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Balance Ability and Occupational Performance in Patients With Parkinson's Disease and On-Medication-State Freezing of Gait

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Abstract

Purpose: The aim of this study was to examine balance ability and occupational performance in patients with Parkinson's disease (PD) and on-medication-state freezing of gait (FOG).

Design: A cohort study with three groups was conducted.

Methods: Seven patients with PD and on-medication-state FOG with optimized pharmacological therapy; seven patients with PD matched by age, gender, length of time since diagnosis, and Hoehn and Yahr stage; and seven controls were included. Outcomes included balance and occupational performance. Nonparametric analyses were used.

Findings: Significant differences were found between the two subgroups of patients with PD in the Timed Up & Go Test when adding a cognitive task, dual-task interference, and self-confidence in balance.

Conclusions: Patients with PD and on-medication-state FOG had lower scores on dual-task interference and self-confidence than matched PD patients.

Clinical Relevance: The assessment and rehabilitation approach for patients with PD and on-medication-state FOG should include balance confidence and dual-task interference.

Keywords: Gait/balance; movement disorders; outcomes assessment/measurement.

Introduction

Freezing of gait (FOG) is an important and disabling clinical phenomenon in patients with Parkinson's disease (PD), characterized by sudden and brief episodes of inability to produce effective forward stepping despite the intention to walk (Giladi & Nieuwboer, 2008). These episodes typically occur in conditions that include dynamic transitional movements such as gait initiation or turning (Nonnekes et al., 2015). FOG is difficult to be managed successfully with pharmacological, rehabilitative, or surgical treatments (Nonnekes et al., 2015). A recent review has shown that some interventions, including visual and auditory cueing and treadmill walking, are effective for FOG and other gait impairments in persons with PD. In addition, aquatic therapy may also be helpful to reduce FOG (Rutz & Benninger, 2020).

Most of the patients with PD have FOG in the off-medication state that improves with dopaminergic medications; however, in some patients, FOG is refractory to drug therapy (Schaafsma et al., 2003). Amboni et al. (2015) analyzed 593 patients, of whom 1.8% experienced FOG during the on-medication state and 36.6% experienced FOG during both the on- and off-medication states. The on-medication state refers to the condition when medications take their full effect and is defined as 1–3 hours following a dose of levodopa or dopamine. The off-medication state is when Parkinson's symptoms return, often because the medication is not working optimally (Amara et al., 2019). Dopamine-resistant FOG has been previously reported to be partly ascribed to the progressive development of nondopaminergic brain lesions involving the frontal lobe, adrenergic locus coeruleus, or the cholinergic pathways.

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Weiss et al. (2020) propose that the pathophysiology of FOG is key in considering the vulnerability of the locomotor network, which is established by structural damage (e.g., from neurodegeneration). This vulnerability leads to an enhanced network susceptibility where modulators can modify the threshold to express FOG. There is a need for studies that characterize this phenomenon and the type of patients in whom it occurs.

Previous research associates FOG with a high risk of falls, a loss of independence, and limitations in the performance of activities of daily living (ADL) in patients who present with it (Bloem et al., 2004; Nonnekes et al., 2015). This risk is increased by the fact that FOG often co-occurs with substantial balance problems (Bloem et al., 2004). Kuljeerung and Lach (2021) indicate that nurses should evaluate medication effects and promote fall prevention behaviors while the people with PD perform activities during the on- and off-medication states.

To our knowledge, no previous study has assessed balance ability in patients with on-medication-state FOG. Determining which specific balance characteristics (e.g., anticipatory transitions, reactive postural control, sensory orientation, or dynamic gait) are impaired and their repercussions on occupational performance may provide a deeper understanding of potential mechanisms of on-medication-state FOG and may facilitate the identification of rehabilitation goals and the development of fall prevention plans (Cosentino et al., 2020; Duncan et al., 2015). Blackwood and Rybicki (2021) state that, as a part of the management of fall risk, some measures such as balance confidence and dual-task should be assessed by members of the healthcare team, including rehabilitation nurses. Because of very limited research in this area, the purpose of the study was to examine balance ability and occupational performance in patients with PD and on-medication-state FOG.

Material and Methods

Participants

This exploratory study was conducted between December 2018 and February 2020. The study was approved by the Andalusian Biomedical Research Ethics Committee. All the participants who met the inclusion criteria were informed verbally and in writing about the purpose and procedure of the project and signed informed written consent before participating. The study has been carried out following the Declaration of Helsinki for experiments involving humans.

