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The association between fear of falling and quality of life for balance impairments based on hip and ankle strategies in the drug On- and Off-phase of patients with idiopathic Parkinson' disease

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Abstract

Background: Despite the negative effect of fear of falling during functioning and social participation of patients with Parkinson' disease, so far, only few studies have investigated its effect on the quality of life in these patients. We aimed to investigate the association between fear of falling and quality of life controlling for balance impairments based on hip and ankle strategy in drug On- and Off-phase of patients with idiopathic Parkinson' disease.

Methods: In this non-experimental cross-sectional study, 139 patients with idiopathic Parkinson' disease (100 male, 39 female) by mean± SD age of 60.2±12.27 years, mean±SD time since diagnosis of 6.7±5.53 years and mean±SD Hoehn and Yahr stage of 2.8±1.49 were selected by a simple non-probability method. Balance function was measured by a functional reach test with hip and ankle strategy. The Persian version of the self-completed Fall Efficacy Scale-International and Parkinson's disease quality of life questionnaire was used to evaluate fear of falling and quality of life, respectively.

Results: The results showed that the score of all dimensions of quality of life (i.e., mobility, activities of daily living, emotional wellbeing, stigma, social support, cognition, communication and bodily discomfort) were significantly affected by the intensity of fear of falling. Multiple regression analysis indicated a significant association between fear of falling and quality of life in a way that fear of falling explained 11% to 47% and 12% to 43% of variance in drug On-phase, as well as 8% to 45% and 9% to 48% of variance in the drug Off-phase in dimensions of quality of life after controlling for balance function based on hip and ankle strategy, respectively. In the drug On-phase, the strongest association ($R=0.85$, $p<0.001$) was found between fear of falling and mobility dimension of quality of life. In the drug Off-phase, the strongest relation was observed between fear of falling and mobility ($R=0.82$, $p<0.001$) as well as activities of daily living ($R=0.78$-0.79, $p<0.001$) dimensions.

Conclusion: This study found that fear of falling affects the quality of life of patients with Parkinson' disease beyond its relationship with balance impairments based on the hip and ankle strategy in both drug On- and Off-phase.

Keywords: Parkinson's disease, Quality of life, Fear of falling, Functional reach test with hip and ankle strategy.

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Introduction

Parkinson's disease (PD), the second most common neurodegenerative disorder (1), is associated with a wide spectrum of clinical

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manifestations which have a marked effect on quality of life (QOL) (2). Quality of life is a multidimensional notion that refers to an individual's subjective percept of life and other dimensions including health, housing, family relationships, social life, financial issues and recreational activities (3). Among the various factors affecting the QOL, fear of falling (FOF) seems to have the greatest effect on QOL and this effect is even greater than the fall experience itself (4). Fear of falling can be described as low confidence (low self-efficacy) to carry out activities without falling (5). Fear of falling is so common in patients with PD that 70% of these patients have reported activity limitations due to it (6). Fear of falling is also associated with an enhanced fall risk, low level of function and physical activity as well as low QOL (7-10). Fear of falling in patients with PD requires special attention because it has been identified as a risk factor for repeated falls (11) and a barrier for performing exercise (12). So far, few studies have investigated the effect of FOF on QOL in these patients. Brozova et al. (2009) reported a significant correlation between FOF and QOL parameters including mobility and activities of daily living (ADL) in drug On-phase of patients with PD (4).

On the other hand, previous studies have shown that balance problems and postural instability are the main variables affecting the QOL (13-15). Impaired balance is seen in about 75% of patients with PD (16) which is one of the most distressing symptoms of the disease (17). By indication and progression of balance impairments, patients with PD are prone to fall (18): forcing them to limit their mobility, social participation and independence, leading to a decrease of QOL (15,18,19).

