Research Article

Safety Predictors in Performance of Activities of Daily Living in Patients with Parkinson's Disease

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Abstract

Background: Safety is recognized as an important factor in personal independence. The aim of this study was to determine the association of factors, such as fatigue, duration of disease, age, dominant involved body side, gender, and severity of disease with safety performance and to identify safety predictors among effective factors for activities of daily living (ADL) among patients with Parkinson's disease (PD).

Methods: Sixty patients with PD participated in this study. Fatigue was assessed using the 16-item Parkinson fatigue scale (PFS-16), while performance safety was examined with the performance assessment of self-care skills (PASS). Linear multiple regression analysis was performed between PASS safety parameter as the dependent variable and independent variables with significant correlations with performance safety, using SPSS version 18.

Results: A significant relationship was observed between ADL safety and fatigue ($r = 0.557$; $P < 0.001$), disease severity ($r = 0.558$; $P \leq$ -0.001), and age ($r = -0.636$; $P < 0.001$). Performance safety in physical and cognitive instrumental ADL showed the most significant correlation with fatigue severity. The stepwise multiple linear regression model revealed that age ($F(1, 58)$, 39.32; $P < 0.001$) with an $R2$ of 0.64 could predict safety in ADL performance.

Conclusions: Age, fatigue severity, and disease are predictors of performance safety in ADL among patients with PD. For implementing more effective interventions on safe ADL performance, rehabilitation teams should conduct more detailed safety assessments with a special focus on the effects of fatigue, aging, and disease severity on the performance of each activity.

Keywords: Safety, Activities of Daily Living, Parkinson's Disease

1. Background

Parkinson's disease (PD) is a progressive neurodegenerative disorder, characterized by motor symptoms (1). The prevalence of PD was estimated at 222.9 per 100,000 people, with a male-to-female ratio of 1:62 in Tehran, Iran (2). Besides motor symptoms, such as bradykinesia, rigidity, and tremor, nonmotor symptoms, including fatigue, mood disorders, pain, and cognitive impairment, are major factors leading to disability (3).

In patients with PD, performance of some activities of daily living (ADL) is of great importance (4, 5). Progression of disease symptoms interferes with the patient's ability to perform daily activities, thereby leading to increased dependence on caregivers (6). ADL performance can be studied by evaluating parameters, such as safety, independence, and adequacy (7). In general, independence and safety show the greatest interactions with each other (8). Although PD patients can be independent individuals, they may require caregiver supervision due to the low safety of ADL performance (7).

For the elderly who want to "age in place", safety maintenance is a major concern. As older adults prefer to age properly, their worries and concerns about their health and safety increase (9). The relationships between environmental factors and a person's habits, attitudes, knowledge, skills, and performance determine his/her general safety. Safety risks, either personal or environmental, can increase the risk of unintended injury or damage.

Sufficient home-safety skills enable an individual to prepare food, control personal health, manage high-risk situations, and avoid injuries. A person with such skills can distinguish the possible threats and solve home-safety problems (8). Therefore, home safety is a major concern for the elderly, especially PD patients. As there is a serious lack of evidence concerning safety factors in patients with PD, in this study, falling and other safety-related variables were discussed.

Among nonmotor problems, more attention should be

paid to fatigue, as healthcare providers often undervalue its influence (10). Fatigue includes a wide range of symptoms, which can emerge due to neurological, mental, and systematic diseases. It is defined as loss of energy, distress, extreme exhaustion, and lethargy, which may appear simultaneously with insomnia (11). It can increase the burden of disease and has various functional consequences (12, 13), which can affect families and society.

Fatigue can predict the development of motor symptoms; therefore, it is considered an alarming sign of PD onset. Although the cause of fatigue remains unknown (13, 14), according to previous reports, it affects almost two-thirds of PD patients. It is one of the 3 most bothersome symptoms in more than half of PD patients and is the most disabling symptom in 15% - 33% of these patients (15). A higher level of fatigue is related to safety concerns, such as a higher risk of falls, cognitive deficits, and reduced quality of life in PD patients (16-18).