Twenty-one participants were included in the study. Seven consecutive inpatients diagnosed with PD and on-medication-state FOG were recruited from the Movement Disorders Unit, University Hospital Virgen de las Nieves (Granada, Spain). Inclusion criteria were being diagnosed with PD according to the 2015 Movement Disorders Society clinical diagnostic criteria (Postuma et al., 2015) and the presence of on-medication-state FOG with optimized pharmacological therapy (the most appropriate treatment option for each patient considering the neurologist's criteria regarding the indications, contraindications, dosing, adverse reactions, interactions and clinical characteristics of each person, and the effects reported by the patient). We excluded persons with a central nervous system disease other than PD, a significant cardiopulmonary disease including serious conditions that affect the heart and lungs associated with decreased functional capacity, communication impairments that affect the reception, processing, and comprehension of concepts that prevented them from following all instructions and answering all questions, such as problems with auditory processing or hearing loss, PD dementia according to Movement Disorders Society criteria (Dubois et al., 2007), any osteomuscular pathology that interferes with gait, and inability to walk. Patients with PD without FOG were matched for age, gender, length of time since diagnosis, and Hoehn and Yahr stage in the off-medication state. They were inpatients recruited consecutively from the Movement Disorders Unit, University Hospital Virgen de las Nieves (Granada, Spain). Also, a control group of healthy controls with the same exclusion criteria who were matched by age and gender was included for comparative purposes. They were recruited from the community.

Procedure

Clinical measures were evaluated by a neurologist experienced in movement disorders. Patient clinical and demographic characteristics included age, gender, disease duration, time in on- and off-medication states during wakefulness, daily levodopa equivalent dosage (Tomlinson et al., 2010), and motor severity using the Unified Parkinson's Disease Rating Scale Part III in the on-medication state (Fahn et al., 1987). The disease stage was assessed according to the modified Hoehn and Yahr Staging Scale (Goetz et al., 2004). Cognitive status was assessed by using the Mattis Dementia Rating Scale-2 (Pirogovsky et al., 2014). Disability was assessed according to the Schwab and England ADL Scale (Gillingham & Donaldson, 1969). In addition, their height and weight were recorded to calculate body mass index.

Patient outcome measures were assessed by an independent assessor (a therapist not directly involved in the patient's care with previous experience in the evaluation and treatment of persons with neurological disorders) who was blinded to the clinical diagnosis of the participants in a laboratory in the

Faculty of Health Sciences. All patients were assessed in the on-medication state, within a 2-hour window after the medication intake. Balance ability was evaluated using the Mini-Balance Evaluation Systems Test (Mini-BESTest), the Timed Up & Go (TUG) test simple and with dual tasking, and the Activities-Specific Balance Confidence (ABC) Scale.

Instruments

The Mini-BESTest is a 14-item test focused on four subscales: anticipatory transitions (maximum score of 6), reactive postural control (maximum score of 6), sensory orientation (maximum score of 6), and dynamic gait (maximum score of 10), with 28 as the best total score. The test is reliable and valid for use in PD (Löfgren et al., 2017). A previous review supports the reliability, validity, and responsiveness of this tool (Di Carlo et al., 2016). It has also been reported to be a strong individual predictor of falls in patients with PD (Lopes et al., 2020). A score of <19 showed a significantly higher risk of sustaining recurrent falls in the next 6 months (Mak & Auyeung, 2013).

Single-task and cognitive dual-task dynamic balance were evaluated using the TUG and cognitive TUG tests (Morris et al., 2001). The participants were asked to sit correctly with their hips to the back of the seat in a stable and standard chair equipped with armrests. The participants were allowed to use the armrests during the standing movement. Participants were instructed to stand up from their seated position, walk 118 inches at a comfortable pace, make a 180° turn, and walk back to the chair. In the cognitive TUG test, the person was asked to simultaneously count backward by threes starting from a random number. This is a valid and reliable test for PD and can detect differences in performance (Mollinedo & Cancela, 2020; Morris et al., 2001). Dual-task interference was calculated using the formula "cognitive TUG – TUG/TUG" and was expressed as a percentage (Plummer & Eskes, 2015).

Balance confidence was evaluated using the ABC Scale, a measure that includes self-reported fall-related self-efficacy during 16 activities. The total ABC score is expressed as a percentage of balance confidence. The psychometric properties demonstrated good test–retest reliability, and convergent and criterion validity (Franchignoni et al., 2014).

Occupational performance assessment included the Functional Independence Measure (FIM), the Lawton–Brody Instrumental ADL Scale, and the Canadian Occupational Performance Measure (COPM).

The FIM is a validated tool for quantifying the extent to which patients require assistance with their ADLs. The added scores of the 18 items give a minimum score of 18 (complete dependence) and a maximum score of 126 (complete independence; Ottenbacher et al., 1996). The psychometric properties show good cross-sectional discriminative ability and support this scale as an internally consistent functional status measure (Stineman et al., 1996).

The performance of instrumental ADLs was evaluated using the Lawton–Brody Instrumental ADL Scale (Lawton & Brody, 1969). The assessor asked whether the person usually performed the task, whether the person could perform the task if necessary, and whether any inability was due to health problems. The summary score ranged from 0 (*low function*) to 8 (*high function*). This measure has excellent reliability and validity and moderate sensitivity to change (Vergara et al., 2012).

