Primary biliary cirrhosis is associated with falls and significant fall related injury


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Summary

Background: Osteoporosis and autonomic dysfunction are prevalent in the autoimmune liver disease primary biliary cirrhosis (PBC). Postural hypotension is one consequence of autonomic dysfunction and is a recognized risk factor for falls, which, alongside osteoporosis could lead to significant injury and fractures.

Aim: To determine the prevalence and sequelae of falls in PBC and to identify modifiable risk factors.

Design: Cross-sectional, geographical, population census of PBC and two control groups: primary sclerosing cholangitis and a community dwelling population. Multidisciplinary falls assessment of a representative group of PBC.

Methods: Symptom assessment tools, completed by the three cohorts, determined the prevalence of falls, injuries and associated symptoms. Multidisciplinary assessments, adhering to NICE guidelines, identified modifiable fall associations.

Results: Significantly more of the PBC population had fallen (72%, \(P<0.001\)) than both control groups. Fifty-five percent had fallen in the last year (\(P<0.001\)), and 22% more than once in the last year (\(P<0.01\)). Seventy percent of PBC fallers were injured, 27% fractured a bone and 19% were admitted to hospital, all significantly more common than controls. Postural dizziness was significantly worse in fallers (\(P<0.001\)), as were balance (\(P<0.001\)) and lower limb strength (\(P=0.002\)). Lower limb strength was independently associated with number of falls in previous year (\(\beta=0.184, P<0.001\)).

Conclusion: Falls and resultant injury are prevalent in PBC and more common than previously recognized. Addressing postural dizziness, poor balance and lower limb weakness using a multidisciplinary approach has the potential to reduce falls, morbidity and mortality and as a result improve quality of life.

Introduction

Primary biliary cirrhosis (PBC) is an autoimmune, cholestatic, chronic liver disease that predominantly affects females in middle or early old age.\(^1\) In addition to the direct effects of liver-related disease processes that affect these patients, it is increasingly being recognized that they suffer from a range of co-morbid processes. These are less directly linked to the severity of underlying liver disease, but give rise to their own, specific risks to patients. The aim of this study is to address the risk of falls.

Several studies have confirmed that autonomic dysfunction, which is a significant risk factor for falls,\(^2\) is highly prevalent in PBC at all stages of the disease.\(^3\)–\(^6\) Furthermore, recent studies from our
group have demonstrated abnormalities in skeletal muscle function in PBC patients which could also potentially predispose this group to falls. The potential impact of falls in PBC patients could, in turn, be increased by the high prevalence of osteoporosis (linked to both demographic and directly disease-related factors) reported in PBC. Falls, whether injurious or benign, can result in considerable physical and social consequences. The importance of these devastating corollaries have been recognized by the National Institute for Clinical Excellence (NICE) and the National Service Framework of the UK Government. Given the increased incidence of both potential risk-factors for falls in PBC and processes likely to increase morbidity associated with falls, we postulated that falls and fall-related injuries might be increased in their prevalence in PBC. In order to address this important clinical question, we examined the prevalence of self-reported falls and fall-related injuries in a comprehensive, geographically defined cohort of patients with PBC, and objectively assessed falls risk factors by multidisciplinary falls team assessment in a representative patient subgroup.

**Methods**

**Participants**

The patient recruitment process is illustrated in Figure 1. The PBC patient cohort was derived from a geographically defined area (NE1–NE25 postal code cohort). This cohort is continuously updated and the rationale for studying this population, and the methods used to identify its members, have previously been described. To be eligible for inclusion patients had to have definite (all three of anti-mitochondrial antibody or PBC-specific anti-nuclear antibody at a titre of >1:40 by immuno-fluorescence, cholestatic liver function tests and compatible liver histology) or probable (two out of the three above criteria) disease as previously defined. Symptom assessment tools were sent to each patient on the database who had consented to be contacted for future research or service development purposes. The entire cohort was also invited to attend our Specialist Falls Service for a full multidisciplinary falls assessment, whether they had fallen or not.

