Self-reported cardiovascular conditions are associated with falls and syncope in community-dwelling older adults

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Abstract

Background: with increasing age, causes of syncope are more often of cardiac origin. Syncope in older persons is often mistaken for falls. Data regarding the association between specific cardiovascular conditions, falls and syncope are limited.

Methods: cross-sectional analyses within a population sample aged 50+ (n = 8,173). Syncope and falls in the past year, cardiovascular conditions and co-variates were gathered through personal interviews. Associations between cardiovascular conditions and (recurrent) falls and syncope were studied through multivariable logistic regression.

Results: mean age was 64 years (range: 51–105); 54% was female. Four per cent reported syncope, 19% falls and 23% cardiovascular morbidity. Abnormal heart rhythm was associated with falls (odds ratio (OR) 1.3 [95% confidence interval (CI) 1.0–1.5]), syncope (OR 1.6 [1.2–2.3]) and recurrent syncope (OR 2.2 [1.3–3.6]). Heart murmur was associated with falls (OR 1.4 [1.1–1.8]), recurrent falls (OR 1.5 [1.0–2.0]) and syncope (OR 1.9 [1.3–2.7]). Angina was associated with recurrent falls (OR 1.4 [1.0–1.9]), syncope (OR 1.8 [1.2–2.6]) and recurrent syncope (OR 2.7 [1.6–4.6]). Heart failure was associated with recurrent falls (OR 1.9 [1.0–3.4]) and myocardial infarction with syncope (OR 1.5 [1.0–2.3]).

Conclusion: self-reported cardiovascular conditions are associated with falls and syncope in a general population cohort. This warrants additional cardiovascular evaluation in older patients with unexplained falls and syncope.

Keywords: falls, syncope, cardiovascular disease, structural cardiac abnormalities, cardiac arrhythmia, older people

Introduction

Falls and syncope in older people form a major and rising health-care burden [1, 2]. Amnesia for loss of consciousness is common in syncope [3, 4] and episodes are often unwitnessed [5]. Therefore, syncope in older persons is easily mistaken for falls. Cardiovascular causes of falls are still underestimated in clinical practice [6] despite the fact that 77% of patients presenting with unexplained falls and syncope have abnormal cardiovascular findings on examination [7].

A few general population studies have reported associations between cardiovascular disease and falls [8, 9]. As these studies reported cardiovascular disease as one comprehensive variable, the contribution of specific cardiovascular conditions to this association is difficult to establish. Few studies have linked cardiovascular conditions with syncope on a general population level [10–12].

If we could determine which specific cardiovascular conditions are associated with falls and syncope in the ageing general population, this would provide new targets for potential prevention and treatment strategies. We therefore investigated whether several self-reported cardiovascular conditions were more common in community-dwelling older adults who experienced falls or syncope in the past year.

Methods

Study design

The Irish Longitudinal Study on Ageing (TILDA) is a prospective cohort study including adults aged 50+, living in the community in the Republic of Ireland. This cross-sectional study is based on the first wave of data, collected between 2009 and 2011 through personal interviews. See Supplementary
data, Appendix S1 available in *Age and Aging* online for a detailed description of the study.

**Falls and syncope**

Participants were asked how often they had a fall, faint or blackout in the past year. Any fall was defined as one or more falls and recurrent falls as two or more falls. Any syncope was defined as one or more faints or blackouts and recurrent syncope as two or more faints or blackouts.

**Cardiovascular conditions**

Participants were asked whether a doctor had ever diagnosed them with high blood pressure or hypertension, angina, heart attack, congestive heart failure, heart murmur and/or abnormal heart rhythm. See Supplementary data, Appendix S2 available in *Age and Aging* online for a description of the modelling strategy. A P value of <0.05 was used as threshold for statistical significance. Analyses were performed using Stata (Version 12.1 for Windows, StataCorp LP, TX, USA).