Self-perception of occupational performance and satisfaction were assessed using the COPM with the help of the assessor (Carswell et al., 2004). This instrument was used to identify and prioritize issues relevant in the areas of self-care, productivity, and leisure. Perceived performance and satisfaction of the selected activities were rated by the participants on a 10-point scale. Higher ratings indicate better performance and increased satisfaction. This measure shows adequate content and construct validity and moderate responsiveness to change (Tuntland et al., 2016).

Statistical Analysis

Descriptive features of participants were compared using the Kruskal–Wallis test, whereas the significance of differences between the pairs of variables in PD subgroups was assessed using the Mann–Whitney *U* test. Given the small number of subjects in each group and to avoid Type 1 error, between-group comparisons were evaluated by nonparametric analysis using the Kruskal–Wallis test. The post hoc Dunn test was used to isolate the differences with pairwise comparisons between the group of persons with PD and on-medication state and healthy participants as well as between patients with PD and on-medication state and matched PD patients. The data were statistically analyzed by the Statistical Package for the Social Sciences (SPSS) software (Version 20.0; IBM Corp., 2011). The level of significance was set at $p < .05$. Effect sizes were calculated as Cohen's *d*.

Results

Participant Characteristics

Descriptive characteristics of the participants are shown in Table 1. The three groups present a similar age ($p = .284$) and body mass index ($p = .056$). The patients with PD exhibited similar values in the Hoehn and Yahr stages, the Unified Parkinson's Disease Rating Scale motor examination,

Table 1 Descriptive Characteristics of the Participants

Variable	PD and On-Medication-State FOG (*n* = 7)	PD Without FOG (*n* = 7)	Healthy Controls (*n* = 7)	*p*
Gender (female), *n* (%)	2 (28.57)	2 (28.57)	2 (28.57)	—
Age (years), mean ± *SD*	67.14 ± 8.78	71.71 ± 5.68	65.43 ± 9.79	.284
BMI (kg/m^2), mean ± *SD*	23.67 ± 2.19	23.38 ± 1.64	26.23 ± 2.57	.056
Hoehn and Yahr "on" stage, *n* (%)			—	
2	1 (14.3)	1 (14.3)		.580
2.5	0 (0.0)	2 (28.6)		
3	6 (85.7)	4 (57.1)		
Hoehn and Yahr "off" stage, *n* (%)			—	—
2	1 (14.3)	1 (14.3)		
2.5	1 (14.3)	1 (14.3)		
3	2 (28.6)	2 (28.6)		
4	3 (42.9)	3 (42.9)		
UPDRS Part III in on-medication state, mean ± *SD*	28.60 ± 12.97	21.83 ± 11.51	—	.100
Disease duration, mean ± *SD*	9.14 ± 2.97	11.71 ± 3.59	—	.366
Time in on-medication state during wakefulness (hours), mean ± *SD*	10.40 ± 2.61	14.00 ± 2.83	—	.167
Time in off-medication state during wakefulness (hours), mean ± *SD*	3.00 ± 1.27	2.26 ± 2.36	—	.252
DRS-2, mean ± *SD*	114.71 ± 20.85	132.00 ± 5.05	—	.343
Schwab and England ADL Scale (off-medication state), mean ± *SD*	64.17 ± 12.81	65.00 ± 21.21	—	.864
Schwab and England ADL Scale (on-medication state), mean ± *SD*	75.83 ± 14.97	85.00 ± 7.07	—	.375
Daily levodopa dose (mg), mean ± *SD*	1330.33 ± 529.96	955.34 ± 278.17	—	.200

Note. PD = Parkinson's disease; FOG = freezing of gait; *SD* = standard deviation; BMI = body mass index; UPDRS = Unified Parkinson's Disease Rating Scale; DRS-2 = Mattis Dementia Rating Scale-2; ADL = activities of daily living.

disease duration, cognitive status, time in the on- and off-medication states during wakefulness, and in the Schwab and England ADL Scale.

On-Medication-State FOG and Balance Ability

Balance ability results are shown in Table 2. This table shows the information about the scores of the Mini-BESTest (total, anticipatory, reactive postural control, sensory orientation, and dynamic gait scores), the TUG test simple, the TUG with dual tasking, dual-task interference, and the ABC Scale. The table shows the comparisons among the three groups. Significant differences were found in the anticipatory subscale (p = .012), the dynamic gait subscales (p = .001), and the total score (p = .010) of the Mini-BESTest. According to the Mini-BESTest mean score (17.00 ± 2.09), the patients

