Good memory as a predictor of falls: fact or artefact

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Abstract

Background: accurate classification of older people into fallers and non-fallers is crucial for falls research, but largely dependent on the accuracy of fall reporting by the participants.

Objective: to investigate the influence of memory in relation to fall reporting.

Subjects: five hundred community-dwelling adults aged 70–90 years.

Methods: memory and executive functioning were assessed using the Rey Auditory Verbal Learning and Trail Making test, respectively. Fall risk was estimated using the physiological profile assessment (PPA). Falls were recorded prospectively for 12 months using monthly falls diaries and follow-up phone calls as required.

Results: Spearman correlations showed that falls were significantly correlated to worse executive functioning, worse PPA scores and better memory. People with better memory had an increased risk of being classified as single fallers and multiple fallers, but not when reported injuries were included as part of the definition.

Conclusion: good memory appears to influence the recording of falls in community-dwelling older people and likely reflects a reporting bias. In research studies, there may be value in using a combination of injurious falls and multiple falls when classifying people into faller and non-faller groups.

Keywords: accidental falls, ageing, memory, elderly, falls

Introduction

There is now an extensive body of research on risk factors and intervention strategies for preventing falls in older people [1]. Accurate classification of older people into fallers or non-faller groups is crucial for this research [2, 3], and over the years a number of different reporting approaches have emerged [4]. The current gold standard is prospective daily recording and a notification system with a minimum of monthly reporting [4], as longer recall periods are likely to result in under-reporting of falls. For example, Cummings et al. found that 13% of older people who reported one or more falls in their weekly calendars over 1 year did not recall any falls at the end of the follow-up period [5]. To maximise reporting accuracy, it is also recommended that older participants should be clearly informed of the study definition of a fall in lay language [6], and that telephone or face-to-face interviews be used to obtain missing data [7]. However, even with the most rigorous reporting methodology, it is likely that falls are under-reported and an obvious reason for this is simply forgetting a fall, especially when no injury is sustained [6]. The current analysis investigates the influence of memory in relation to fall reporting. We hypothesise that better memory influences the reporting of falls with the exception of injurious falls.

Methods

Participants

A total of 500 people aged 70–90 years participated in the prospective cohort study with a 1-year follow-up for falls. Participants were randomly recruited from a cohort of 1,037 non-demented, community-dwelling men and women living in eastern Sydney and participating in wave 1 of the Sydney Memory and Ageing Study (MAS, January 2006 to October 2007) [8]. Exclusion criteria for the study were neurological, cardiovascular or major musculoskeletal impairments (determined at a baseline assessment) that precluded participants walking 20 m without a walking aid, and cognitive impairment determined by a score of <24 on the Mini-Mental State Examination (MMSE) [9]. Approval for the study was obtained from the University of New South Wales Human Research Ethics Committee.

Measures

At baseline, all participants underwent an extensive medical, neuropsychological and physiological assessment by trained research assistants, described in detail elsewhere [10]. For the purpose of this analysis, we have selected the following three main outcome measures. The Rey Auditory Verbal Learning test (RA VLT, Trials 1–5) was used to assess new learning and retrospective episodic memory. Participants are required to learn 15 words over five trials; total number of words learned correctly over the five trials was used in the analyses [11]. Executive functioning was assessed using the trail-making test (TMT, Part B), which requires participants to draw lines connecting alternating letters and numbers (e.g. 1-A-2-B). Physiological fall risk was estimated using five parameters of physiological performance of the physiological profile assessment (PPA): visual contrast sensitivity (assessed using the Melbourne Edge Test), proprioception (measured using a lower limb-matching task, with errors in degrees recorded using a protractor inscribed on a vertical clear acrylic sheet placed between the legs), quadriceps strength (measured isometrically in the dominant leg with participants seated with the hip and knee flexed 90°), simple reaction time (measured using a light as stimulus and a finger-press as response)
and postural sway (path length, measured using a sway meter recording displacements of the body at the level of the pelvis with participants standing on a foam rubber mat with eyes open).

