NCPD Nursing Continuing Professional Development

Extrinsic and Behavioral Fall Risk Factors in People With Parkinson's Disease: An Integrative Review

Orawan Kuljeerung[1], MSN & Helen W. Lach[2], PhD, RN, CNL, FGSA, FAAN

Abstract

Aim: The aim of the study was to explore extrinsic and behavioral risks for falls in older adults with Parkinson's disease (PD).
Background: Falls that cause injury and disability in people with PD are common. Understanding the role of extrinsic and behavioral factors is important for fall prevention.
Design: Integrative literature review with search of CINAHL, MEDLINE, and SCOPUS and ancestry searching was performed.
Methods: The methodology of Whittemore and Knafl guided the review; ten studies were included.
Findings: Falls occur indoors and outdoors, commonly during daily activities in familiar home environments, but also when out in the community. Common challenges include uneven and unfamiliar environments and risky behavior like hurrying.
Conclusion: Extrinsic risk factors combined with behavioral and intrinsic factors contribute to falls in people with PD both at home and in the community.
Clinical Relevance: Rehabilitation of people with PD should include assessment of falls, function, extrinsic risk factors, and fit with their environment to develop fall prevention plans.

Keywords: Environmental hazards; extrinsic factors; falls circumstances; Parkinson's disease.

Introduction

Parkinson's disease (PD) is a neurodegenerative disease affecting over 10 million people worldwide (Parkinson's Foundation, 2018). The prevalence of this disease increases with age (Pringsheim, Jette, Frolkis, & Steeves, 2014). The incidence of PD in industrialized countries is 8–18 per 100,000 people per year (Lee & Gilbert, 2016). The main clinical features are tremor, rigidity, bradykinesia, and postural instability, which are related to motor impairment (Kalia & Lang, 2015) that typically worsens over a period of years (Lee & Gilbert, 2016). As a result, falling is a major problem in this population. Allen, Schwarze, and Canning (2013) reported 60% of people with PD have falls, and 39% have recurrent falls. People with mild-to-moderate PD who experience falls and near falls report that they have a fear of falling (FOF) and avoid physical activities (Kader, Iwarsson, Odin, & Nilsson, 2016). Over half of those who fall are no longer able to live alone (Hely, Morris, Reid, & Trafficante, 2005). Falls result in lower health-related quality of life (Rascol et al., 2015). Therefore, fall prevention is an important component of care in the rehabilitation of people with PD.

There are three main categories of fall risk factors: intrinsic, extrinsic, and behavioral factors (Feldman & Chaudhury, 2008; Pynoos, Steinman, & Nguyen, 2010), with most fall events resulting from interactions between these three categories (Pynoos et al., 2010). Intrinsic factors are related to the individual, such as age, fall history, FOF, medical conditions, and gait and mobility impairments (Feldman & Chaudhury, 2008; Pynoos et al., 2010). Extrinsic factors are outside the individual, such as environmental hazards, footwear, clothing, and inappropriate walking aids (Pynoos et al., 2010). Behavioral factors result from actions performed by the individual, such as risk-taking behaviors (Feldman & Chaudhury, 2008). Individuals might perform risky behaviors such as walking on a slippery floor or avoiding behaviors that could reduce fall risk such as exercise (Pynoos et al., 2010).

Falls prevent an individual from achieving optimal functional ability, a goal of rehabilitation. Extrinsic risk factors were the dominant cause of falls in a study of 45 people with PD (Hely et al., 2005). Among 100 people with PD, 12% reported falls associated with environmental hazards (Rudzińska et al., 2013). Allen et al. (2013)

Correspondence: *Orawan Kuljeerung, MSN, Nursing Faculty of Burapha University, 169 Long-Hard Bangsaen Road, Tambon Saensook, Amphur Muang, Chonburi 20131, Thailand. E-Mail: okuljeerang@gmail.com*

1 Nursing Faculty of Burapha University, Chonburi, Thailand.

2 Saint Louis University School of Nursing, St. Louis, MO, USA.

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identified that people with mild PD severity had a higher risk of recurrent falls than those with moderate to severe PD. Those with milder disease may have increased risk due to being more active. Slaug, Nilsson, and Iwarsson (2013) found people with PD who had poor balance, coordination, and lived in inappropriate environments had lower functional capacity. Extrinsic factors in the environment might support functional ability or create further disability (Pynoos et al., 2010). Thus, understanding extrinsic and behavioral fall risk factors in people with PD could promote function and prevent falls for this population. However, there are no reviews that specifically explore these fall risk factors in people with PD. Therefore, the aim of this integrative review is to explore the literature related to extrinsic and behavioral fall risk factors in people with PD.

