ORIGINAL ARTICLE

Dementia and severity of parkinsonism determines the handicap of patients in late-stage Parkinson's disease: the Barcelona–Lisbon cohort

M. Coelho[a,b], M. J. Marti[c], C. Sampaio[b,d], J. J. Ferreira[a,b,d], F. Valldeoriola[c], M. M. Rosa[a,b,d] and E. Tolosa[c]

[a]*Neurology Service, Department of Neurosciences, Hospital Santa Maria, Lisbon;* [b]*Clinical Pharmacology Unit, Instituto de Medicina Molecular, Lisbon, Portugal;* [c]*Movement Disorders Unit, Neurology Service, Hospital Clinic, University of Barcelona, Centro de Investigacion en Red de Enfermedades Neurodegenerativas (CIBERNED), Barcelona, Spain; and* [d]*Laboratory of Clinical Pharmacology and Therapeutics, Faculty of Medicine, University of Lisbon, Lisbon, Portugal*

Keywords:
advanced, caregiver, dementia, disability, handicap, late stage, Parkinson's disease, quality of life

Received 9 March 2014
Accepted 1 August 2014

European Journal of Neurology 2015, **22:** 305–312

doi:10.1111/ene.12567

Background and purpose: Handicap has not been explored as a patient-centred outcome measure in Parkinson's disease (PD). The clinical features and medication use in late stages of PD (LS-PD) were reported previously.

Methods: Handicap, medical conditions, use of healthcare resources and the impact of LS-PD upon caregivers were characterized in a cross-sectional study of LS-PD stages 4 or 5 of Hoehn and Yahr (H&Y). Handicap was measured using the London Handicap Scale (LHS: 0, maximal handicap; 1, no handicap).

Results: The mean LHS score in 50 patients was 0.33 (SD ±0.15). The presence of dementia, the Unified Parkinson's Disease Rating Scale part I score and the H&Y stage in 'off' independently predicted the LHS score (adjusted $R^2 = 0.62$; $P = 0.000$). Comorbidities and past medical conditions were frequent. Thirty-five patients lived at their house. Forty-five received unpaid care. Mean visits to the family doctor in the preceding 6 months were 2.2 (SD ±3.0) and to a neurologist 1.7 (SD ±1.0). Use of other health resources was low. Unpaid caregivers spent much time with patients and reported a high burden.

Conclusion: Handicap could be measured in LS-PD and the LHS was easily completed by patients and caregivers. The high handicap in our cohort was mostly driven by the presence of dementia, behavioural complaints and the severity of non-dopaminergic motor features. Patients visited doctors infrequently and made low use of health resources, whilst unpaid caregivers reported a high burden.

Introduction

There are few published studies on late-stage Parkinson's disease (LS-PD) [1-4]. A hospital-based population of LS-PD has recently been reported by us [3]. These subjects were severely disabled mostly from non-levodopa responsive problems and suffered frequent motor fluctuations and dyskinesias.

Correspondence: M. J. Martí, Movement Disorders Unit, Neurology Service, Hospital Clinic, University of Barcelona, Centro de Investigacion en Red de Enfermedades Neurodegenerativas (CIBERNED), Villaroel 170, 08036 Barcelona, Spain (tel.: +34 932 275785; fax: +34 932 275783; e-mail: MJMARTI@clinic.ub.es).

The impact that PD has on patients has been addressed using several outcome measures, such as disability, interference in activities of daily living or quality of life (QoL) [5,6]. Handicap, an outcome measure widely used in chronic neurological or non-neurological diseases [7,8], has never been used in PD. The WHO defines handicap as '... a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfilment of a role that is normal, depending on age, sex, and social and cultural factors, for that individual' [9], and thus it is central to the management of patients with chronic diseases [10]. Handicap seems a more under-

standable concept to patients than QoL and a more meaningful measure of the impact of disease in the health status (HS) of an individual patient. The London Handicap Scale (LHS) is one of the most frequently used instruments to measure handicap [8,11,12] but has never previously been used in PD. It has proven good validity, reliability, sensitivity to change and transcultural validation [11–14].

The results concerning handicap caused by very advanced PD are reported. In addition, the presence of comorbidities and past medical conditions, health resources use and the impact of disease on caregivers are described.