**Control groups**

1. Participants with Primary Sclerosing Cholangitis were recruited as a biliary disease control group. Diagnosis of PSC was made in patients who demonstrated cholangiographic evidence of bile duct disease compatible with PSC shown by ERCP or MRCP and compatible liver histology. This control group was identified and approached in an identical manner to the PBC cohort (continuously updated database), and originate from the same geographical area, this group has also been described previously. Given the demographic of the patient with PSC (typically younger males) it was only possible to match for biliary disease, co-morbidity, number of medications and geographical area.

2. A non-liver disease, community control group from the same geographically defined area. Participants were recruited randomly (computer-generated), via postal letter, through one General Practice within the same geographical area. Data collection was performed (via postal letter) in an identical manner to that described above under PBC recruitment. Participants, already matched geographically, were then matched for age, co-morbidity and number of medications.

**Symptom assessment tools**

A self-reported falls history questionnaire was designed to identify those who had fallen in the previous 5 years (to identify infrequent fallers, F), those who had fallen in the last 12 months (current fallers, CF), those who had fallen more than once in the previous 12 months (recurrent fallers, RF) leaving those who had never fallen (non-fallers, NF). These categories are well recognized in falls research. Information reported by patients regarding injuries they had sustained secondary to falls, and current medications were reported.

To quantify symptoms of postural dizziness, participants completed the orthostatic grading-scale (OGS), comprising five questions quantifying the
severity of orthostatic symptoms experienced by an individual. Scores range from 0 to 20; zero indicates no orthostatic symptoms, a score greater than four indicates orthostatic intolerance. It has been fully validated against autonomic nervous system testing and has previously been used to assess orthostatic hypotension symptoms in PBC.

To assess each individual's fear of falling they completed the Falls Efficacy Scale-International (FES-I). This validated tool is a 16 item questionnaire quantifying people's confidence to perform activities of daily living without falling on a scale of 16–64. Higher scores indicate a greater fear of falling.

### Multidisciplinary assessment

Patients responding to the invitation for assessment were seen in a specialist falls clinic by a physician, physiotherapist and nurse. Falls risk factors were identified and recorded (Table 1) according to the NICE guidelines.

The medical assessment included symptom profile, past medical, social and medication history, a neuro-cardiovascular examination (including visual acuity) and cognition using the Mini Mental State Examination (MMSE).

The physiotherapy assessment included assessment of balance and gait using the performance orientated assessment of mobility and the 5 Times Sit-to-Stand Test (5STS). Poor handgrip strength has previously been shown to be associated with recurrent falls. The 5STS (timing how long it takes to stand up and sit down five times) has been validated as a measure of leg strength and is independently associated with falls; time >15 s indicating a falls risk.

The nursing assessment included a postural challenge to detect orthostatic hypotension (OH) and an electrocardiogram. Subjects rested supine for 10 min then stood upright; OH was diagnosed if patients met recognized diagnostic criteria. All subjects refrained from smoking and caffeine ingestion on the day of investigation and ate a light breakfast only. All investigations were performed at the same time of day, taking place in a warm, quiet room using continuous heart rate and beat-to-beat blood pressure measurement (Taskforce: CN Systems).

The occupational therapy assessment involved an occupational therapist with a specialist interest in falls visiting the usual residence of each PBC participant who had fallen and took part in the multidisciplinary assessment. Risk of falling from home hazards was assessed (flooring, furniture, lighting, bathroom, storage, steps and mobility) and participants were judged to have home hazards or not Home Falls and Accidents Screening Tool (HOME FAST).

### Ethical consideration

Approval was sought from the Newcastle and North Tyneside Research Ethics Committee who deemed the data collection to be service development, and therefore did not require research ethical approval. Approval for the recruitment of community dwelling participants was granted by County Durham and Darlington Local Research Ethics Committee.

