Original Studies

Risk of Hospitalized Falls and Hip Fractures in 22,103 Older Adults Receiving Mental Health Care vs 161,603 Controls: A Large Cohort Study

Brendon Stubbs PhD, MSc, MCSPa,b,*, Gayan Perara PhD b, Ai Koyanagi MD, PhDc,d, Nicola Veronese MD e, Davy Vancampfort PhD f,g, Joseph Firth PhD h,i, Katie Sheehan PhD j, Marc De Hert MD, PhD k,l, Robert Stewart MD a,b, Christoph Mueller MD a,b

a South London and Maudsley NHS Foundation Trust, Denmark Hill, London, United Kingdom
b Institute of Psychiatry, Psychology and Neuroscience (IoPPN), King’s College London, London, United Kingdom
c Research and Development Unit, Parc Sanitari Sant Joan de Déu, Universitat de Barcelona, Fundació Sant Joan de Déu, CIBERSAM, Barcelona, Spain
d ICREA, Barcelona, Spain
* Primary Care Department, Azienda ULSS (Unità Locale Socio Sanitaria) 3 “Serenissima,” Dolo, Venice, Italy
e Department of Population Health Sciences, School of Population Health & Environmental Sciences, King's College London, London, United Kingdom
f Department of Rehabilitation Sciences, KU Leuven University of Leuven, Leuven, Belgium
g University Psychiatric Centre, KU Leuven, University of Leuven, Kortenberg, Belgium
h NICM Health Research Institute, Western Sydney University, Sydney, New South Wales, Australia
i Division of Psychology and Mental Health, Faculty of Biology, Medicine and Health, University of Manchester, Manchester, United Kingdom
j Department of Population Health Sciences, School of Population Health & Environmental Sciences, King’s College London, London, United Kingdom
k University Psychiatric Centre KU Leuven, Kortenberg, Belgium
l Antwerp Health Law and Ethics Chair, University of Antwerp, Antwerp, Belgium

Keywords:
Hip fracture
dementia
mental illness
schizophrenia
substance use disorder

A B S T R A C T

Objectives: To investigate the risk of hospitalized fall or hip fracture among older adults using mental health services.

Design: Retrospective cohort study.

Setting and Participants: Residents of a South London catchment aged >60 years receiving specialist mental health care between 2008 and 2016.

Measures: Falls and/or a hip fracture leading to hospitalization were ascertained from linked national records. Incidence rates and incidence rate ratios (IRRs) were age- and gender-standardized to the catchment population. Multivariable survival analyses were applied investigating falls and/or hip fractures as outcomes.

Results: In 22,103 older adults, incidence rates were 60.1 per 1000 person-years for hospitalized falls and 13.7 per 1000 person-years for hip fractures, representing standardized IRRs of 2.17 [95% confidence interval (CI) 2.07-2.28] and 4.18 (3.79-4.60), respectively. The IRR for falls was high in those with substance-use disorder (IRR = 6.72 (5.35-8.33)), bipolar disorder (IRR = 3.62 (2.50-5.05)), depression (IRR = 2.28 (2.00-2.59)), and stress-related disorders (IRR = 2.57 (2.10-3.11)). Hip fractures were increased in all populations (IRR > 2.5), with greatest risk in substance use disorders (IRR = 12.64 (7.22-20.52)), dementia (IRR = 4.38 (3.82-5.00)), and delirium (IRR = 4.03 (3.00-5.29)). Comparing mental disorder subgroups with each other, after the adjustment for 25 potential confounders, patients with dementia and substance use had a significantly increased risk of falls, and patients with dementia also had an increased risk of hip fractures.

Conclusion and Implications: Older people using mental health services have more than double the incidence of falls and 4 times the incidence of hip fractures compared to the general population. Although incidences differ between diagnostic subgroups, all groups have a higher incidence than the general population. Targeted interventions to prevent falls and hip fractures among older adult mental health service users are urgently needed.
Falls are common in older adults\(^1\) and associated with substantial morbidity, reduced quality of life, substantial health care expenditure, and premature mortality.\(^2,3\) Falls are a leading cause of hip fractures, which are associated with pronounced disability\(^4\) and reduced functional capacity.\(^5\) Research in the general population has suggested that between 27% and 59% of older people transition into permanent long-term care within the first year after a hip fracture.\(^6\) Moreover, hip fractures are associated with increased mortality.\(^7-11\) Unsurprisingly, understanding and preventing falls and hip fractures is a global health priority.\(^12\)

Older adults using mental health services are at a particularly increased risk of experiencing falls and hip fractures due to a range of risk factors.\(^13-16\) For instance, people with late-life cognitive and functional mental disorders have increased risk of physical multiand comorbidities,\(^15,16\) polypharmacy,\(^7\) use of individual medications (e.g., antipsychotic medication,\(^2\) antidepressants\(^3\)), and impaired cognition. Moreover, these populations often have other risk factors such as inadequate nutrition,\(^24\) physical inactivity,\(^25\) impaired physical performance,\(^26,27\) and high smoking rates.\(^28\) Previous research has demonstrated that mental health service users including people with dementia, psychotic disorders, bipolar disorder, anxiety- and stress-related disorders, and major depression have increased risk of osteoporosis compared with age- and sex-matched controls and are thus at greater risk of hip fractures.\(^29,30\) Falls are the leading cause of patient safety incidents reported in older adult mental health services.\(^31\)