Patients and methods

Objectives

The primary objective was to quantify the handicap of a hospital-based population of LS-PD patients and to identify its determinants. Secondary objectives were to determine comorbidities and past medical conditions, quantify the use of health resources and assess the impact of disease upon the caregivers.

Study participants

The study participants were Parkinson's disease patients attending the movement disorders outpatient clinics of two university hospitals, one in Barcelona, Spain (Hospital Clínic Universitari), and the other in Lisbon, Portugal (Hospital Santa Maria). PD was diagnosed according to the UK Parkinson's Disease Society Brain Bank Criteria [15]. Patients in stage 4 or 5 of Hoehn and Yahr (H&Y) in 'on' were included (stage 4, patients with severe disability but still able to walk or stand unassisted; stage 5, wheelchair bound or bedridden unless aided) [16]. Patients' informal caregivers (unpaid caregivers) were interviewed. The study was approved by the local ethics committees and written informed consent was obtained.

Study design

This was a cross-sectional study in subjects consecutively recruited during a 24-month period.

Participants' evaluation

Patients

Data on demographics, clinical manifestations and disease management, comorbidities and past medical conditions, and usage of healthcare resources were obtained using a structured questionnaire (interviewing the patients and caregivers), a physical examination form and review of medical charts when needed. Details of other assessments performed in this same group of patients have been reported previously [3]. Briefly, patients were evaluated using the Unified Parkinson's Disease Rating Scale (UPDRS) and the Schwab and England (S&E) scale [17], and a structured questionnaire adapted from Witjas *et al*. [18] to assess non-motor symptoms in three domains: behavioural and cognition; dysautonomia; and other (sleep, fatigue, pain, paresthesias, anorexia and drooling). Dementia and depression were diagnosed according to the DSM-IV definitions [19] and rated using the Mini-Mental State Examination [20] and the Beck Depression Inventory [21], respectively.

Handicap was assessed using the LHS [11,12]. This scale was developed to determine the effect of chronic disease on a person's functional ability [8,11–14]. It takes around 10 min to be completed and consists of a self-completed questionnaire, although the descriptions of questions are objective enough for completion by a proxy. The questionnaire has six questions, one for each domain of handicap (mobility, physical independence, occupation, social integration, orientation and economic self-sufficiency), and each question contains six sentences hierarchically describing the degree of handicap; for each question, the patient must choose the most suitable sentence. Each sentence is assigned a scale weight. The questionnaire comprises a matrix of scale weights which when combined give a total score for handicap, to which a constant value of 0.456 is added; the final score ranges from 0 (maximal handicap) to 1 (no handicap).

Caregivers

Informal caregivers were asked to rate the impact of PD on their life (0, no impact; 4, maximal impact) [18] and the time per week they spent caregiving. The time allocated to caregiving was calculated by multiplying number of hours per day by the number of days per week.

Statistical analysis

The software program SPSS 14.0 (SPSS, Chicago, IL, USA) was used. A descriptive analysis was performed of demographic data, of motor symptoms according to UPDRS and a structured questionnaire and non-motor symptoms according to a structured questionnaire adapted from Witjas *et al.,* of the impact of symptoms on perceived HS (impact on perceived HS rated by patients: 0, no impact; 4, extreme impact) [3], of medication use, of associated medical conditions, of patients' residency ('own home', 'relatives home' or 'nursing home') and use of health resources,

and of caregiver burden according to time allocated to caregiving and the impact of PD on caregivers' life. A descriptive analysis of the LHS total score and subscores was performed.

A comparison of cohorts from Lisbon and Barcelona was done. The independent samples *t* test and Mann–Whitney *U* test were used for comparison of continuous variables, and the Pearson chi-squared test and Fisher's exact test for differences in proportions. Univariable analysis was performed, and variables associated with the LHS score at a significance level of $P \leq 0.1$ were entered in a multiple linear regression analysis using the LHS total score as dependent variable. Two-tailed *P* values <0.05 were considered significant.

Results

Patients

Fifty patients were studied. Results on demographics, clinical manifestations and medication use have been reported previously [3] and are shown in Tables 1 and 2.

