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Risk of hospitalised falls and hip fractures in working age adults receiving mental health care

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ABSTRACT

Objective: This retrospective cohort study investigates risks of hospitalised fall or hip fractures in working age adults receiving mental health care in South London.

Methods: Patients aged 18 to 64, who received a first mental illness diagnosis between 2008 and 2016 were included. Primary outcome was hospitalised falls, secondary outcome was hip fractures. Age- and gender-standardised incidence rates and incidence rate ratios (IRRs) compared to local general population were calculated. Multivariate Cox proportionate hazard models were used to investigate which mental health diagnoses were most at risk.

Results: In 50,885 patients incidence rates were 8.3 and 0.8 per 1,000 person-years for falls and hip fractures respectively. Comparing mental health patients to the general population, age-and-gender-adjusted IRR for falls was 3.6 (95% CI: 3.3–4.0) and for hip fractures 7.5 (95% CI: 5.2–10.4). The falls IRR was highest for borderline personality and bipolar disorder and lowest for schizophreniform and anxiety disorder. After adjusting for multiple confounders in the sample of mental health service users, borderline personality disorder yielded a higher and anxiety disorder a lower falls risk.

Conclusion: Working age adults using mental health services have almost four times the incidence of hospitalised falls compared to general population. Targeted interventions are warranted.

1. Introduction

Falls are a significant public health issue, especially in older adults [1], resulting in disability, poor life quality and premature mortality [2]. Falls are a leading cause of fractures, with hip fractures being associated with adverse outcomes [3]. Approximately 1.5 million fractures occur per year [4]. Up to 25% 1-year mortality has been reported following a hip fracture [5], and over half of patients with hip fractures do not return to their baseline level of function [6]. The causes of falls and hip fractures are multifactorial, including increasing age [7], osteoporosis and physical comorbidities [8,9]. Preventing falls and hip fractures is a major global health priority [10].

People with mental disorders may have a higher risk for falls and hip fractures due to medications [11,12], polypharmacy, multimorbidity [13,14], sedentary lifestyle [15], smoking and alcohol consumption [16]. For people with depression, frontal lobe changes [17] and reduced grey matter volume [18], may be associated with balance and gait problems [19], and lower bone formation has also been documented in patients with anorexia nervosa [20] and borderline personality disorder (BPD) [21]. Working age adults (i.e., adults of an age at which people
are typically engaged in work) with depression and schizophrenia also have reduced hip bone mineral density (BMD) and higher risk of osteoporosis [22,23], both strong predictors of fractures [12,19]. Similar deficits in bone health occur in working age adults with anorexia nervosa, although findings vary [24,25]. For working age adults with mental health problems, injuries from falls and concomitant loss of income due to their mental health diagnoses may lead to significant economic consequences. Therefore, filling in this knowledge gap will identify mental health populations at high-risk who will benefit from screening for risk factors, early sign of osteoporosis and preventive measures.

There are few studies investigating risks of falls and hip fractures in working age adults with mental disorders considering different diagnostic groups, mostly with limited sample sizes for anxiety disorders, bipolar disorders and BPD [26–28]. We therefore carried out a retrospective cohort study utilising routine healthcare data to examine the risks for hospitalised falls or hip fractures among working age adults with various mental health diagnoses.

2. Methods

Data were extracted using the Clinical Record Interactive Search (CRIS) resource, which renders a de-identified version of the South London and Maudsley NHS Foundation Trust’s (SLaM) electronic record available for research purposes [29]. CRIS is one of Europe’s largest mental health care providers, serving a population of more than 1.3 million people in four south London boroughs (Lambeth, Lewisham, Southwark, and Croydon). CRIS operates within a robust, patient-led governance framework [30,31] and has received ethical approval as a de-identified data resource for secondary analysis (Oxford Research Ethics Committee C, reference 18/SC/0372). CRIS is linked to national data on hospitalisation within England (Hospital Episode Statistics (HES)) and mortality data from the Office of National Statistics (ONS), and data from CRIS have been considerably supplemented through natural language processing applications using Generalised Architecture for Text Engineering (GATE) software, applying information extraction techniques to derive structured information from free text fields in the mental health record [29]. The current analysis builds on a wider body of work examining falls and fractures in cohorts of patients in contact with mental health services [13,14,32].