**Statistical analysis**

Baseline differences were tested using independent t-tests for continuous variables and χ² tests for dichotomous variables. Mann–Whitney U test was used in case of non-normal distribution. For associations, odds ratios (OR) for cardiovascular conditions in patients with any (one or more), or recurrent falls or syncope were calculated through logistic regression analysis. See Supplementary data, Appendix S3 available in *Age and Aging* online for a description of the modelling strategy.

**Results**

In total, 8,175 participants aged 50+ were recruited to the TILDA study. Mean age was 64 (±10) years; 54% was female. Of participants, 17% reported any fall in the last year and 7% recurrent falls. Four per cent reported any syncope and 2% reported recurrent syncope. Twenty-three per cent reported one or more cardiovascular conditions.

Table 1 shows baseline characteristics of participants. Table 2 shows associations between cardiovascular conditions and falls and syncope. After adjustment in the final model, heart murmur and abnormal heart rhythm were associated with any fall. Heart murmur, angina and heart failure were associated with recurrent falls. Angina, myocardial infarction, heart murmur and abnormal heart rhythm were associated with any syncope. Both angina and abnormal

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**Table 1. Clinical characteristics and self-reported cardiovascular conditions in patients with and without falls and syncope in the past year**

<table>
<thead>
<tr>
<th>Clinical characteristics</th>
<th>Fall in past year</th>
<th>Syncope in past year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None, n = 6,590</td>
<td>One, n = 997</td>
</tr>
<tr>
<td>Age, mean</td>
<td>63.5 (±9.7)</td>
<td>65.3 (±10.0)</td>
</tr>
<tr>
<td>Gender, female</td>
<td>53.6% (3,533)</td>
<td>57.8% (376)</td>
</tr>
<tr>
<td>Education, primary school is highest</td>
<td>30.3% (1,993)</td>
<td>30.0% (299)</td>
</tr>
<tr>
<td>Alcohol units/week (n = 6,428)</td>
<td>55.8% (3,675)</td>
<td>57.8% (355)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>36.8% (2,426)</td>
<td>36.4% (363)</td>
</tr>
<tr>
<td>Angina</td>
<td>5.1% (337)</td>
<td>5.6% (56)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>4.6% (306)</td>
<td>3.4% (34)</td>
</tr>
<tr>
<td>Coronary disease</td>
<td>7.9% (523)</td>
<td>7.4% (74)</td>
</tr>
<tr>
<td>Heart failure</td>
<td>0.9% (62)</td>
<td>1.0% (10)</td>
</tr>
<tr>
<td>Heart murmur</td>
<td>4.3% (285)</td>
<td>5.9% (59)</td>
</tr>
<tr>
<td>Abnormal heart rhythm</td>
<td>6.6% (438)</td>
<td>8.6% (86)</td>
</tr>
</tbody>
</table>

Data are expressed as either mean (SD) or percentage (frequency). ADL, activity of daily living; CV, cardiovascular; CV A, cerebrovascular accident; TIA, transient ischemic attack.
heart rhythm were associated even stronger with recurrent syncope.

Adjustment for cardiovascular drugs did not change results, except for associations between myocardial infarction and syncope, and the association between angina and recurrent falls, in which statistical significance was just lost, although ORs remained unchanged (data not shown). For all models, log-likelihood $\chi^2$'s were statistically significant. Also, $P$ values for Hosmer and Lemeshow’s goodness-of-fit tests ranged from 0.2 to 0.7, indicating no evidence of poor fit.

### Discussion

Patients with syncope frequently present with falls [3–5]. This general population study provided data on both falls and syncope. Abnormal heart rhythm was associated with falls and syncope, and even stronger with recurrent syncope. Angina was associated with syncope and even stronger with recurrent syncope and recurrent falls. Heart murmur was associated with syncope and recurrent falls. Heart failure was only associated with recurrent falls and not with syncope. Myocardial infarction was associated with syncope, but not with falls.