Fatigue has major effects on the life of PD patients. The results of previous studies show that fatigue severity is inversely related to physical activity, functional status, and quality of life (15, 17, 19, 20). It also increases the rate and risk of falls and is highly correlated with fear of falling (18, 21). However, there is no evidence regarding the effect of fatigue on the safety performance of each ADL. Therefore, high prevalence of nonmotor symptoms, especially fatigue, and their influence on the patient's life are important determinants in our efforts to optimize treatment and care for this group of patients.

Several studies have shown that safety of PD patients, especially the rate and risk of falling, is affected by disease severity (22-27). Evidence also shows that more patients are institutionalized due to the greater severity of PD (28). Overall, various individual characteristics can affect performance safety. Aging, which results in numerous changes in the body (eg, sensory, proprioceptive, kinesthetic, vestibular, neural, cardiovascular, and cognitive changes), may affect the performance of ADL. In addition, considering the progressive nature of PD, the symptoms may deteriorate over time (29). If the dominant side of the body is more severely affected by PD or gender-related effects are found in the patient, it is necessary to investigate the influential factors for performance safety.

Overall, factors affecting performance safety remain unclear in patients with PD. We hypothesized that fatigue, age, disease duration, disease severity, body laterality, gender, and dominant affected body side can influence the safety of ADL in patients with PD; however, the effects of these factors have not been studied yet. Therefore, in order to promote a safe and independent lifestyle in PD patients, evaluation of safety predictors of ADL is of great importance in rehabilitation programs.

2. Objectives

The aim of this study was to determine factors related to performance safety (eg, fatigue severity, disease duration, age, dominant involved body side, gender, and disease severity) and to identify safety predictors among effective factors for ADL in patients with PD.

3. Methods

In this study, an observational, cross sectional, association-analysis design was applied. The study was approved by the ethics committee of Iran University of Medical Sciences. A total of 60 subjects (33 males and 27 females) with the average age of 61 ± 11.86 years (age range, 32 - 86 years) were recruited among clinically stable patients with PD, who were referred to neurology clinics during 2015 - 2016 in Tehran, Iran. The study sample was selected, using available sampling method.

The inclusion criteria were as follows: 1) diagnosis of PD by 2 neurologists using MRI records; 2) age range of 30 - 90 years; 3) scores above 21 on the mini-mental state examination (30) to confirm proper cognitive function; 4) literacy (minimum of 5 years of formal education); 5) lack of other neurological diseases (eg, stroke, Alzheimer's disease, and multiple sclerosis); and 6) absence of diabetes or addiction. On the other hand, the exclusion criterion was the nonmedical on-off phenomenon in PD.

During the initial visit with patients and their families, the purpose, methods, and use of findings were completely explained. The subjects visited the occupational therapy clinic in a prescribed medicated state at a time of day when they felt their best both physically and mentally. During these visits, the demographic information, medical profile, and safety measures for ADL performance and fatigue were collected.

The literature review showed that self-report questionnaires are generally used to measure performance. However, in the current study, a functional observational test was used to measure performance safety in ADL, including a classification system for activities based on the prerequisite skills. This classification system allowed us to investigate the effects of fatigue on 4 activity categories, including functional mobility, personal care or basic activities of ADL (BADL), cognitive instrumental activities of daily living (CIADL), and physical instrumental activities of daily living (PIADL).

In addition, the fatigue scales used in previous studies were general, while in the present study, we used a PD-specific scale to measure fatigue severity. Using standardized techniques, examinations were executed by an experienced occupational therapist during a 3-4 hour visit in

1 day. Disease severity was assessed, using the Hoehn and Yahr Scale (HYS).

