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Recurrent falls in Parkinson's disease after one year of follow-up: A nested case-control study

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ABSTRACT

The aims of this study were to compare clinical and fall characteristics of single and recurrent falls among persons with PD and to evaluate factors associated with recurrent falls. A total of 120 consecutive persons with PD, who denied having fallen in the past 6 months, were recruited. Occurrence of falling was registered during one year. Each person was given a "fall diary" with the aim at writing characteristics of the fall and contacted by telephone each month. Over one year of follow-up 42 persons with PD (35.0%) reported falling. Of 42 persons, 19 (45.2%) went on to become single and 23 (54.8%) went on to become recurrent fallers. Indoor falls were more common among single fallers, whilst outdoor falls were more common among recurrent fallers ($p = 0.017$). Slipping and freezing of gait was more common among single fallers ($p = 0.035$ and $p = 0.024$, respectively). Lower extremity weakness was more frequent among recurrent fallers ($p = 0.023$). The most common injury both among single and recurrent fallers was the soft-tissue contusion. The only factor associated with recurrent falling among persons with PD, who did not fall in past 6 months before the start of follow-up, was worse motor performance as measured by the UPDRS III score (odds ratio [OR] = 1.06, 95% confidence interval [CI] 1.01–1.11, $p = 0.022$). These results could be used in selection of persons with PD to enroll in fall prevention programs.

1. Introduction

Parkinson's disease (PD) is a neurodegenerative disorder presenting with bradykinesia/akinesia, rigidity, tremor and postural instability. The symptoms worsen over time, causing impaired physical functioning and disability (Dal Bello-Haas, Klassen, Sheppard, & Metcalfe, 2011). As a result, persons with PD are prone to falling. Falls in PD are regarded as disabling, continuing and costly problem (Contreras & Grandas, 2012; Hely, Morris, Reid, & Trafficante, 2005; Hiorth, Larsen, Lode, & Pedersen, 2014; Kerr et al., 2010). Estimated prevalence of falling in PD increases with time, reaching 72% after 8 years of follow-up (Hiorth et al., 2014). In a long-term prospective study of persons with PD, after 20 years of follow-up, at least one fall occurred in 81% of individuals (Contreras & Grandas, 2012). Previous studies suggested that poor standing balance, impaired ambulation, impaired lower-limb motor planning, postural instability and falling in previous year are associated with falling in PD (Dennison et al., 2007; Duncan et al., 2012; Pickering et al., 2007). Moreover, factors in the environment, such as inadequate lighting and type of footwear, might predispose falling among older persons (Boelens, Hekman, & Verkerke, 2013; Kelsey et al., 2010). Frequent falls account for 16.8% of hospital admissions of persons with PD (Oguh & Videnovic, 2012). As a result of falling, persons with PD often experience activity limitations, participation restrictions, social isolation or premature mortality (Idjadi et al., 2005). Specifically, a 51% increase in risk of injury-related mortality over nine years of follow-up has been reported (Allyson Jones, Wayne Martin, Wieler, King-Jesso, & Voaklander, 2012).

Frequency of falling among persons with PD varies. The general division of fallers into single and recurrent fallers is based on the occurrence of one or more than one fall, respectively, over the twelve month assessment period (Stack & Roberts, 2013). Despite a plethora of studies on fall assessment, a little is known about characteristics of recurrent falls in comparison with single falls

Abbreviations: PD, Parkinson's disease; UK PDS, United Kingdom Parkinson's Disease Society; MDS UPDRS, Movement Disorder Society Unified Parkinson's Disease Rating Scale; FES, Fear of falling; SADS, Self-Assessment of Disability Scale; NFOG, New Freezing of Gait Questionnaire; HDRS, Hamilton Depression Rating Scale; HARS, Hamilton Anxiety Rating Scale.

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among persons with PD. Similarly, recurrent fallers might as well be at a higher risk of injuries as a result of frequent falling.

Previously, using a cross-sectional study design, we assessed risk factors and circumstances of falls among persons with PD who experienced falling prior to study baseline (Gazibara et al., 2014, 2015). We observed that non-fallers in our study population (120 out of 300, 40%) had better motor and non-motor PD-related features (Gazibara et al., 2015). Bearing in mind that previous falls represent the strongest predictor of future falling (Pickering et al., 2007), the non-fallers with PD were subsequently followed after baseline assessment over the period of one year. In the current paper, we present results of our observations using a distinctive study design (current prospective cohort study vs. past cross-sectional study), but the same study population.

The aims of this study were: (1) to compare clinical features of PD between persons who were classified as non-fallers, single and recurrent fallers after follow-up as well as to compare fall-related characteristics of persons with PD who sustained single and recurrent falls, and (2) to evaluate potential factors contributing to recurrent falls during one-year of follow-up.

2. Material and methods

2.1. Study design

Initial study was cross-sectional at baseline (a total of 300 persons with PD were included). A subgroup of persons who denied falling in past 6 months ($n = 120$ persons with PD) were subsequently followed for 1 year (prospective cohort study). After follow-up period, we identified and compared persons with PD who went on to become single and recurrent fallers ($n = 42$ persons with PD) by using a nested case-control study. Results of the nested case-control study are presented in this report.