A few general population studies have evaluated associations between cardiovascular conditions and syncope. Within the Framingham heart study, Soteriades et al. [10] found that 10% of syncopal events had a cardiac cause. Ruwald et al. [12] found that ischaemic heart disease, arrhythmia and heart failure were associated with syncope in a nationwide Danish cohort. Within the same cohort, aortic valve stenosis, heart failure and atrial fibrillation were significant predictors for recurrent syncope [11]. General population studies have also linked cardiovascular disease to falls. Lawlor et al. [8] and Lee et al. [9] found that heart disease was associated with (recurrent) falls with comparable effect sizes with the present study. In the Rotterdam study, left ventricular systolic dysfunction was an independent predictor of injurious falls [13].

Structural cardiovascular conditions or rhythm abnormalities can cause syncope or falls when physical demands outweigh the output capacity of the heart. This explains the associations between heart failure and recurrent falls. Aortic valve stenosis is a cause of syncope [14], and other heart valve abnormalities have been identified as predictors of falls in a cohort of geriatric outpatients [15]. This could explain the association between heart murmur and (recurrent) falls and syncope although not all self-reported heart murmur can be attributed to aortic valve stenosis. Heart rhythm abnormalities can lead to decreased cardiac output due to increased or irregular ventricular response and loss of the atrial kick [16, 17]. Myocardial infarction and angina can be linked to falls and syncope through (i) decreased cardiac output due to myocardial scarring, cardiomyopathy and arrhythmia and through (ii) impaired blood pressure recovery, which is associated with ischaemic heart disease [5, 18]. Cerebral hypoperfusion, caused by decreased cardiac output, has been linked with impaired cognition and depression [19, 20], which are both important risk factors for falls [21]. Adjusting for cognition and depressive symptoms in our analysis however did not weaken the associations, thus pleading for an independent effect of cardiovascular conditions on falls and syncope as well.

Some limitations must be mentioned. Variables used in our analyses relied on self-report. Self-report shows high specificity but lower sensitivity, especially for chronic conditions such as heart failure [22]. We may therefore underestimate the burden of cardiovascular disease in the present study.

### Table 2. Association between cardiovascular conditions and falls and syncope in the past year

<table>
<thead>
<tr>
<th></th>
<th>Any falls ($n = 1,583$) versus no falls ($n = 6,590$)</th>
<th>Two or more falls ($n = 586$) versus no falls ($n = 7,587$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted ($n = 8,173$)</td>
<td>Fully adjusted ($n = 7,990$)</td>
</tr>
<tr>
<td></td>
<td>OR 95% CI P value</td>
<td>OR 95% CI P value</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.06 0.95 1.19 0.321 0.90 0.80 1.02 0.099 1.20 1.01 1.43 0.035 0.98 0.82 1.18 0.865</td>
<td>1.20 1.01 1.43 0.035 0.98 0.82 1.18 0.865</td>
</tr>
<tr>
<td>Angina</td>
<td>1.41 1.13 1.76 0.002 1.08 0.85 1.37 0.522 1.46 1.22 1.94 &lt;0.001 1.35 1.06 1.71 0.015 1.71 1.23 2.37 0.001 1.46 1.04 2.05 0.030</td>
<td>1.47 1.21 1.79 &lt;0.001 1.25 1.02 1.53 0.029 1.65 1.26 2.17 0.000 1.31 0.98 1.75 0.070</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0.98 0.75 1.27 0.872 0.84 0.64 1.10 0.207 0.61 &lt;0.001 1.17 0.81 1.68 0.402</td>
<td>1.69 1.06 2.70 0.028 1.38 0.85 2.23 0.192 1.74 1.26 2.17 0.000 1.31 0.98 1.75 0.070</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1.69 1.06 2.70 0.028 1.38 0.85 2.23 0.192 1.74 1.26 2.17 0.000 1.31 0.98 1.75 0.070</td>
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<td>Abnormal heart rhythm</td>
<td>1.47 1.21 1.79 &lt;0.001 1.25 1.02 1.53 0.029 1.65 1.26 2.17 0.000 1.31 0.98 1.75 0.070</td>
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</tr>
</tbody>
</table>

Fully adjusted model: adjusted for depressive symptoms, any ADL disability, (osteo-)arthritis, impaired vision, cognitive measures and the use of psychotropic drugs. ADL, activity of daily living. Bold values indicate statistically significant results ($P < 0.05$).