### Data analysis

Data were analysed using the Graphpad software package (Prism), or SPSS15 for regression analyses. For continuous, parametric data the mean and standard deviation are provided. For non-parametric data the median is displayed with the inter-quartile range. Differences between two categorical variables were analysed with the Chi-squared test or Fisher's exact test if numbers were too small. Analysis of variance was used to analyse the differences between continuous, parametric data in multiple categorical groups. For comparison of non-parametric data between multiple categorical groups, the Kruskall–Wallis test was used; data was considered a priori and therefore no corrections were made for multiple testing. Comparison between continuous variables were carried out using Spearman (non-parametric data) or Pearson (parametric data) correlation. Logistic regression analysis was performed for dependent binary variables and linear regression analysis was performed for continuous dependent variables. Assumptions were verified. Variables were included in the model if they demonstrated a linear relationship with the dependent variable and did not show multi-collinearity. Results were considered significant when $P < 0.05$.

### Table 1 Risk factor assessment

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falls history</td>
<td>Cognitive impairment</td>
</tr>
<tr>
<td>Gait</td>
<td>Visual impairment</td>
</tr>
<tr>
<td>Balance</td>
<td>Neurological examination</td>
</tr>
<tr>
<td>Muscle weakness</td>
<td>Cardiovascular examination</td>
</tr>
<tr>
<td>Osteoporosis risk</td>
<td>Continence</td>
</tr>
<tr>
<td>Perceived functional ability</td>
<td>Home hazard</td>
</tr>
<tr>
<td>Fear of falling</td>
<td>Medication review</td>
</tr>
</tbody>
</table>
Results

Geographical cohort

Participants

The current geographical cohort consists of 146 PBC patients, 13 of whom have previously declined to be contacted regarding research. Of the 133 remaining patients, all of whom were invited to participate in the study, 97 (73%) fully completed the symptom assessment tools. Forty-one patients accepted the invitation to participate in the multidisciplinary assessment. Demographic data for the geographical cohort responders are summarized in Table 2.

Results were compared to the control groups, both of which were similar in terms of age, number of medications, the presence of heart disease and the presence of diabetes to our geographical cohort (Table 2).

Falls

Falls were highly prevalent in the PBC patient cohort with 70 (72%) patients having had at least one fall. Overall, 55% of patients were CF, having had at least one fall in the previous year, and 22% RF, having had more than one fall in the past year. Perhaps unsurprisingly, there was a significant difference in fear of falling between the four groups (NF, F, CF, RF) with fear of falls greatest in RF and decreasing through CF, F and NF ($P < 0.001$) (Figure 2).

Table 2  Demographic data of the NE1–25 PBC cohort and the control groups

<table>
<thead>
<tr>
<th></th>
<th>PBC Geographical Cohort ($n=97$)</th>
<th>PSC controls ($n=15$)</th>
<th>Controls ($n=96$)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>68 (11)</td>
<td>61.9 (12)</td>
<td>68.45 (2.5)</td>
<td>0.051$^a$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.696$^b$</td>
</tr>
<tr>
<td>Female</td>
<td>89 [92%]</td>
<td>3 [20%]</td>
<td>96 [100%]</td>
<td>$&lt;0.001^a$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.01$^b$</td>
</tr>
<tr>
<td>Number of medications</td>
<td>3.2 (3.6) ($n=96$)</td>
<td>3.4 (2.2)</td>
<td>2.97 (1.8)</td>
<td>0.835$^a$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.608$^b$</td>
</tr>
<tr>
<td>Diabetic</td>
<td>5 [5%]</td>
<td>0 [0%]</td>
<td>5 [5%]</td>
<td>1.0$^b$</td>
</tr>
<tr>
<td>Histological stage</td>
<td>1 (1–3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fallers</td>
<td>70 [72.2%]</td>
<td>3 [20%]</td>
<td>46 [47.9%]</td>
<td>$&lt;0.001^{a,b}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current fallers</td>
<td>53 [54.6%]</td>
<td>2 [13%]</td>
<td>23 [24%]</td>
<td>$&lt;0.001^{a,b}$</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Recurrent fallers</td>
<td>21 [21.6%]</td>
<td>1 [6.7%]</td>
<td>8 [8.3%]</td>
<td>0.003$^a$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.01$^b$</td>
</tr>
<tr>
<td>Non-fallers</td>
<td>27 [27.8%]</td>
<td>12 [80%]</td>
<td>50 [52.1%]</td>
<td>$&lt;0.001^{a,b}$</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Number of falls in previous year</td>
<td>1.9 (2.3)</td>
<td>0.27 (1.03)</td>
<td>0.67 (2.67)</td>
<td>0.008$^a$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$&lt;0.001^b$</td>
</tr>
</tbody>
</table>