Theoretical Underpinnings

The built environment refers to the physical environment and includes the home and outside surroundings that are human-made or modifiable (Tuckett, Banchoff, Winter, & King, 2018), which has implications for falls. This relationship can be examined through the person–environment fit (P-E fit) framework of Lawton and Nahemow (Lawton, 1989). Human behavior and human function result from the transactional process between the competencies of the individual, environmental demand (press), and the interaction or adaptation of the person to the environment. The individual adapts by feeling, realizing, or managing their environment (Satariano, 2006). For example, researchers found a good P-E fit results in high life satisfaction, performance, and productivity (Lien, Steggell, & Iwarsson, 2015). However, if the environment offers barriers and demands beyond the individual's ability, there is a poor P-E fit. The individual might encounter difficulty carrying out daily activities and have increased disability and functional problems, such as falls (Lien et al., 2015). Understanding extrinsic and behavioral factors for falls and P-E Fit could help inform interventions to reduce falls in people with PD.

Methods

This integrative review was based on the methodology of Whittemore and Knafl (2005). The authors identified the problem or gap in knowledge about extrinsic and behavioral risk factors in people with PD. Three databases, CINAHL, MEDLINE, and SCOPUS, were searched without restricting the year through December 2019. The search terms were "Parkinson*," AND "fall OR falls OR falling," AND "environment* OR circumstance* OR indoor OR outdoor OR event* OR location* OR daily activity.*" The inclusion criteria were as follows: Study participants were people with PD in community settings, the article included data on specific extrinsic and behavioral fall risk factors, and the article was published in English. If studies included people with other illnesses but the results for people with PD were reported separately, they were included. Theses, dissertations, qualitative studies, and case studies were excluded.

A total of 1,018 studies were generated from the three databases (n = 1,016) and ancestry searching (n = 2). After duplicates were excluded, titles and abstracts were screened. Studies meeting inclusion criteria were reviewed by the authors. Three were excluded because of inadequate information. Finally, 10 studies remained for analysis (Figure 1). Study data were extracted, and findings were analyzed to identify themes.

Findings

The included studies were conducted in seven countries, the United Kingdom, Serbia, the Netherlands, Canada, Australia, Thailand, and Hong Kong (Table 1), and published between 1999 and 2019. Nine studies were observational: three prospective cohort studies (Ashburn, Stack, Ballinger, Fazakarley, & Fitton, 2008; Gazibara et al., 2016; Gray & Hildebrand, 2000), two case–control studies (Bloem, Grimbergen, Cramer, Willemsen, & Zwinderman, 2001; Mak & Pang, 2010), and four cross-sectional studies (Foongsathaporn, Panyakaew, Jitkritsadakul, & Bhidayasiri, 2016; Gazibara et al., 2014; Stack & Ashburn, 1999; Stack & Roberts, 2013). One study was a randomized controlled trial (Lamont, Morris, Menz, McGinley, & Brauer, 2017). The researchers collected data by structured or semistructured interviews (Gazibara et al., 2014; Stack & Ashburn, 1999), telephone interviews (Gazibara et al., 2016; Lamont et al., 2017; Mak & Pang, 2010), questionnaires (Foongsathaporn et al., 2016; Stack & Roberts, 2013), falls diaries (Ashburn et al., 2008; Bloem et al., 2001; Gazibara et al., 2016; Gray & Hildebrand, 2000), and medical records (Gazibara et al., 2014). The mean age of the participants in the study was greater than 50 years old, except one study that did not report age (Gazibara et al., 2016). Four studies only included people with a history of falls (Ashburn et al., 2008; Foongsathaporn et al., 2016; Gazibara et al., 2014; Stack & Roberts, 2013). Several studies reported participant symptoms using the Hoehn and Yahr (2001) scale (Ashburn et al., 2008; Bloem et al., 2001; Gazibara et al., 2016; Gray & Hildebrand, 2000; Lamont et al., 2017; Mak & Pang, 2010; Stack & Ashburn, 1999). The scale indicates severity of PD symptoms using a 5-point rating (1 = *few symptoms* and 5 = *severe symptoms with confinement to bed or chair*). All of the study participants were independently mobile, and those reported fell into Stages 2–3 using the Hoehn and Yahr scale.