A fall was defined as ‘an unexpected event in which the participant comes to rest on the ground, floor, or lower level’. Fall frequency during the 1-year follow-up was monitored with monthly falls diaries and follow-up telephone calls as required [4]. Participants were instructed to record it on the fall diary any time they had a fall and to mail it at the end of each month. They were contacted by telephone if they had forgotten to return it at the end of the month. Participants were also asked whether they suffered any injuries as a result of the fall including bruises, lacerations or fractures.

Statistical analyses

For purposes of this study, we used four common classifications of fallers and non-fallers [3]: (i) people who fell at least once versus people who did not fall, (ii) people who fell at least twice versus people who fell once or not at all, (iii) people who suffered an injurious fall or multiple falls versus people who did not fall or suffered a single non-injurious fall [10, 12], (iv) people who had at least one injurious fall versus people who had no injurious falls. Raw test scores of the RAVLT and TMT were transformed to standard scores using published age and education stratified normative data [13, 14]. Higher scores indicated better performance. Spearman’s $\rho$ correlations were used to explore the strength of the association of RAVLT, TMT and PPA with the total number of falls and falls with some reported injury. Logistic regression was used to calculate univariate odds ratios for the associations between RAVLT and faller status. Multivariate logistic regression (using enter method) was then used to see if memory function was related to fallers status, independent of physiological falls risk. As relatively few variables were included in the analyses, a $P$-value of 0.05 was used to determine statistical significance. The data were analysed using SPSS 19 for Windows (SPSS, Inc., Chicago, IL, USA).

Results

The mean age of participants was 77.9 (SD 4.1) and 270 (54.0%) were female. During the 1-year follow-up period, 214 participants (43.6%) reported one or more falls, of whom 120 (24.0%) reported only one fall and 94 (19.1%) reported two or more falls. Seventy-two of 120 single fallers (60.0%) and 69 of 94 multiple fallers (73.4%) had at least one injurious fall, resulting in a total of 141 injurious fallers (60.0%) and 69 of 94 multiple fallers (73.4%) had at least one injurious fall, resulting in a total of 141 injurious fallers (60.0%) and 69 of 94 multiple fallers (73.4%) had at least one injurious fall. One hundred sixty-six (33.2%) participants reported two or more falls. Seventy-two of 120 single fallers (28.2%) participated reported injurious or multiple falls as defined above.

Spearman’s $\rho$ correlations showed a significant correlation between memory and executive function ($\rho = 0.25$, $P < 0.001$), between memory and the total number of falls ($\rho = 0.10$, $P = 0.03$) and a significant negative correlation between executive function and the total number of injurious falls ($\rho = -0.10$, $P = 0.04$). There was no significant association between memory and physiological fall risk (Table 1). Univariate logistic regression analyses showed that people with better memory performance had an increased risk of being classified as single fallers (OR = 1.23, 95% CI = 1.04–1.45, $P = 0.02$) and multiple fallers (OR = 1.23, 95% CI = 1.00–1.23, $P = 0.05$). This association was not statistically significant when reported injuries were included as part of the definition. Multivariate logistic regression analyses showed that better memory could predict a person’s faller status independently of physiological falls risk, for single or recurrent fallers but not for injurious falls. Table 2 shows the multivariate odds ratios and 95% confidence intervals of the association between the PPA and memory and each of the falls outcome measures.