2.1. Participants

We included all SLaM patients who received one of the mental disorder diagnoses outlined below between 1st January 2008 and 31st March 2016 who were between the age of 18 and 64 years at first diagnosis during that period. Mental health diagnoses were ascertained from a structured field in the source record [33], which is mandatory to complete for clinicians, with high rates of completion. Diagnoses are given by mental health care specialists according to ICD-10 [34], following a discussion in a multidisciplinary team. Compared to research-based diagnoses, ICD-10 diagnoses are accurate and consistent, with about 90% diagnostic specificity [35].

We defined diagnostic categories according to ICD-10 [34] criteria: schizoaffective disorder (F20–29), bipolar disorder (F30, F31), unipolar depression (F32, F33), any anxiety disorder (including OCD; F40–F42), any eating disorder (F50), or BPD (F60.3). The grouping of diagnostic categories was undertaken based on the electronic patient mental health record, assigning only one category to each individual patient, whereby we gave earlier ICD-10 codes precedence over later ones (e.g. those diagnosed with both paranoid schizophrenia (F20) and BPD (F60.3) would be assigned to the schizoaffective disorder group). The date of the first recorded diagnosis (in a structured field in the source record) after the age of 18 years in the observation window served as index date for further analyses and ascertainment of covariates.

2.2. Outcomes

The primary outcome was a fall leading to hospitalisation and the secondary outcome was a hip fracture, both ascertained from discharge diagnoses ascertained from linked HES data. A hospitalised fall was ascertained if discharge diagnoses included an ICD-10 code of W00–19 [13,14], and a hip fracture from an ICD-10 code of S72. First, we identified all falls and hip fractures occurring in the first year after the index date. All patients were further followed-up until at censoring point for Cox regression analyses, which was either the first fall or hip fracture, death or 31st March 2017.

2.3. Covariates

Demographic information recorded at or closest to the index date comprised age, gender, index of multiple deprivation (developed to identify small area concentrations of deprivation) [36,37], ethnicity, coded as either white (British, Irish, other White) and non-white (Black, Asian, mixed-race, and other non-White), and cohabiting status, was ascertained. Cohabiting status which was dichotomised into cohabiting (civil partnership, married, cohabiting) and non-cohabiting (single, divorced, civil partnership dissolved, widowed, separated) groups.

The Health of the Nation Outcome Scales (HoNOS), which are routinely used in UK mental health services and recorded as structured data on the electronic health record [38] were extracted within 6 months before or after the index date. The subscales obtained measured difficulties (i.e. overactive, aggressive, disruptive or agitated behaviour, non-accidental self-injury, problematic drinking or drug taking, cognitive problems, physical illness or disability problems, problems associated with hallucinations and delusions, problems with depressed mood, other mental and behavioural problems). HoNOS subscale scores for each item range from 0 (no problem) to 4 (severe problem). For physical illness we created an ordinal scale (0–1: no or minor problem; 2: mild problem; 3–4: moderate to severe problem) and dichotomised the scores of all other scales into ‘no or mild problem’ (score 0–1) and ‘problem present’ (score 2–4). From HES data, we further established whether patients had at least one hospitalised fall in the year before index date.

Medications received by participants were ascertained from structured medication fields supplemented by natural language processing algorithms applied to free text [33]. The algorithm performance has been previously evaluated; in a random sample of 100 free-text documents related to antipsychotic use, precision (positive predictive value) for ‘ever use’ was 96% and ‘current use’ at document level 82%. In a different random sample recall (sensitivity) for ‘current use’ was 90% [39]. Medication use was ascertained from records 6 months before and to 6 months after the index date and classified as present/absent binary variables relating to the following medication groups: medications for osteoporosis, calcium/vitamin D supplementation, anticholinergics, analgesics, hypnotics, antihypertensives, antipsychotics, and antidepressants.

