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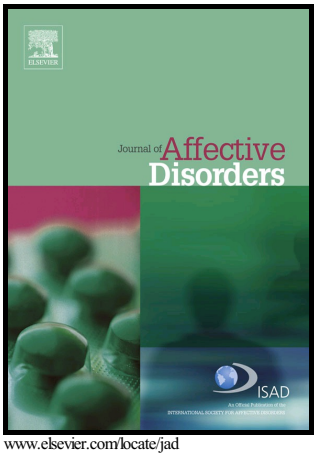

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Anxiety disorders and falls among older adults

Holloway KL[1*], Williams LJ[1], Brennan-Olsen SL[1,2,3,4], Morse AG[1], Kotowicz MA[1,3,5], Nicholson GC[2,6] and Pasco JA[1,3,5]

[1]Deakin University, Geelong, VIC Australia;

[2]The Institute for Health and Ageing, Australian Catholic University, Melbourne, VIC, Australia;

[3]Melbourne Medical School, Western Campus, The University of Melbourne, VIC, Australia;

[4]Australian Institute of Musculoskeletal Sciences (AIMSS), The University of Melbourne, VIC, Australia;

[5]Barwon Health, Ryrie Street, Geelong, VIC Australia;

[6]Rural Clinical School, The University of Queensland, Toowoomba, QLD, Australia.

[*]Corresponding author: Dr KL Holloway. Epi-Centre for Healthy Ageing (ECHA), IMPACT Strategic Research Centre. School of Medicine, Deakin University. PO Box 281 (Barwon Health), Geelong VIC 3220. Telephone: +61 3 42153335; Fax: +61 3 42153491. Email: khollo@barwonhealth.org.au

Abstract

Background:

Falls are common among older adults and can lead to serious injuries, including fractures. We aimed to determine associations between anxiety disorders and falls in older adults.

Methods:

Participants were 487 men and 376 women aged ≥60 years enrolled in the Geelong Osteoporosis Study, Australia. Using the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Non-patient edition (SCID-I/NP), lifetime history of anxiety disorders was determined. Falls were determined by self-report. In men, a falls-risk score (Elderly Falls Screening Test (EFST)) was also calculated.

Results:

Among fallers, 24 of 299 (8.0%) had a lifetime history of anxiety disorder compared to 36 of 634 (5.7%) non-fallers (p=0.014). Examination of the association between anxiety and falls suggested differential relationships for men and women. In men, following adjustment for

psychotropic medications, mobility and blood pressure, lifetime anxiety disorder was associated with falling (OR 2.96; 95%CI 1.07-8.21) and with EFST score (OR 3.46; 95%CI 1.13-10.6). In women, an association between lifetime anxiety disorder and falls was explained by psychotropic medication use, poor mobility and socioeconomic status.

Limitations:

Sub-group analyses involving types of anxiety and anxiety disorders over the past 12-months were not performed due to power limitations.

Conclusion:

Although anxiety disorders were independently associated with a 3-fold increase in likelihood of reported falls and high falls risk among men, an independent association was not detected among women. These results may aid in prevention of falls through specific interventions aimed at reducing anxiety, particularly in men.

Keywords: Anxiety, Accidental falls, Men and women, Australia

Introduction

The prevalence of fallers in community-dwelling adults is 28-35% for those aged 65 years and over and 42% for those aged over 75 years (Iinattiniemi et al., 2009; Masud et al., 2013; Williams et al., 2015b). In aged care, falls risk is greater, with residents falling on average, 2-6 times per year (Chen et al., 2008). In Australia, there has been a 4-fold increase in the incidence of falls since 2002, considered to be due to an increasing number of falls associated with an ageing population (Williams et al., 2015b). Approximately 40-50% of falls in older adults lead to injuries; 30-50% experience minor trauma, 10-15% serious injuries, 5-10% fractures and 1-2% hip fractures (Masud et al., 2013).

Almost three-quarters of hospitalisations in older adults are related to falls (AIHW: Bradley C, 2013). In Australia during 2009-2010, there were 127,295 separations with an average length of stay of 15.5 days (AIHW: Bradley C, 2013). The cost of falls presentations to the emergency department (ED) is substantial; two Australian studies from Western Australia (Hendrie et al., 2004) and New South Wales (Tiedemann et al., 2008) showed averages of $4619 and $6756 per ED presentation, respectively, related to falls in older adults. The cost for all falls, including those that did not present to an ED is also substantial; at $1600 for adults aged 75 years or over (Tiedemann et al., 2008). During the 2001-2002 financial year, the total cost to the healthcare system from the 18,706 ED presentations in Western Australia was $86.4 million, which is projected to increase to $181 million by 2021 with the ageing population (Hendrie et al., 2004) and by 2051, the cost per year in the whole country of Australia is expected to reach $1.4 billion (Lord et al., 2011). Falls can lead to other sequelae, even if a person is not physically injured, such as loss of independence, fear of falling, institutionalisation and are associated with an increased mortality risk (Chen et al., 2008; Kelly et al., 2003; Morsch et al., 2015). Falls and near falls often go undetected by health professionals due to under-reporting by the patient and the fact that it is not an issue about which enquires are usually made (Miller and Pantel, 2003).