3.1. Performance Assessment of Self-Care Skills (PASS)

PASS test was used to evaluate the safety of ADL performance. This test involves rating 3 occupational performance concepts: independence, safety, and adequacy. The Persian version consists of 24 core tasks, categorized in 4 functional domains: functional mobility (5 tasks), personal self-care (3 tasks), CIADL (13 tasks), and PIADL (3 tasks). In addition, PASS has 2 versions: PASS-clinic and PASS-home. In the current study, the clinic version was used (31, 32).

Generally, safety involves preventing hazards to the client, therapist, objects, or environment of the task. In a standardized manner, tasks, which include placement of objects, are presented to clients and verbal instructions are provided; if needed, the clients are assisted when they intend to perform a task. First, minimum assistive prompt is used, and if necessary, it is increased progressively.

The assistance levels, from least to most assistive, are as follows: 1) verbal supportive (encouragement); 2) verbal nondirective (cue to alert); 3) verbal directive (instruction); 4) gestures (pointing at objects); 5) task/environment rearrangement (breaking down the task); 6) ability to perform activities and tasks/subtasks; 7) physical guidance ("hands down", move the intended body part); 8) physical support ('hands up', lift the body part/clothes/ support); and 9) total assistance (performing tasks/subtasks for the person).

An ordinal 4-point scale is used to rate safety. From the beginning to the end of the tasks, the client's performance is observed precisely to detect the presence and extent of unsafety. The scale is graded as follows: 3, safe practice; 2, minor risks but no assistance provided; 1, risk to safety, assistance provided to prevent potential harm; and 0, risk to safety of such severity that task was stopped or taken over to prevent harm. Overall, safety only produces a general score, which demonstrates the safety of the entire task (33). This scale has been translated into Persian by Hoseini and colleagues. Moreover, Taghizadeh et al. have shown its great psychometric properties in a study on PD patients in Iran (34).

3.2. Parkinson Fatigue Scale (PFS-16)

PFS-16 was used to evaluate fatigue severity in PD patients. It is a self-rated assessment tool, containing 16 items on the influence of fatigue on everyday functions in PD (and its physical features), 7 items on the experience and physical effects of fatigue, and 9 items on the effects of fatigue on ADL performance. The scale intentionally eliminates emotional and cognitive aspects of fatigue. Responses are organized in 5 categories, with scores ranging from 1 to 5 (1, strongly disagree; 2, disagree; 3, don't agree or disagree; 4, agree; and 5, strongly agree). The sum of the scores represents the total score of fatigue, ranging from 0 to 80 (80, a high level of fatigue). The Swedish, Brazilian, and Persian translations of this scale are available. Moreover, Baghoori et al. reported the high face and content validity of the Persian version (12, 35, 36).

3.3. Modified HYS for PD

The modified HYS is a broadly used clinical rating scale, which characterizes a wide range of motor functions in PD. Its advantages include simplicity, easy application, and description of typical patterns of progressive motor impairments. Progress in HYS stage seems to be correlated with motor disorders and reduced quality of life. This index includes 5 major scales: 1.0, unilateral involvement only; 1.5, unilateral and axial involvement; 2.0, bilateral involvement without balance impairment; 2.5, mild bilateral disease with recovery on pull test; 3.0, mild to moderate bilateral disease, some postural instabilities, and physical independence; 4.0, severe disability, but able to walk or stand unassisted; and 5.0, wheelchair bound or bedridden unless aided (37).

3.4. Data Analysis

Descriptive statistics, including mean, standard deviation, and percentage, were described for the main variables, using SPSS version 18.0. Normality tests indicated that all the variables were normally distributed; therefore, parametric tests were used for analysis. The correlations of PFS-16 score with age, disease duration, and disease severity were examined by Pearson's correlation coefficient test. A linear multiple regression analysis was performed in SPSS between the safety parameter of PASS as the dependent variable and independent variables with significant correlations with performance safety to evaluate our assumptions.