2.4. Statistical analysis

We used STATA 13 (StataCorp, 2013) for all analyses. First, we compared the six diagnosis categories in terms of demographic, symptom, functioning and medication prescription baseline variables. Next, the number of hospitalised falls or hip fractures were ascertained in the first year after the initial diagnostic statement in the whole cohort of mental disorders and subgroups according to diagnostic group. Multiple events for a single person, if occurring, were counted. We calculated age-and-gender-standardised incidence rates of these outcomes in the 18–64 years age range, indirectly standardising number of outcomes in the mental disorder groups to the expected number of outcomes in the local general population according to age-group and gender strata (age-groups commencing at 18–24 followed by 5-year groups thereafter).

Lastly, we constructed multivariable Cox proportionate hazard
models of increasing complexity comparing each condition to remainder of the mental health patient sample (e.g. comparing those with a psychotic disorder to those with all other mental health conditions combined) with first hospitalised fall or first hospitalised hip fracture as the outcome variable. If no fall or hip fracture occurred, the censoring point was either the date of death or 31st March 2017.

A substantial degree of missingness was present in the covariates used in the Cox regression models (ethnicity: 5%, cohabiting status 10%, deprivation score 3%, each HoNOS subscale 42–43%). Hence, imputed samples were used if more than 10% missingness would have occurred in the complete case sample. We imputed missing values using chained equations to maximise statistical power [40] using the mi package in STATA to create twenty-five imputed datasets by replacing missing values through simulated values assembled from potential covariates and outcome values. We applied Rubin’s rules [41] to combine coefficients in final analyses.

3. Results

We identified 50,885 patients between the age of 18 and 64 with one of the predefined mental health diagnoses in the observation period. The mean (SD) age was 37.9 (11.9) years and 56.2% were female. In terms of diagnostic group, 14,902 (29.3%) were grouped as having a schizophrreniform disorder, 4,986 (9.8%) with bipolar disorder, 21,979 (43.2%) with unipolar depression, 4,354 (8.5%) with an anxiety disorder (including OCD), 2,892 (5.7%) with an eating disorder, and 1,772 (3.5%) with BPD. The largest group were those with psychotic disorder, of which 2,013 (13.5%) had a co-morbid lifetime diagnosis of bipolar affective disorder and 2,112 (14.2%) of unipolar depression. Of those with bipolar disorder 653 (13.1%) had a co-morbid lifetime diagnosis of BPD and of those with unipolar depression 1,268 (5.8%) had a co-morbid lifetime diagnosis of BPD.

Baseline characteristics for the diagnostic groups are presented in Table 1. Except for the rarely recorded medications for osteoporosis, baseline differences across groups were significant for all covariates. Patients with an eating disorder were the youngest group with the largest proportion of females. Patients with unipolar depression or anxiety disorder were most likely to be married or cohabiting and patients with schizophreniform disorder or BPD least likely. The highest proportion of ethnic minorities was in the schizophreniform disorder