Many risk factors for falls have been identified, including older age, female sex, previous falls and low weight, as well as muscle-related factors such as sarcopenia, and physical inactivity, which lead to decreased balance, thus increasing falls risk (Lord et al., 2003; Pasco et al., 2016; Taylor et al., 2012).Medication use is also an important risk factor for falls. Polypharmacy, as well as specific classes of drugs that cause dizziness and impaired balance (e.g. antidepressants, antipsychotics and anxiolytics) and those that cause orthostatic hypotension (e.g. diuretics, vasodilators and beta blocking agents) can increase the risk of falls (Bath et al., 2000; Iinattiniemi et al., 2009; Masud et al., 2013; Thorell et al., 2014).

Other factors that increase the risk of falls through effects on neurological and cognitive function have also been identified, such as excessive daytime sleepiness, dizziness, fear of falling and depression (Bath et al., 2000; Hayley et al., 2015; Iinattiniemi et al., 2009; Painter et al., 2012; Williams et al., 2015b). However, there has been little research in the area of anxiety as a risk factor for falls.

The prevalence of anxiety disorders in Australian community-dwelling elderly adults has been estimated to range between 7-14% (Williams et al., 2010; Williams et al., 2015a), with the prevalence of sub-threshold anxiety considered to be even higher (Miller and Pantel, 2003). Anxiety can affect falls risk through a variety of mechanisms, including gait; individuals taking shorter strides and having a slower gait speed, increasing falls risk (Young and Williams, 2015). Furthermore, people with anxiety may focus more internally (for example on their own feet) rather than externally (such as on an obstacle) and this further increases falls risk (Young and Williams, 2015). Even sub-threshold anxiety can increase falls risk; it is associated with decreased physical activity, poor perceptions of health and reduced quality of life (Miller and Pantel, 2003).

Few studies have investigated the association between anxiety and falls; most existing studies have combined data for men and women and, as far as we are aware, only a single study has examined anxiety and falls risk in men (Chen et al., 2008). That study used data from individuals in a Veterans Care Home and thus the results may not be generalisable to the broader population. Given the paucity of data in this field, the aim of this study was to determine if a lifetime history of anxiety disorder was associated with falls in a sample of older men and women aged 60 years or over enrolled in a population-based study.

Methods

Participants

This cross-sectional study included data obtained from a population-based study, the Geelong Osteoporosis Study (GOS), which recruited residents of the Barwon Statistical Division, located in south-eastern Australia. The Barwon Statistical Division is an ideal region for conducting epidemiological studies as it contains individuals from a range of social, cultural and geographical settings as well as a large, stable population (n ~ 280,000). Further details of the study are provided elsewhere (Pasco et al., 2012). At baseline, the GOS included 1,538 men and 1,494 women, with an age range of 20 to 97 years. Participants were randomly selected from Commonwealth electoral rolls. Since voting is compulsory in Australia from age 18 years, this sampling frame effectively captures all adults within the region. Females underwent baseline assessments from 1993 to 1997 (77% response). Baseline recruitment of men occurred from 2001 to 2006 (67% response).

The data for this cross-sectional analysis are drawn from the 5-year follow-up for men (2006-2011) and the 10-year follow-up for women (2004-2008). Only individuals aged 60 years and over were included (n=487 men and n=376 women) and there were no specific exclusion criteria, although criteria for inclusion in the GOS included living in the BSD, being listed on the electoral roll and being able to provide informed, written consent. The age of 60 years was selected because the Elderly Falls Screening Test (Cwikel et al., 1998) that we utilised to more accurately determine falls risk in men is validated for this age range. All participants provided written, informed consent and Barwon Health Human Research Ethics Committee approved the study.

Clinical measurements

All clinical measurements were collected at the 5-year follow-up for men (2006-2011) and the 10-year follow-up for women (2004-2008). Weight and height were measured to the nearest ±0.1 kg and ±0.1 cm, respectively. Whole body scans using dual energy X-ray

absorptiometry (DXA) provided an estimate of "lean" mass (kg) (muscle, skin, connective tissue), and the lean component of adipose tissue (water and protein). A Lunar DPX-L (Lunar, Madison, WI) was used in women and a Lunar Prodigy (GE Lunar, Madison, WI) was used in men. Blood pressure (BP, mmHg) was measured using an automated meter (TakedaMedical UA-751). From these measurements, mean arterial pressure (MAP) was calculated as: Diastolic BP + 1/3*(Systolic BP-Diastolic BP) (Cywinski, 1980).