Table 1 Demographics and medication use in late-stage PD patients

Characteristic	PD patients (*n* = 50)
Female, *n* (%)	27 (54)
Patients from Barcelona, *n* (%)	28 (56)
Patients from Lisbon, *n* (%)	22 (44)
Age (years), mean (SD)	74.1 (7.0)
Duration of disease (years), mean (SD)	17.94 (6.3)
Hoehn & Yahr stage[a], *n* (%)	
4	30 (60)
5	20 (40)
Levodopa, *n* (%)	49 (98)
Monotherapy	18 (36)
In combination	31 (62)
Daily dose of levodopa (mg), mean (SD)	785 (318)
Range of daily dose of levodopa (mg)	250–1900
Agonists, *n* (%)	25 (50)
Amantadine, *n* (%)	9 (18)
Entacapone, *n* (%)	6 (12)
Selegiline, *n* (%)	5 (10)
Anticholinergics, *n* (%)	1 (2)
Brain surgery for PD, *n* (%)	4 (8)
Neuroleptics, *n* (%)	25 (50)
Clozapine, *n* (%); daily dose (mg), mean (SD)	19 (38); 56.5 (71.0)
Quetiapine, *n* (%); daily dose (mg), mean (SD)	5 (10); 125 (90.1)
Other, *n* (%)	1 (2)
Benzodiazepines, *n* (%)	22 (44)
Antidepressants, *n* (%)	14 (28)
Rivastigmine, *n* (%)	2 (4)
Non-neurological medication, *n* (%)	32 (64)

PD, Parkinson's disease.
[a]Scored during 'on' period.

Table 2 Clinical manifestations in late-stage PD patients

Clinical manifestation	PD patients (*n* = 50)
UPDRS motor 'on', mean (SD)[a, b]	49.18 (13.0)
UPDRS ADL, mean (SD)[b]	
'On'	28.2 (6.3)
'Off'	29.6 (5.8)
S&E, mean (SD)[c]	
'On'	31.0 (15.7)
'Off'	23.2 (14.2)
Asymmetric disease, *n* (%)	16 (32)
UPDRS limb bradykinesia items, median[b]	3
Limb rigidity, *n* (%)	32 (64)
Rest tremor, *n* (%)	8 (16)
Postural tremor, *n* (%)	25 (50)
Postural instability, *n* (%)	50 (100)
Freezing, *n* (%)	31 (62)
Falls, *n* (%)	25 (50)
UPDRS speech, median[b]	3
UPDRS swallowing, median[b]	2
L-dopa-induced motor complications, *n* (%)	39 (78)
Wearing-off, *n* (%)	39 (78)
'Off' duration >75% of the day, *n* (%)	7 (14)
Dyskinesia, *n* (%)	31 (62)
Troublesome dyskinesias, *n* (%)	13 (26)
L-dopa-induced non-motor fluctuations, *n* (%)	33 (66)
Cognition, mood and behaviour, *n* (%)	50 (100)
Visual hallucinations, *n* (%)	22 (44)
Delusion, *n* (%)	16 (32)
Dementia (DSM-IV), *n* (%)	25 (50)
MMSE, mean (SD)	17.7 (8.1)
Anxiety, *n* (%)	25 (50)
Irritability, *n* (%)	20 (40)
Aggressive behaviour, *n* (%)	8 (16)
Depression (DSM-IV), *n* (%)	31 (62)
BDI, mean (SD)	16.8 (5.29)
Symptoms suggestive of apathy, *n* (%)	28 (56)
UPDRS part I, mean (SD)[b]	6.4 (3.9)
Dysautonomic complications, *n* (%)	48 (96)
Orthostatic hypotension[d], *n* (%)	3 (6)
Orthostatism[e] (item 42 of UPDRS), *n* (%)	13 (26)
Syncope, *n* (%)	4 (8)
Constipation, *n* (%)	41 (82)
Urinary dysfunction (incontinence, urgency or retention), *n* (%)	32 (64)
Hyperhidrosis, *n* (%)	18 (36)
Sweats, *n* (%)	18 (36)
Dyspnoea, *n* (%)	7 (14)
Night sleep problems, *n* (%)	30 (60)
Diurnal somnolence, *n* (%)	18 (36)
Pain, *n* (%)	12 (24)
Drooling, *n* (%)	35 (70)

PD, Parkinson's disease; UPDRS, Unified Parkinson's Disease Rating Scale; ADL, activities of daily living; S&E, Schwab and England scale; MMSE, Mini-Mental State Examination; BDI, Beck Depression Inventory.
[a]Scored during 'on' period; [b]higher numbers indicate a greater severity of impairment; [c]higher numbers indicate more independence in the activities of daily living; [d]it was possible to measure arterial blood pressure in 18 patients; [e]item 42 of UPDRS was completed by all patients.