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Table 1

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>Whole cohort (n = 50,885)</th>
<th>Psychotic Disorder (n = 14,902)</th>
<th>Bipolar Affective Disorder (n = 4,986)</th>
<th>Unipolar Depression (n = 22,027)</th>
<th>Anxiety Disorder &amp; OCD (n = 4,954)</th>
<th>Eating disorder (n = 2,892)</th>
<th>Borderline personality disorder (n = 1,772)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heads</td>
<td>83</td>
<td>38.6 (11.9)</td>
<td>38.8 (11.9)</td>
<td>36.4 (11.9)</td>
<td>29.3 (9.2)</td>
<td>33.1 (10.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>Gender</td>
<td>56.2%</td>
<td>39.8%</td>
<td>46.5%</td>
<td>12.6%</td>
<td>9.5%</td>
<td>3.6%</td>
<td>0.001</td>
</tr>
<tr>
<td>Socio-demographic status and cognitive function²</td>
<td>14,902</td>
<td>14,902</td>
<td>14,902</td>
<td>14,902</td>
<td>14,902</td>
<td>14,902</td>
<td>14,902</td>
</tr>
<tr>
<td>Mean age at diagnosis (SD)</td>
<td>37.9 (11.9)</td>
<td>39.0 (11.8)</td>
<td>38.6 (11.9)</td>
<td>38.8 (11.9)</td>
<td>36.4 (11.9)</td>
<td>29.3 (9.2)</td>
<td>33.1 (10.5)</td>
</tr>
<tr>
<td>Female gender (%)</td>
<td>56.2%</td>
<td>39.8%</td>
<td>61.8%</td>
<td>61.0%</td>
<td>52.8%</td>
<td>93.7%</td>
<td>67.1%</td>
</tr>
<tr>
<td>Non-white Ethnicity</td>
<td>39.2%</td>
<td>55.8%</td>
<td>30.5%</td>
<td>37.2%</td>
<td>22.5%</td>
<td>15.8%</td>
<td>23.4%</td>
</tr>
<tr>
<td>Married or cohabiting (%)</td>
<td>39.2%</td>
<td>55.8%</td>
<td>30.5%</td>
<td>37.2%</td>
<td>22.5%</td>
<td>15.8%</td>
<td>23.4%</td>
</tr>
<tr>
<td>Mean index of deprivation (SD)</td>
<td>28.0 (11.4)</td>
<td>30.1 (10.8)</td>
<td>27.0 (11.5)</td>
<td>28.1 (11.2)</td>
<td>25.0 (12.3)</td>
<td>23.3 (11.6)</td>
<td>28.6 (12.1)</td>
</tr>
<tr>
<td>HoNOS symptoms/disorders (%)²</td>
<td>17.9%</td>
<td>23.6%</td>
<td>26.0%</td>
<td>12.1%</td>
<td>11.1%</td>
<td>10.5%</td>
<td>28.7%</td>
</tr>
<tr>
<td>Overactive, aggressive behaviour</td>
<td>14.9%</td>
<td>7.2%</td>
<td>13.0%</td>
<td>20.9%</td>
<td>9.3%</td>
<td>14.1%</td>
<td>38.5%</td>
</tr>
<tr>
<td>Non-accidental self-injury</td>
<td>16.7%</td>
<td>18.8%</td>
<td>17.7%</td>
<td>15.2%</td>
<td>9.8%</td>
<td>11.1%</td>
<td>33.1%</td>
</tr>
<tr>
<td>Problem-drinking or drug taking</td>
<td>11.7%</td>
<td>17.3%</td>
<td>10.1%</td>
<td>8.3%</td>
<td>7.5%</td>
<td>11.1%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Cognitive problems</td>
<td>24.0%</td>
<td>51.7%</td>
<td>17.4%</td>
<td>8.1%</td>
<td>4.6%</td>
<td>2.8%</td>
<td>11.4%</td>
</tr>
<tr>
<td>Hallucinations or delusions</td>
<td>55.1%</td>
<td>29.1%</td>
<td>49.1%</td>
<td>78.1%</td>
<td>48.5%</td>
<td>57.1%</td>
<td>60.8%</td>
</tr>
<tr>
<td>Depressed mood</td>
<td>145.8%</td>
<td>84.3%</td>
<td>83.1%</td>
<td>25.5%</td>
<td>13.4%</td>
<td>10.6%</td>
<td>15.3%</td>
</tr>
<tr>
<td>HoNOS Physical illness or disability scale – Co-morbidity (%)²</td>
<td>121.1%</td>
<td>11.4%</td>
<td>9.7%</td>
<td>13.4%</td>
<td>10.6%</td>
<td>15.3%</td>
<td>11.7%</td>
</tr>
<tr>
<td>Moderate - severe problem</td>
<td>9.0%</td>
<td>6.7%</td>
<td>6.0%</td>
<td>11.5%</td>
<td>6.5%</td>
<td>12.6%</td>
<td>8.1%</td>
</tr>
<tr>
<td>HoNOS functional problems (%)²</td>
<td>37.6%</td>
<td>35.9%</td>
<td>33.3%</td>
<td>39.0%</td>
<td>34.8%</td>
<td>37.7%</td>
<td>58.1%</td>
</tr>
<tr>
<td>Relationship problem</td>
<td>23.6%</td>
<td>27.4%</td>
<td>18.1%</td>
<td>21.9%</td>
<td>24.1%</td>
<td>31.5%</td>
<td>17.1%</td>
</tr>
<tr>
<td>Activities of daily living problem</td>
<td>17.8%</td>
<td>22.7%</td>
<td>13.3%</td>
<td>16.8%</td>
<td>10.3%</td>
<td>8.0%</td>
<td>18.6%</td>
</tr>
<tr>
<td>Problem with living conditions</td>
<td>28.2%</td>
<td>31.8%</td>
<td>22.9%</td>
<td>27.6%</td>
<td>23.2%</td>
<td>23.0%</td>
<td>27.5%</td>
</tr>
<tr>
<td>Problem with occupational and recreational activities</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.1%</td>
<td>0.2%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Medication prescription (%)³</td>
<td>1.8%</td>
<td>2.5%</td>
<td>1.7%</td>
<td>0.9%</td>
<td>0.6%</td>
<td>6.5%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Osteoporosis medications</td>
<td>50.7%</td>
<td>75.2%</td>
<td>61.2%</td>
<td>41.3%</td>
<td>30.0%</td>
<td>10.2%</td>
<td>47.1%</td>
</tr>
<tr>
<td>Calcium / Vitamin D</td>
<td>7.2%</td>
<td>9.6%</td>
<td>8.6%</td>
<td>6.2%</td>
<td>3.2%</td>
<td>2.8%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Any anticholinergic</td>
<td>27.6%</td>
<td>41.4%</td>
<td>37.5%</td>
<td>21.3%</td>
<td>14.8%</td>
<td>4.9%</td>
<td>29.4%</td>
</tr>
<tr>
<td>Analgesics</td>
<td>4.1%</td>
<td>6.4%</td>
<td>4.3%</td>
<td>3.6%</td>
<td>1.8%</td>
<td>0.5%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Hypnotics</td>
<td>34.0%</td>
<td>75.6%</td>
<td>46.5%</td>
<td>12.6%</td>
<td>9.5%</td>
<td>3.6%</td>
<td>24.4%</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>43.4%</td>
<td>28.4%</td>
<td>41.8%</td>
<td>58.1%</td>
<td>36.3%</td>
<td>22.0%</td>
<td>43.2%</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>0.8%</td>
<td>0.7%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>0.6%</td>
<td>0.1%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