Table 2 Balance Ability in the Participants Included in the Study

Variables	PD and On-Medication-State FOG (*n* = 7)	PD Without FOG (*n* = 7)	Healthy Controls (*n* = 7)	*p*	Effect Size (On-Medication-State FOG-PD)	Effect Size (On-Medication-State FOG-Healthy Controls)
Mini-BESTest (mean ± *SD*)						
Total score	17.00 ± 2.09	19.43 ± 2.99	26.03 ± 4.04	.010[a]	0.942	2.808
Anticipatory score	3.50 ± 0.55	3.86 ± 1.07	5.57 ± 1.13	.012[a,c]	0.423	2.329
Reactive postural control score	4.17 ± 2.56	4.57 ± 0.97	5.43 ± 1.13	.238	0.206	0.637
Sensory orientation score	4.83 ± 0.98	4.43 ± 1.27	5.71 ± 0.76	.084	0.353	1.004
Dynamic gait score	4.50 ± 1.05	6.43 ± 1.47	9.29 ± 1.11	.001[a,c]	1.511	4.433
TUG (mean ± *SD*)	21.70 ± 9.37	12.66 ± 4.28	8.37 ± 1.56	.003[a]	1.241	1.985
Cognitive TUG (mean ± *SD*)	30.72 ± 12.67	14.22 ± 3.77	12.30 ± 2.51	.002[a,b]	1.765	2.017
Dual-task interference, % (mean ± *SD*)	29.73 ± 12.67	13.22 ± 3.77	11.30 ± 2.51	.002[a,b]	1.766	2.018
ABC score, %(mean ± *SD*)	40.45 ± 7.55	65.64 ± 13.39	92.98 ± 7.51	<.001[a,b]	2.317	6.976

Note. PD = Parkinson's disease; FOG = freezing of gait; Mini-BESTest = Mini-Balance Evaluation Systems Test; *SD* = standard deviation; TUG = Timed Up & Go; ABC = Activities-Specific Balance Confidence.

[a]Significant difference between on-medication-state FOG and healthy controls

[b]Significant differences between on FOG and PD without FOG.

[c]Significant differences between PD patients without FOG and healthy controls.

with PD and on-medication-state FOG were at higher risk of recurrent falls in the next 6 months. Significant differences were also found in the TUG test (p = .003), the TUG with dual tasking (p = .002), dual-task interference (p = .002), and self-reported confidence in balance (p < .001). The post hoc analysis revealed significant differences between PD patients with on-medication-state FOG and healthy controls. In the TUG with dual tasking and dual-task interference scores, significant differences (p < .05) were also found between patients with on-medication-state FOG and matched PD patients. The effect size was large (d > 1) in the dynamic gait subscale, the TUG test, the TUG test with dual tasking, dual-task interference, and the ABC score.

On-Medication-State FOG and Occupational Performance

Occupational performance results are shown in Table 3. This table includes information about the scores of the FIM, the Lawton–Brody Instrumental ADL Scale, and the COPM. The table shows the comparisons among the three groups. The scores were lower in the patients with on-medication-state FOG for all the measures. Significant differences were found in all the variables (p < .05). The post hoc analysis indicated that patients with on-medication-state FOG had lower scores compared to healthy controls in the performance of basic and instrumental ADLs, but no PD subgroup difference was found. Significant differences p < .05) were found in the COPM subscales between both groups of patients with PD and healthy participants. The effect size was very large in all the variables (d > 1).

Discussion

This study shows lower scores in most of the balance ability scores and all the occupational performance measures in the persons with PD and on-medication-state FOG. Significant differences were found between the two subgroups of patients with PD in the TUG test when adding a cognitive task, dual-task interference, and self-confidence in balance, with worse scores in those patients with on-medication-state FOG. Also, significant differences with larger effect sizes were observed in most of the variables between the persons with PD and on-medication-state FOG and healthy participants.

FOG and postural instability have been reported to be two interconnected phenomena; therefore, the high risk of falling in patients with FOG might result not only from FOG but from the associated balance impairments (Bloem et al., 2004). Vervoort et al. (2016) showed more severe progression in abnormalities of postural control in patients with FOG when compared to patients without FOG using the Mini-BESTest. To our knowledge, no previous study has assessed balance ability and occupational performance in patients with on-medication-state FOG.

The effect size was higher for the dynamic gait subscale of the Mini-BESTest. Plotnik and Hausdorff (2008) reported that gait and turning deficits are unrelated to disease severity or asymmetry but are related to postural instability. In our results, although the results obtained were worse for balance performance regarding the Mini-BESTest score in the patients with on-medication-state FOG, no significant differences were found between patients with PD and on-medication-state FOG and the matched PD patients. Peterson et al. (2020) suggests that dynamic balance and gait initiation are associated with the severity of the disease and the presence of FOG when controlling for disease severity, whereas reactive stepping responses and postural sway are not. In this study, no significant differences were found in reactive postural control and sensory orientation scores between patients with and without FOG. This aligned well with what has been previously suggested that reactive postural control may be related to the progression of PD (Mezzarobba et al., 2018).

