**	0.94 (0.64–1.38)	0.65 (0.50–0.84)**	0.96 (0.65–1.42)	0.65 (0.50–0.840)**	0.97 (0.65–1.45)
Psychotropic medication	0.90 (0.79–1.03)	1.00 (0.79–1.27)	0.96 (0.84–1.09)	1.25 (1.00–1.57)*	0.93 (0.82–1.06)	1.14 (0.91–1.42)
Smoker	0.94 (0.72–1.21)	0.61 (0.41–0.91)*	0.96 (0.73–1.25)	0.70 (0.47–1.03)	0.94 (0.72–1.22)	0.79 (0.53–1.19)
Alcohol frequency 2	1.25 (1.07–1.46)**	1.44 (1.16–1.80)**	1.25 (1.07–1.45)**	1.13 (0.90–1.41)	1.29 (1.10–1.50)**	0.95 (0.74–1.20)
Alcohol frequency 3	0.82 (0.72–0.93)**	1.09 (0.88–1.34)	0.82 (0.72–0.94)**	1.01 (0.81–1.27)	0.82 (0.72–0.94)**	0.92 (0.74–1.13)
Semitandem balance 2	1.39 (0.69–2.80)	2.36 (0.82–6.83)	1.75 (0.87–3.53)	2.68 (0.90–7.98)	1.54 (0.76–3.11)	1.90 (0.64–5.66)
Semitandem balance 3	1.61 (0.86–3.02)	2.24 (0.88–5.74)	1.90 (1.02–3.56)*	1.94 (0.75–5.05)	1.88 (1.00–3.51)*	1.60 (0.63–4.11)
Visual acuity	1.00 (0.99–1.01)	1.00 (0.99–1.02)	1.00 (0.99–1.01)	1.01 (0.99–1.02)	1.00 (0.99–1.01)	0.99 (0.98–1.01)
Functional reach	0.96 (0.95–0.96)**	0.98 (0.97–1.00)**	0.95 (0.95–0.96)***	0.99 (0.97–1.00)*	0.96 (0.95–0.96)***	0.98 (0.97–1.00)*
Grip strength	1.01 (1.00–1.02)*	0.98 (0.97–1.00)	1.01 (1.00–1.02)*	1.00 (0.98–1.02)	1.01 (1.00–1.02)*	1.01 (0.99–1.03)
MMSE	0.99 (0.98–1.01)	0.97 (0.94–1.01)	0.99 (0.98–1.01)	0.96 (0.93–1.00)*	0.99 (0.97–1.01)	0.96 (0.94–0.99)*
Morale	0.94 (0.93–0.96)**	0.94 (0.92–0.97)***				
Control			1.02 (1.00–1.03)*	1.00 (0.98–1.01)		
Depressive symptoms					1.02 (1.01–1.03)***	1.03 (1.02–1.04)***

Notes: IRR = incidence rate ratio; CI = confidence interval; MMSE = Mini-Mental State Examination; TIA = transient ischemic attack; alcohol frequency 2 = consumed alcohol 2 to 3 times per month; alcohol frequency 3 = consumed alcohol 4 or more times per month; semitandem balance 2 = able to hold the position for <10 s; semitandem balance 3 = tried but unable to hold the position.

*p < .05; **p < .01; ***p < .001.