Despite the aforementioned, minimal representative research has considered and compared which mental disorder groups are at greatest risk. A systematic review identified that people with dementia are at increased risk of falls, but all the sample sizes included fewer than 300 people.\(^32\) Two cohort studies suggested that people with dementia are at increased risk of fractures.\(^33,34\) Falls risk in late-life psychotic disorders has received very little investigation, although recent cohort studies have suggested that this population is at increased risk of fractures.\(^35,36\) A recent systematic review suggested that people with depressive symptoms are at increased risk of hip fractures, although relatively few (\(n = 5\)) studies included people with confirmed depression.\(^37\) A meta-analysis suggested that people with major depression were at increased risk of future falls, but the sample size was small (\(n = 965\)).\(^38\) Minimal information is available on falls and hip fractures in older adults with bipolar disorder, substance use disorder, or anxiety- and stress-related disorders to date.\(^39\)

In light of the above, we assembled a cohort study from routine health care data for a catchment population of 1.3 million with the following aims: (1) to compare the incidence of falls and/or hip fractures among older patients with diagnosed mental disorders to that in the general population; and (2) to compare risk of falls and/or hip fracture for diagnostic subgroups to establish if any particular group of mental health conditions was at greatest risk of a hospitalized fall or hip fracture.

**Methods**

**Study Setting and Data Source**

A retrospective observational study was conducted using data from the South London and Maudsley NHS Foundation Trust (SLaM) Biomedical Research Centre (BRC) Case Register. SLaM serves a geographic catchment of 4 South London boroughs with a population in excess of 1.3 million residents. The data for the current study were assembled from the Clinical Record Interactive Search (CRIS) resource, which renders a deidentified version of SLaM’s routine electronic health record accessible for research projects within a robust and patient-led governance framework.\(^40\) The SLaM BRC Case Register has been described in detail.\(^41,42\) Data are currently archived in CRIS on more than 400,000 people with a range of mental disorders and the database has full approval for secondary analysis (Oxford Research Ethics Committee C, reference 18/SC/0372).

**Participants**

All SLaM patients aged 60 years or older who received a specific diagnosis of a mental or behavioral disorder according to International Classification of Diseases—10th Revision (ICD-10)\(^43\) Chapter 5 between January 1, 2008 and December 31, 2016 were included. Dates of diagnosis and ICD-10 code were obtained from a structured field, and the first diagnosis date after the age of 60 years served as the index date for defining both the inclusion criterion and covariates. We categorized these index diagnoses according to the following ICD-10 groups: dementia (F00-F03), delirium (F05), mild cognitive impairment (MCI; F06.7), substance use disorder (F10-F19), psychotic disorder (F20-29), bipolar affective disorder (F30, F31), unipolar depression (F32, F33), any anxiety disorder (F40, F41), or a stress-related disorder (F43.0, F43.2, F43.8, F43.9), an exceptionally stressful life event producing an acute stress reaction or a significant life change leading to continued unpleasant circumstances that result in an adjustment disorder. All remaining diagnoses were grouped in the “other category.” SLaM patient records have been linked with Hospital Episode Statistics (HES), a database of all hospital care received in England,\(^44\) which were available until March 31, 2016 at the time of analysis. From available HES data, we further generated a population control data set for all residents in the catchment area, ascertaining all admissions for falls (W00-W19) and/or hip fractures (S72) for the catchment in the year 2011, and applying 2011 national census data for the over-60s population in this catchment to derive denominators.\(^45,46\)

**Outcomes**

The co-primary outcomes were (1) a fall leading to hospitalization and (2) a hip fracture. Admission due to a fall was classified if an ICD-10 code of W00-19 was recorded as any discharge diagnosis. For hip fractures, we identified hospitalizations that contained the ICD-10 code S72 among the discharge diagnoses. We ascertained all falls and hip fractures occurring within the first 12 months after the index date, and then additionally followed all patients to a censoring point defined as the first of the following: fall or hip fracture, death, or March 31, 2016.

**Covariates**

Covariates included age, gender, neighborhood deprivation level (based on index of multiple deprivation applied to the lower super output area geographic unit containing the patient’s address),\(^47\) ethnicity (white vs nonwhite), and cohabiting status, dichotomized into cohabiting (civil partnership, married, cohabiting) and noncohabiting (single, divorced, civil partnership dissolved, widowed, separated) groups. Mental and physical health, as well as functioning, was determined from the Health of the Nation Outcome Scales.\(^48\) We extracted the following Health of the Nation Outcome Scales subscale...
Incidence of Hospitalized Hip Fractures in the Year After Index Date

In total, 424 hip fractures occurred in the mental health cohort with an age-and-gender-standardized incidence rate of 13.7 (95% CI: 12.3-15.3) hip fractures per 1000 person-years. In the general population, 484 hip fractures occurred in 2011 with an age- and gender-standardized IRR of 2.78 (95% CI: 2.53-3.05) hip fractures per 1000 person-years. Comparing the patient and the general population the age- and gender-adjusted IRR for hip fractures was 4.18 (95% CI: 3.79-4.60). Examining the individual diagnostic groups (see Table 2), the highest age- and gender-standardized incidence rates for hip fractures were found in patients with a substance use disorder or dementia with rates above 15 hip fractures per 1000 person-years, and the lowest in patients with a psychotic disorder with a rate below 10 hip fractures per 1000 person-years. The highest increase of hip fractures compared with the general population was detected in people with a substance use disorder (IRR: 12.62), and the lowest in MCI (IRR: 2.45).

Risk of First Hospitalized Fall by Diagnostic Group

In total, 15.2% (n = 3366) of the patient cohort had at least 1 hospitalized fall in the follow-up period, with a median interval until first fall or other censoring point of 2.1 years (interquartile range 0.7-4.4). Cox proportional hazard models assessing risk to first fall, comparing those with individual mental health conditions against the remainder of the patient sample, are presented in Table 3.