Table 3 Occupational Performance Assessment

Variables	PD and On-Medication-State FOG (n = 7)	PD Without FOG (n = 7)	Healthy Controls (n = 7)	p	Effect Size (On-Medication-State FOG-PD)	Effect Size (On-Medication-State FOG-Healthy Controls)
FIM (mean ± *SD*)	99.09 ± 5.83	111.57 ± 8.30	125.29 ± 1.89	<.001[a]	1.740	6.047
Lawton–Brody Scale (mean ± *SD*)	4.60 ± 1.14	6.33 ± 1.63	7.43 ± 0.79	.015[a]	1.230	2.886
COPM performance (mean ± *SD*)	4.41 ± 1.15	5.60 ± 1.01	8.00 ± 1.29	.001[a,c]	1.099	2.938
COPM satisfaction (mean ± *SD*)	3.14 ± 1.34	4.96 ± 1.11	8.50 ± 0.76	<.001[a,c]	1.479	4.921

Note. PD = Parkinson's disease; FOG = freezing of gait; FIM = Functional Independence Measure; *SD* = standard deviation; COPM = Canadian Occupational Performance Measure.

[a]Significant difference between on-medication-state FOG and healthy controls.

[b]Significant differences between on FOG and PD without FOG.

[c]Significant differences between PD patients without FOG and healthy controls.

A sit-to-walk task requires demanding postural control abilities to maintain balance during the movement (Mak & Pang, 2009). The cognitive task produced an appreciable effect on movement's execution in the three groups, with significant differences between the on-medication-state FOG patients, the matched PD, and the healthy participants, showing an impact on dual-task interference. Circumstances that precipitate FOG include dual tasking, crowded places, and being under time pressure (Weiss et al., 2020). In this sense, dual-task interference has a negative impact on the performance of ADLs (Plummer & Eskes, 2015). Lower self-perceived balance confidence has also been previously associated with an increased risk of falls in PD (Mak & Pang, 2009). Persons with on-medication-state FOG show significantly lower values of self-reported confidence in balance in comparison with paired PD patients and healthy participants. Considering that lower balance confidence may contribute to limited mobility, reduced activity levels, and falls rehabilitation, nurses have an important role in screening these areas to identify risk factors that should be addressed through a multifactorial approach (Blackwood & Rybicki, 2021).

Most of the people with idiopathic PD with FOG show significant improvement with levodopa, and FOG limited to the on-medication state is quite rare (Amboni et al., 2015). However, it greatly interferes with daily life. In previous research, the results of pharmacological treatments to reduce FOG in dopamine-resistant FOG have been disappointing (Nonnekes et al., 2015). In this sense, it poses a major burden on both patients and their families, as freezing often leads to a loss of independence. Health promotion and nursing interventions related to educational practice with patients and caregivers may promote the development of strategies for maintaining independence and safety in patients with PD (Tosin et al., 2016). Bok et al. (2016) conducted a qualitative study to explore the meaning of a fall or fall prevention in a sample of 742 rehabilitation nurses. Their results show the presence of negative emotions of stress, anxiety, or fear in the rehabilitation nurses associated with a patient's fall. In addition, fall prevention was associated with positive feelings of emotion in the nurses. In this sense, the knowledge of the clinical profile of specific populations with a high risk of falls, especially in patients with PD and FOG, may be of interest for rehabilitation professionals like rehabilitation nurses to understand and facilitate the development of prevention and rehabilitation programs.

In our study, the patients with PD and on-medication-state FOG present worse values of dual-task interference and low levels of self-confidence in balance. According to Visschedijk et al. (2015), fear of falling is regarded as a major constraint for successful rehabilitation. Hence, the development of a treatment plan should consider increasing the self-confidence of patients in balance as an important clinical issue with an impact on the performance of ADLs. Considering the low reported values of occupational performance and satisfaction in patients with on-medication-state FOG in our study, task-specific training may offer an individualized approach to rehabilitation. In addition, the ability to safely transfer learned strategies from the clinic to their daily lives could increase the patients' confidence level (Shen & Mak, 2014). Moreover, taking into account the dual-task interference shown in patients with on-medication-state FOG, these programs could include the use of attention as an easily used strategy, the avoidance of swivel turns, and the provision of visual information regarding correct amplitude or velocity to avoid falls (Iansek & Danoudis, 2016).

In addition, a rehabilitation program needs to be addressed with each person and their family by allied health professionals. The understanding of the pathophysiology and clinical profile underlying on-medication-state FOG remains imperative for the adequate development of future treatments.

Limitations

This study serves as a basis for a better understanding of this challenging clinical phenomenon. However, some issues prevent generalizing the findings beyond the participants of the study because of the limited sample size. As all of the participants were recruited from the same region, it may be difficult to generalize the study findings. In addition, the participant's physical activity level was not assessed. Furthermore, when interpreting these explorative results, it has to be taken into account that patients were assessed during the on-medication state within a 2-hour window after the medication intake. The additional exploration in the off-medication state would give further information about underlying mechanisms leading to this clinical phenomenon. However, testing the patients in the on-medication state is a more realistic assessment of everyday occupational performance.