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Several cardiovascular conditions are associated with falls and syncope. Evidence on the association between separate cardiovascular conditions and falls and syncope may be underestimated. Also, we cannot rule out that certain syncope-like events were reported as faints or blackouts, leading to an overestimation of the prevalence of syncope in our cohort. Finally, this study is cross-sectional, and therefore, we could not identify independent cardiovascular predictors of falls and syncope.

In summary, this study shows that self-reported angina, heart failure, heart murmur, arrhythmia and myocardial infarction are cross-sectionally associated with (recurrent) falls and syncope in community-dwelling adults. This warrants additional cardiovascular evaluation in older adults with falls and syncope, especially in those with recurrent events. Early recognition of cardiovascular abnormalities in older adults might decrease fall and syncope risk. However, there is a need of randomised controlled trials that study the influence of treatment of cardiovascular conditions on risk of injurious falls and syncope.

**Key points**

- Syncope in older persons is often mistaken for falls.
- With increasing age, syncope is more often of cardiac origin.
- Evidence on the association between separate cardiovascular conditions and falls and syncope is limited.
- Several cardiovascular conditions are associated with falls and syncope.

**Acknowledgements**

See details in Supplementary data available in *Age and Ageing* online.

**Conflicts of interest**

None declared.

**Supplementary data**

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

**References**

Double-balloon enteroscopy and outcomes in patients older than 80

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Abstract

Background: double-balloon enteroscopy (DBE) is becoming more commonly used for investigation of small bowel pathology. Currently, there are limited data to describe its safety and efficacy in the population over age 65.
Aim: to investigate the indications, findings and outcomes of DBE performed in patients older than 80, as well as the correlation between DBE and prior capsule endoscopy (CE) findings.
Methods: we retrospectively reviewed our large DBE database, including procedures from January 2006 to September 2012. Patients aged 80 or older at the time of DBE were included in the study. The indications, findings, outcomes and diagnostic yield of DBE were calculated by frequency analysis.
Results: two hundred and fifteen DBEs were performed in 130 patients aged 80 or older. The mean age was 83.6 ± 3.03 years (range: 80–94). Twelve patients (9.2%) were assigned an American Society of Anaesthesiologists score of II prior to procedure, 102 patients (78.4%) were assigned a score of III and 16 patients (12.3%) were given a score of IV. The most common indication for DBE was obscure gastrointestinal bleeding (N = 204, 94.9%). One hundred and fourteen patients (87.7%) underwent CE prior to DBE, and correlation between findings of CE and DBE occurred in 74.6% of these patients. The overall diagnostic yield of DBE was 77.2% (N = 166). There were no immediate post-procedural complications or failed procedures.
Conclusion: DBE is a safe and effective technique for investigation of the small bowel in patients aged 80 and older. Age alone should not be a contraindication to performing DBE when clinically indicated.

Keywords: double-balloon enteroscopy, capsule endoscopy, older people, complications

Introduction

The number of people aged 85 and older in the USA is projected to increase from 5.5 million in 2010 to 6.6 million by 2020 [1]. This patient population has a higher prevalence of co-morbidities, specifically anaemia and obscure gastrointestinal bleeding (OGIB) [2]. Double-balloon enteroscopy (DBE) is now widely recognised as a safe and effective modality for endoscopic evaluation of the small intestine, and its most common indication is evaluation of OGIB [3]. Developed in