Risk of Hip Fracture by Diagnostic Group

Of the patient cohort, 5.2% (n = 1146) were hospitalized at least once for a hip fracture, with a median follow-up time to first hip fracture or other censoring point of 2.3 years (interquartile range 0.8-4.7). Cox proportional hazard models assessing risk to first hip fracture comparing those with individual mental health conditions against the remainder of the patient sample are presented in Table 4. After further adjustment for mental health, physical and functional difficulties, as well as prescribed medications, a significantly increased hazard remained for patients with dementia [hazard ratio (HR): 1.18], whereas patients with MCI had a lower risk (HR: 0.71).

Discussion

To our knowledge, we describe the first representative clinical cohort study to assess the risk of hospitalized falls and hip fractures in older adults using mental health services. For the full cohort of more than 20,000 patients aged 60 years and older using a mental health service, we found incidence rates of 60.1 and 13.7 per 1000 person-years for falls for hip fractures, respectively, and a total 15.2% and 5.2% had a fall leading to hospitalization or hip fracture over median 2.1 and 2.3 years follow-up, respectively. When compared to data on more than 160,000 residents in the catchment population, age- and gender-standardized incidence was twice as high for hospitalized fall...
Table 1
Sample Characteristics for the Whole Cohort and by Diagnostic Group

| Diagnoses                  | Whole Cohort (n = 22,103) | Dementia (n = 7,650) | Delirium (n = 2,158) | MCI (n = 1,026) | Substance Use Disorder (n = 1,119) | Psychotic Disorder (n = 1,777) | Bipolar Affective Disorder (n = 542) | Unipolar Depression (n = 542) | Anxiety Disorder (n = 942) | Stress-Related Disorder (n = 1,257) | Other (n = 2,150) | P Value* |
|----------------------------|--------------------------|---------------------|---------------------|----------------|---------------------------------|-------------------------------|-------------------------------|-------------------------------|------------------|------------------------------|--------------------|---------|
| Sociodemographic status and cognitive function | | | | | | | | | | | | |
| Mean age at diagnosis (SD) | 77.0 (9.6)               | 82.1 (7.6)          | 80.9 (8.3)          | 79.3 (8.3)     | 66.6 (6.0)                      | 71.6 (8.1)                   | 70.2 (7.8)                    | 75.2 (9.4)                    | 74.4 (9.1)     | 76.3 (9.3)                   | 69.8 (9.3)         | <.001   |
| Female gender              | 57.3                     | 61.5                | 54.6                | 59.6            | 31.7                           | 58.5                         | 56.1                         | 58.8                         | 67.5            | 55.5                         | 51.1               | <.001   |
| Nonwhite ethnicity         | 22.1                     | 25.7                | 16.8                | 25.5            | 12.3                           | 40.8                         | 17.2                         | 18.5                         | 11.9            | 14.8                         | 17.9               | <.001   |
| Married or cohabiting status | 32.6                    | 33.3                | 31.3                | 34.4            | 28.7                           | 16.7                         | 17.2                         | 35.7                         | 34.1            | 40.9                         | 32.3               | <.001   |
| Mean index of deprivation (SD) | 26.8 (11.7)             | 27.0 (11.5)         | 26.7 (11.8)         | 27.6 (11.1)     | 27.1 (11.5)                    | 29.6 (11.1)                  | 25.5 (12.2)                   | 26.3 (11.9)                   | 25.8 (11.9)     | 27.4 (11.8)                   | 24.9 (12.3)        | <.001   |
| HoNOS symptoms or disorders | | | | | | | | | | | | |
| Overactive, aggressive behavior | 21.6                   | 23.9                | 40.0                | 6.0             | 25.3                           | 23.7                         | 28.3                         | 12.2                         | 13.9            | 10.4                         | 21.0               | <.001   |
| Nonaccidental self-injury  | 4.6                      | 1.4                 | 2.2                 | 0.5             | 11.0                           | 3.6                          | 2.6                          | 13.0                         | 5.4             | 10.8                         | 9.5                | <.001   |
| Problem drinking or drug taking | 5.1                    | 3.2                 | 3.6                 | 3.6             | 73.3                           | 4.6                          | 5.7                          | 5.0                          | 3.8             | 5.0                          | 4.8                | <.001   |
| Cognitive problems         | 56.2                     | 88.7                | 76.1                | 45.4            | 41.9                           | 24.0                         | 17.8                         | 20.6                         | 11.9            | 20.4                         | 34.3               | <.001   |
| Hallucinations or delusions| 18.1                     | 13.6                | 33.4                | 4.9             | 13.8                           | 63.1                         | 8.6                          | 2.9                          | 2.9             | 2.9                          | 20.3               | <.001   |
| Depressed mood             | 13.1                     | 17.7                | 13.5                | 28.3            | 14.0                           | 25.2                         | 75.4                         | 45.3                         | 52.2            | 32.4                         | 36.2               | <.001   |
| HoNOS þ Physical illness or disability score—Comorbidity | | | | | | | | | | | | |
| No or minor problem         | 35.3                     | 41.6                | 9.6                 | 46.1            | 40.9                           | 51.3                         | 47.8                         | 30.0                         | 38.3            | 15.3                         | 36.2               | <.001   |
| Mild problem               | 26.4                     | 27.5                | 23.5                | 30.6            | 27.5                           | 25.4                         | 28.5                         | 23.9                         | 29.4            | 25.4                         | 27.2               |         |
| Moderate-severe problem    | 38.3                     | 30.9                | 66.9                | 23.3            | 31.6                           | 23.3                         | 23.7                         | 46.1                         | 32.3            | 59.3                         | 36.6               |         |
| HoNOS functional problems  | | | | | | | | | | | | |
| Relationship problem       | 22.1                     | 18.3                | 26.2                | 10.3            | 34.7                           | 35.5                         | 29.6                         | 21.8                         | 21.1            | 17.3                         | 33.5               | <.001   |
| Activities of daily living problem | 58.0           | 66.9                | 76.6                | 31.4            | 51.9                           | 41.9                         | 35.0                         | 51.3                         | 39.8            | 61.9                         | 44.0               | <.001   |
| Problem with living conditions | 13.8                   | 13.6                | 14.8                | 9.2             | 24.4                           | 20.1                         | 11.3                         | 12.9                         | 10.1            | 10.1                         | 14.7               | <.001   |
| Problem with occupational and recreational activities | 32.1                  | 32.9                | 36.8                | 16.8            | 37.9                           | 29.6                         | 24.1                         | 37.3                         | 30.2            | 25.6                         | 29.4               | <.001   |
| Medication prescription    | | | | | | | | | | | | |
| Osteoporosis medication    | 3.4                      | 4.7                 | 3.3                 | 4.1             | 1.1                            | 1.7                          | 2.4                          | 3.3                          | 3.4             | 2.4                          | 1.8                | <.001   |
| Calcium/vitamin D          | 6.5                      | 5.9                 | 12.7                | 3.7             | 3.6                            | 6.2                          | 5.7                          | 6.6                          | 6.5             | 8.9                          | 3.7                | <.001   |
| Any anticholinergic        | 48.9                     | 41.2                | 55.9                | 32.2            | 32.1                           | 71.4                         | 73.1                         | 66.1                         | 58.4            | 41.6                         | 33.6               | <.001   |
| Analgesics                 | 20.3                     | 24.0                | 22.3                | 21.6            | 16.5                           | 17.0                         | 20.3                         | 20.3                         | 15.5            | 15.9                         | 13.8               | <.001   |
| Hypnotics                  | 18.5                     | 13.0                | 21.0                | 6.3             | 20.2                           | 25.0                         | 41.9                         | 25.2                         | 33.1            | 14.2                         | 13.9               | <.001   |
| Antihypertensives          | 27.0                     | 32.2                | 26.7                | 34.8            | 14.6                           | 26.2                         | 23.8                         | 28.5                         | 25.9            | 18.1                         | 16.1               | <.001   |
| Antipsychotics             | 21.1                     | 14.4                | 29.5                | 3.3             | 7.9                            | 74.2                         | 59.4                         | 17.9                         | 12.6            | 5.0                          | 16.7               | <.001   |
| Antidepressants            | 35.3                     | 24.4                | 29.5                | 20.2            | 19.6                           | 21.4                         | 38.8                         | 76.5                         | 61.4            | 37.9                         | 27.0               | <.001   |
| Hospitalized fall 1 year before | 8.5                  | 9.9                 | 15.1                | 6.8             | 8.7                            | 3.6                          | 4.2                          | 8.0                          | 5.1             | 9.0                          | 4.2                | <.001   |