Implications for Rehabilitation Nurses

Rehabilitation nurses, as part of the healthcare team, have an important role in screening balance confidence and dual-task interference in patients with PD and on-medication-state FOG. The development of a treatment plan should consider increasing the self-confidence in balance as a relevant clinical issue. This program could include individualized task-specific training with transference to daily life to increase balance confidence. In addition, greater attention to avoiding falls is needed in dual-task

Key Practice Points

- The members of the healthcare team, including rehabilitation nurses, should consider assessing balance confidence and dual-task interference in patients with Parkinson's disease and on-medication-state freezing of gait.
- The development of a fall prevention program in patients with Parkinson's disease and on-medication-state freezing of gait should consider increasing the self-confidence in balance as an important clinical issue with an impact on the performance of activities of daily living.
- Greater attention is needed in dual-task conditions in order to avoid falls in patients with Parkinson's disease and on-medication-state freezing of gait

conditions in this population. In this sense, a fall prevention program may include some strategies, such as the use of attention, the avoidance of swivel turns, and increased visual information.

Conclusion

Significant differences between patients with on-medication-state FOG and matched PD patients without FOG were found when adding a cognitive task to functional mobility, dual-task interference, and self-confidence in balance. Also, there were significant differences with a large effect size in most of the variables between patients with PD and on-medication-state FOG and healthy participants. These results should be considered in the development of fall prevention strategies given the high risk of falls of patients with PD and on-medication-state FOG with optimized pharmacological therapy. Although the explorative results provide new information regarding this clinical phenomenon, more research is needed to develop effective therapeutic strategies to improve functionality in this population.

Conflict of Interest

The authors declare no conflict of interest.

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REFERENCES

Amara, A. W., Chahine, L., Seedorff, N., Caspell-Garcia, C. J., Coffey, C., Simuni, T., & Parkinson's Progression Markers Initiative (2019). Self-reported physical activity levels and clinical progression in early Parkinson's disease. *Parkinsonism & Related Disorders*, *61*, 118–125. 10.1016/j.parkreldis.2018.11.006

Amboni, M., Stocchi, F., Abbruzzese, G., Morgante, L., Onofrj, M., Ruggieri, S., Tinazzi, M., Zappia, M., Attar, M., Colombo, D., Simoni, L., Ori, A., Barone, P., Antonini, A., & DEEP Study Group (2015). Prevalence and associated features of self-reported freezing of gait in Parkinson disease: The DEEP FOG study. *Parkinsonism & Related Disorders*, *21*(6), 644–649. 10.1016/j.parkreldis.2015.03.028

Blackwood, J., & Rybicki, K. (2021). Balance confidence and falls self-efficacy in older breast cancer survivors. *Rehabilitation Nursing*, *46*(3), 146–154. 10.1097/rnj.0000000000000316

Bloem, B. R., Hausdorff, J. M., Visser, J. E., & Giladi, N. (2004). Falls and freezing of gait in Parkinson's disease: A review of two interconnected, episodic phenomena. *Movement Disorders*, *19*(8), 871–884. 10.1002/mds.20115

Bok, A., Pierce, L. L., Gies, C., & Steiner, V. (2016). Meanings of falls and prevention of falls according to rehabilitation nurses: A qualitative descriptive study. *Rehabilitation Nursing*, *41*(1), 45–53. 10.1002/rnj.221

Carswell, A., McColl, M. A., Baptiste, S., Law, M., Polatajko, H., & Pollock, N. (2004). The Canadian Occupational Performance Measure: A research and clinical literature review. *Canadian Journal of Occupational Therapy*, *71*(4), 210–222. 10.1177/000841740407100406

Cosentino, C., Baccini, M., Putzolu, M., Ristori, D., Avanzino, L., & Pelosin, E. (2020). Effectiveness of physiotherapy on freezing of gait in Parkinson's disease: A systematic review and meta-analyses. *Movement Disorders*, *35*(4), 523–536. 10.1002/mds.27936

Di Carlo, S., Bravini, E., Vercelli, S., Massazza, G., & Ferriero, G. (2016). The Mini-BESTest: A review of psychometric properties. *International Journal of Rehabilitation Research*, *39*(2), 97–105. 10.1097/MRR.0000000000000153

Dubois, B., Burn, D., Goetz, C., Aarsland, D., Brown, R. G., Broe, G. A., Dickson, D., Duyckaerts, C., Cummings, J., Gauthier, S., Korczyn, A., Lees, A., Levy, R., Litvan, I., Mizuno, Y., McKeith, I. G., Olanow, C. W., Poewe, W., Sampaio, C., & Emre, M. (2007). Diagnostic procedures for Parkinson's disease dementia: Recommendations from the movement disorder society task force. *Movement Disorders*, *22*(16), 2314–2324. 10.1002/mds.21844

Duncan, R. P., Leddy, A. L., Cavanaugh, J. T., Dibble, L. E., Ellis, T. D., Ford, M. P., Foreman, K. B., & Earhart, G. M. (2015). Balance differences in people with Parkinson disease with and without freezing of gait. *Gait & Posture*, *42*(3), 306–309. 10.1016/j.gaitpost.2015.06.007

Fahn, S., Marsden, C. D., Calne, D., & Goldstein, M. (Eds.) (1987). *Recent developments in Parkinson's disease*. Macmillan Healthcare Information.

