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## **What predicts hospital admissions in community-dwelling people with parkinsonism?**

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## **ABSTRACT**

**Objectives:** Previous studies have looked at the reasons for hospital admission in people with parkinsonism (PwP), yet few have looked at factors that precipitate admission.

**Methods:** PwP with a diagnosis of Idiopathic Parkinson's disease of Hoehn and Yahr stage III-V, and those with Parkinson's plus syndromes were assessed for motor and non-motor symptoms, quality of life and functional performance. Logistic regression was used to investigate predictors of hospital admission over the subsequent two years.

**Results:** Overall 162 patients consented to be part of the study. Seventy-one PwP (43.8%) had at least one hospital admission and 17 patients (10.5%) had three or more admissions to hospital. Poorer cognition, more non-motor symptoms, poorer quality of life, slower timed-up-and-go test scores and abnormal swallow predicted a subsequent hospital admission.

**Discussion:** Our study emphasises the importance of non-motor symptoms in predicting admission. A cost-benefit analysis of early intervention to prevent admission should be considered.

**Keywords:** Geriatrics, hospital admissions, movement disorders, Parkinson's disease.

## **INTRODUCTION**

Parkinsonism is an umbrella term for a group of chronic progressive neurodegenerative diseases, of which idiopathic Parkinson's disease (PD) is by far the most common. In 2015, there were estimated to be 137,000 people with PD in the UK.<sup>1</sup> Furthermore, the number of people with parkinsonism (PwP) is expected to increase rapidly in the coming decades.<sup>1</sup> Compared to the general elderly, PwP are more likely to be admitted to hospital, on average have a longer admission and are more likely to have a hospital related complication during their stay.<sup>2,3,5</sup>

Previous studies have looked at the reasons for hospital admission in PwP.<sup>2,4-6</sup> However, few have looked at baseline factors that could precipitate hospital admission in this population.<sup>7</sup> Understanding precipitating factors may help healthcare services to work proactively to predict, and potentially prevent, some hospital admissions. Given the high costs associated with hospital admission in parkinsonism,<sup>8</sup> this could reduce overall costs to health services, improve patient outcomes and minimise distress to PwP and their families. In this prospective, longitudinal study we aimed to identify predictors of hospital admission in PwP.

## **METHODS**

### **Ethics and consent**

The study described here is nested within the Northumbria Care Needs Project; which looks at changing care needs in people with moderate to advanced parkinsonism over a ten-year period. Ethical approval for the Northumbria Care Needs Project, including this nested study, was granted by the Newcastle and North Tyneside 1 Research Ethics Committee (ref: 14/NE/1093).

## **Setting, participants and inclusion/exclusion criteria**

The Northumbria Healthcare NHS Foundation Trust movement disorders service covers two local government areas in the North East of England; North Tyneside and Northumberland. Patients are admitted to the service upon diagnosis (or occasionally from another service after diagnosis) and reviewed in clinic or at home according to need. Discharge from the service occurs only if the patient dies or moves to another service. The service is primarily for people with idiopathic PD, but patients with other movement disorders (e.g. essential tremor, vascular parkinsonism, multiple system atrophy (MSA), progressive supranuclear palsy (PSP), corticobasal degeneration (CBD)) are also cared for and around half of all patients have a diagnosis other than PD. On the 1st of January 2015, the service had 1386 registered patients. Based on previous prevalence studies, the vast majority of people with PD in the catchment area are under the service.<sup>9,10</sup>

The Northumbria Care Needs Project included all patients known to the service with a diagnosis of Idiopathic PD or Parkinson's disease with dementia (PDD) - Hoehn and Yahr (H&Y) stage III-V<sup>11</sup> and those with Parkinson's plus syndromes CBD, MSA and PSP. Furthermore, to be included patients needed to be alive, diagnosed (or be displaying symptoms consistent with their later confirmed disease) and living in their own home (including a relative's home or sheltered housing) on the 1st January 2015. We chose to include those with Parkinson's plus syndromes because, although the disease course usually varies from idiopathic PD,<sup>12-14</sup> the disease groups are managed in a similar way and present similar challenges upon hospital admission and care home placement to those with idiopathic PD. Patients were excluded from the study if they had died before, or were a resident in a residential or nursing care home, on the 1st January 2015.

