



## Feature Article

## Circumstances of falls and fall-related injuries among patients with Parkinson's disease in an outpatient setting



Tatjana Gazibara, MD<sup>a</sup>, Tatjana Pekmezovic, MD, PhD<sup>a</sup>,  
 Darija Kisic Tepavcevic, MD, PhD<sup>a</sup>, Aleksandra Tomic, MD<sup>b</sup>, Iva Stankovic, MD<sup>b</sup>,  
 Vladimir S. Kostic, MD, PhD<sup>b</sup>, Marina Svetel, MD, PhD<sup>b,\*</sup>

<sup>a</sup> Institute of Epidemiology, Faculty of Medicine, University of Belgrade, Serbia

<sup>b</sup> Clinic of Neurology, Clinical Centre of Serbia, Faculty of Medicine, University of Belgrade, Dr Subotica 6, Belgrade 11000, Serbia

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## ABSTRACT

Falls represent continuing, disabling and costly problem in Parkinson's disease (PD). The study was carried out at the Neurology Clinic in Belgrade from August 2011 to December 2012. As many as 180 community dwelling persons with PD aged 22–83 years who sustained a fall in past 6 months were included. Characteristics of the most recent fall were obtained through detailed interviews. Inclusion criteria were: Mini Mental State Examination (MMSE)  $\geq 24$ , ability to walk independently for at least 10 m and ability to statically stand for at least 90 s. Exclusion criteria were: presence of other neurologic as well as psychiatric, visual, audio-vestibular and orthopedic impairments. Falls more frequently took place outside (57.2%) and in the morning (53.9%). As much as 38.9% of persons with PD sustained an injury. Soft-tissue contusion was the most common injury (71.8%) both after indoor and outdoor falls. Fractures accounted for 5% of all fall-related injuries. All the fractures were either arm, clavicle or rib fractures. Tripping was identified as risk factor for outdoor falls (OR = 7.90; 95% confidence interval [95% CI] 3.21–19.39;  $p = 0.001$ ). In contrast, lower extremity weakness (OR = 0.20; 95% CI 0.05–0.72;  $p = 0.015$ ) and internal sense of sudden loss of balance (OR = 0.19; 95% CI 0.05–0.73;  $p = 0.015$ ) were risk factors for indoor falls. To accomplish long-term results, development of particular prevention programs for persons with PD who fall at home vs. outdoors is recommended.

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## Introduction

Parkinson's disease (PD) is a neurodegenerative disorder caused by dysfunction of basal ganglia in midbrain. Main clinical features include bradykinesia/akinesia, rigidity, tremor and postural instability. Apart from motor impairment, persons with PD also develop diverse non-motor symptoms such as depression, anxiety, sleep disorders and autonomic dysfunction.<sup>1,2</sup> Because of motor impairments, PD has a considerable impact on walking and subsequent occurrence of falls.

Falls represent continuing, disabling and costly problem in PD.<sup>3–6</sup> 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 of whom 23% sustained a fracture.<sup>4</sup> Cross-sectional studies have demonstrated that falling was significantly associated with increased age, longer disease duration, more advanced disease, stability

and posture-related impairments and autonomic dysfunction.<sup>5,7</sup> Furthermore, case-control studies have reported that persons with PD who fall have a higher prevalence of PD-associated disturbances (poor standing balance, motor-issues and brain-related changes) compared with persons with PD who do not fall.<sup>8,9</sup> Other factors associated with falling include psychosocial factors in terms of mental status changes, depression and fear of falling.<sup>10–12</sup> Considering heterogeneity of risk factors for falling, only a small proportion of falls among persons with PD result from an obvious, single cause.<sup>13</sup>

To differentiate conditions in which a fall occurs, a distinction of intrinsic and extrinsic risk factors has been proposed.<sup>14</sup> Intrinsic (or patient-related) causes include dizziness/vertigo, syncope, lower extremity weakness and concomitant chronic conditions (cardiovascular diseases, poor vision and hearing) as well as medication side-effects among persons with PD. Extrinsic factors are related to surrounding space and include environmental factors such as tripping, slipping, walking on uneven surfaces and inadequate illumination. Although intrinsic factors such as postural instability and freezing of gait have been commonly cited causes of falls

\* Corresponding author. Tel./fax: +381 11 2685596.

E-mail address: [marinasvetel@gmail.com](mailto:marinasvetel@gmail.com) (M. Svetel).

among persons with PD<sup>4,9,10</sup> other factors should also be considered. Study by Ashburn et al pointed out that most falls in persons with PD occur indoors.<sup>15</sup> Yet, some authors consider that outdoor environment may impact ability to walk and experience of everyday walking.<sup>16,17</sup> Nevertheless, specific and detailed aspects of falls of persons with PD are still unclear.