Table 3 Total and sub-scores in the six domains of the London Handicap Scale in late-stage PD patients

	Total	Mobility	Physical independence	Occupation	Social integration	Orientation	Economic self-sufficiency
Mean (SD)	0.338 (0.155)	−0.042 (0.044)	−0.057 (0.003)	−0.047 (0.051)	0.007 (0.031)	0.004 (0.074)	0.013 (0.062)
Median	0.325	−0.036	−0.057	−0.035	0.007	−0.008	0.033
Minimum/maximum	0.044/0.628	−0.108/0.038	−0.061/−0.053	−0.350/0.099	−0.041/0.063	−0.075/0.109	−0.111/0.100
Minimum/maximum possible values for total score[a] and each domain sub-score[b]	0/1	−0.108/0.071	−0.061/0.102	−0.060/0.099	−0.041/0.063	−0.075/0.109	−0.111/0.100

PD, Parkinson's disease.
[a]In the London Handicap Scale total score, 0 indicates total disability and 1 indicates normal function; [b]in the London Handicap Scale sub-scores of the six domains, the minimum value indicates most severe disadvantage and the maximum value indicates no disadvantage.

Handicap

London Handicap Scale values followed a Gaussian distribution with a mean LHS total score of 0.338 (SD ±0.155) (Table 3). The most affected domain was orientation.

In simple linear regression analysis, the following variables were significantly correlated with the total LHS score: dementia (DSM-IV) ($P < 0.001$); depression (DSM-IV) ($P < 0.05$); unsteadiness causing severe or extreme impact on patients' perceived HS ($P < 0.05$); falls causing severe or extreme impact on patients' perceived HS ($P < 0.05$); hallucinations ($P < 0.05$); H&Y in 'on' ($P < 0.01$); H&Y in 'off' ($P < 0.005$); patients' residency ($P < 0.05$); UPDRS part I score ($P < 0.01$); UPDRS part II score in 'on' ($P < 0.01$) and 'off' ($P < 0.05$); S&E score in 'on' ($P < 0.001$) and 'off' ($P < 0.01$); and wearing-off ($P < 0.05$). Dementia (DSM-IV) was not correlated with UPDRS part I.

In multiple linear regression analysis using the backwards method, the independent variables that still remained significant were dementia (DSM-IV), UPDRS part I score, H&Y stage in 'off', S&E score in 'on', wearing-off, and falls. The variables that best predicted the total score of LHS in the final model were presence of dementia (DSM-IV) ($r = -0.66$; $P < 0.000$), UPDRS part I score ($r = -0.57$; $P < 0.000$) and H&Y stage in 'off' ($r = -0.47$; $P = 0.001$) (Table 4). This model explained 62% of the variance in the total score of LHS ($P = 0.000$). The Durbin–Watson test and collinearity statistics showed lack of correlation and multicollinearity between the independent variables.

Comorbidities and past medical conditions

Thirty-seven patients (74%) had comorbidities whilst 27 (54%) reported past medical conditions (Table 5). No significant differences in the mean total score of LHS were found between patients with and without past or concomitant medical diseases or those with more than two past or concomitant medical diseases.

Use of health resources

Most patients lived in their home and the majority had an informal caregiver. Patients seldom visited doctors, as the number of visits included those to get prescriptions only, and the use of other health resources was low (Table 6).

Caregivers

Mean time per week spent in informal caregiving was 5 days (SD ±2.57), this meaning 5 days × 24 h/week. Informal caregivers rated the impact of PD in their

Table 4 Multiple linear regression model for London Handicap Scale

Independent variables	Unstandardized beta	Standardized beta	SE	95% CI	*P*	Dependent variable	*R*	R^2	Adjusted R^2	*P*
Presence of dementia (DSM-IV)	−0.125	−0.408	0.037	−0.200; −0.051	0.02	Total score in	0.8	0.65	0.62	0.000
Score in UPDRS part I	−0.015	−0.368	0.005	−0.024; −0.005	0.03	London Handicap				
Hoehn & Yahr staging in 'off'	−0.115	−0.361	0.034	−0.183; −0.046	0.02	Scale				

CI, confidence interval; UPDRS, Unified Parkinson's Disease Rating Scale.