Questionnaire data

Self-reported falls were classified for both sexes as one or more falls over the past 12 months, which was collected during the 5-year follow-up for men (2006-2011) and the 10-year follow-up for women (2004-2008). The falls question was based on the definition in Cwikel et al. (1998):

> *"We all fall from time to time. The definition of a fall is 'when you suddenly find yourself on the ground, without intending to get there, after you were in either a lying sitting or standing position' Have you had a fall during the past year?"*

This was intended to reduce social desirability bias and to define a fall to the participants. In addition, a falls risk score was determined for men using the Elderly Falls Screening Test (EFST) score (Cwikel et al., 1998). This score was used for men because it is more effective at determining high falls risk than self-reported falls over the past 12 months, particularly since men often do not report falls due to social desirability biases (Smith et al., 2007). One point was given for each positive response to five items:

1. More than one fall reported in the previous year
2. A fall that resulted in injury in the last year
3. Reporting "near falls" occasionally or often (near falls defined as "How often does it happen that you think you are about to fall, but manage to grab something and then don't fall?" (Cwikel et al., 1998))

4. Slow walking speed (> 10 seconds over 5 m)

5. Unsteady or uneven gait (gait was observed and recorded and an uneven gait was defined as shuffling. on a wide base. and/or unsteady (Cwikel et al., 1998))

Items 1-3 are assessed by self-report and items 4-5 are determined by clinical assessment. As previously utilised, an EFST score of two or more indicates a "high" falls risk. (Holloway et al., 2015). EFST scores were not available for women at the 10 year follow up.

Using the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Non-patient edition (SCID-I/NP), a diagnosis of lifetime history of anxiety and mood disorders was determined during the 5-year follow-up for men (2006-2011) and the 10-year follow-up for women (2004-2008). Anxiety disorders included panic disorder, agoraphobia, social phobia, specific phobia, obsessive-compulsive disorder, generalised anxiety disorder, anxiety disorders due to a general medical condition, substance induced anxiety disorder and anxiety disorders not otherwise specified (First et al., 2002). In this study, we combined all anxiety disorders because we did not have a large enough sample size to investigate sub-groups of anxiety disorders. Mood disorders included major depressive disorder (MDD), minor depression, bipolar disorder, dysthymia, mood disorder due to a general medical condition, and substance induced mood disorder (First et al., 2002). All SCID-I/NP interviews were conducted by trained personnel. Experienced interviewers with postgraduate qualifications in psychology were trained using live and videotaped interviews, and regular supervision was held with an experienced psychiatrist. The use of psychotropic medications including opiates, benzodiazepines, anticholinergic agents, dopaminergic agents and antidepressants were documented by self-report. Other pertinent medications included cardiovascular drugs (that can cause orthostatic hypotension) such as diuretics, beta-blockers, calcium channel blockers and renin-angiotensin system inhibitors (Thorell et al., 2014).

Physical mobility was dichotomised into "high" or "low". High physical mobility included light exercise or more, at least several times per week; "low" mobility included individuals ranging from those who walk reasonable distances (e.g. several blocks), do light housework/shopping and normal activities of day-to-day living, but no appreciable exercise to those who remain in a chair or bed most of the time. "Risky alcohol consumption" was assessed by a Food Frequency Questionnaire (Giles and Ireland, 1996). An item "Glasses per day" asked the participant *"over the last 12 months, on days when you were drinking, how many glasses of beer, wine and/or spirits altogether did you usually drink?"* Additionally, "Maximum glasses per day" asked participants to report: *"Over the last 12 months, what was the maximum number of glasses of beer, wine and/or spirits that you drank in 24 hours?"* The answers to these items allow the determination of whether alcohol intoxication may be associated with falling. Socio-economic status (SES) was ascertained using Socio-Economic Index For Areas (SEIFA) index scores, based on the 2006 Australian Bureau of Statistics Census data; SEIFA scores were used to determine the level of SES via the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD). The IRSAD accounts for parameters measured at the area-level, including high and low income, and type of occupation. A low score using the IRSAD identifies the most disadvantaged (quintile 1), while a high score identifies the most advantaged (quintile 5).

Statistical Analysis

The two-sample t-test or Mann-Whitney test was used to determine differences for continuous data according to falls status. A Chi-Square test or Fisher's test was used for categorical variables. Binary logistic regression was performed to determine the association between anxiety and falls. Multivariable models were developed that included the following continuous variables: age (yr), weight (kg), height (cm), lean mass (kg), MAP (mmHg), average glasses of alcohol per day and highest number of glasses of alcohol per day as well

as the categorical variables: sex, mood disorders (yes/no), psychotropic medication use (yes/no), cardiovascular medication use (yes/no), narcotic analgesic use (yes/no), mobility (high/low), and SES as potential confounders. Interaction terms were investigated for all variables listed above in all models, and no interactions were identified. All statistical analyses were performed using Minitab (version 16, Minitab, State College, PA, USA).