The standard test that clinicians use to evaluate balance impairments in patients with PD is the Pull test on the Unified Parkinson's Disease Rating Scale (UPDRS) (20). In this test, the patient's response to an abrupt and intense pull backwards on the shoulders is evaluated in a standing position. Despite the common use of this test in clinical cases, previous studies have shown that this test alone is not a sufficient predictor of postural instability in patients with PD (21). According to the dynamic nature of the balance, the functional reach test (FRT) has been designed in order to reflect the actual requirements of balance (22). The use of two types of hip and ankle strategy has been reported in the implementation of this test. In the hip strategy, hip flexion plays a key role in maintaining balance (23) and vestibular sensory information is mainly used (24). In the ankle strategy, an ankle plantar flexion and the use of somatosensory information are mainly involved (23,24). Studies have shown that this simple test provides a precise and reliable estimation of postural instability (22). This test has been validated in patients with PD and the cutoff reach score of 24.5 cm exactly identifies patients with a high risk of falling (positive predictive value=90%, specificity=92%) (25). Jenkins et al. (2010) also reported that this test can better predict the risk of postural instability to which these patients are faced in ADL compared to other common measures of balance in patients with PD such as the UPDRS (20). Moreover, the correlation of FRT and FOF has been reported in patients with PD (18). The relation between FRT and QOL also has been reported in a recent study (26).

Balance is defined as an ability to maintain center of pressure in the stability limit and is completely task-dependent. Three well-known strategies have been proposed for balance control in different tasks including hip, ankle and stepping strategy (27). The relation between balance and FOF, balance and QOL as well as FOF and QOL in patients with PD has been reported in previous studies (4,13-15,26). According to the results of these studies, balance should be evaluated and considered in the rehabilitation of patients with PD in order to improve the QOL and decrease the effect of FoF on QOL in these patients.

However, it is not clear as to which aspect of balance has the most effect on the relation between FoF and QOL. Therefore, the aim of this study was to determine which of the two important balance strategies (i.e., hip and ankle strategy) has the most effect on this relation in order to determine which of these strategies should be considered in rehabilitation to improve the QOL and decrease the effect of FoF on the QOL in patients with PD.

Methods

Participants

One hundred and thirty-nine patients with idiopathic PD (100 male, 39 female) by mean±SD age of 60.2±12.27 years, mean±SD time since diagnosis of 6.7±5.53 years and mean±SD Hoehn and Yahr stage of 2.8±1.49 (the score in this staging system ranges from 1 to 5 so that a higher score indicates more severe impairment and disability) participated in this non-experimental cross-sectional descriptive study. They were selected from a clinic of motor disorders in Rasoul Akram hospital, Tehran, Iran during one year. The main inclusion criteria were the following: having Parkinson's disease according to the neurologist diagnosis, having an acceptable level of cognitive function(i.e. score of more than 23 on the Mini Mental Status Examination (MMSE) (28)), having the ability to stand and walk (at least 10 meters in length) independently without an assistive device (29), having no other neurological diseases (such as stroke), orthopedic problems (such as low back pain, arthritis, flat foot), diabetes or addiction according to the patient's or physician's report. Participants were excluded if they did not cooperate in the implementation of the tests. This study was approved by the Ethics Committee of Iran University of Medical Sciences. All patients signed a written consent form to participate in the study.

Instruments

A demographic questionnaire was used to record age, sex, level of disease progression according to the Hoehn and Yahr Scale, time since diagnosis of PD, and history of falling during the last 6 months.

Functional reach test (FRT) with hip and ankle strategy was used to evaluate the balance function. In order to perform FRT with a hip strategy, patients were asked to stand next to the wall from their preferred side and the examiner used a ruler to draw a line on the wall at the level of the patient's acromion horizontally parallel to the ground.

Then the patient was asked to elevate his/her upper extremity to the shoulder level (90 degree of flexion) and reach out in an extended position of the elbow and fisted hand along the drawn line on the wall. Reaching was done by hip flexion without lifting the fee or stepping. The difference between the start and end point at the metacarpophalangeal joint was measured using a ruler. Implementation of FRT with an ankle strategy was similar to the FRT with a hip strategy except that the patients were asked to reach out without hip flexion, lifting the foot as well as stepping (30).