4. Results

The demographic and clinical characteristics of the participants are summarized in Table 1. The HYS stage ranged from 1.0 to 4.0 in the subjects. The mean duration of PD was 7.4 ± 5.40 years (range, 1 - 26 years). The total score of performance safety in ADL was 2.13 ± 0.61, based on PASS test scores; the mean score was highly variable among the participants (range, 0.17 - 3). In addition, the mean score of PFS was 60.73 ± 13.88, with the scores ranging from 26 to 80. Table 2 presents the correlations between PFS-16 score, age, YH stage, and safety of performance in each ADL task and 4 activity categories.

Table 1. The Basic Characteristics of Patients with Parkinson's Disease (n, 60)

Parameters	No. (%)
Gender	
Female	27 (45)
Male	33 (55)
Body laterality	
Right	48 (81.6)
Left	11 (18.3)
More involved body side	
Right	27 (45)
Left	33 (55)
Dominant involved body side	
Same as the dominant side	30 (50)
Different from the dominant side	30 (50)
Severity of disease (HYS stage)	
Level 1	24 (40)
Level 2	14 (23.3)
Level 3	19 (31.7)
Level 4	3 (5)

There was no significant relationship between safety and the dominant involved side of body (r = 0.878; P = 0.155,), gender (r = 0.391; P= -0.865), or disease duration (r = 0.061; P= -0.244). As reflected by the safety parameter of PASS, safety in ADL had a significant inverse correlation with PD-related fatigue (determined by PFS-16) and disease severity. Age also had a significant correlation with the safety score.

Among 4 categories of ADL, including functional mobility, BADL, CIADL, and PIADL, safety of performance in PIADL and CIADL had the most significant correlations with fatigue severity, respectively. Safety of CIADL (eg, shopping and paying bills by check) had the most significant correlation with age. Among 24 tasks included in PASS test (Persian version), carrying heavy objects, cleaning after meal preparation, safety at home, paying bills by check, and obtaining important information via visual media had the most significant correlations with fatigue, respectively.

Furthermore, the "enter method" in multiple linear regression analysis was used to predict safety in ADL performance with respect to fatigue, age, and severity of PD. A significant regression was found (F(3, 56), 29.51; P < 0.001) with an R^2 of 0.62. The predicted safety in ADL performance was -0.15 for fatigue, -0.22 for age, and -0.18 for PD severity. Fatigue was measured by PFS, age was measured in years, and PD severity was examined with HYS.

The participants' safety decreased by 0.15 for each PFS, 0.22 for each advancing year, and 0.18 for HYS. Fatigue, age, and PD severity were significant predictors of safety in ADL performance. The regression results are presented in Table 3. The stepwise multiple linear regression model revealed that age (F(1, 58), 39.32; P < 0.001) could predict safety in ADL performance with an R2 of 0.64. In other words, safety in ADL performance was equal to 4.1–0.33 with respect to age (t = -6.2; P < 0.001).

5. Discussion

The results of the present study showed that fatigue severity, age, and disease are predictors of performance in ADL among patients with PD. Performance safety in PIADL and CIADL had the most significant correlations with fatigue severity. Therefore, fatigue had the greatest effect on the safety of activities involving more physical and cognitive burden on patients with PD.

To the best of our knowledge, the present study is the first research on the effects of fatigue on performance safety in ADL among PD patients. There is a serious lack of evidence regarding the influence of fatigue on the safety of ADL in PD patients. In fact, such information can be important for occupational therapy interventions. Therefore, we used the available literature to reach a reasonable conclusion about our findings regarding the relationship between fatigue and safety.

Circuits linking the basal ganglia, amygdala, thalamus, and frontal cortex are related to central fatigue, which refers to a decline in the intentional initiation of muscle fiber activation by the central neural system (38-40). According to the literature, amygdala plays a vital role in safety and mediation of emotional responses and memories. Schiller believes that "The human amygdala tracks the predictive aversive value of stimuli as they reverse from fear to safety" (41). Failure to distinguish between safe and dangerous cues produces inappropriate responses (42), exposes the patient to more hazardous situations, and causes failure in performance of safe ADL (8, 41-45).