HoNOS, Health of the Nation Outcome Scales; SD, standard deviation.
Unless otherwise noted, values are percentages.
*P value for heterogeneity across diagnostic groups, calculated from chi² tests or 1-way analysis of variance.
†At or closest to index date.
‡Ascertained in a window of 1 year around the index date.
and 4 times as high for hip fractures. Although differences existed between the diagnostic subgroups, with incidence of falls more than 12 times as high in substance use disorder and almost 8 times as high in bipolar affective disorder, all 9 diagnostic groups of interest were associated with a higher incidence of fall and/or hip fractures than the general population. In further regression analyses within the patient sample, we found that those with dementia and substance use disorder diagnoses were at an increased risk of both hospitalized fall and hip fracture compared with the remainder of the sample. We found that even in the final model where we adjusted for medications associated with an increased risk of falls and fractures (eg, antidepressants and antipsychotics), the risk of falls and fractures was elevated in the aforementioned groups.

To date, the overwhelming majority of research in older adults has focussed on those with cognitive disorders; although this has indicated that people with dementia, delirium, and MCI are at increased risk of self-reported falls, there has been minimal use of representative health care data to investigate the most severe falls that lead to hospitalization in these cohorts. Similarly, although prior research has also suggested that older people with dementia, delirium, and MCI are at increased risk of hip fractures, sample sizes have been limited. Furthermore, our study is, to our knowledge, the first to establish that older people with dementia are at greatest risk of falls (HR 1.14) and hip fractures (HR 1.18) compared with those with other mental and cognitive disorders.

Beyond cognitive disorders, our findings suggest that older adults receiving mental health care for substance use disorders are also at particularly high risk of falls leading to hospitalization (IRR 6.72), followed by bipolar disorder (IRR 3.62), stress-related disorders (IRR 2.57), and clinical depression (IRR 2.28). A similar pattern was noted for substantially increased risk of hip fractures in each of these populations. Previous small-scale research relying on self-reported information on falls has suggested that older adults with substance use disorder and particularly alcohol use disorder are at increased risk. Potential reasons underlying these findings include intoxication or withdrawal states, as well as the influence of other key established risk factors for falls such as physical co/morbidity, inadequate nutrition, low physical activity and poor lower limb function, high smoking, and lower compliance with walking aids. Future research is clearly needed to identify and understand risk factors for older adults with substance use disorders for falls so that adequate falls prevention interventions can be developed.