1 - p-value calculated chi² test or one-way ANOVA.
2 - at or closest to index date.
3 - ascertained in a window of one year around index date.
group, with more than half identifying with a non-white background. A hospitalised fall in the year before index date was present in 0.8% of all patients; most frequently in patients with BPD with 1.7%.

3.1. Incidence of hospitalised falls and hip fractures in the year after index date

In whole cohort of mental health patients, 408 hospitalised falls occurred in the year after index date, whereby 320 patients had one fall and 35 patients two or more in this time-period. The age-and-gender-standardised incidence rate was 8.3 (95% CI 7.5–9.2) falls per 1,000 person-years.

For 50,877 mental health patients sufficient data for age- and gender standardisation was available and Table 2 shows incidence rates per 1,000 person-years and incidence rate ratios according to diagnostic groups. The local catchment area population comprised 846,097 residents aged 18 to 64 years, suffering 1970 hospitalised falls over one year, and the age-and-gender-standardised incidence rate for this local catchment population was 2.3 (95% CI: 2.2–2.4) falls per 1,000 person-years. For all patients under mental health services the age-and-gender-standardised incidence rate was substantially higher with 8.3 (95% CI: 7.5–9.2) falls per 1,000 person-years. Patients with anxiety disorders (including OCD) and eating disorders had the lowest age- and gender-adjusted incidence rates of hospitalised falls with around 4 falls per 1,000 person years. By far the group with the highest incidence rate was detected in people with BPD with 23 falls per 1,000 person-years.