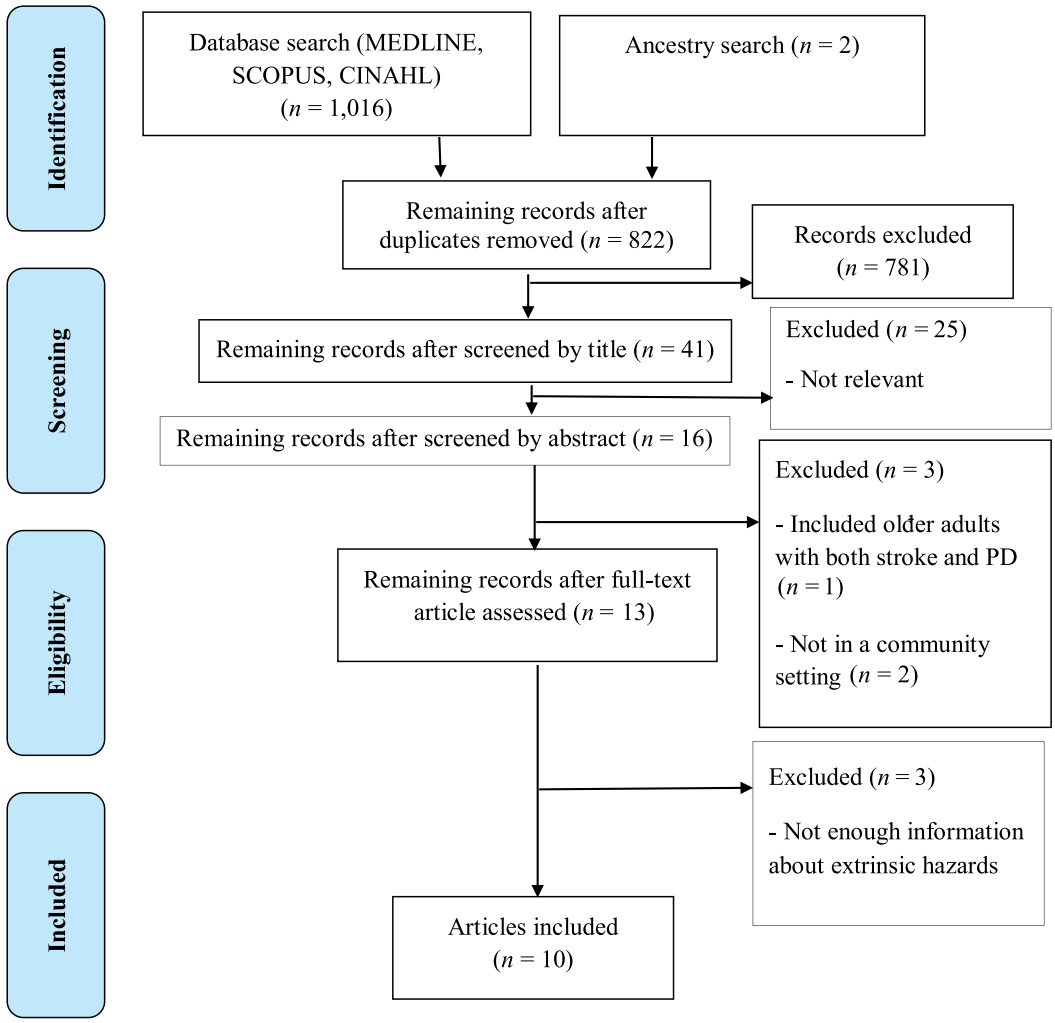

Figure 1. PRISMA flowchart.