This test has a good validity and reliability as well as a good sensitivity to clinical changes (31,32). Also, it has a high test-retest reliability (ICC=0.94) (30). In both FRT with the hip and ankle strategies, reaching was performed three times and a mean of three trials was calculated.

The Persian version of a self-completed Parkinson's disease QOL questionnaire (PDQ-39) was used to evaluate QOL. The PDQ-39 has 39 items in eight different dimensions including: mobility (10 items), ADL (6 items), emotional wellbeing (6 items), stigma (6 items), social support (3 items), cognition (4 items), communication (1 item) and bodily discomfort (3 items). Each item has five choices according to the Likert scale in a way that the first and fifth choice indicates the best and the worst condition, respectively. Sum of scores of all items in each dimension was calculated in a way that 0 and 100 shows the best and the worst QOL. It has been reported that the Persian version of PDQ-39 has a high

reliability (Cronbach's alpha=0.93) (33).

We evaluated the FOF by the Persian version of a self-completed Fall Efficacy Scale-International (FES-I) consisting of 16 items. Each item measures the amount of concern or fear of falling during performing a specific activity. A good reliability has been reported for the Persian version of FES-I (34). Using this scale, the patients could be divided to two groups of high and low level of FOF based on a cutoff point of 21 (35).

Procedure

First, patients completed the demographic questionnaire and then the balance function, FOF and QOL were evaluated. All evaluations were performed by one examiner in one day and in both the drug On-phase (1 hour after Levodopa administration) and the Off-phase (12 hours after Levodopa administration) (36). The sequence of evaluations was selected randomly.

Statistical analysis

The Shapiro-Wilks test was used to investigate the normal distribution of the data. All of QOL dimensions, balance function and FOF variables were normally distributed, while sex and history of fall variables did not have normal distribution. Comparison of the patients with high and low level of FOF in terms of normally distributed variables including quantitative demographic variables and different dimensions of QOL was down by independent t-test. Chi-square test was used to compare the sex and history of fall in patients with high and low level of FOF. Multiple regression analysis was done in order to investigate the relation between FOF (independent variable) and QOL (dependent variable), after controlling for balance impairments using FRT with hip and ankle strategy. In addition, simultaneous multiple regression was used to determine the relation between FOF and QOL in order to simultaneously control balance impairments using FRT with hip and ankle strategy. A p-value less than 0.05 was considered as statistically significant.

Results

Participant characteristics

All patients were receiving dopaminergic treatment and none of them had brain surgery for PD. The results showed that FOF in female participants was greater than male participants (χ^2=6.07, p=0.01 and χ^2=7.11, p=0.008 in drug On- and Off-phase, respectively). The mean age of patients with high and low level of FOF were not significantly different (t=-1.09, p=0.24 and t=0.02, p=0.98 in drug On- and Off-phase, respectively). Compared to patients with a high level of FOF, the ones with a low level of FOF had less severe PD as indicated by Hoehn and Yahr scale (t=-4.19, p<0.001 and t=-5.02, p<0.001 in drug On- and Off-phase, respectively).

The average time since diagnosis of PD was significantly greater in patients with high level of FOF compared to ones with low level of FOF in the drug Off-phase (t=12.68, p=0.008) while it was not significantly different between two groups in the drug On-phase (t= -1.54, p=0.13). The majority of patients with high FOF reported a history of fall in the last 6 months (χ^2=9.14, p=0.002 and χ^2=6.16, p=0.01 in drug On- and Off-phase, respectively).

Comparison of QOL between patients with idiopathic PD who have high and low level FOF

The current study found that mobility and ADL dimensions of QOL were weaker in patients with a higher level of FOF compared to patients with a lower level of FOF. Also, emotional wellbeing, social support, cognition and communication were impaired significantly in patients with a higher level of FOF (p<0.001).

Patients with a higher level of FOF had a higher score of stigma and bodily discomfort (p<0.001). Finally, the results showed that QOL of patients with a severe FOF was significantly lower than patients with a less FOF (Table 1).