## **Data collection**

The Northumbria Care Needs Project baseline dataset were collected on all those meeting the inclusion criteria between October 2014 and December 2015. Data collection was prospective and was completed on a visit to the PwP's home by a nurse with a specialist interest in parkinsonian disorders. Demographic and clinical data included gender, age, age of onset, disease duration, H&Y stage,<sup>11</sup> living situation, dysphagia, timed-up-and-go test (TUG),<sup>15</sup> Montreal Cognitive Assessment (MoCA),<sup>16</sup> Movement Disorder Society Unified Parkinson's disease rating scale (MDS-UPDRS),<sup>17</sup> Non-Motor Symptom Scale (NMSS)<sup>18</sup> and Parkinson's Disease quality of life Questionnaire (PDQ-39).<sup>19</sup> At the point of data collection, TUG times were categorised for simplicity. TUG times were categorised as: <10 seconds (Excellent – mobility expected of someone with no problems), 10-19 seconds (Good – can go out alone without a mobility aid but with some slowness), ≥20 seconds (Problem – cannot go outside alone without a gait aid). These categorisations were in line with observed gait speed for the TUG test.<sup>20</sup> To complement the Care Needs Project baseline dataset, we collected data on hospital admissions across the two-year period from 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2016. These data were collated from a review of clinical records conducted from February to March 2017. Any presentation where a patient was discharged from the emergency department without hospital admission or was admitted and discharged on the same day was excluded. Admissions for any causes, whether parkinsonism-related or not, were recorded. However, elective admissions (e.g. admissions for a planned endoscopic examination) were excluded. Data collected included total number of admissions and date of admission.

## **Statistical analysis**

The data were quantitative in nature and collected at a nominal, ordinal and interval/ratio level. Data were analysed using standard statistical software, IBM SPSS (version 24; IBM, Armonk, NY, USA).

Age and disease duration were normally distributed and so were summarised in terms of mean and standard deviation and inferential parametric tests were applied in bivariate analysis. All other non-categorical data were measured on either an ordinal scale or were skewed and so summarised using the median and inter-quartile range and non-parametric tests applied in bivariate analysis. Categorical data were summarised using frequency, with chi-squared tests used in bivariate analysis.

In multivariable modelling, binary logistic regression was used to identify independent predictors of hospital admission, with hospital admission (yes/no) used as the outcome variable. Any variable which was found to show a statistically significant difference between those admitted to hospital and those not admitted in bivariate analysis, was considered for inclusion in the multivariable model. All such variables were initially entered into the model and then sequentially eliminated using backwards methods. Those variables eliminated during the final four steps of the process were then re-entered and removed in a stepwise method until a final overall model was identified. Model fit, validity and robustness was assessed by examining chi-squared, Hosmer-Lemeshow and Wald statistics, eigenvalues, Cook's distances and residual values. Significance was set at 5% and two tailed tests used throughout.

## **RESULTS**

On 1<sup>st</sup> January 2015, 377 people known to the service met the inclusion criteria with regard to disease type and stage. Ninety-one of these were living in care homes and so were excluded. Of the remaining 286, 77 declined to participate, 20 moved into a care home, 17 died and 2 moved out of the area before they could be interviewed and 8 were in a palliative state and unsuitable for recruitment. This gave a final cohort of 162 patients (99 males and 63 females) who consented to be part of the study and had baseline data collected. The mean age was 73.9 years (SD 7.80, range 52-90), with 99 (61.1%) males. One-hundred and forty-two PwP (87.7%) had a diagnosis of idiopathic PD, 10 (6.2%) had PD dementia, 5 (3.1%) MSA and 5 (3.1%) PSP. The median disease duration for those with idiopathic PD was 7 years (IQR 5-11). Disease stages for the 152 PwP with idiopathic PD or PD dementia were: III, n= 90 (59.2%); IV, n= 55 (36.2%); and V, n= 7 (4.6%).

Seventy-one PwP (43.8%) had at least one hospital admission and 17 patients (10.5%) had 3 or more admissions to hospital. Demographic and clinical data for these groups are presented in **Table 1**. There was no statistically significant difference in the variables of age, sex, H&Y stage, age at disease onset or disease duration between PwP who were admitted to hospital when compared to patients who were not admitted. However, those admitted to hospital had poorer cognition, more non-motor symptoms, poorer quality of life, slower TUG test scores and greater prevalence of dysphagia. They also had poorer UPDRS section 1 (non-motor symptoms), UPDRS section 2 (motor symptoms) and UPDRS section 3 (motor examination) scores. Individual questions within the UPDRS, NMSS and PDQ-39 were also examined to identify any differences between the two groups, see **Table 2**. Items assessing cognition, depression, anxiety, urinary symptoms, swallowing dysfunction, slow sit-to-stand, gait dysfunction, dizziness/light-headedness, fear of



falling and a perceived (by the PwP) lack of support from a partner or the wider family were found to be significantly difference between the two groups.

A multivariable analysis was conducted to identify independent risk factors for admission. This analysis was conducted including and excluding the patients with Parkinson's plus syndromes. The independent risk factors identified were the same in both models; dizziness/light-headedness, cognitive impairment, anxiety and gait dysfunction, see **Table 3**.