Extrinsic Factors

Indoor Falls

Indoor falls happened more often than outdoor falls (Bloem et al., 2001; Gazibara et al., 2016), as well as recurrent falls (Mak & Pang, 2010). Indoor falls tended to happen in places people frequent: bedrooms, living rooms, kitchens, bathrooms, and hallways (Ashburn et al., 2008). However, they also occurred at unfamiliar sites (Stack & Ashburn, 1999). Indoor fall hazards for people with PD included uneven walking surfaces and objects on the floor, as well as slippery, sticky, and soft surfaces (Lamont et al., 2017). Wooden surfaces, such as steps, were common sites for falls (Gazibara et al., 2016). Surface changes, that is, the threshold of a doorway or connection between a wooden and tile surface, were hazards related to walking difficulty (Gazibara et al., 2014). Carpets and objects on the floor, that is, a dog's bed, were tripping hazards (Gazibara et al., 2014; Gray & Hildebrand, 2000; Stack & Ashburn, 1999).

Time of day was associated with falls in some studies, with daytime falls most common in studies from Serbia (Gazibara et al., 2016, 2014). Morning and nighttime falls tended to happen indoors (Gazibara et al., 2014). Because falls occurred most often during the day, daylight was more common than artificial light or darkness (Gazibara et al., 2014).

Outdoor Falls

One researcher reported outdoor falls happened more frequently than indoor falls (Gazibara et al., 2014). Mak and Pang (2010) reported outdoor falls were usually single events and did not recur. Challenging sites were doorways and gardens (Ashburn et al., 2008; Stack & Ashburn, 1999), stairs (Ashburn et al., 2008), streets, parking lots, or unfamiliar gardens or places (Stack & Roberts, 2013). Similar to indoors, outdoor hazards included objects on the ground, uneven surfaces, that is, curbs, slopes, ramps, hills, and rough surfaces (Gazibara

Table 1 Summary of Extrinsic Factors and Behavioral Factors for Falls

Study/Country	Design/Purposes	Participants With PD	Extrinsic Factors and Behavioral Factors for Falls
Stack & Ashburn (1999) United Kingdom	Cross-sectional study To identify the circumstances of falls Structured interview	*N* = 55 Age 71.5 ± 7.6 PD severity 1–3 (H&Y) Independent mobility	Indoor falls: dog's bed, carpet, unfamiliar house Outdoor falls: sloping ground, curbs, steps, doorways, roots, snow, garden Behavioral factors: turning, rushing, bending over, picking up thing from the floor, reaching things, carrying things
Gray & Hildebrand (2000) Canada	Prospective cohort study To identify falls risk factors Fall diaries, interview 12-week FU	*N* = 118 Age 70–79 PD severity 1–4 (H&Y) Independent mobility	Indoor falls: carpets Behavioral factors: walking, turning, standing, rising, being in a confined space, ambulation without aid, performing activities while "on phase" of medication (medications effective)
Bloem et al. (2001) the Netherlands	Case–control study To determine the circumstances of falls Fall diaries 24-month FU	*N* = 59 Age 60.8 ± 9.7 PD severity 2–3 (H&Y) Independent mobility	Indoor falls: indoor falls > outdoor falls Behavioral factors: turning around, standing up, bending forward, performing activities during "on phase" of medication (medications effective)
Ashburn et al. (2008) United Kingdom	Prospective cohort study To describe the circumstances of fall events Falls diaries 6-month FU	142 Fall >1 in previous 12 months Mean age 72 PD severity 2–4 (H&Y) Independent mobility	Indoor falls: bedrooms, living areas, kitchens, bathrooms, hallways Outdoor falls: doorways, stairs, gardens Behavioral factors: walking, turning, stepping, turning too quickly and slipping, walking and carrying things, bending toward, reaching things, washing, dressing, preparing things, making bed, gardening, transferring from place to another place
Mak & Pang (2010) Hong Kong	Case–control study To compare the causes and circumstance of falls Telephone interview 12-month FU	*N* = 72 Independent mobility 47 nonfallers Mean age 63.7 ± 8.4 PD severity 2.6 ± 0.4 (H&Y) Duration 6.3 ± 3.7 12 single fallers Mean age 60.6 ± 6.3 PD severity 2.6 ± 0.7 (H&Y) Duration 9.3 ± 5.1 13 recurrent fallers Mean age 65.2 ± 8.4 PD severity 2.9 ± 0.4 (H&Y) Duration 8.0 ± 3.5	Indoor falls: recurrent falls most happened at home Outdoor falls: single falls most happened outdoors Behavioral factors: Single falls walking, standing, transferring, and stair climbing Recurrent falls walking, standing, turning, stair climbing, sitting
Stack & Roberts (2013) United Kingdom	Cross-sectional study To describe falls beyond home Questionnaires	*N* = 136 Falls in previous 12 months Median age 72 Median duration 8	Outdoor falls: street/car park, unfamiliar building, green spaces or unfamiliar garden Behavioral factors: walking, vehicle transfers, on steps, standing, sit or stand transfers, shopping, gardening, playing with grandchildren, toileting/dressing
Gazibara et al. (2014) Serbia	Cross-sectional study To identify intrinsic and extrinsic risk factors of falls Interview and medical records	*N* = 180 Falls in previous 6 months 77 indoor fallers Age 64.6 ± 8.6 years Duration 8.5 ± 5.8 103 outdoor fallers Age 60.5 ± 10.1 years Duration 7.7 ± 5.7	Indoor falls: carpet, the connection between tile surface and wooden surface, nighttime Outdoor falls: outdoor falls > indoor falls curbs, object on the ground, ice, wet grass, wet pavement, daytime Behavioral factors: walking Indoor falls wearing close-up top slippers, open-top slippers, barefoot Outdoor falls wearing flat shoes, tennis shoes, sandals, high heel shoes