Table 5 Comorbidities and past medical conditions in late-stage PD patients

	PD patients (n = 50)
Comorbidities, n (%)	37 (74)
Patients with ≥2 comorbidities, n (%)	26 (52)
Musculoskeletal diseases, n (%)	20 (40)
Cardiovascular disease, n (%)	14 (28)
Benign prostate hypertrophy, n (%)	8 (16)
Eye cataract, n (%)	7 (14)
Weight loss, n (%)	7 (14)
Skin infection or ulceration, n (%)	5 (10)
Gastrostomy, n (%)	5 (10)
Non-skin cancer, n (%)	3 (6)
Skin neoplasm, n (%)	3 (6)
Miscellaneous, n (%)	7 (14)
Past diseases, n (%)	27 (54)
Patients with ≥2 past diseases, n (%)	10 (20)
Bone fractures in the previous 5 years, n (%)	10 (20)
Pneumonia in the previous 5 years, n (%)	10 (20)
Lower urinary tract infection in the previous year, n (%)	10 (20)
Kidney or bladder disease (urinary infection apart), n (%)	3 (6)
Stroke (ischaemic or haemorrhagic), n (%)	2 (4)
Skin neoplasm, n (%)	1 (2)
Pulmonary embolism, n (%)	1 (2)
Lung disease (pneumonia and embolism apart), n (%)	1 (2)
Miscellaneous, n (%)	6 (12)

PD, Parkinson's disease.

Table 6 Use of health resources in late-stage PD patients

	PD patients (n = 50)
Patients living in their home, n (%)	35 (70)
Patients living in their relatives' home, n (%)	7 (14)
Patients living in a nursing home, n (%)	8 (16)
Patients with an informal caregiver, n (%)	45 (90)
Patients with a paid caregiver, n (%)	19 (38)
Patients with both informal and paid caregiver, n (%)	14 (28)
Patients visited at State-owned hospitals, n (%)	43 (86)
Patients visited at private clinics, n (%)	3 (6)
Patients visited at State-owned hospitals and private clinics	4 (8)
Visits to family physician in the preceding 6 months (includes visits to get prescription only), mean (SD)	2.2 (3.0)
Visits to neurologist in the preceding 6 months (includes visits to get prescription only), mean (SD)	1.7 (1.0)
Hospital admissions in the preceding 12 months, mean (SD)	0.78 (1.0)
Patients using a physiotherapist, n (%)	10 (20)
Patients using a speech therapist, n (%)	3 (6)
Patients using a homecare nurse, n (%)	3 (6)

PD, Parkinson's disease.

life as high (mean score 3.5; SD ±0.8), which was significantly correlated with the LHS total score ($r = -0.5$; $P < 0.01$). The domains of LHS that resulted in a statistically significant association with caregiver burden were mobility ($r = -0.30$) and orientation ($r = -0.4$) ($P < 0.05$).

Discussion

Handicap was assessed in a cohort of LS-PD patients and it was found that the LHS was useful and easy to apply in these patients. This cohort of LS-PD patients was highly handicapped. Handicap was strongly associated with the presence of dementia (DSM-IV), the severity of mental problems and the severity of parkinsonism in 'off'. These independent variables explained more than half of the variance in the LHS total score. Furthermore, the patients were highly dependent on caregivers who spent much time in care, which resulted in a high burden for caregivers. Overall, health resources were used infrequently.

Handicap

Data about the health burden of PD obtained from the patients' perspective are essential to understand the impact of disease on patients, to complement the data obtained through observer-based instruments and also to assess the effectiveness of therapeutic interventions. The most commonly used subjective outcome measures in PD research have been the perceived HS, generic QoL scales and health-related QoL [22]. The concept of handicap was explored for several reasons [7,11]: handicap is the central aim of rehabilitation [10], which is crucial in progressive and chronic diseases such as PD; although intimately related to the concept of (health-related) QoL, its definition is more objective although keeping the subjective perspective and social interaction context that (health-related) QoL does; it is a focused and concrete concept, easily understandable to patients and caregivers; it is a relevant outcome despite being mostly limited to the context of health experience. In addition, there is good transcultural agreement on the construct of handicap [23] and the objectivity of the concept allows caregivers to fill in the questionnaires in those cases where patients are incapable of doing so. In our study, LHS was easily completed by patients and caregivers. The scores had a normal distribution and no obvious ceiling or floor effects. Dementia (DSM-IV), the severity of mental problems assessed by UPDRS part I [24,25] and the severity of parkinsonism in 'off' according to the H&Y explained a major percentage of the variance in the total LHS score. The H&Y staging is deeply anchored on postural instability, but it also reflects the severity of bilateral parkinsonism [26]. Indeed, others have also found that postural