It can be concluded that the relationship between safety and fatigue is reasonable, considering the common neural basis of the underlying mechanisms of safety and fatigue. Therefore, there is an interrelationship between safety and fatigue, which may lead to the concurrent occurrence of these disorders in PD. Safety was affected by fatigue, especially in physical activities, such as carrying heavy objects and cleaning after meal preparation, which involve more muscular strength and postural stability. In future studies, for a more detailed analysis, use of electrophysiological systems is suggested to determine the exact effect of central fatigue caused by PD on muscle activity

Table 2. The Correlations between Safe Performance of ADL, Fatigue, PFS Score, Age, and HYS Score for Severity of Parkinson's Disease Symptoms (n, 60)[z]

PASS	PFS-16	Age	YHS
	r (P Value)	r (P Value)	r (P Value)
Functional mobility (total)	-0.474 (0.000)	-0.466 (0.000)	-0.498 (0.000)
Bed transfer	-0.437 (0.000)	-0.325 (0.011)	-0.374 (0.003)
Stair use	-0.379 (0.003)	-0.391 (0.002)	-0.498 (0.000)
Toileting	-0.404 (0.001)	-0.457 (0.000)	-0.389 (0.002)
Bathtub transfer	-0.418 (0.001)	-0.423 (0.001)	-0.403 (0.001)
Walking indoors	-0.446 (0.000)	-0.467 (0.000)	-0.554 (0.000)
Personal care (BADL) (total)	-0.396 (0.002)	-0.520 (0.000)	-0.494 (0.000)
Toenail trimming	-0.384 (0.002)	-0.480 (0.000)	-0.450 (0.000)
Dressing	-0.283 (0.028)	-0.392 (0.002)	-0.331 (0.010)
Oral hygiene	-0.295 (0.022)	-0.399 (0.002)	-0.437 (0.000)
PIADL (total)	-0.564 (0.000)	-0.514 (0.000)	-0.557 (0.000)
Carrying heavy objects	-0.566 (0.000)	-0.492 (0.000)	-0.481 (0.000)
Changing bed linen	-0.425 (0.000)	-0.488 (0.000)	-0.526 (0.000)
Cleaning after meal preparation	-0.526 (0.000)	-0.401 (0.001)	-0.492 (0.000)
CIADL (total)	-0.537 (0.000)	-0.666 (0.000)	-0.512 (0.000)
Paying bills by check	-0.498 (0.000)	-0.614 (0.000)	-0.420 (0.001)
Checkbook balancing	-0.473 (0.000)	-0.595 (0.000)	-0.377 (0.003)
Obtaining information from visual media	-0.479 (0.000)	-0.462 (0.000)	-0.408 (0.001)
Obtaining information from auditory media	-0.394 (0.002)	-0.482 (0.000)	-0.395 (0.002)
Oven use	-0.435 (0.001)	-0.538 (0.000)	-0.476 (0.000)
Stovetop use	-0.398 (0.002)	-0.510 (0.000)	-0.504 (0.000)
Sharp utensil use	-0.315 (0.014)	-0.447 (0.000)	-0.344 (0.007)
Mailing bills	-0.376 (0.003)	-0.594 (0.000)	-0.403 (0.001)
Shopping	-0.411 (0.001)	-0.682 (0.000)	-0.350 (0.004)
Medication management	-0.352 (0.006)	-0.549 (0.000)	-0.393 (0.002)
Small home repairs	-0.319 (0.013)	-0.434 (0.001)	-0.363 (0.004)
Safety at home	-0.515 (0.000)	-0.453 (0.000)	-0.459 (0.000)
Telephone use	-0.558 (0.000)	-0.444 (0.000)	-0.397 (0.002)
Total safety	-0.557 (0.000)	-0.636 (0.000)	-0.558 (0.000)

[z] Abbreviations: BADL, basic activities of daily living; CIADL, cognitive instrumental activities of daily living; PASS, Performance Assessment of Self-care Skills; PFS-16, Parkinson Fatigue Scale; PIADL, physical instrumental activities of daily living; r, correlation coefficient; YHS, Hoehn and Yahr Scale for severity of Parkinson's disease symptoms.