Franchignoni, F., Giordano, A., Ronconi, G., Rabini, A., & Ferriero, G. (2014). Rasch validation of the Activities-Specific Balance Confidence Scale and its short versions in patients with Parkinson's disease. *Journal of Rehabilitation Medicine*, *46*(6), 532–539. 10.2340/16501977-1808

Giladi, N., & Nieuwboer, A. (2008). Understanding and treating freezing of gait in Parkinsonism, proposed working definition, and setting the stage. *Movement Disorders*, *23*(Suppl. 2), S423–S425. 10.1002/mds.21927

Gillingham, F. J., & Donaldson, I. M. L. (Eds.) (1969). *Proceedings of the Third Symposium on Parkinson's Disease*. Churchill Livingstone.

Goetz, C. G., Poewe, W., Rascol, O., Sampaio, C., Stebbins, G. T., Counsell, C., Giladi, N., Holloway, R. G., Moore, C. G., Wenning, G. K., Yahr, M. D., Seidl, L., & Movement Disorder Society Task Force on Rating Scales for Parkinson's Disease (2004). Movement Disorder Society task force report on the Hoehn and Yahr Staging Scale: Status and recommendations. *Movement Disorders*, *19*(9), 1020–1028. 10.1002/mds.20213

Iansek, R., & Danoudis, M. (2016). Freezing of gait in Parkinson's disease: Its pathophysiology and pragmatic approaches to

management. *Movement Disorders Clinical Practice*, *4*(3), 290–297. 10.1002/mdc3.12463

IBM Corp (2011). *IBM SPSS Statistics for Windows, Version 20.0*. Author.

Kuljeerung, O., & Lach, H. W. (2021). Extrinsic and behavioral fall risk factors in people with Parkinson's disease: An integrative review. *Rehabilitation Nursing*, *46*(1), 3–10. 10.1097/rnj.0000000000000265

Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *Gerontologist*, *9*(3), 179–186.

Löfgren, N., Benka Wallén, M., Sorjonen, K., Conradsson, D., & Franzén, E. (2017). Investigating the Mini-BESTest's construct validity in elderly with Parkinson's disease. *Acta Neurologica Scandinavica*, *135*(6), 614–621. 10.1111/ane.12640

Lopes, L. K. R., Scianni, A. A., Lima, L. O., de Carvalho Lana, R., & Rodrigues-De-Paula, F. (2020). The Mini-BESTest is an independent predictor of falls in Parkinson's disease. *Brazilian Journal of Physical Therapy*, *24*(5), 433–440. 10.1016/j.bjpt.2019.07.006

Mak, M. K., & Auyeung, M. M. (2013). The Mini-BESTest can predict parkinsonian recurrent fallers: A 6-month prospective study. *Journal of Rehabilitation Medicine*, *45*(6), 565–571. 10.2340/16501977-1144

Mak, M. K., & Pang, M. Y. (2009). Balance confidence and functional mobility are independently associated with falls in people with Parkinson's disease. *Journal of Neurology*, *256*(5), 742–749. 10.1007/s00415-009-5007-8

Mezzarobba, S., Grassi, M., Valentini, R., & Bernardis, P. (2018). Postural control deficit during sit-to-walk in patients with Parkinson's disease and freezing of gait. *Gait & Posture*, *61*, 325–330. 10.1016/j.gaitpost.2018.01.032

Mollinedo, I., & Ma Cancela, J. (2020). Evaluation of the psychometric properties and clinical applications of the timed up and go test in Parkinson disease: A systematic review. *Journal of Exercise Rehabilitation*, *16*(4), 302–312. 10.12965/jer.2040532.266

Morris, S., Morris, M. E., & Iansek, R. (2001). Reliability of measurements obtained with the timed "up & go" test in people with Parkinson's disease. *Physical Therapy*, *81*(2), 810–818. 10.1093/ptj/81.2.810

Nonnekes, J., Snijders, A. H., Nutt, J. G., Deuschl, G., Giladi, N., & Bloem, B. R. (2015). Freezing of gait: A practical approach to management. *The Lancet Neurology*, *14*(7), 768–778. 10.1016/S1474-4422(15)00041-1

Ottenbacher, K. J., Hsu, Y., Granger, C. V., & Fiedler, R. C. (1996). The reliability of the Functional Independence Measure: A quantitative review. *Archives of Physical Medicine & Rehabilitation*, *77*(12), 1226–1232. 10.1016/s0003-9993(96)90184-7

Peterson, D. S., Van Liew, C., Stuart, S., Carlson-Kuhta, P., Horak, F. B., & Mancini, M. (2020). Relating Parkinson freezing and balance domains: A structural equation modeling approach. *Parkinsonism & Related Disorders*, *79*, 73–78. 10.1016/j.parkreldis.2020.08.027