Mean is provided with (SD), the median with the (inter-quartile range) and proportions as [%].

$^a$PBC vs. PSC controls.

$^b$PBC vs. community controls.

Figure 2. Fear of falling score (NF: non-fallers; F: fallers; CF: current fallers; RF: recurrent fallers).

All types of fallers were significantly more prevalent in the PBC cohort than in both the control groups (Table 2). Number of falls in the previous 12 months was also significantly greater in the PBC population ($P < 0.001$).

Injury

Of those PBC participants who had fallen 49 (70%) were injured [16 (34.7%) of community controls ($P < 0.001$), 1 of 3 PSC controls]. Eighteen (25.7%) of the fallers sustained a fracture [1 (2%) of community controls ($P < 0.001$), 0 PSC controls], 44 (63%) suffered a soft tissue injury [17 (37%) of controls ($P=0.006$), 1 of 3 PSC controls], 24 (34%) attended
casualty [3 (6.5%) of controls (P < 0.001), 1 of 3 PSC
controls] and 13 (19%) were admitted to hospital as
a result of their fall (0 controls, P=0.002) (Figure 3).

Relationship between falls and postural
dizziness
The median score in the OGS was 2.0 (0–6) in the
PBC population. The highest scores were found in
RF (7, 4–10.5); CF also had relatively high scores (3,
0–6), F had lower scores (0, 0–3) and NF had the
lowest scores (0, 0–3). The difference in scores
reached statistical significance (P < 0.001). Orthostatic
intolerance was present in 29% of the
PBC population. The increasing prevalence through
the groups (NF, 15%; F, 51%; CF, 62%; RF, 86%)
reached statistical significance (P < 0.001)
(Figure 4).

Multidisciplinary assessment
Participants
Forty-one subjects with PBC attended for an assess-
ment (42% of those who responded). The sample
was representative of the full geographical cohort
in terms of age (P=0.315), number of medications
(P=0.557) and histological stage (P=0.624) and
included all types of fallers. The PBC MDT cohort
was divided into two fall categories, NF and CF.

Fall risk factors
Objective falls risk factors, as detailed in Table 1,
were present in 100% of the participants. The mean
number of risk factors per patient was 4.5 (1.6).
When risk factors between NF and CF were com-
pared there was a significantly higher number of fall
risk factors in those who had fallen in the last year
(P=0.032) (Table 3).

Autonomic dysfunction
OH was diagnosed in nine (22%) of the participants
who underwent postural challenge. There was no
statistical difference in the presence of OH between
the groups (NF, CF). When the degree of blood pres-
sure drop below baseline was compared between
groups there was also no difference in the mean
BP drop.

Gait and balance
On assessing the PBC participants’ ability to main-
tain stability in a variety of postures, and on assess-
ing their ability to walk normally we found that
balance was significantly different between the NF
and CF groups (P<0.001), whereas gait was not.
Gait scores did not reach statistical significance
between the groups, but did show a tendency to be poorer in CF (Table 3). Balance scores correlated
negatively with the OGS scores (Spearman –0.377,
P=0.017), suggesting poor balance was associated
with higher levels of postural dizziness.