Table 3. Regression Analysis of Safety Performance of ADL in Parkinson's Disease Patients (n, 60)[z]

	B	Std. Error	Beta	T	Sig.
Constant	4.741	0.310		15.289	0.000
Fatigue	-0.015	0.004	-0.340	-3.795	0.000
Age, y	-0.022	0.005	-0.419	-4.509	0.000
Disease severity (HYS)	-0.180	0.060	-0.282	-3.020	0.004

[z] Abbreviation: HYS, Hoehn and Yahr Scale

and balance and to identify the relationship between these parameters and safety in ADL.

The physical and cognitive functional changes related to age can affect ADL performance (29). The significant correlation between performance safety and age in the present study is consistent with the findings reported by Foster and colleagues. They reported that older age was associated with poorer IADL performance (46). Furthermore, Wielinski et al. reported that older age is a risk factor for falling and a predictor of fracture in PD patients. Therefore, there is a special need for postinjury healthcare services for older patients (47).

In addition, Friedman et al. revealed that PD predicts falls, while age is one of the predictors of fear of falling (48). Roller et al. observed that falling was related to age in patients with PD (49). The results of the present study showed that safety of CIADL (eg, shopping and paying bills by check) had the most significant relationship with age. Similarly, Foster et al. showed that PD patients had a poorer performance in CIADL (46). Therefore, as PD patients grow older, the need for cognitive rehabilitation programs on safe ADL performance is more highlighted.

A significant relationship was also observed between safety of performance and disease severity, which is in accordance with previous studies. In consistence with these findings, Balash et al. revealed that patients with more falls had a longer and more severe PD in comparison with non-fallers (23). In addition, Ashburn et al. found that PD fallers had impaired postural control and greater disease severity (22). Gray and Hildebrand also suggested that risk of fall increases with disease severity and disease duration (25).

Additionally, Bloem et al., Schaafsma et al., and Wood et al. observed a relationship between disease severity and risk of fall (24, 26, 27); considering the disease progress, this was an expected result. In fact, as the disease progresses, the symptoms tend to aggravate, which will naturally affect performance safety in ADL. Therefore, higher levels of fatigue, aging, and disease progression cause serious issues regarding ADL performance safety. Moreover, there is a greater need for support and rehabilitation interventions in these patients, the investigation of impact of fatigue with other scales such as Fatigue Impact Scale (50, 51) is suggested.

The present results showed no significant relationship between safety and the dominant involved side of body. This might be due to the fact that patients with high disease severity did not participate in this study. By decreasing and regulation of fatigue in PD patients, it will be possible to enhance safety of performance in ADL and facilitate proper aging for community-dwelling older adults with PD.

This study has a number of limitations. First, there are many other factors, such as cognitive and motor skills, motivation, and mental state, which were not considered in the safety of ADL in the present study. Second, we used the clinic version of PASS test for the evaluation of performance safety. However, in order to collect more detailed and realistic information about the patients' performance, it is suggested to use the home version of this test.

5.1. Implications

The present findings provided information for occupational therapists to address safety and fatigue in interventions for patients with PD. For instance, they can make indoor and outdoor modifications to decrease fatigue and its effects and facilitate safe and independent performance of ADL. Moreover, occupational therapists need to broaden their analyses and interventions for patients with PD and focus on performance safety and central fatigue, besides motor and cognitive symptoms. Clinicians should also provide suitable strategies to minimize fatigue for a safe performance in patients, especially community-dwelling older patients.

Acknowledgments

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