Conclusion

This study has included all recent recommendations regarding the definition of a fall and method of recording a fall
and follow-up was undertaken in line with best practice recommendations. Physiological fall risk was able to predict multiple fallers and injurious fallers and showed borderline significance in the prediction of single falls. This is consistent with previous studies that have found that multiple fallers are more likely to have physiological impairments and chronic conditions than non- or single fallers [16]. The presented analyses suggest that impaired retrospective episodic memory is an important confounder in the reporting of falls. Remembering to record a fall on the diary is dependent on both retrospective memory (remembering a fall event) as well as prospective memory (remembering to report a fall event), both of which are strongly reliant on episodic memory. This finding is in line with a previous study by Holtzer et al. who reported a non-significant association between good episodic memory and single or recurrent falls [17]. On the other hand, memory did not appear to bias the classification of injurious falls to the same extent. This is in line with study findings by Zecevic et al., which indicated that older people focus more on the consequences of a fall than the fall itself, with the possibility that non-injurious falls might be disregarded [6].

In conclusion, it appears that good memory influences the recording of falls in community-dwelling older people and likely reflects a reporting bias. As good memory has less influence on the reporting of injurious falls, there may be value in using a combination of injurious falls and multiple falls when classifying people into fallers and non-fallers [10, 12] to reduce the artefact of good memory influencing the reporting of falls.

Key points

- Accurate classification of older people into fallers and non-fallers is dependent on the fall reporting by the research participants.
- In a large cohort of community-dwelling older people, better memory was associated with the reporting of more falls.
- Using a combination of injurious falls and multiple falls when classifying people into faller and non-faller groups might reduce this response bias.

Acknowledgements

We are grateful to the many researchers involved in this study.

Funding

This research was conducted as part of a study on Understanding fear of falling and risk-taking in older people, which has been funded by an Australian NHMRC grant (No. 400941). The participants in this study were drawn from the Memory and Ageing Study of the Brain and Ageing Program, School of Psychiatry, UNSW, funded by a NHMRC Program grant (No. 350833) to Profs P.S.S., H. Brodaty and G. Andrews.

References

Platelet immunoglobulin and amyloid precursor protein as potential peripheral biomarkers for Alzheimer’s disease: findings from a pilot study

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Abstract

Background: the diagnosis of dementia, in particular Alzheimer’s disease (AD), is enhanced with the use of molecular biomarkers. Since cerebrospinal fluid analysis and molecular neuroimaging are not routinely used in many countries, blood biomarker molecules may be more readily applicable in a routine clinical setting.

Methods: twenty-five subjects with a clinical diagnosis of AD and 26 control participants were assessed for cognitive and behavioural functioning. Platelet measures of amyloid protein precursor (APP), tau protein, clusterin, α-synuclein and immunoglobulin (Ig) were measured. Linear regression analysis for platelet proteins and cognitive and behavioural status were determined, and receiver operating characteristic (ROC) curves created to assess the discriminating power of each biochemical parameter between AD and control groups.

Results: both AD and control subjects had similar platelet levels of measures platelet proteins, with the exception of slightly elevated Ig levels in AD subjects ($P = 0.052$). The latter were not related to increasing age, or extent of cognitive impairment. APP-N measures were negatively correlated with cognitive scores.

Conclusion: these preliminary findings suggest that platelet measures of the traditional biomarkers for AD are feasible in the periphery. The measures of platelet APP-N and Ig, in particular, merit further study in a larger cohort of AD and control subjects.

Keywords: Alzheimer’s disease, biomarker, platelet, immunoglobulin, α-synuclein, clusterin, APP, tau, elderly

The diagnosis of Alzheimer’s disease (AD) is based on the application of standardised diagnostic criteria following clinical and neuropsychological assessments. The recently revised NINCDS-ADRDA research criteria for AD [1] and National Institute on Aging (NIA) and Alzheimer’s Association guidelines [2] recommend inclusion of at least one or more abnormal biomarkers among structural (MRI) and molecular (PET) neuroimaging, and cerebrospinal fluid (CSF) analysis of amyloid beta ($A\beta$) or tau proteins as a supportive diagnostic feature. Since these procedures are invasive and not routinely used in many countries, the identification of blood biomarker molecules may be more readily applicable in a routine clinical setting, including primary care.