Comparing the group of mental health patient and the local general population, the incidence rate ratio (IRR) for falls was 3.6 (95% CI: 3.3–4.0). Patients with BPD had the highest IRR for falls (IRR = 13.23; 95% CI: 9.6–18.0), followed by bipolar disorder (IRR = 4.2; 95% CI: 3.0–5.6) and unipolar depression (IRR = 4.0; 95% CI: 3.5–4.6), while eating disorders (IRR = 3.6; 95% CI: 2.0–5.9) showed a similar rate to the overall cohort. Finally, patients with schizophrenia (IRR = 2.6, 95% CI: 2.1–3.1) and anxiety (IRR = 1.7, 95% CI: 1.0–2.8) disorders had lower ratios compared to the mental health population average, with the latter being closest to the general population.

Hip fractures were rare, with in total 34 occurring in the cohort of 50,885 patients with mental illness in the year after index date (27 patients had one hip fracture and 3 two or more hip fractures) and 83 in the general local population of 846,097 people. In the whole cohort of 50,877 mental health patients for whom date for age-and-gender standardisation was available, the age-and-gender-standardised incidence rate was 0.8 (95% CI: 0.5–1.1) per 1000 person-years and incidence rate ratio compared to the local general population was 7.5 (95% CI: 5.2–10.4).

3.2. Risk of first hospitalised fall or hip fracture comparing across people with mental disorders

Of 50,885 patients under mental health services, 1,385 (2.7%) had a hospitalised fall over a mean (SD) follow-up time (to fall, death or census) of 5.43 (SD 2.47) years. By diagnostic groups, 410 people with schizoaffective disorder had a fall, 133 with bipolar disorder, 622 with unipolar depression, 78 with anxiety disorder, 43 with an eating disorder, and 99 with BPD.

Findings from Cox proportional hazard models assessing risk to first fall comparing each individual diagnostic group against the remainder of the sample (e.g. comparing those with a psychotic disorder to those with all other mental health conditions combined) are presented in Table S. After adjustment for all covariates, an 89% higher falls hazard in patients with BPD and a 34% reduced falls hazard in patients with an anxiety disorder remained significant. The 26% reduced falls hazard in patients with an eating disorder was non-significant (p = 0.070).

Over a mean follow-up time (to hip fracture, death or census) of 5.52 (SD 2.44) years, 151 (0.3%) patients under mental health services had a hip fracture. Specifically, 48 patients with schizoaffective disorder had a hip fracture, 11 patients with bipolar disorder, 67 patients with unipolar depression, 10 patients with an anxiety disorder, 6 with an eating disorder, and 9 with BPD. In Cox full adjusted regression, no significant associations between mental health diagnosis and hip fracture risk were detected for any group (see Supplementary Table 1).

4. Discussion

To our knowledge, this is the first study using routine healthcare data to identify risks for hospitalised falls or hip fractures among working age adults with mental health diagnoses received in specialist care, compared to the general population. According to our results, the incidence of falls and hip fractures in people with mental health conditions during the year of the diagnosis is higher than the general population baseline; however, hip fracture were rare. Among patients with inclusion diagnoses, those with BPD had the highest incidence rate of hospitalised falls, while those with anxiety disorders and eating disorders had the lowest.

There can be several explanations for the higher risk of falls reported in our population of mental health service users. A follow-up study on older Australians found three measures of well-being linked to falls, specifically higher depressive symptoms, lower control, and lower morale [42], and we know that over 50% of our cohort reported depressive mood, about 27% reported relationship problems and 28% had problems with occupational or recreational activities. These points indicate an overall low well-being in our sample which could impact certain domains of control relevant to physical functioning [43]. Moreover, 17.8% of our sample also reported problems with living conditions, which could lead to environmental hazards causing a further risk of falls. Another potential explanation is that, depending on specific diagnoses, people attending mental health services may engage in adverse health behaviours leading to higher risk of falls [44,45]. Finally, a good portion of our sample used anticholinergic and/or antidepressants drugs, and both report an association with risk of fall [46,47], potentially through increased risks for movement and seizure disorders, as reported in a review on the effects of antipsychotics, antidepressants and mood stabilizers on people with schizophrenia, depression and bipolar disorder [48]. Fractures were rarer in our population, but still more frequent compared to the general population. This higher risk in our sample could be attributable to deficits in BMD associated with mental health conditions [19,24,25,49].