2.2. Selection of participants

A total of 120 consecutive persons with PD, who denied having fallen in the past 6 months, were recruited at the Department of Movement Disorders, Neurology Clinic, Clinical center of Serbia in Belgrade from August 15, 2011 to December 15, 2012. To ensure that persons with PD were mobile and independent at least around their living space the following inclusion criteria were set: ability to walk independently for at least 10 m and ability to statically stand for at least 90 s. The exclusion criteria were the following: presence of other neurologic (e.g., stroke, traumatic brain injuries, dementia) as well as psychiatric (e.g., psychoses), visual, audio-vestibular and orthopedic impairments (e.g., fracture, moderate to severe osteoarthritis).

The study was approved by the Ethics Committee of Faculty of Medicine of the University of Belgrade. Participants signed an informed consent prior to enrollment in the study.

2.3. Measurement instruments

Demographic (age, gender, marital status, education level) and clinical (age at onset, duration of PD) characteristics were taken from the medical records of the Neurology Clinic. The PD diagnosis was made according to the United Kingdom Parkinson's Disease Society (UK-PDS) Brain Bank criteria (Hughes, Daniel, Kliford, & Lees, 1992). Cognitive status was assessed by the Mini Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) and only those with a score $\geq$24 were included (i.e., those without cognitive impairment). Disease stage and severity was assessed using the Hoehn and Yahr scale (HY) (Hoehn & Yahr, 1967) and the Movement Disorder Society UPDRS (MDS-UPDRS) (Goetz et al., 2008). The UPDRS is divided in 4 subscores UPDRS I (non-motor aspects of experiences of daily living), UPDRS II (motor aspects of experiences of daily living), UPDRS III (motor examination) and UPDRS IV (motor complications). In patient assessment we used UPDRS III and IV, because non-motor and motor aspects of daily living were evaluated using other scales (described in the following text). The scores for UPDRS III ranged from 0 to 132, and for UPDRS IV ranged from 0 to 64. Dosages of levodopa were calculated based upon the systematic review of levodopa dose equivalency reporting in PD (Tomlinson et al., 2010).

The Falls Efficacy Scale (FES) was applied to estimate fear of falling and the Self-Assessment Disability Scale (SADS) to quantify the level of difficulty while performing activities of daily living. Both scales were previously validated and culturally adapted (Gazibara et al., 2013a, 2013b). The FES questionnaire quantifies the degree of perceived efficacy in avoiding a fall during 10 activities of daily living (Tinetti, Mendes de Leon, Doucette, & Baker, 1994). All 10 items in the scale have 10 possible responses (quantifications) ranging from 1 to 10, where 1 represents "being very confident" and 10 represents "being not confident at all" at carrying out the listed activities. The total FES score was obtained from the sum of these 10 items, ranging from 10 to 100 where a score >70 suggests a fear of falling (Tinetti et al., 1994). The SADS-PD questionnaire (Brown, MacCarthey, Jahanshai, & Marsden, 1989) consists of 25 items related to daily activities that include social dimension (such as walking outside, climbing up and down the stairs) and manipulating small and medium sized objects. All items in the scale have five possible responses (quantifications) ranging from 1 to 5 that refer to the level of performance of the given activity. The lowest mark 1 represents "performing the task alone and without difficulty", while the highest mark 5 denotes "not able to perform the task at all". The total SADS-PD score is obtained from the sum of these 25 items, ranging from 25 to 125. A higher total score indicates greater disability.

Additionally, participants answered the New Freezing of Gait Questionnaire (NFOG), to assess frequency and impact of freezing on daily activities (with permission of the author) (Nieuwboer et al., 2009). To answer this questionnaire, persons with PD were required to watch a short film footage of a person experiencing freezing of gait, to ensure that the patient differentiates these episodes from other walking and movement difficulties. Afterwards, participants were asked to answer 9 items, depending on whether or not they experienced freezing of gait. The NFOG score (obtained by adding scores of each item) ranges from 0 (indicating no freezing) to 29, where higher values indicate greater severity of freezing of gait. To assess the mood we used the Hamilton Depression Rating Scale (HDRS) (Hamilton, 1967) and the Hamilton Anxiety Rating Scale (HARS) (Hamilton, 1959). The HDRS consists of 21 items that examine presence of symptoms and signs of depression. Answers are graded on 0–2 or 0–4 point scale, based on severity. The total HDRS score was obtained by summing each item score that may range from 0 to 64. Values >10 suggest presence of depression. The HARS has 14 items examining symptoms and signs of anxiety. Answers are graded on a 5-point scale (0–4), with higher values denoting more severe symptoms and signs of anxiety. The total score is calculated by summing item scores. The total HARS score may range from 0 to 56, with cut-off of >17 suggesting presence of anxiety.

2.4. Follow-up and registration of falls

A fall was defined as an event which results in an individual coming to rest inadvertently on the ground/floor. Occurrence of falling was followed for one year. Each subject was given a "fall diary" with the aim at writing characteristics of the fall as soon as possible after falling. To ensure that persons with PD report