Pirogovsky, E., Schiehser, D. M., Litvan, I., Obtera, K. M., Burke, M. M., Lessig, S. L., Song, D. D., Liu, L., & Filoteo, J. V. (2014). The utility of the Mattis Dementia Rating Scale in Parkinson's disease mild cognitive impairment. *Parkinsonism & Related Disorders*, *20*(6), 627–631. 10.1016/j.parkreldis.2014.03.010

Plotnik, M., & Hausdorff, J. M. (2008). The role of gait rhythmicity and bilateral coordination of stepping in the pathophysiology of freezing of gait in Parkinson's disease. *Movement Disorders*, *23* (Suppl 2), S444–S450. 10.1002/mds.21984

Plummer, P., & Eskes, G. (2015). Measuring treatment effects on dual-task performance: A framework for research and clinical practice. *Frontiers in Human Neuroscience*, *9*, 225. 10.3389/fnhum.2015.00225

Postuma, R. B., Berg, D., Stern, M., Poewe, W., Olanow, C. W., Oertel, W., Obeso, J., Marek, K., Litvan, I., Lang, A. E., Halliday, G., Goetz, C. G., Gasser, T., Dubois, B., Chan, P., Bloem, B. R., Adler, C. H., & Deuschl, G. (2015). MDS clinical diagnostic criteria for Parkinson's disease. *Movement Disorders*, *30*(12), 1591–1601. 10.1002/mds.26424

Rutz, D. G., & Benninger, D. H. (2020). Physical therapy for freezing of gait and gait impairments in Parkinson's disease: A systematic review. *PM&R*, *12*(2), 1140–1156. 10.1002/pmrj.12337

Schaafsma, J. D., Balash, Y., Gurevich, T., Bartels, A. L., Hausdorff, J. M., & Giladi, N. (2003). Characterization of freezing of gait subtypes and the response of each to levodopa in Parkinson's disease. *European Journal of Neurology*, *10*(4), 391–398. 10.1046/j.1468-1331.2003.00611.x

Shen, X., & Mak, M. K. (2014). Balance and gait training with augmented feedback improves balance confidence in people with Parkinson's disease: A randomized controlled trial. *Neurorehabilitation and Neural Repair*, *28*(6), 524–535. 10.1177/1545968313517752

Stineman, M. G., Shea, J. A., Jette, A., Tassoni, C. J., & Ottenbacher, K. J. (1996). The Functional Independence Measure: Tests of scaling assumptions, structure, and reliability across 20 diverse impairment categories. *Archives of Physical Medicine and Rehabilitation*, *77*(11), 1101–1108. 10.1016/s0003-9993(96)90130-6

Tomlinson, C. L., Stowe, R., Patel, S., Rick, C., Gray, R., & Clarke, C. E. (2010). Systematic review of levodopa dose equivalency reporting in Parkinson's disease. *Movement Disorders*, *25*(15), 2649–2653. 10.1002/mds.23429

Tosin, M. H., Campos, D. M., Andrade, L. T., Oliveira, B. G., & Santana, R. F. (2016). Nursing interventions for rehabilitation in Parkinson's disease: Cross mapping of terms. *Revista Latino-Americana de Enfermagem*, *24*, e2728. 10.1590/1518-8345.0689.2728

Tuntland, H., Aaslund, M. K., Langeland, E., Espehaug, B., & Kjeken, I. (2016). Psychometric properties of the Canadian Occupational Performance Measure in home-dwelling older adults. *Journal of Multidisciplinary Healthcare*, *9*, 411–423.

Vergara, I., Bilbao, A., Orive, M., Garcia-Gutierrez, M., Navarro, G., & Quintana, J. M. (2012). Validation of the Spanish version of the Lawton IADL Scale for its application in elderly people. *Health and Quality of Life Outcomes*, *10*, 130.

Vervoort, G., Bengevoord, A., Strouwen, C., Bekkers, E. M., Heremans, E., Vandenberghe, W., & Nieuwboer, A. (2016). Progression of postural control and gait deficits in Parkinson's disease and freezing of gait: A longitudinal study. *Parkinsonism & Related Disorders*, *28*, 73–79. 10.1016/j.parkreldis.2016.04.029

Visschedijk, J. H., Caljouw, M. A., Bakkers, E., van Balen, R., & Achterberg, W. P. (2015). Longitudinal follow-up study on fear of falling during and after rehabilitation in skilled nursing facilities. *BMC Geriatrics*, *15*, 161. 10.1186/s12877-015-0158-1

Weiss, D., Schoellmann, A., Fox, M. D., Bohnen, N. I., Factor, S. A., Nieuwboer, A., Hallett, M., & Lewis, S. J. G. (2020). Freezing of gait: Understanding the complexity of an enigmatic phenomenon. *Brain*, *143*(1), 14–30. 10.1093/brain/awz314

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