Interestingly, our analysis reported that patients with BPD had the highest incidence of falls compared to general population, as well as a higher risk of falls and fractures compared to other diagnostic groups. According to our demographic data, patients with BPD report high recurrence of overactive and aggressive behaviours, non-accidental self-
injuries and problematic alcohol/drug abuse, which might have accounted for the significant risk of falls. Moreover, patients with BPD often report stressful events early in life, such as childhood abuse and parental neglect [50], which can result in changes in body composition, malnutrition, and lack of physical activity [51], further contributing to higher risks of falls and fractures. While we could not identify the potential comorbidities in our patients, demographic data report that at least 60% of the sample with BPD had depressive symptoms, and 43.2% were prescribed antidepressants, which are both associated with low BMD [52,53] and higher risk of fractures [22,53]. Furthermore, BPD patients are more likely to have medical comorbidities involving nearly all organs compared to patients without mental illness [54], which could also explain the higher risk for falls in this population.

Despite the association between low BMD and eating disorders reported in literature [25], patients with eating disorders and anxiety disorder had the lowest incidence of falls, while patients with anxiety disorder and schizoaffective disorder reported the lowest incidence risk compared to general population. Regarding patients with anxiety disorder, this might be due to safety-seeking behaviours our analysis could not account for, but are common among these patients [55], and might be a protective factor against falls in leading to risk-avoidant behaviours [56]. In case of eating disorders, we know these patients often engage in weight-loss activities such as exercise [57], which can be preventive against risk of falls [58]; alternatively, since excessive exercise in eating disorders may accelerate weight loss, reduce BMD and lead to complications associated with body weight [59], it could be that exercise restrictions recommended for patients with eating disorders [60] may account for the reduced fall risks in patients with eating disorders in our sample.

Our study comes with several strengths, like a wide population, as well as comparing single diagnostic groups both with each other and with the general population. Analyses within the cohort of mental health service users could be controlled for many potential confounders (e.g. medications, symptoms, functional problems) However, some limitations need to be considered. First, our comparison to the general population was standardised for age and gender, but could not be adjusted for medical co-morbidities, as this data isn’t available for those in our catchment area. Since medical co-morbidities could lead to higher rates of mental illness [61], causality cannot be inferred in our analysis. However, in our mental health population about one fifth had a problem with physical health (see Table 1), similarly to general population [62,63], and can therefore at population level not fully explain the substantially increased risk of hospitalised falls we found. Future studies should assess cohorts with and without mental illness matched for medical co-morbidity. Second, when comparing within the group of mental health service users, we use the HoNOS Physical Illness and Disability scale to account for physical co-morbidity. This scale is relatively brief without details on the specific long-term conditions defining its score, but it has been shown to predict adverse outcomes, including falls, in this data [13,64].

Third, while we considered psychotropic medication use, we could not investigate the contribution of specific agents. Fourth, we could not verify under which conditions falls occurred, and similarly what site/type of hip fractures were reported. Fifth, only a small number of people could be retrieved for certain groups (e.g. patients with BPD and eating disorders); however, our sample was still substantially larger than in previous studies. Moreover, while we controlled for presence of co-morbidities, we could not identify the most recurrent ones (e.g. hypertension and diabetes) [65], which could have partly explained our results. Finally, certain confounders could not be investigated in the current study, such as balance and mobility [66] or health behaviours like alcohol consumption or smoking [16].