Muscle strength
Lower-limb strength was significantly poorer in CF
than in NF (P=0.002). When using the value of
>15 s as a predictor of falls there was no significant
difference between the groups in the presence of
this risk (P=0.204). Handgrip strength was similar
between each group but appeared stronger in the
NF, this did not show statistical significance
however.
Cognition

Cognition was not statistically different between the CF and the NF groups (\(P = 0.921\), Table 3). When a crude value of <24 was used as a screening tool for dementia, there was also no significance between the groups.

Injury

In those with osteoporosis/osteopenia who had fallen there was a trend for more fractures than in fallers with no bone abnormality (\(P = 0.046\)). When analysing which factors may have a bearing on injury the factors which showed levels of significance were number of medications (\(P = 0.037\) and number of co morbidities (\(P = 0.005\)). However, on logistic regression analysis there were no independently associated factors which associated with injury (Hosmer–Lemeshow goodness of fit value 0.0).

Home ‘hazards’

The occupational therapy assessment revealed that each (100%) PBC participant who had fallen had modifiable home hazards (hazards relevant specifically to people who fall). No PBC faller had steps or stairs with defined edges, and only 10% of participants had non-slip flooring throughout the house (modifiable risk factors in those who fall).

Fall predictors

Logistic regression was used to identify factors significantly associated with F compared to NF. Variables included in the model were age and fall risk factors which are described in Table 1. Significant predictors of being a faller were lower limb strength, fear of falling, having abnormal vision and increasing number of medications (Table 4).

Multi-linear regression was performed to identify factors significantly associated with number of falls in previous year, in those who had fallen. Variables excluded because of a non-linear relationship with the dependent variable or because of multi-collinearity were age, hand grip, fear of falls, orthostatic symptoms and number of medications. Significant factors were lower limb strength and the use of walking aids (Table 5).

Discussion

This study has shown for the first time that falls are very common in patients with PBC, and occur

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**Table 3** Multidisciplinary team assessment data

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>NF (n = 17)</th>
<th>F (n = 13)</th>
<th>CF (n = 7)</th>
<th>RF (n = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait [0–9]</td>
<td>4.0 (1.7)</td>
<td>4.8 (1.5)</td>
<td>5.4 (1.4)</td>
<td>5.3 (1.7)</td>
</tr>
<tr>
<td>Balance [0–26]</td>
<td>24.41 (1.6)</td>
<td>22.04 (4.4)</td>
<td>19.36 (4.8)</td>
<td>19.75 (6.7)</td>
</tr>
<tr>
<td>Hand strength (kg)</td>
<td>18.15 (8.5)</td>
<td>14.65 (4.5)</td>
<td>14.23 (3.0)</td>
<td>14.48 (1.0)</td>
</tr>
<tr>
<td>Lower limb strength (5STS) (s)</td>
<td>15.59 (4.5)</td>
<td>23.17 (12.2)</td>
<td>29.30 (15.4)</td>
<td>34.50 (21.1)</td>
</tr>
<tr>
<td>Cognition [0–30]</td>
<td>26.7 (2.0)</td>
<td>27.2 (2.4)</td>
<td>26.8 (3.3)</td>
<td>27.0 (2.2)</td>
</tr>
</tbody>
</table>

Mean is provided with (SD), the median with the (inter-quartile range). NF, non-fallers; F, fallers; CF, current fallers; RF, recurrent fallers; 5STS, timed sit-to-stand test; kg, kilograms.

*aThe full range is provided here as numbers are too small for the inter-quartile range.

**Table 4** Predictors of being a faller

<table>
<thead>
<tr>
<th>Variable</th>
<th>Exp (B)</th>
<th>Confidence interval (95%)</th>
<th>Wald statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.887</td>
<td></td>
<td>0.003</td>
<td>0.953</td>
</tr>
<tr>
<td>Lower limb strength</td>
<td>1.481</td>
<td>1.062–2.066</td>
<td>5.345</td>
<td>0.021</td>
</tr>
<tr>
<td>Balance</td>
<td>2.303</td>
<td>0.94–5.639</td>
<td>3.333</td>
<td>0.068</td>
</tr>
<tr>
<td>Fear of falls</td>
<td>1.328</td>
<td>1.013–1.74</td>
<td>4.23</td>
<td>0.04</td>
</tr>
<tr>
<td>Abnormal vision</td>
<td>0.008</td>
<td>0.0–0.501</td>
<td>5.248</td>
<td>0.022</td>
</tr>
<tr>
<td>Number of medications</td>
<td>0.28</td>
<td>0.091–0.866</td>
<td>4.937</td>
<td>0.026</td>
</tr>
</tbody>
</table>