To our knowledge, the current study provides the first representative data on falls leading to hospitalization and hip fractures in people with diagnosed bipolar disorder and stress-related disorders. Previous research has suggested that anticonvulsant use may be associated with increased risk of any fracture in older veterans with bipolar disorder. A previous systematic review of 3 studies suggested that bipolar disorder (at any age) was associated with an increased incidence of any fracture vs the general population. Our study advances the field demonstrating the increased risk of falls requiring hospitalization in older adults with bipolar disorder. For stress-related disorders, although previous research has suggested that some cases could arise as a consequence of both a fall and hip fracture and lead to worse outcomes, previous research has also reported that older adults with depressive symptoms, that is, a potentially related group, have an increased risk of hip osteoporosis, self-report falls, and fractures. Our data indicate that people with

Table 3
Hazard Ratios (95% CIs) for Falls in Cox Regression Models for the Diagnostic Groups (Comparing Those With and Without the Respective Diagnosis)

| Diagnostic Group | Unadjusted | Age and Gender | All Demographic Factors | Demographic, Physical Illness, and Previous Fall | Demographics, Mental Health, and Functioning | Demographics and Medications | All Previous |
|------------------|------------|----------------|-------------------------|-----------------------------------------------|-----------------------------------------------|-------------------------------|-------------|
| Dementia (n = 7650) | 1.63 (1.53-1.75) | 1.10 (1.02-1.18) | 1.17 (1.09-1.26) | 1.21 (1.12-1.30) | 1.10 (1.01-1.21) | 1.18 (1.10-1.28) | 1.14 (1.04-1.25) |
| Delirium (n = 2158) | 1.41 (1.25-1.59) | 1.14 (1.01-1.28) | 1.11 (0.98-1.25) | 1.03 (0.91-1.16) | 1.04 (0.93-1.19) | 1.10 (0.97-1.24) | 0.99 (0.88-1.13) |
| MCI (n = 1026) | 1.02 (0.86-1.20) | 0.86 (0.73-1.01) | 0.86 (0.73-1.02) | 0.89 (0.75-1.05) | 0.90 (0.76-1.07) | 0.87 (0.74-1.03) | 0.91 (0.77-1.08) |
| Substance use disorder (n = 1139) | 0.92 (0.79-1.06) | 1.71 (1.46-2.01) | 1.52 (1.29-1.78) | 1.44 (1.23-1.69) | 1.34 (1.13-1.59) | 1.52 (1.29-1.78) | 1.28 (1.08-1.52) |
| Psychotic disorder (n = 1777) | 0.57 (0.50-0.66) | 0.75 (0.65-0.86) | 0.80 (0.69-0.93) | 0.82 (0.71-0.95) | 0.82 (0.71-0.96) | 0.81 (0.69-0.95) | 0.87 (0.74-1.02) |
| Bipolar affective disorder (n = 542) | 0.74 (0.60-0.93) | 1.07 (0.85-1.33) | 1.02 (0.82-1.28) | 1.04 (0.83-1.30) | 1.08 (0.86-1.36) | 1.03 (0.82-1.29) | 1.10 (0.88-1.38) |
| Unipolar depression (n = 3462) | 0.88 (0.80-0.97) | 0.97 (0.88-1.07) | 0.94 (0.85-1.03) | 0.93 (0.84-1.02) | 1.01 (0.91-1.13) | 0.90 (0.81-1.00) | 0.97 (0.87-1.09) |
| Anxiety disorder (n = 942) | 0.68 (0.57-0.83) | 0.76 (0.63-0.91) | 0.71 (0.59-0.86) | 0.74 (0.61-0.89) | 0.78 (0.64-0.94) | 0.70 (0.58-0.85) | 0.77 (0.63-0.94) |
| Stress-related disorder (n = 1257) | 0.94 (0.80-1.11) | 1.01 (0.86-1.19) | 0.96 (0.81-1.13) | 0.92 (0.78-1.08) | 1.02 (0.86-1.21) | 0.95 (0.81-1.12) | 0.99 (0.83-1.17) |

Boldfaced indicates statistical significance (P < .05).
clinical depression specifically have a 2.2 and 3.9 increased risk of hospitalized falls and hip fractures, respectively.

The underlying reasons for the increased risk of falls and hip fractures are likely complex, but include increased physical comorbidity, side effects of common psychotropic medication, vulnerability from lifestyle risk factors (eg, increased smoking, low physical activity, and inadequate diet), potentially diagnostic overshadowing, and difficulty accessing mainstream falls prevention and bone health care pathways. To compound this, current evidence-based guidelines should be noted. First, it was not possible to collect information on all potential confounding factors (eg, pre-fall/hip fracture mobility, balance), which are key risk factors for falls. Second, the study relied only on falls and fractures leading to a hospital admission, which is the most severe end of the spectrum for these outcomes. It is likely that the figures for falls are substantial underestimates of the true risk of falls in older adults with mental disorders. Third, some of the mental disorder groups had relatively small numbers of people, although they were substantially higher than in previous literature.

Conclusions and Implications

Our novel data suggest that older adults using mental health services are at substantially increased risk of falls leading to hospitalization and hip fractures compared with the general population. There is a particularly high risk of falls and hip fractures in those with substance use disorders, bipolar disorder, dementia, MCI, and delirium. Future interventions and care pathways are needed to identify older adults with mental health and cognitive disorders at risk of falls and hip fractures and to prevent these adverse outcomes.