Results

During the 12 months prior to assessment, 105 of 487 men (21.6%) and 124 of 376 women (33.0%) reported one or more falls. Eighty-three of 487 men (17.0%) were classified as high falls risk by the EFST score. Of the 105 men who fell, eight had a lifetime history of anxiety disorder (7.6%), compared to 17 of the 382 men (4.5%) who did not fall. In women, 16 of the 124 (12.9%) women who fell and 19 of the 252 women (7.5%) who did not fall had a lifetime history of anxiety disorder.

Results for men and women combined

Among 229 male and female fallers, 24 (10.5%) met the criteria for a lifetime history of anxiety disorder. A Chi-squared test showed that a lifetime history of anxiety disorder was associated with falls (p=0.014). A significant association was observed between lifetime anxiety disorders and falling after adjustment for age and sex (OR 2.06, 95%CI 1.18-3.61, p=0.011).

Lifetime anxiety disorders remained independently associated with falls after further adjustment for psychotropic medications, MAP, mobility and SES (OR 1.92, 95%CI 1.02, 3.62, p=0.042); however an age*sex interaction term was evident (p=0.057). Data were subsequently stratified by sex and separate models developed for men and women.

Results for Men

Results for men who reported one or more falls in the past 12 months

Among 105 male fallers, eight (7.6%) met the criteria for a lifetime history of anxiety disorder (Table 1). Male fallers were older, had higher MAP, used more psychotropic medications, had lower mobility and had lower risky alcohol consumption.

Compared to men who were anxiety-free, the age-adjusted association between lifetime anxiety disorders and falling (OR 2.41; 95%CI 0.98, 5.95; p=0.055) was strengthened after further adjustment for psychotropic medication use and MAP (OR 2.96 95%CI 1.07, 8.21, p=0.037) (Table 3).

Results for men who had an EFST score ≥2

Among 83 men with a high EFST score, seven (8.4%) had an anxiety disorder (Table 2). Men with a high EFST score had higher MAP, used more psychotropic medications, had lower mobility and had lower risky alcohol consumption than men with a low EFST score.

There was an age-adjusted association between lifetime anxiety disorder and high EFST score (OR 3.38; 95%CI 1.28, 8.93, p=0.014), increased after further adjustment for psychotropic medication use, mobility and MAP (OR 3.46 95%CI 1.13, 10.6, p=0.030) (Table 3).

Results for Women

Among 124 female fallers, 16 (12.9%) met criteria for a lifetime history of anxiety disorder (Table 1). Women who reported falling were more likely to have a mood disorder sometime during their life, were more likely to use psychotropic medications and in contrast to men, had higher mobility; 76.6% of fallers and 90.5% of non-fallers had low mobility (Table 1). Additionally, there were more than expected fallers in quintile 1 of SES and fewer than expected in quintile 3.

After adjusting for age, the association between anxiety disorders (ever) and falls (OR 1.91 95%CI 0.94, 3.88; p=0.074) did not reach statistical significance and was further attenuated

by adjusting for psychotropic medication use, mobility and SES (OR 1.48; 95%CI 0.69, 3.17; p=0.315) (Table 4).

In the above models for men and women, no other variables (including lifetime history of mood disorder, use of cardiovascular medications, lean mass, risky alcohol consumption etc.) were identified as confounders or effect modifiers.

Discussion

This study investigated the association between lifetime anxiety disorders and falls in men and women aged ≥60 years. In men, anxiety disorders were independently associated with an increased risk of falls; however, an independent association was not detected among women.

Previous studies have indicated that anxiety and falls may be linked. We were also unable to investigate the impact of different types of anxiety disorders on falls risk due to inadequate sample size.

A study involving Chinese men aged ≥65 years living in a veterans care home (Chen et al., 2008) reported that men who had fallen were older, had poorer functional status, had past anxiety, a history of cardiovascular disease and took more hypnotic medications. However, when a multivariable analysis was conducted, only two independent predictors of falls remained: poor functional status and use of hypnotic medications. The authors suggested that anxiety and cardiovascular disease may impact falls risk through the medications used to treat these conditions, rather than an effect of the condition itself. In our study, we report that anxiety was an independent predictor of falls in men, which was not explained by medication use. The reason for these differing results could be due to differences in cohorts (population setting compared to an institution). A Brazilian study (Morsch et al., 2015) also reports an association between falls and "not feeling calm and relaxed" in a group of men and women

aged >60 years. The multivariable model developed in their study included age, sex, reduced activity, anxiety (OR 1.67), depression and "feeling calm and relaxed (OR 2.90)." The point estimate for the OR for "not feeling calm and relaxed" was similar to our study. The Brazilian study used self-reported data for anxiety, whereas we determined this information by clinical interview. Therefore, we may have identified more men, particularly those who were not aware they had anxiety, compared to the self-report in the Brazilian study. However, the other question regarding "not feeling calm and relaxed" may have identified individuals who did not have a diagnosis of anxiety, but had some symptoms.