(continues)

Table 1 Summary of Extrinsic Factors and Behavioral Factors for Falls, Continued

Study/Country	Design/Purposes	Participants With PD	Extrinsic Factors and Behavioral Factors for Falls
Foongsathapor et al. (2016) Thailand	Cross-sectional study To identify specific predictor of future falls from daily activity Questionnaires	*N* = 160 Age 64.41 ± 10.55 PD severity 1–4 (H&Y) Falls in previous month	Behavioral factors: getting in/out of car, standing on chair to reach something, picking up slippers from floor
Gazibara et al. (2016) Serbia	Prospective cohort study To compare features and location of fall events Falls diaries and telephone interview 12 - month FU	*N* = 120 PD severity 1–3 (H&Y) Duration 4.0 No fall in past 6 months Independent mobility	Indoor falls: indoor falls> outdoor falls, breaking of a wooden step at the house entrance, daytime Behavioral factors: performing activities during on state of medication (medications effective), wearing shoes
Lamont et al. (2017) Australia	Prospective 14 months RCT To compare the characteristics of people with PD who fell at home and/or community Telephone interview 14-month FU	*N* = 210 Age 67.4 ± 9.5 PD severity 1–4 (H&Y) Duration 5.0 Independent mobility	Behavioral factors: walking on terrain (a ramp, stairs, a curb, a slope, a hill or a rough, slippery, sticky, or soft surfaces, or walking from one surface to another), changing speed or direction, changing position, reaching up or down, changing position of their head, carrying something, performing activities during "on state" of medication (medications effective), walking quickly or felt pressured to rush, performing multiple tasks

Note. PD = Parkinson's disease; FU = follow-up; H&Y = Hoehn and Yahr scale; RCT = randomized controlled trial.

et al., 2014; Lamont et al., 2017; Stack & Ashburn, 1999). Wet surfaces, wet grass, pavement, ice, or snow were also outdoor hazards (Gazibara et al., 2014; Stack & Ashburn, 1999). Tripping outdoors resulted from objects on the ground (Gazibara et al., 2014). In addition, outdoor falls most often happened in the morning (Gazibara et al., 2014).

Behavioral Factors

Falls often occurred in persons while completing daily activities, usually while walking (Ashburn et al., 2008; Gazibara et al., 2014; Gray & Hildebrand, 2000; Lamont et al., 2017; Mak & Pang, 2010; Stack & Roberts, 2013). Researchers identified challenging terrains, including ramps, stairs, curbs, slopes, hills; rough, slippery, sticky, or soft surfaces; or walking from one surface to another (Lamont et al., 2017). Gazibara et al. (2016, 2014) noted that walking barefoot or wearing slippers, flat shoes, tennis shoes, sandals, or high-heeled shoes were implicated in indoor and outdoor falls. Moreover, people with PD tended to fall while carrying items (Lamont et al., 2017; Stack & Ashburn, 1999), gardening (Ashburn et al., 2008; Stack & Roberts, 2013), shopping, and playing with grandchildren (Stack & Roberts, 2013). Falling occurred while performing challenging tasks such as standing on a chair to reach something (Ashburn et al., 2008; Foongsathaporn et al., 2016; Lamont et al., 2017).