instability is amongst the most disabling problems in advanced PD [1,2,27–29]. Severe disability was previously reported in these same patients using observer-based outcome measures [3] and perceived HS was also assessed. Results showed that falls and dysautonomia were the symptoms most contributing to poor perceived HS, closely followed by bradykinesia, freezing, bulbar symptoms, dementia (DSM-IV), apathy, anxiety and depression (DSM-IV) [3]. Interestingly, the symptoms most associated with handicap did not fully overlap those most impacting on HS, suggesting that handicap and HS are different constructs for patients' perception of health states. During the revision process that led to the new WHO International Classification of Functioning, Disability and Health (ICF) [30], the term *handicap* was replaced with *participation restriction*, in order to move the emphasis from consequence of disease to functioning, health and limitation of functioning. Nevertheless, the major concept that one's environment influences the functioning of an individual was still embodied in the ICF. In fact, qualitative studies showed a strong transcultural agreement on six domains of participation, and these corresponded to the handicap dimensions [31]; additionally a study by Perenboom and Chorus [32] found that two handicap scales from a pool of 11 existing generic instruments were the ones closest to measuring solely participation. Indeed, one of those two scales was the LHS.

Comorbidities and past medical conditions

Parkinson's disease is associated with significant comorbidity [33]. However, this excess comorbidity is largely confined to conditions associated with PD such as urinary complaints or to complications of PD such as bone fractures [33]. Similarly, the most frequent medical conditions of our patients were related to or complications of PD. In contrast to other studies [33,34], stroke, cardiovascular disorders or diabetes were either low or absent, suggesting that our population may have a long survival due to the lack of potentially fatal medical conditions. 22% of our cohort reported pneumonia in the previous 5 years, a finding in accordance with data showing pneumonia as a major cause of death in PD [2,33,34]. The finding that neither past nor concomitant diseases were associated with a higher handicap strengthens the finding of the impact of PD symptoms on the level of handicap.

Use of health resources

A higher percentage of institutionalized patients was expected in the light of the high UPDRS score, frequent falls, dementia and hallucinations in the cohort, all strong independent predictors of institutionalization [35]. Importantly, low income, the lack of availability of long-stay facilities within the health system and a family-centred organization of Latin societies may combine to explain our findings. Keeping patients at home was accomplished at the expenses of a heavy burden of disease on caregivers and the need for a paid caregiver in many instances.

Our patients consulted doctors fewer times than those in a Dutch study, where PD patients with ≥8 years of disease duration made 1.9 visits to a neurologist and 1.1 to the family physician [36]. Admissions to hospital were few in our sample, taking into account the number of comorbidities and the frequency of psychosis and dementia. Many of these acute medical events might be managed in emergency rooms which could explain the low rate of admissions. A minority made use of other healthcare resources such as speech therapist or homecare nurse, whereas 20% used a physiotherapist which is a low figure in view of the degree of motor involvement [36].

Caregivers

The amount of time spent in caregiving was very high in LS-PD. Accordingly, caregivers' burden and mental health status in PD has been found to correlate significantly with weekly hours of caregiving [37–39]. Two Spanish studies found that caring for patients with disease duration of 7.6–10 years was permanent in 86%–96.5% of the cases [37,39]. Caregiver time is thus a hidden cost in LS-PD, and in other cultures it would mean paid caregiver time. Caring for LS-PD patients had a strong impact on the life of caregivers and this was correlated with the LHS total score, in line with others reporting an increase in caregivers' burden with disease severity [37–40].