Hosmer–Lemeshow goodness of fit 5.346, \(P = 0.618\).
significantly more frequently than in a matched, community dwelling population and in a biliary-disease control group, PSC. We had hypothesized that falls would be prevalent considering recent study findings suggesting a high prevalence of falls risk factors in PBC patients (specifically autonomic dysfunction3–6 and lower limb muscle impairment7). Furthermore, considering the increased prevalence of osteoporosis seen in PBC9,10 together with falls risk factors our finding of increased injuries, fractures and hospital admissions related to falls is of great clinical significance to this population. The prevalence of both falls and of injuries was far greater than we had expected and we believe is a significant contributor to the symptomatic/complication burden in the PBC population.

Amongst the falls literature it is generally accepted that an increasing number of falls risk factors increases the risk of falls, and the number of falls.26 Falls risk factors were almost universal in our PBC population, even in our NF; however, the number of falls risk factors was significantly greater in our CF. Interestingly, despite the significantly greater prevalence of falls, the mean number of falls risk factors seen in our PBC population is comparable to that seen in other falls prevalence studies.27 This finding is important for the development of falls prevention strategies specifically for this patient group as in general falls populations, it is recognised that single interventions to prevent falls are generally ineffective.28 Our study supports the need in PBC for a multi-faceted intervention programme optimally delivered by a multidisciplinary team. We believe that our study suggests that this will be the most efficacious intervention to reduce falls in those with chronic liver disease.

In our study we identified an important potentially modifiable association between orthostatic symptoms and falls. Although clearly in this study we have not established causation, it is important to appreciate that recognition of, and treatment to reverse, orthostatic symptoms is recognized in the NICE Falls guidelines to be an effective intervention to prevent falls.12 For clinicians managing patients with PBC, assessing the presence of orthostatic symptoms in a clinical setting is simple. We have effectively incorporated its use into our clinical service.29 The degree of symptoms related to adopting an upright posture was strongly related to whether the PBC responders had not fallen, fallen once or had fallen recurrently. Previous research demonstrates a strong link between autonomic dysfunction and PBC. This article confirms the significance of this link and places it into a clinical context which is highly relevant to patients-falls and injury. Although our nursing assessment for the presence of OH did not show a difference between the falls groups this clinical test does not assess symptoms or cerebral perfusion. OH can be symptomatic or asymptomatic, those who are symptomatic demonstrate abnormalities of cerebral blood flow regulation significantly more than those who are asymptomatic with OH.30–32 The discrepancy in postural symptoms and actual blood pressure changes may therefore be explained, at least in part by abnormal cerebral auto-regulation which we were unable to measure.

Objective balance scores were poorest in those who had fallen in the previous year and were also associated with the degree of subjective orthostatic dizziness. This finding re-iterates that the clinical consequences of autonomic dysfunction in PBC are great and by affecting balance could impact upon everyday activity such as standing from sitting, bending down, reaching up, turning around and walking. Poor balance is a modifiable risk factor for falls in the general population and improving it can reduce fear of falls.33 Whether this intervention will be applicable to a PBC population is, at present, unknown. Impaired balance in PBC may also be explained by the mitochondrial dysfunction and muscle impairment that we have recently shown using magnetic resonance spectroscopy in PBC.7