Nonetheless, our study has relevant implications. Hospitalised falls and fractures are mainly examined in older populations, but our results report they also recur among working age adults attending mental health services, suggesting a need to examine the risk factors associated to falls and fractures in more populations. Moreover, our results suggest that patients with certain diagnosis (e.g. BPD) should receive more frequent checks for BMD and osteoporosis to prevent hospitalizations. People with mental health problems struggle with accessing screening resources and receiving proper attention when it comes to physical health controls [67]. Programmes aimed at improving physical and mental health, such as exercise [68,69], could also result as a positive effect on physical health [70], reducing the risk of falls and fractures in this population. Future studies should consider long-term effects of prevention interventions on falls and fractures among people attending mental health services, focussing on risk factors for specific patient groups utilising mental health services, such as patients with BPD, as our study underscores an exceptional higher risk for falls and fractures in patients with BPD. This work highlights a need to investigate the mechanisms by which specific BPD risk factors undermine BMD in this vulnerable patient group, calling for targeted interventions and preventive measures as part of treatment of patients with BPD.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.genhosppsych.2021.07.006.

### Table 3

Hazard ratios (95% CIs) for falls in Cox regression models for the diagnostic groups (comparing those with and without the respective diagnosis).

<table>
<thead>
<tr>
<th></th>
<th>Crude (n = 50,885)</th>
<th>Adjusted for age and gender (n = 50,877)</th>
<th>Adjusted for age, gender, ethnicity, deprivation (n = 46,666)</th>
<th>Adjusted for age, gender, ethnicity, deprivation, medications, previous fall (n = 46,666)</th>
<th>Adjusted for age, gender, ethnicity, deprivation, cohabiting status, HoNOS disability score (imputed, n = 50,885)</th>
<th>Adjusted for age, gender, ethnicity, deprivation, cohabiting status, HoNOS disability score (imputed, n = 50,885)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychotic disorder</td>
<td>0.98 (0.87-1.10)</td>
<td>0.90 (0.80-1.01)</td>
<td>1.06 (0.94-1.21)</td>
<td>1.07 (0.92-1.24)</td>
<td>1.10 (0.95-1.28)</td>
<td>1.07 (0.92-1.25)</td>
</tr>
<tr>
<td>Bipolar disorder</td>
<td>0.97 (0.81-1.16)</td>
<td>0.94 (0.79-1.12)</td>
<td>0.88 (0.74-1.06)</td>
<td>0.84 (0.70-1.01)</td>
<td>0.91 (0.76-1.09)</td>
<td>0.86 (0.72-1.04)</td>
</tr>
<tr>
<td>Unipolar depression</td>
<td>1.10 (0.99-1.23)</td>
<td>1.05 (0.95-1.17)</td>
<td>0.99 (0.89-1.11)</td>
<td>1.00 (0.88-1.14)</td>
<td>1.02 (0.90-1.15)</td>
<td>1.04 (0.92-1.18)</td>
</tr>
<tr>
<td>Anxiety disorder</td>
<td>0.63 (0.50-0.79)</td>
<td>0.67 (0.53-0.84)</td>
<td>0.62 (0.49-0.78)</td>
<td>0.66 (0.52-0.84)</td>
<td>0.62 (0.49-0.78)</td>
<td>0.66 (0.52-0.84)</td>
</tr>
<tr>
<td>Borderline disorder</td>
<td>2.34 (0.39-0.71)</td>
<td>2.97 (0.62-1.15)</td>
<td>2.71 (0.54-1.02)</td>
<td>2.39 (0.58-1.10)</td>
<td>2.04 (0.50-0.94)</td>
<td>1.89 (0.54-1.02)</td>
</tr>
<tr>
<td>Personality disorder</td>
<td>1.91 (1.91-2.87)</td>
<td>2.42 (2.42-3.65)</td>
<td>2.19 (2.19-3.35)</td>
<td>1.93 (2.19-2.96)</td>
<td>1.64 (2.42-2.54)</td>
<td>1.52 (2.36-2.36)</td>
</tr>
</tbody>
</table>
References