Shortcomings

Our low recruitment rate perhaps indicates that there were few LS-PD cases available at the study centres, suggesting that patients withdraw from specialized medical care once they reach later stages of disease. Thus, our results may not be representative for the entire population of LS-PD. Whilst the concept of handicap was addressed, QoL which could have been of interest in order to compare these outcomes of HS was not measured. More information regarding caregivers could have been gathered but our aim was to obtain general data concerning caregivers' burden.

Conclusions

Handicap is an important patient-centred outcome measure which is valuable to use in LS-PD since it provides an overall measure of patients' HS and gives insight into several domains of disadvantage. The LHS proved to be easily completed and might in the future be explored in earlier stages of disease. Our results show that LS-PD is associated with high handicap and caregivers' burden, and support the notion that cognitive and behavioural symptoms, with a special emphasis on dementia, and severity of parkinsonism, in particular falls and unsteadiness, should be the focus of management in later stages of PD.

Acknowledgement

None.

Disclosure of conflicts of interest

The authors declare no financial or other conflicts of interest.

References

1. Martin WE, Loewenson RB, Resch JA, Baker AB. Parkinson's disease. Clinical analysis of 100 patients. *Neurology* 1973; **23:** 783–790.
2. Hely MA, Reid WG, Adena MA, Halliday GM, Morris JG. The Sydney multicenter study of Parkinson's disease: the inevitability of dementia at 20 years. *Mov Disord* 2008; **23:** 837–844.
3. Coelho M, Marti MJ, Tolosa E, *et al*. Late-stage Parkinson's disease: the Barcelona and Lisbon cohort. *J Neurol* 2010; **257:** 1524–1532.
4. Clarke CE. Mortality from Parkinson's disease in England and Wales 1921–89. *J Neurol Neurosurg Psychiatry* 1993; **56:** 690–693.
5. Marras C, Rochon P, Lang AE. Predicting motor decline and disability in Parkinson disease: a systematic review. *Arch Neurol* 2002; **59:** 1724–1728.
6. Schrag A, Dodel R, Spottke A, Bornschein B, Siebert U, Quinn NP. Rate of clinical progression in Parkinson's disease. A prospective study. *Mov Disord* 2007; **22:** 938–945.
7. Harwood RH, Jitapunkul S, Dickinson E, Ebrahim S. Measuring handicap: motives, methods, and a model. *Qual Health Care* 1994; **3:** 53–57.
8. Harwood RH, Carr AJ, Thompson PW, Ebrahim S. Handicap in inflammatory arthritis. *Br J Rheumatol* 1996; **35:** 891–897.
9. World Health Organization. *International Classification of Impairments, Disabilities and Handicaps*. Geneva: WHO, 1980.
10. Ebrahim S. Measurement of impairment, disability and handicap. In: Hopkins A, Costain D, eds. *Measuring the Outcomes of Medical Care*. London: Royal College of Physicians of London, 1990: 27–41.
11. Harwood RH, Gompertz P, Ebrahim S. Handicap one year after a stroke: validity of a new scale. *J Neurol Neurosurg Psychiatry* 1994; **57:** 825–829.
12. Harwood RH, Rogers A, Dickinson E, Ebrahim S. Measuring handicap: the London Handicap Scale, a new outcome measure for chronic disease. *Qual Health Care* 1994; **3:** 11–16.
13. Kutlay S, Kucukdeveci AA, Yanik B, Elhan A, Oztuna D, Tennant A. The interval scaling properties of the London Handicap Scale: an example from the adaptation of the scale for use in Turkey. *Clin Rehabil* 2011; **25:** 248–255.
14. Harwood RH, Gompertz P, Pound P, Ebrahim S. Determinants of handicap 1 and 3 years after a stroke. *Disabil Rehabil* 1997; **19:** 205–211.
15. Hughes AJ, Daniel SE, Kilford L, Lees AJ. Accuracy of clinical diagnosis of idiopathic Parkinson's disease: a clinico-pathological study of 100 cases. *J Neurol Neurosurg Psychiatry* 1992; **55:** 181–184.
16. Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. *Neurology* 1967; **17:** 427–442.
17. Fahn S. *Unified Parkinson's Disease Rating Scale*. Florham Park, NJ: MacMillan Healthcare Information, 1987: 153–163.
18. Witjas T, Kaphan E, Azulay JP, *et al*. Nonmotor fluctuations in Parkinson's disease: frequent and disabling. *Neurology* 2002; **59:** 408–413.
19. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders DSM-IV*, 4th edn. Washington DC: American Psychiatric Association, 1994.
20. Folstein MF, Folstein SE, McHugh PR. 'Mini-mental state'. A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975; **12:** 189–198.
21. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Arch Gen Psychiatry* 1961; **4:** 561–571.
22. Den Oudsten BL, Van Heck GL, De Vries J. Quality of life and related concepts in Parkinson's disease: a systematic review. *Mov Disord* 2007; **22:** 1528–1537.
23. Lo RS, Kwok TC, Cheng JO, *et al*. Cross-cultural validation of the London Handicap Scale and comparison of handicap perception between Chinese and UK populations. *Age Ageing* 2007; **36:** 544–548.
24. Fenelon G, Mahieux F, Huon R, Ziegler M. Hallucinations in Parkinson's disease: prevalence, phenomenology and risk factors. *Brain* 2000; **123:** 733–745.
25. Giladi N, Treves TA, Paleacu D, *et al*. Risk factors for dementia, depression and psychosis in long-standing Parkinson's disease. *J Neural Transm* 2000; **107:** 59–71.
26. Goetz CG, Poewe W, Rascol O, *et al*. Movement Disorder Society Task Force report on the Hoehn and Yahr staging scale: status and recommendations. *Mov Disord* 2004; **19:** 1020–1028.
27. Hely MA, Morris JG, Reid WG, Trafficante R. Sydney Multicenter Study of Parkinson's disease: non-L-dopa-responsive problems dominate at 15 years. *Mov Disord* 2005; **20:** 190–199.
28. Kempster PA, Williams DR, Selikhova M, Holton J, Revesz T, Lees AJ. Patterns of levodopa response in Parkinson's disease: a clinico-pathological study. *Brain* 2007; **130:** 2123–2128.
29. van Rooden SM, Visser M, Verbaan D, Marinus J, van Hilten JJ. Patterns of motor and non-motor features in