We have recently published a study that examined psychiatric disorders, psychotropic medication use and falls in a large group of women aged >20 years (Williams et al., 2015b). While depression within the past 12 months and psychotropic medication use were confirmed as independent risk factors for two or more falls, in this group that included younger women, anxiety disorders were not. Other Australian data including investigations of the relationship between anxiety and falls have been published. One such study (Menant et al., 2013) assessed how dizziness impacts the risk of multiple falls in community-dwelling men and women aged 73-92 years and found that the most important confounding factors in the relationship between dizziness and falls were neck and back pain (OR 1.68; 95%CI 1.14-2.48) and anxiety (OR 1.22; 1.00-1.49). Another study (Taylor et al., 2014) examined the association between anxiety and falls in community-dwelling men and women aged 60 years or over with cognitive impairment, reporting that although in univariate analysis (adjusted for age and number of years of education) anxiety was significantly associated with falls (IRR 1.342, 95%CI 1.113–1.617), it was not significant in the final multivariable model. This is similar to our results for women, which may reflect the similarities in sample age range and population. Lastly, a study of community-dwelling men and women aged 70-90 years (Delbaere et al., 2010) reported an OR of 1.07 (95%CI 0.88-1.29) for the association between anxiety and

falls. The authors suggest that the reason they may not have picked up associations between mental health (or psychotropic medication use) and falls is that their sample was biased towards healthier members of the community, who are less likely to have these issues (mental health or medications for mental health). This may explain the differences between our study and this study; as our sample is randomly selected from the general population.

A recent meta-analysis (Hallford et al., 2015), examined the association between anxiety and falls and reported that elevated anxiety symptoms were associated with a 1.53 times increased risk of falling. Further research is required to determine the potential confounding factors in this association as well as impact of different types of anxiety. Several previous studies have discussed the potential mechanisms through which anxiety may impact falls risk. One study from the US (Painter et al., 2012) showed that fear of falling was associated with depression, anxiety and activity level in community-dwelling men and women aged 55 years and over. Additionally, anxiety predicted fear of falling and activity restriction, which may be another pathway by which anxiety may impact falls risk. A summary of how anxiety may increase falls risk through an impact on gait and balance (Hadjistavropoulos et al., 2011) highlights that activity avoidance can be positive for an individual in the short term because feelings of anxiety and fear (of falling) are avoided, however, limitation of activity can result in muscle deconditioning, leading to decreased balance and a higher risk of falling in the longer term. Anxiety has also been reported to cause a stiffening of the ankle joint, making balancing more difficult when an individual encounters a falls hazard (Hadjistavropoulos et al., 2011). Additionally, anxiety can result in decreased walking speed and step length, which also reduces balance. Different types of anxiety may impact gait and balance differently; some anxiety disorders (e.g. generalised anxiety) may have an impact on gait and balance at all times, whereas others only in response to specific stimuli (e.g. specific phobia). Another recent publication (Young and Williams, 2015) highlights how anxiety can result in an

attentional bias for threatening stimuli as well as a compromise of working memory. Consequently, more time is required by individuals with anxiety to obtain spatial information about the environment. Individuals with anxiety also have different patterns of eye movement and stepping compared to individuals at low falls risk, which impacts balance and gait (Young and Williams, 2015). Anxiety also causes an individual to focus internally, reducing the amount of cognitive resources available for motor tasks and obtaining visual-spatial information. All of these factors together can lead to increased falls risk.

In this study, we identified an association between anxiety and falls in men, but not women. This may be because our sample size was not large enough to detect an association in women, or that anxiety impacts falls risk differently in men and women. Men are less likely to have anxiety at all ages throughout the lifespan (Sanders et al., 2015). They are also less likely to self-report anxiety or any symptoms of anxiety, due to social desirability bias (McLean and Anderson, 2009; Smith et al., 2007). This may lead to fewer men being diagnosed and prescribed psychotropic medications. In women, psychotropic medication use, mobility and IRSAD were identified as independent risk factors in the association between falls and anxiety. It may be that these factors are more important than anxiety in predicting falls in women. This is supported by our results; nearly 40% of women who fell were using psychotropic medication, compared to 19.1% of men. Thus, in women, psychotropic medications may play an important role in falls risk, whereas in men, there were fewer using those medications. Additionally, we may not have observed an association between anxiety disorders and falls in women due to heterogeneity among the disorders; where different subgroups of the disorders may have differing directions of effect on falls. There are few studies in the literature that investigate reasons for differences in anxiety between men and women (McLean and Anderson, 2009; Pasco et al., 2016; Sanders et al., 2015); and this area needs further research.