Acknowledgments

Brendon Stubbs is supported by a Clinical Lectureship (ICA-CL-2017-03-001) jointly funded by Health Education England (HEE) and the National Institute for Health Research (NIHR). BS, RS, CM, GP are part funded by the NIHR Biomedical Research Centre at South London and Maudsley NHS Foundation Trust. BS and RS are also part funded by Guy’s & St Thomas Charity (GSTT). This article presents independent research supported by the National Institute for Health Research (NIHR) and GSTT Charity. The views expressed are those of the author(s) and not necessarily those of the (partner organization), the NHS, the NIHR, or the Department of Health and Social Care.

References

1. Vieira ER, Palmer RC, Chaves PH. Prevention of falls in older people living in the community. BMJ 2016;353:i1419.
2. Johnell O, Kanis JA. An estimate of the worldwide prevalence, mortality and disability associated with hip fracture. Osteoporos Int 2004;15:897–902.
3. Deandrea S, Lucenteforte E, Bravi F, et al. Risk factors for falls in community-dwelling older people: A systematic review and meta-analysis. Epidemiology 2010;21:658–668.
4. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev 2012;9:CD007146.
5. Dyer SM, Crotty M, Fairhall N, et al. A critical review of the long-term disability outcomes following hip fracture. BMC Geriatr 2016;16:158.
6. Ouellet JA, Ouellet GM, Romegialli AM, et al. Functional outcomes after hip fracture in independent community-dwelling patients. J Am Geriatr Soc 2019;67:1386–1392.
7. Fransen M, Woodward M, Norton R, et al. Excess mortality or institutionalization after hip fracture: men are at greater risk than women. J Am Geriatr Soc 2002;50:685–690.
8. Leibson CL, Tofteson AN, Gabriel SE, et al. Mortality, disability, and nursing home use for persons with and without hip fracture: A population-based study. J Am Geriatr Soc 2002;50:1644–1650.
9. Sheehan KJ, Sobolev B, Guy P, et al. In-hospital mortality after hip fracture by treatment setting. CMAJ 2016;188:1219–1225.
10. Neuhauß V, King J, Hageman MC, Ring DC. Charlson comorbidity indices and in-hospital deaths in patients with hip fractures. Clin Orthop Relat Res 2013;471:1712–1719.
11. Uzogwe CE, Burnand HG, Cheesman CL, et al. Early and ultra-early surgery in hip fracture patients improves survival. Injury 2013;44:726–729.
12. Recommendations: Abstracted from the American Geriatrics Society Consensus Statement on Vitamin D for Prevention of Falls and Their Consequences. J Am Geriatr Soc 2014;62:147–152.
13. Stubbs B, Gaughan F, Mitchell AJ, et al. Schizophrenia and the risk of fractures: A systematic review and comparative meta-analysis. Gen Hosp Psychiatry 2015;37:126–133.
14. Jeon JH, Park JH, Oh C, et al. Dementia is associated with an increased risk of hip fractures: A nationwide analysis in Korea. J Clin Neurol 2019;15:243–249.
15. Smith DJ, Langan J, McLean G, et al. Schizophrenia is associated with excess multiple physical-health comorbidities but low levels of recorded cardiovascular disease in primary care: Cross-sectional study. BJM Open; 2013:3.
16. Smith DJ, Martin D, McLean G, et al. Multimorbidity in bipolar disorder and undertreatment of cardiovascular disease: A cross sectional study. BMC Med 2013;11:263.
17. Read JR, Sharpe L, Modini M, Dear BF, Multimorbidity and depression: A systematic review and meta-analysis. J Affect Disord 2017;221:36–46.
18. Doraiswamy PM, Leon J, Cummings JL, et al. Prevalence and impact of medical comorbidity in Alzheimer’s disease. J Geriatr Psychiatry Neurol 2002;15:173–177.
19. Stubbs B, Vancampfort D, Veronese N, et al. Depression and physical health multimorbidity: Primary data and country-wide meta-analysis of population data from 190 593 people across 43 low- and middle-income countries. Psychol Med; 2017:1–11.

Table 4

| Hazard Ratios (95% CI) for Hip Fractures in Cox Regression Models for the Diagnostic Groups (Comparing Those With and Without the Respective Diagnosis) | Crude | Age and Gender | All Demographics | Demographics, Physical Illness, and Previous Fall | Demographics, Mental Health, and Functioning | Demographics and Medications | All Previous |
|---|---|---|---|---|---|---|---|
| Dementia (n = 7650) | 2.07 (1.84-2.32) | 1.30 (1.15-1.47) | 1.41 (1.24-1.59) | 1.43 (1.26-1.63) | 1.15 (0.99-1.33) | 1.44 (1.27-1.64) | 1.18 (1.01-1.37) |
| Delirium (n = 2158) | 1.67 (1.37-2.03) | 1.31 (1.07-1.59) | 1.26 (1.04-1.54) | 1.22 (1.00-1.49) | 1.10 (0.89-1.35) | 1.20 (0.99-1.47) | 1.07 (0.87-1.32) |
| MCI (n = 1026) | 0.75 (0.54-1.04) | 0.62 (0.45-0.87) | 0.63 (0.45-0.87) | 0.64 (0.46-0.88) | 0.69 (0.49-0.96) | 0.64 (0.46-0.89) | 0.71 (0.51-0.99) |
| Substance use disorder (n = 1139) | 0.73 (0.55-0.97) | 1.74 (1.30-2.34) | 1.50 (1.11-2.01) | 1.46 (1.09-1.97) | 1.31 (0.95-1.78) | 1.53 (1.04-2.27) | 1.32 (0.97-1.81) |
| Psychotic disorder (n = 1777) | 0.52 (0.40-0.67) | 0.70 (0.54-0.91) | 0.83 (0.64-1.07) | 0.84 (0.65-1.09) | 0.86 (0.68-1.18) | 0.71 (0.54-0.93) | 0.83 (0.62-1.10) |
| Bipolar affective disorder (n = 542) | 0.55 (0.36-0.85) | 0.86 (0.56-1.34) | 0.81 (0.52-1.28) | 0.79 (0.58-1.09) | 0.78 (0.58-1.06) | 0.77 (0.59-1.01) | 0.85 (0.54-1.31) |
| Unipolar depression (n = 3462) | 0.74 (0.63-0.88) | 0.82 (0.69-0.97) | 0.78 (0.65-0.92) | 0.77 (0.65-0.91) | 0.97 (0.80-1.17) | 0.78 (0.65-0.94) | 0.95 (0.78-1.16) |
| Anxiety disorder (n = 942) | 0.81 (0.60-1.10) | 0.88 (0.65-1.20) | 0.80 (0.60-1.05) | 0.83 (0.61-1.12) | 1.02 (0.75-1.39) | 0.83 (0.61-1.13) | 1.04 (0.76-1.42) |
| Stress-related disorder (n = 1257) | 0.88 (0.66-1.18) | 0.98 (0.73-1.30) | 0.91 (0.68-1.21) | 0.89 (0.66-1.19) | 1.10 (0.82-1.48) | 0.93 (0.70-1.24) | 1.13 (0.84-1.52) |