Parkinson's disease. *J Neurol Neurosurg Psychiatry* 2009; **80:** 846–850.
30. World Health Organization. *International Classification of Functioning, Disability and Health*. WHO: Geneva, 2001.
31. Harwood RH, Ebrahim S. The London handicap scale. *J Neurol Neurosurg Psychiatry* 2000; **69:** 406.
32. Perenboom RJ, Chorus AM. Measuring participation according to the International Classification of Functioning, Disability and Health (ICF). *Disabil Rehabil* 2003; **25:** 577–587.
33. Leibson CL, Maraganore DM, Bower JH, Ransom JE, O'Brien PC, Rocca WA. Comorbid conditions associated with Parkinson's disease: a population-based study. *Mov Disord* 2006; **21:** 446–455.
34. Pressley JC, Louis ED, Tang MX, *et al*. The impact of comorbid disease and injuries on resource use and expenditures in parkinsonism. *Neurology* 2003; **60:** 87–93.
35. Goetz CG, Stebbins GT. Risk factors for nursing home placement in advanced Parkinson's disease. *Neurology* 1993; **43:** 2227–2229.
36. de Boer AG, Sprangers MA, Speelman HD, de Haes HC. Predictors of health care use in patients with Parkinson's disease: a longitudinal study. *Mov Disord* 1999; **14:** 772–779.
37. Martinez-Martin P, Arroyo S, Rojo-Abuin JM, Rodriguez-Blazquez C, Frades B, de Pedro Cuesta J. Burden, perceived health status, and mood among caregivers of Parkinson's disease patients. *Mov Disord* 2008; **23:** 1673–1680.
38. Peters M, Fitzpatrick R, Doll H, Playford D, Jenkinson C. Does self-reported well-being of patients with Parkinson's disease influence caregiver strain and quality of life? *Parkinsonism Relat Disord* 2011; **17:** 348–352.
39. Martinez-Martin P, Benito-Leon J, Alonso F, *et al*. Quality of life of caregivers in Parkinson's disease. *Qual Life Res* 2005; **14:** 463–472.
40. Schrag A, Hovris A, Morley D, Quinn N, Jahanshahi M. Caregiver-burden in Parkinson's disease is closely associated with psychiatric symptoms, falls, and disability. *Parkinsonism Relat Disord* 2006; **12:** 35–41.