In this study, we have also reported on other risk factors for falls, including as alcohol consumption, which has been reported to increase falls risk in some studies, but has not been confirmed in prospective studies (Iinattiniemi et al., 2009). We have reported that men who had fallen consumed fewer "highest number of glasses per day" but this variable was not significant in the multivariable model. Mobility however, was an independent risk factor for high falls risk (EFST) in men and falls over 12 months in women. Results for the sexes were opposite; men with low mobility had an increased falls risk, whereas women who had low mobility had a decreased risk. Both low and high mobility can lead to an increase in falls (Delbaere et al., 2010; Pereira et al., 2014). A moderate amount of physical activity can aid in maintaining balance and muscle strength (Hadjistavropoulos et al., 2011), however a high level of physical activity can result in an increased risk of falls through increased exposure to risky activity (e.g. sports) (Robertson and Cillespie, 2013). The age of an individual also plays a role in the impact of mobility on falls risk. In a study of US men (Cauley et al., 2013), individuals aged <80 years had a higher risk of falls if they had high mobility, but those aged ≥80 had a higher falls risk with lower mobility. In our study, the impact of mobility on falls risk was different between the sexes; men with lower mobility had a higher risk of falling, consistent with muscle decline, whereas women who exposed themselves to fall risk through physical activity were at a higher risk of falling. Finally, we also reported that psychotropic medication use was an independent predictor of falls in both men and women. Psychotropic medications have an impact on the central nervous system, which can impact the ability of a person to maintain balance and avoid falling (Thorell et al., 2014; Williams et al., 2015b). The results in this study support the effect of psychotropic medication use on increasing falls risk in both sexes.

This study has several strengths and weaknesses. First, a major strength is that we have studied a sample that is representative of the underlying population. We collected information

about anxiety disorders using clinical interviews rather than self-report, which enabled us to identify individuals with anxiety disorders who would otherwise not self-report it due to social desirability bias or because they were unaware. Data were collected in both men and women, which is important given the observed differences between the sexes. We also collected data on numerous lifestyle factors. There are also some limitations in this study. We were not able to investigate the anxiety-falls association for anxiety during the past 12 months, or for different sub-types of anxiety due to power limitations. Additionally, we cannot exclude the possibility of a type II error (failing to detect an association between anxiety disorders and falls, due to a small sample size) in our female dataset. We also rely on self-reported falls over the past 12 months, and consequently, these may be subject to recall bias. However, recall of falls is acceptable alternative to extensive ascertainment of falls; in a prospective study (Sanders et al., 2015), 82% of elderly women were able to accurately recall their falls history for the preceeding 12 months. Additionally, we were unable to obtain EFST for women in this study, which prevented a comparison of results between sexes for these scores. Given our cross-sectional analysis, we were unable to determine the reasons for any associations reported, nor were we able to investigate incident falls, or any changes over time. We did not assess participants for cognitive disturbances, which may be a confounder of associations reported in this study. Finally, our sample included mostly white men and women, so our results may not be generalisable to other populations.

Conclusions

We report that men with a history of anxiety disorders were at greater risk of falling than those with no past history. This association was not explained by age, psychotropic medication use, mobility or mean arterial pressure. In women, there was a non-significant association between anxiety and falls, but this was attenuated by adjustment for other

variables including psychotropic medications, mobility and SES. Prospective studies on large sample sizes are warranted to further investigate anxiety and falls risk, particularly in older men, as well as to determine the impact of different types of anxiety disorders on falls risk.

Implications for practice

Since fear of falling and anxiety may operate in similar ways through activity avoidance, it can be suggested that an intervention to reduce fear of falling may aid individuals with anxiety. However, in the literature, interventions focussed on reducing fear of falling have had limited success. For example, a study in the Netherlands (Zijlstra et al., 2012) implemented an 8-week program to reduce fear of falling and increase activity level in community-dwelling older adults. Data were collected prior to baseline, at 2 months and 4 months. Concerns about falls, activity avoidance, feelings of anxiety and symptoms of depression improved over 4 months whereas there was no improvement in daily activity, feelings of loneliness and fall-related medical attention. Feedback given by participants showed that most found the program useful. A recent systematic review (Kumar et al., 2016) also describes that current exercise interventions may be useful to reduce the fear of falling in older adults immediately after the intervention, but these effects did not persist in the short term (<6 months) or longer term (≥6 months). The systematic review also highlights that studies in the literature may have be biased, due to lack of blinding participants and researchers, as well as having self-reported outcomes. Thus, programs to reduce fear of falling can be effective in older community-dwelling populations, but further research is needed in this area to tackle the problem of anxiety and fear surrounding falls. Finally, since anxiety disorders are common and treatable, if an association between anxiety disorders and falls can be confirmed in larger studies, powered for anxiety sub-type analyses, clinical trials can begin, thus allowing a translation of this finding into clinical practice.