Boldface indicates statistical significance (P < .05).
20. Stubbs B, Koyanagi A, Veronese N, et al. Physical multimorbidity and psychosis: Comprehensive cross sectional analysis including 2,422,952 people across 48 low- and middle-income countries. BMC Med 2016;14:189.

21. Richardson K, Bennett K, Kenny RA. Polypharmacy including falls risk-increasing medications and subsequent falls in community-dwelling middle-aged and older adults. Age Ageing 2013;42:90–96.

22. Wu CS, Chang CM, Tsai YT, et al. Antipsychotic treatment and the risk of hip fracture in subjects with schizophrenia: A 10-year population-based case-control study. J Clin Psychiatry 2015;76:1216–1223.

23. Stubbs BA. meta-analysis investigating falls in older adults taking selective serotonin reuptake inhibitors confirms an association but by no means implies causation. Am J Geriatr Psychiatry 2015;23:1098.

24. Teasdale SB, Ward FB, Samaras K, et al. Dietary intake of people with severe mental illness: Systematic review and meta-analysis. Br J Psychiatry 2019;214:251–259.

25. Vancampfort D, Firth J, Schuch FB, et al. Sedentary behavior and physical activity levels in people with schizophrenia, bipolar disorder and major depressive disorder: A global systematic review and meta-analysis. World Psychiatry 2017;16:308–315.

26. Vancampfort D, Rosenbaum S, Probst M, et al. What are the top 10 physical activity research questions in schizophrenia? Disabil Rehabil 2016;38:2235–2243.

27. Vancampfort D, Rosenbaum S, Probst M, et al. Top 10 research questions to promote physical activity in bipolar disorders: A consensus statement from the International Organization of Physical Therapists in Mental Health. J Affect Disord 2016;190:152–156.

28. Myles N, Newall HD, Curtis J, et al. Tobacco use before, at, and after first episode psychosis: A systematic meta-analysis. J Clin Psychiatry 2012;73:468–475.

29. Gomez L, Stubbs B, Shirazi A, et al. Lower bone mineral density at the hip and lumbar spine in people with psychosis versus controls: A comprehensive review and skeletal site-specific meta-analysis. Curr Osteoporos Rep 2016;14:249–259.

30. Stubbs B, Brefta S, Dallmeier D, et al. Depression and reduced bone mineral density at the hip and lumbar spine: A comparative meta-analysis of studies in adults 60 years and older. Psychosom Med 2016;78:492–500.

31. Healey F, Scobie S, Oliver D, et al. Falls in English and Welsh hospitals: A national observational study based on retrospective analysis of 12 months of patient safety incident reports. Qual Saf Health Care 2008;17:424–430.

32. Fernando E, Fraser M, Hendriksen J, et al. Risk factors associated with falls in older adults with dementia: A systematic review. Physiother Can 2017;69:161–170.

33. Tolpanen AM, Lvikainen P, Soininen H, Hartikainen S. Incident hip fractures among community dwelling persons with Alzheimer’s disease in a Finnish nationwide register-based cohort. PLoS One 2013;8:e59124.

34. Sharma S, Mueller C, Stewart R, et al. Predictors of falls and fractures leading to hospitalization in people with dementia: A representative cohort study. J Am Med Dir Assoc 2018;19:607–612.

35. Sorensen HJ, Jensen SO, Nielsen J. Schizophrenia, antipsychotics and risk of hip fracture: A population-based analysis. Eur Neuropsychopharmacol 2013;23:972–984.

36. Stubbs B, Mueller C, Gaughran F, et al. Anticonvulsant use, bipolar disorder, and association with fear of falling after hip fracture. J Am Geriatr Soc 2017;65:1251–1252.

37. Shi TT, Min M, Zhang Y, et al. Depression and risk of hip fracture: A systematic review and exploratory meta-analysis of cohort studies. Osteoporos Int 2019;30:262–269.

38. Sommerlad A, Perera G, Stewart R, et al. Hospitalisation of people with dementia: Evidence from English electronic health records from 2008 to 2016. Eur J Epidemiol 2019;34:567–577.

39. Noble M, McLennan D, Wilkinson K, et al. The English Indices of Deprivation 2007. The National Archives. London: Communities and Local Government; 2007.