Fall-related burden among persons with PD should not be underestimated. Falls among persons with PD often result in activity limitations, participation restrictions, social isolation or premature mortality.<sup>18</sup> For example, persons with PD who exert less fall-related self-efficacy have less ability to perform activities of daily living.<sup>19</sup> At the same time, persons with PD who fall avoid walking on slippery surfaces, crowded areas and public transport.<sup>20</sup> Furthermore, over nine years of follow-up a 51% increase in risk of injury mortality has been documented.<sup>21</sup> Frequent falls account for 16.8% of hospital admissions, while traumatic injuries make up 27.6%.<sup>22</sup> In terms of fall-related hip fracture, the risk among persons with PD was four times higher compared with age- and sex-matched healthy controls.<sup>23</sup> Consequently, fall-related fractures among persons with PD contribute to higher health-care costs compared with health expenditure in management of fractures among persons without PD.<sup>24</sup> Interestingly, it has been reported that fewer fallers describe injuries than mentioned needing help to stand up.<sup>25</sup> Despite the extensive epidemiological research on risk factors associated with falling,<sup>4,5,7–12</sup> there is a lack of detailed information on circumstances and consequences of falls among persons with PD. Identifying circumstances of falls may be crucial in planning fall prevention programs. The purpose of this study was to examine differences in features of PD attributing to circumstances of falls in persons with PD.

## Material and methods

### Selection of participants

The study was conducted from August 2011 to December 2012, when consecutive persons with PD presenting at the outpatient Department of Movement disorders (Neurology Clinic, Clinical Center of Serbia in Belgrade) were invited to participate. A fall was defined as an event which results in an individual coming to rest inadvertently on the ground/floor.<sup>26</sup> Therefore, a person with PD who was defined as 'faller' had to answer affirmatively to "Have you fallen on a ground or a floor in the past 6 months?" To identify specific circumstances of outdoor vs. indoor fall only characteristics of the most recent fall in the past 6 months were recorded and analyzed.<sup>12</sup> This survey was approved by the Ethical Committee of Faculty of Medicine of the University of Belgrade. Participants signed an informed consent prior to enrollment in the study.

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. To eliminate potential walking difficulties and participation restrictions, influenced by other impairments or disabilities that could have facilitated falling at the time of fall, 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).

### Measurement instruments

The PD diagnosis was made according to the United Kingdom Parkinson's Disease Society (UK-PDS) Brain Bank criteria.<sup>27</sup> Disease stage and severity was assessed using the Hoehn and Yahr scale (HY)<sup>28</sup> and the newer version of the Unified Parkinson's Disease

Rating Scale (UPDRS).<sup>29</sup> The total UPDRS score represented the sum of four subscores from the equivalent subscales: UPDRS I, II, III and IV. Subscales' scores UPDRS I and II ranged from 0 to 52; UPDRS III score ranged from 0 to 132, while UPDRS IV ranged from 0 to 64. Therefore, the total UPDRS score varied from 0 to 248. Higher values in each subscale and in total UPDRS represented higher level of activity limitations and participation restrictions.<sup>29</sup> Cognitive status was assessed by Mini Mental State Examination (MMSE)<sup>30</sup> and only those with a score  $\geq 24$  were included (i.e. those without cognitive impairment).

Falls data were obtained through detailed interviews with persons with PD and their caregivers. Demographic (age, sex) and clinical (age at onset, duration of PD) characteristics were taken from the medical records of the Neurology Clinic. Respondents were classified, according to location of most recent fall, as indoor fallers or outdoor fallers. An indoor fall was defined as occurring inside any building, while an outdoor fall was defined as occurring outside a building (including front and back garden, patio, porch, deck or outdoor stairs). Other aspects of the latest fall were investigated: time of day, type of lighting (daylight/artificial lighting), footwear (such as flat shoes, home slippers with open and closed-up top, tennis shoes, no shoes at all), circumstance preceding the fall and specific situation that led to falling. Specifically, circumstances were grouped as extrinsic factors (such as tripping, slipping) and intrinsic factors that comprised postural instability, dizziness, sudden loss of strength in lower extremities (i.e. muscles giving away), internal sense of sudden loss of balance and freezing of gait. Postural instability was defined as involuntary movement of the body either forward (anteropulsion), backward (retropulsion) or to the side (lateropulsion). Participants were asked whether or not they needed an assistance to stand up and whether or not they sought medical treatment after falling. In addition, injury type was logged based on self-report and previous medical reports.

### Data analysis

Proportions were used to describe frequencies in categories of indoor and outdoor falling. Differences in categorical variables were assessed by using Chi-square test, while for continuous variables Mann–Whitney *U* test for 2 independent samples was applied. Bivariate logistic regression was performed to evaluate the association of variables (categories of circumstances of falls) to outdoor and indoor falls. As a measure of effect size, odds ratio (OR) was used to describe the strength of association between particular circumstance and occurrence of fall. Adjusted ORs (according to age, HY stage and PD duration) were analyzed. The probability level of  $\leq 0.05$  was considered statistically significant. For statistical analysis the SPSS 17.0 statistical software package (SPSS Inc, Chicago, IL, USA) was used.

## Results

Of 300 participants, 180 (60%) reported occurrence of falls in the past 6 months. Basic demographic and clinical characteristics of fallers according to location of fall are presented in [Table 1](#). Exactly 103 falls (57.2%) took place outdoors. Indoor fallers were, on average, significantly older and demonstrated higher degree of non-motor impairment (as measured by UPDRS I) than outdoor fallers.

Characteristics of most recent fall sustained by our respondents are shown in the [Table 2](#). Typical time of day when persons with PD sustained a fall was morning (53.9%). Majority of falls (77.2%) occurred in daylight. Dominant causes of falls differed in relation to location of fall. Circumstances of outdoor falls involved mainly extrinsic factors: tripping and slipping accounted for 66.0% of outdoor falls. In this case, tripping resulted mainly while walking over a

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