Table 5  Associations with number of falls

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (β)</th>
<th>Standard error</th>
<th>Confidence interval (95%)</th>
<th>t-statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>−8.166</td>
<td>3.753</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower limb strength</td>
<td>0.184</td>
<td>0.045</td>
<td>0.093–0.275</td>
<td>4.111</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Balance</td>
<td>0.219</td>
<td>0.197</td>
<td>−0.183–0.622</td>
<td>1.11</td>
<td>0.275</td>
</tr>
<tr>
<td>Gait</td>
<td>0.027</td>
<td>0.279</td>
<td>−0.543–0.597</td>
<td>0.096</td>
<td>0.924</td>
</tr>
<tr>
<td>Abnormal vision</td>
<td>−0.194</td>
<td>0.57</td>
<td>−1.357–0.969</td>
<td>−0.34</td>
<td>0.736</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>−0.142</td>
<td>0.656</td>
<td>−1.481–1.196</td>
<td>−0.217</td>
<td>0.83</td>
</tr>
<tr>
<td>Walking aids</td>
<td>3.432</td>
<td>1.664</td>
<td>0.038–6.827</td>
<td>2.062</td>
<td>0.048</td>
</tr>
</tbody>
</table>

Model $R^2$ 0.624.
It is probable that with appropriate, exercise-based targeted interventions, the lower limb weakness that we detected, which translates into impaired balance, can be reversed. Further studies are needed to address this.

Lower limb function measured with the 5STS is generally accepted as a measure of lower limb strength but will also involve other functions such as balance and proprioception. The significantly poorer function of the lower limb is associated with a greater degree of falls. This test is widely accepted as a falls screening tool in specialist falls clinics, and may be an appropriate tool to screen for falls in PBC patients, although modified cut off points would be required as current levels do not distinguish F from NF in our PBC group. When analysing for associations with number of falls in the previous year, lower limb function showed a significant independent association. Lower limb strength and function are modifiable with appropriate physiotherapy in the general population, but we are yet to see if lower limb strength can be improved in PBC, and what impact that could have upon falls.

The widespread resultant injury from falls has important clinical and financial implications. As expected, those with osteoporosis/osteopenia had significantly more fractures than those with normal bone density. Measurement of bone density must therefore, become standard practice in a population at high risk of falls and injury. As 20% of F were admitted to hospital (that is 14% of the full PBC population), the problem of falls clearly needs to be addressed. No factor was independently associated with injury of any type (in comparison to fracture in osteoporosis) suggesting that targeting the prevention of falls rather than injury would be more appropriate.

It is important to acknowledge that our study has some limitations. The patients who attended for the MDT assessment might be considered to be a biased sample group but we believe that this is not the case as those who participated appeared to be no different from those who did not in terms of falls prevalence. Retrospective reporting of falls is limited to a participant’s ability to recall the event. Recall for more recent events is, unsurprisingly, more reliable and therefore our prevalence of CF may more accurately reflect the prevalence of falls rather than falls over longer periods of time. Nonetheless, as retrospective events are prone to under-reporting our prevalence rates are probably an underestimate of the true prevalence. Estimating the sample size required to detect significant proportional differences was challenging given that falls in PBC have never before been reported. Notwithstanding the limitations of a post hoc power analysis the sample sizes were large enough to detect significant differences (all comparisons regarding F and CF between PBC and the control groups were powered at least o the 0.85 level). While PSC is a useful cohort to control for biliary disease in PBC participants it is worth noting that the demographics between the two groups are different with regards to age and gender.

In a population where social dysfunction already exists, it is essential we try to identify modifiable factors which may contribute to a poor quality of life. Falls, fear of falling and postural dizziness all lead to poor quality of life, increased medication use, activity restriction, admission to care and increased mortality. In order to address quality of life issues in this population, it would appear that a multidisciplinary approach is necessary. In addition to the usual medical follow up of patients with PBC, the issue of falls ought to be raised with each individual patient. For those who have fallen, are fearful of falling or suffer from postural dizziness a referral to a falls specialist clinic should be considered. Whether a multidisciplinary team assessment would improve their quality of life, prevent further falls and reduce significant morbidity and mortality remains to be seen.

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References
Primary biliary cirrhosis