Changing position was a fall risk in several studies, including turning (Ashburn et al., 2008; Bloem et al., 2001; Gray & Hildebrand, 2000; Mak & Pang, 2010; Stack & Ashburn, 1999), bending over (Ashburn et al., 2008; Bloem et al., 2001; Foongsathaporn et al., 2016; Stack & Ashburn, 1999), reaching (Ashburn et al., 2008; Lamont et al., 2017; Stack & Ashburn, 1999), standing up from sitting or lying (Bloem et al., 2001; Gray & Hildebrand, 2000; Lamont et al., 2017; Mak & Pang, 2010), and transferring from one place to another place or vehicle (Ashburn et al., 2008; Foongsathaporn et al., 2016; Mak & Pang, 2010; Stack & Ashburn, 1999). Lamont et al. (2017) noted that changing speed or direction while moving was related to falls. Moving too quickly or rushing were described as a behavioral fall risk (Ashburn et al., 2008; Lamont et al., 2017; Stack & Ashburn, 1999).

It is significant that, in three of the studies, fall events occurred after taking PD medications. Evidence from these studies showed that falling happened while being in the "on phase" (medication effective) more often than in the "off phase" (medication ineffective; Bloem et al., 2001; Gazibara et al., 2016; Gray & Hildebrand, 2000). Similarly, Lamont et al. (2017) found falls occurred in both the community and at home during the time that antiparkinsonian medications were working well (on phase). Gray and Hildebrand (2000) reported that consuming one drink of alcohol per day or more was a behavioral fall risk factor.

Discussion

The current review is the first integrative review of research related to extrinsic and behavioral factors related to falls among people with PD. This review may inform practice, policy, and future research in rehabilitation. These findings suggest that falls occur in all kinds of places, any time of day and while doing a variety of activities. More challenging environments and hazardous behaviors increased the risk of falls for people with PD. Unfortunately, falls are common even while performing daily activities, particularly in those with poor mobility and balance. Although extrinsic and behavioral factors have long been identified as risks for older adults and people with PD, the authors found only 10 studies focused on these factors over the past 20 years. The findings support the need to address these factors for falls in people with PD.

The P-E fit provides an appropriate framework for approaching fall prevention in people with PD. According to the P-E fit framework, falling is associated with personal components (intrinsic factors) as they interact with environmental components (extrinsic factors). As an individual experiences functional decline caused by PD, they need to change the environment, increase their functional abilities, or adapt their behaviors, such as the use of adaptive equipment, to maintain function (Lawton, 1989; Lien et al., 2015). Slaug et al. (2013) found poor P-E fit reduced accessibility and increased functional limitations in older adults with PD compared with controls. Based on these studies, both indoors and outdoors have an extrinsic factor (i.e. stairs, thresholds, irregular flooring) that may provide barriers resulting in poor P-E fit. Assessment of P-E fit should be part of a fall prevention plan for people with PD.

For both indoor and outdoor falls, challenging factors in the environments such as uneven walking surfaces may interact with intrinsic risk factors such as fatigue, FOF, balance problems, or freezing episodes in people with PD, increasing the probability of falling. Even those with mild PD showed more difficulty maintaining balance and stability while walking on irregular surfaces (Xu, Hunt, Bo Foreman, Zhao, & Merryweather, 2018). Thus, individualized assessment of walking surfaces at home and awareness of walking surfaces out in the community are needed to help people with PD prevent falls.

Extrinsic factors are critical risks for falls in people with PD, especially when combined with intrinsic and behavioral factors. Nurses should consider these factors and assess how environmental hazards or type of shoes affect the P-E fit. Environmental assessment tools are available to identify risk factors and targets for home modification, such as the Westmead Safety Home Assessment or the Home Falls and Accidents Screening Tool (Romli, Mackenzie, Lovarini, Tan, & Clemson, 2018). Evidence supports home assessment and modifications to prevent injurious falls (Tricco et al., 2017) and decrease the rate and risks for falls (Stark, Keglovits, Arbesman, & Lieberman, 2017).