40. Burns A, Beevor A, Lelliott P, et al. Health of the Nation Outcome Scales for elderly people (HoNOS-E); Br J Psychiatry 1999;174:424–427.

41. Oudshorn CGM, Buuren S, Rijkesveld JLA. Flexible Multiple Imputation by Chained Equations of the AVO-95 Survey. Leiden: TNO Prevention and Health, 1999.

42. Rubin DB. Multiple Imputation for Nonresponse in Surveys. Vol 81. London: John Wiley & Sons; 2004.

43. Babine K, Kochan NA, Close JC, et al. Mild cognitive impairment as a predictor of falls in community-dwelling older people. Am J Geriatr Psychiatry 2012;20:845–853.

44. Mosk CA, Mus M, Vroemen JP, et al. Dementia and delirium, the outcomes in elderly hip fracture patients. Clin Interv Aging 2017;12:421–430.

45. Finkelstein E, Prabhu M, Chen H. Increased prevalence of falls among elderly individuals with mental health and substance abuse conditions. Am J Geriatr Psychiatry 2007;15:611–619.

46. Delhaere K, Kochan NA, Close JC, et al. Mild cognitive impairment as a predictor of falls in community-dwelling older people. Am J Geriatr Psychiatry 2012;20:845–853.

47. Korn EL. A Survey Design: A companion to Applied Regression Analysis (2nd ed.). Beverly Hills: Sage Publications; 1983.

48. Sommerlad A, Perera G, Stewart R, et al. Factors associated with response to antidepressant prescription in people with in-patient safety incident reports. Qual Saf Health Care 2008;17:424–430.

49. Oudshorn CGM, Buuren S, Rijkesveld JLA. Flexible Multiple Imputation by Chained Equations of the AVO-95 Survey. Leiden: TNO Prevention and Health, 1999.

50. Sommerlad A, Perera G, Stewart R, et al. Hospitalisation of people with dementia: Evidence from English electronic health records from 2008 to 2016. Eur J Epidemiol 2019;34:567–577.

51. Noble M, McLennan D, Wilkinson K, et al. The English Indices of Deprivation 2007. The National Archives. London: Communities and Local Government; 2007.

52. Burns A, Beevor A, Lelliott P, et al. Health of the Nation Outcome Scales for elderly people (HoNOS-E); Br J Psychiatry 1999;174:424–427.

53. Oudshorn CGM, Buuren S, Rijkesveld JLA. Flexible Multiple Imputation by Chained Equations of the AVO-95 Survey. Leiden: TNO Prevention and Health, 1999.

54. Rubin DB. Multiple Imputation for Nonresponse in Surveys. Vol 81. London: John Wiley & Sons; 2004.

55. Babine K, Kochan NA, Close JC, et al. Mild cognitive impairment as a predictor of falls in community-dwelling older people. Am J Geriatr Psychiatry 2012;20:845–853.

56. Delhaere K, Kochan NA, Close JC, et al. Mild cognitive impairment as a predictor of falls in community-dwelling older people. Am J Geriatr Psychiatry 2012;20:845–853.

57. Mosk CA, Mus M, Vroemen JP, et al. Dementia and delirium, the outcomes in elderly hip fracture patients. Clin Interv Aging 2017;12:421–430.

58. Finkelsstein E, Prabhu M, Chen H. Increased prevalence of falls among elderly individuals with mental health and substance abuse conditions. Am J Geriatr Psychiatry 2007;15:611–619.

59. Delhaere K, Kochan NA, Close JC, et al. Mild cognitive impairment as a predictor of falls in community-dwelling older people. Am J Geriatr Psychiatry 2012;20:845–853.

60. Vancampfort D, Hallgren M, Mugisha J, et al. The prevalence of metabolic syndrome in alcohol use disorders: A systematic review and meta-analysis. Alcohol Alcohol 2016;51:515–521.

61. Vancampfort D, Mugisha J, Hallgren M, et al. The prevalence of diabetes mellitus type 2 in people with alcohol use disorders: A systematic review and large scale meta-analysis. Psychiatry Res 2016;246:394–400.

62. Vancampfort D, Hallgren M, Vandaal H, et al. Test-retest reliability and clinical correlates of the EuroQol test battery in people with alcohol use disorders. Psychiatry Res 2019;271:208–213.

63. Johnstone LE, Parker MJ. Hip fractures and chronic alcohol excess: a series of 7,062 cases. Hip Int 2019;29:449–454.

64. Mezuk B, Morden NE, Ganoczy D, et al. Anticonvulsant use, bipolar disorder, and risk of fracture among older adults in the Veterans Health Administration. Am J Geriatr Psychiatry 2010;18:245–255.

65. Chandrasekaran V, Brennan-Olsen SL, Stuart AL, et al. Bipolar disorder and bone health: A systematic review. J Affect Disord 2019;249:262–269.

66. Korn EL. A Survey Design: A companion to Applied Regression Analysis (2nd ed.). Beverly Hills: Sage Publications; 1983.

67. Mundi S, Chaudhry H, Bhandari M. Systematic review on the inclusion of patients with cognitive impairment in hip fracture trials: A missed opportunity? Can J Surg 2014;57:E141–E145.

68. Voeten SC, Krijnen P, Voeten DM, et al. Quality indicators for hip fracture care, a systematic review. Osteoporos Int 2018;29:1963–1985.

69. Wheatley A, Bamford C, Shaw C, et al. Developing an Intervention for Fall-Related Injuries in Dementia (IFRID): An integrated, mixed-methods approach. BMC Geriatr 2019;19:57.