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Disclosures

Conflicts of interest:

None.

Author contributions:

KLH, GCN and JAP were involved in the development of the sub-study, KLH and AGM were involved in data extraction and cleaning. KLH, LJW, SLB-O, MAK and JAP were involved in data interpretation. All authors were involved in the critical appraisal of the manuscript and approved the final version.

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Table 1: Descriptive statistics for men and women aged 60 years and over stratified by falls (one or more) during the previous 12 months.

	Men				Women			
Factor	Total (n=487)	Fallers		P value	Total (n=376)	Fallers		P value
		Yes (n=105)	No (n=382)			Yes (n=124)	No (n=252)	
Age (years)	73.4 (66.4, 80.8)	77.4 (69.4, 83.8)	72.5 (66.1, 80.2)	**0.001**	71.7 (65.1, 79.1)	72.3 (66.3, 80.0)	71.0 (64.6, 78.4)	0.202
Weight Missing: Men: n=71 Women: n=9	83.2±13.4	82.3±14.5	83.4±13.1	0.537	70.0±13.2	71.1±14.2	69.4±12.6	0.268
Height Missing: Men: n=71 Women: n=9	172.6±6.6	171.9±7.0	172.8±6.4	0.280	158.5±6.2	158.1±6.3	158.6±6.1	0.464
Lean mass Missing: Men: n=31 Women: n=25	55.7±7.0	54.8±7.8	56.0±6.8	0.198	37.5±4.0	37.4±3.9	37.6±4.1	0.602
Mean arterial pressure Missing: Men: n=60	101.9±13.3	105.6±16.8	100.9±11.9	**0.013**	96.7±11.6	97.0±11.9	96.5±11.4	0.765

Women: n=33								
Mood disorder (ever)	53 (10.9)	14 (13.3)	39 (10.2)	0.363	79 (21.0)	36 (29.0)	43 (17.1)	**0.007**
Medications (y/n)								
Psychotropic	62 (12.7)	20 (19.1)	42 (11.0)	**0.028**	98 (26.1)	49 (39.5)	49 (19.4)	**<0.001**
Cardiovascular	314 (64.5)	73 (69.5)	241 (63.1)	0.222	250 (66.5)	90 (72.6)	160 (63.5)	0.079
Narcotic analgesics	19 (3.9)	5 (4.8)	14 (3.7)	0.575	12 (3.2)	6 (4.8)	6 (2.4)	0.221
Mobility (low)	178 (36.7)	49 (46.7)	129 (34.0)	**0.017**	323 (85.9)	95 (76.6)	228 (90.5)	**<0.001**
Missing: Men: n=2 Women: n=10								
Alcohol								
Missing: Men: n=21 Women: n=10								
Average glasses per day	2.0 (1.0, 4.0)	2.0 (1.0, 4.0)	2.0 (1.0,4.0)	0.148	1.0 (0.0, 2.0)	1.0 (0.0, 1.0)	1.0 (0.0, 2.0)	0.138
Highest number of glasses per day	2.0 (1.0, 5.0)	2.0 (1.0, 4.0)	2.0 (1.0, 5.0)	**0.033**	1.0 (0.0, 1.0)	1.0 (0.0, 1.0)	1.0 (0.0, 1.0)	0.166
IRSAD‡				0.518				**0.012**
Quintile 1 (low)	81 (16.6)	13 (12.4)	68 (17.8)		61 (16.2)	28 (22.6)	33 (13.1)	

	107	28	79		71	19	52	
Quintile 2	(22.0)	(26.7)	(20.7)		(18.9)	(15.3)	(20.6)	
	93	22	71		106	24	82	
Quintile 3	(19.1)	(21.0)	(18.6)		(28.2)	(19.4)	(32.5)	
	96	19	77		65	25	40	
Quintile 4	(19.7)	(18.1)	(20.2)		(17.3)	(20.2)	(15.9)	
	110	23	89		73	28	45	
Quintile 5	(22.6)	(21.8)	(22.7)		(19.4)	(22.6)	(17.9)	
Anxiety	25 (5.1)	8 (7.6)	17 (4.5)	0.19	35 (9.3)	16	19 (7.5)	0.09
disorder (ever)				3		(12.9)		2

Weight (kg), height (cm), lean mass (kg) and mean arterial pressure (mmHg) presented as mean±standard deviation. Other data are presented as median (inter-quartile range) or n (%).
‡Index of Relative Socio-economic Advantage and Disadvantage.
Missing data: Men; Weight & Height: 71, Lean mass: 31, Mean arterial pressure: 60, Mobility: 2, Glasses per day (alcohol) & Maximum glasses per day (alcohol): 21. Women: Weight: 9, Height: 9, Lean mass: 25, Mean arterial pressure: 33, Average glasses per day: 10, Highest number of glasses per day: 10.