Although in the current review participants were independent in their mobility, it can be assumed most had motor function deficits common in PD (Fasano et al., 2017; Hoehn & Yahr, 2001). Those with better mobility are exposed more often to unfamiliar environments and outdoor risks than those with severe functional limitations (Pynoos et al., 2010). Fall events are also common in familiar environments, where an individual might be less cautious and exposed to more fall risks indoors at home (Pynoos et al., 2010). Thus, falls happen both indoors and outdoors, at home and out in the community. People with PD need individualized assessments and fall prevention plans based on their functional limitations and the extrinsic falls risks they regularly encounter.

Falls occur during common, frequently performed daily activities in people with PD, especially in the daytime. Pynoos et al. (2010) suggested that risky behaviors may affect the personal competence of the individual, increasing falls, resulting from the dynamic interaction between extrinsic, intrinsic, and behavioral risk factors (Pynoos et al., 2010). Individuals may encounter hazards, such as an uneven surface, and take a risk by rushing or not using their walking aid. LaPointe, Stierwalt, and Maitland (2010) noted increased fall risks when people with PD performed dual tasks, such as talking while walking or standing and reaching things. The first task worsens when a second task is introduced. It was not clear whether participants in these studies engaged in high-risk behaviors or if the activities just exceeded the participants' abilities because of their PD symptoms; however, people may take more risks doing commonly performed activities.

Researchers explored how older adults performed activities in relation to their environmental barriers to identify safe methods and adaptive equipment or home modifications to reduce risk of falling (Stark, Somerville, & Morris, 2010). Thus, nurses and other healthcare providers should educate people with PD about the need to assess home risks, reduce extrinsic factors and barriers, and find ways to perform daily activities safely, such as using a nightlight, wearing appropriate shoes, avoiding hurrying, or using walking aids, even though their medications are working well.

Timing of anti-PD medications was significantly related to falls, particularly Levodopa that can decrease motor symptoms associated with the disease (Lamont, Morris, Woollacott, & Brauer, 2012; Schrag, Choudhury, Kaski, & Gallagher, 2015). During the "on phase," people with PD have a more efficient gait pattern and less fatigue (Allen et al., 2013; Lamont et al., 2012). They may be

more mobile and active during this time and exposed to more extrinsic fall risks (Pynoos et al., 2010). In addition, the side effects of the medications such as dyskinesia or anticholinergic effects like orthostatic hypotension can be related to falls (Crispo et al., 2016; Robinson et al., 2005). Nurses should evaluate medication effects and promote fall prevention behaviors while the people with PD perform activities during the "on phase" of medications as well as the "off phase" of medications. More research on symptoms related to medications, environments, and behavioral factors is needed.

Although falls often occur at home, it is also critical to address extrinsic factors beyond the home. People with PD need to be engaged in meaningful, productive, and fun activities. Accessibility of community environments should be considered, as well as how medication, fatigue, and level of activity may affect the person with PD. Furthermore, policy to continue to improve accessibility of public places will support our aging population with chronic disease, including PD, so they can maintain active lives.

The current integrative review was a first review about extrinsic factors and behavioral factors related to falls in people with PD. However, this review had some limitations. Although a rigorous search process was used, studies may have been missed. In addition, studies were from a limited number of researchers and sites and had small sample sizes, limiting generalizability. Little research explored participants from different lifestyles and cultures, particularly, less developed counties and rural participants. Some common extrinsic risk factors were not addressed in these studies, such as clothing or walking aids. Few studies focused on behavioral risks and how they interacted with extrinsic factors or the P-E fit in people with PD, supporting the need for more research in this area. Despite these limitations, studies clearly outlined the importance of extrinsic and behavioral factors related to falls in people with PD. Future research is needed to examine the best ways to modify extrinsic risk factors in the environment and promote fall prevention behaviors to improve P-E fit for individuals with PD and continue to decrease fall incidents.

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Conflict of Interest

The authors declare no conflicts of interest.

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