## **DISCUSSION**

To our knowledge, our study is the first published prospective research study to identify modifiable risk factors for hospital admission in parkinsonism. We identified dizziness/light-headedness, cognitive impairment, anxiety and gait dysfunction as independent predictors of hospital admission. Even within a dedicated and well-resourced movement disorders service, the finite resources available must be directed towards areas where they will have the greatest clinical impact on PwP's well-being. Identifying potentially modifiable factors associated with hospital admission, may help to inform decision making as to how best to allocate resources and reduce the overall burden of parkinsonism on hospital services. Dizziness/light-headedness and anxiety are amenable to improvement with evidenced-based interventions that can minimise the impact of such symptoms on PwP, even in later stage disease. Cognitive impairment and gait dysfunction are less easily managed as the disease progresses, where maintenance of function and quality of life for as long as possible is likely to be the main aim of any intervention.<sup>21</sup>

Over two-fifths of our PwP had at least one hospital admission during a two year period. A multi-centre study by Hassan et al<sup>7</sup> found that a third of PwP had a hospital encounter (emergency room visit or hospital admission) during a 12 month period. However, data collection was cross-sectional and hospital encounters were recorded based on retrospective recall by the PwP, with the likelihood of significant bias. Our study recorded data on hospital admission prospectively based on hospital records. Hassan et al<sup>7</sup> identified co-morbidity, slower TUG time, motor fluctuations and deep brain stimulation as independently associated with a hospital admission. There is some overlap in the factors identified in both studies, with gait problems common to both. Only one of our patients was using deep brain stimulation, so we were unable to consider this as a predictor. As well as data on motor symptoms, we collected baseline data that also assessed non-motor symptoms, mental health, quality of life and social support, and this may explain the rather broader range of predictors identified in our study. Although TUG category was associated with hospital admission in bivariate analysis, it did not appear as an independent predictor in multivariable modelling. This is most likely due to a high degree of multicollinearity between TUG category and gait impairment rating from the UPDRS, with only one able to appear in the final model.

Of the non-motor predictors identified, anxiety has been shown to be at least as important as motor symptoms in predicting quality of life in PD.<sup>22,23</sup> Therefore, it is perhaps unsurprising that it was a significant independent predictor of hospital admission in our study. It may be that anxiety is a proxy for poor overall mental health. Clinicians who manage patients with parkinsonism should be aware of mental health problems as well as more obvious motor symptoms. Dizziness/light headedness was also a significant independent predictor. These symptoms are well

described in parkinsonism and are usually linked to autonomic dysfunction.<sup>24</sup> Interestingly, dizziness/light-headedness remained an independent predictor even when patients with MSA and PSP (conditions strongly associated with autonomic dysfunction) were removed from the multivariable analysis. Such symptoms can be highly disabling for PwP, and are likely to be linked to anxiety, depression and fear of falling.<sup>25,26</sup> Fear of falling has been linked to the avoidance of activity in the general population and this is likely to be the case in parkinsonism.<sup>27</sup> This in turn will result in sarcopenia and further declines in functional ability. Once a fear of falling has been identified, increasing access to physiotherapy and occupational therapy services may help reduce some of the fear around falling and help avoid hospital admission.<sup>28,29</sup>

Although, swallowing problems were found to be associated with hospital admissions in bivariate analysis, surprisingly they did not appear in the final model. Aspiration pneumonia is a known risk in parkinsonism.<sup>30</sup> Indeed, pneumonia is one of the leading causes of hospital admission and mortality in PwP.<sup>3</sup> It may be that within our dedicated service there is a high level of awareness of swallowing problems, and although they are common (over a quarter of all participants had abnormal swallow), early intervention means that such problems are generally well-managed.

It is of interest that many of the single question items from the UPDRS were as good or better at predicting hospital admission than multi-item scales (e.g. MoCA vs UPDRS item 1.1) and objective assessments (e.g. TUG vs UPDRS section 3 items). This not only emphasises the clinical usefulness of the MDS-UPDRS, but also may reflect the disease-specific nature of many of parkinsonian symptoms, which are not fully identified in more generic scales and assessments. As an example, while MoCA considers various domains of cognition, UPDRS 1.1 focused on the effect of

cognition on activities of daily living rated by the PwP themselves or their carer. We believe that one of the reasons UPDRS 1.1 was superior to MoCA is that the MoCA is a 'snapshot' at a point in time and does not account for the day-to-day variability in cognition that is experienced by a PwP. In contrast, UPDRS 1.1 looks at the functional impact of cognition over a period of a week. Management of cognitive decline using anticholinesterase inhibitors may also help reduce gait variability and so help prevent falls.<sup>31</sup> Likewise, UPDRS 3.10 (gait examination) may be better than the TUG in predicting hospital admission since it assesses the multiple domains of gait rather than time taken to complete a specific task.

### **Limitations of the study**

Our study investigated a well-defined, representative community-dwelling population of PwP. While including Parkinson's plus syndromes might increase the heterogeneity of our data, these patients were included since they are managed in a similar way and pose similar challenges in terms of management as those with idiopathic PD. Our data may only be applicable to community-dwellers with later stage disease, and any extrapolation to other settings should be considered with caution. The patterns and nature of hospital admissions of PwP is known to be different in care home residents and is likely to vary considerably in early stage disease.<sup>32</sup>

In summary, our study looked at a very large number of potential risk factors for hospital admission and emphasises the importance of non-motor symptoms in predicting admission, particularly in relation to autonomic dysfunction and mental health. The factors identified are all potentially modifiable. The potential for the costs of prospective long-term care planning and preventative initiatives to be offset by

reduced costs associated with use of hospital services in later stage disease should be investigated.

**Conflicts of interest statement**

None declared.

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