Table 2: Descriptive statistics for men aged 60 years or over stratified by falls risk (according to EFST* score: High≥2 and Low <2).

Factor	EFST score		P value
	High (n=83)	Low (n=404)	
Age (yr)	78.5 (70.7, 84.9)	72.4 (65.7, 79.6)	**<0.001**
Weight	81.4±13.6	83.5±13.4	0.235
Missing: n=71			
Height	171.4±6.3	172.8±6.6	0.080
Missing: n=71			
Lean mass	54.4±7.3	56.0±6.9	0.077
Missing: n=71			
Mean arterial pressure	105.7±17.9	101.1±11.9	**0.031**
Missing: n=60			
Mood disorder (ever)	11 (13.3)	42 (10.4)	0.447
Medications (y/n)			
Psychotropic	21 (25.3)	41 (10.2)	**<0.001**

Cardiovascular	61 (73.5)	253 (62.6)	0.059
Narcotic analgesics	6 (7.2)	13 (3.2)	0.112
Mobility (low)	47 (56.6)	131 (32.6)	<**0.001**
Missing: n=2			
Alcohol			
Missing: n=21			
Average glasses per day	2.0 (0.8, 3.3)	2.0 (1.0, 4.0)	**0.042**
Highest number of glasses per day	2.0 (0.8, 4.0)	2.5 (1.0, 5.0)	**0.022**
IRSAD‡			0.683
Quintile 1	10 (12.1)	71 (17.6)	
Quintile 2	20 (24.1)	87 (21.5)	
Quintile 3	16 (19.3)	77 (19.1)	
Quintile 4	15 (18.1)	81 (20.1)	
Quintile 5	22 (26.4)	88 (21.7)	
Anxiety disorder (ever)	7 (8.4)	18 (4.5)	0.167

Weight (kg), height (cm), lean mass (kg) and mean arterial pressure (mmHg) presented as mean±standard deviation. Other data presented as median (inter-quartile range) or n (%).
*Elderly Falls Screening Test.
‡Index of Relative Socio-economic Advantage and Disadvantage.

Table 3: Odds ratios for men aged 60 years and over. Reported falls over the past 12 months and EFST* scores (high/low). Data presented as OR (95%CI).

Factor	Model 1 falls†	p	Model 2 falls‡	p	Model 1 EFST†	p	Model 2 EFST‡	p
Age (years)	1.05 (1.02, 1.07)	<0.001	1.05 (1.02, 1.08)	0.001	1.08 (1.05, 1.11)	<0.001	1.07 (1.03, 1.10)	<0.001
Anxiety (ever)	2.41 (0.98, 5.95)	0.055	2.96 (1.07, 8.21)	0.037	3.38 (1.28, 8.93)	0.014	3.46 (1.13, 10.6)	0.030
Psychotropic medications (y)	-	-	2.07 (1.09, 3.92)	0.026	-	-	2.80 (1.42, 5.52)	0.003
Mobility (low)	-	-	NS	NS	-	-	1.76	0.050

							(1.00, 3.10)	
Mean arterial pressure (mmHg)	-	-	1.03 (1.01, 1.05)	0.001	-	-	1.03 (1.01, 1.05)	0.002

* Elderly Falls Screening Test
† Model 1 includes age adjusted anxiety (ever).
‡ Model 2 includes age-adjusted anxiety (ever) and all other factors.
NS=Not Significant

Table 4: Odds ratios for women aged 60 years and over. Reported falls over the past 12 months. Data presented as OR (95%CI). All data age-adjusted.

	Model 1†	p	Model 2‡	p
Age (years)	1.02 (0.99, 1.05)	0.119	1.00 (0.97, 1.04)	0.762
Anxiety (ever)	1.91 (0.94, 3.88)	0.074	1.48 (0.69, 3.17)	0.315
Psychotropic medications (y)	-		2.38 (1.42, 3.99)	0.001
Mobility (low)	-		0.48 (0.23, 1.00)	0.050
IRSAD*	-			
Quintile 1	-		-	Referent
Quintile 2	-		0.46 (0.22, 0.99)	0.046
Quintile 3	-		0.35 (0.17, 0.70)	0.003
Quintile 4	-		0.77 (0.37, 1.62)	0.492
Quintile 5	-		0.83 (0.40, 1.72)	0.618

* Index of Relative Socio-economic Advantage and Disadvantage
† Model 1 includes age adjusted anxiety (ever).
‡ Model 2 includes age-adjusted anxiety (ever) and all other factors.

Highlights:

Falls are common in community-dwelling older adults and can result in injuries.
Anxiety can impact falls risk, but there are not many studies describing this.
In this study, we show that falls risk is increased in men with anxiety.
In women, there is a trend for increasing falls risk with anxiety.
Anxiety could be an important intrinsic risk factor for falls that is preventable.