Table 1. Comparison QOL measures between high and low levels of fear of falling in drug On- and Off-phase of patients with Parkinson' disease

Dependent variables		High FOF Mean (SD)	Low FOF Mean (SD)	t	p
Drug On-phase	Mobility	42.47(22.82)	12.62(21.65)	-6.88	<0.001
	ADL	35.60(23.20)	12.70(19.80)	-5.36	<0.001
	Emotional wellbeing	48.75(24.44)	28.33(24.46)	-4.27	<0.001
	Stigma	37.41(28.29)	18.14(19.39)	-4.37	<0.001
	Social support	32.69(25.06)	13.21(17.17)	-4.97	<0.001
	Cognition	34.90(21.01)	18.75(16.82)	-4.25	<0.001
	Communication	37.78(24.99)	14.83(20.95)	-5.01	<0.001
	Bodily discomfort	43.75(25.31)	20.73(22.90)	-4.85	<0.001
	Total score of PDQ39	39.13(16.03)	17.43(14.31)	-7.18	<0.001
Drug Off-phase	Mobility	11.77(19.00)	52.80(27.63)	-8.39	<0.001
	ADL	13.83(16.21)	48.86(28.09)	-7.94	<0.001
	Emotional wellbeing	30.67(29.03)	56.25(26.82)	-4.13	<0.001
	Stigma	10.66(14.53)	32.76(26.34)	-4.14	<0.001
	Social support	17.00(22.92)	44.24(30.53)	-5.46	<0.001
	Cognition	17.00(19.30)	38.21(19.79)	-4.75	<0.001
	Communication	17.66(25.03)	42.13(27.27)	-4.03	<0.001
	Bodily discomfort	19.23(20.78)	49.34(27.38)	-5.18	<0.001
	Total score of PDQ39	17.15(16.55)	45.09(18.50)	-6.70	<0.001

Table 2. The relationship between quality of life measures and fear of falling controlling for ankle and hip functional reach in drug On-phase of patients with Parkinson' disease: results of multiple regression analysis

Dependent variable	Independent variable	Coefficient (B)	SE	p	R	ΔR^2
Mobility	FR hip	-1.37	22.59	<0.001	0.50	0.25
	FR hip; FOF	-0.41;1.83	14.01	0.014; <0.001	0.85	0.47
	FR ankle	-1.25	21.93	<0.001	0.54	0.29
	FR ankle; FOF	-0.33;1.82	14.00	0.024; <0.001	0.85	0.43
ADL	FR hip	-0.91	22.87	<0.001	0.36	0.13
	FR hip; FOF	-.027;1.25	19.24	0.226; <0.001	0.62	0.26
	FR ankle	-0.81	22.72	<0.001	0.37	0.14
	FR ankle; FOF	-0.17;1.28	19.29	0.402; <0.001	0.62	0.24
Emotional wellbeing	FR hip	-0.32	26.77	0.242	0.12	0.01
	FR hip; FOF	0.35;1.22	23.90	0.208; <0.001	0.46	0.20
	FR ankle	-0.30	26.60	0.193	0.13	0.02
	FR ankle; FOF	0.36;1.27	23.70	0.138; <0.001	0.46	0.19
Stigma	FR hip	-0.16	28.06	0.579	0.05	0.003
	FR hip; FOF	0.49;1.22	25.31	0.097; <0.001	0.43	0.17
	FR ankle	-0.13	28.04	0.572	0.06	0.003
	FR ankle; FOF	0.55;1.32	25.07	0.035; <0.001	0.45	0.19
Social support	FR hip	-0.13	24.93	0.606	0.05	0.003
	FR hip; FOF	0.33; 0.89	23.71	0.233; <0.001	0.35	0.11
	FR ankle	-0.09	24.97	0.678	0.04	0.002
	FR ankle; FOF	0.39; 0.97	23.60	0.113; <0.001	0.36	0.12
Cognition	FR hip	-0.15	21.50	0.490	0.07	0.005
	FR hip; FOF	0.31; 0.91	19.54	0.165; <0.001	0.42	0.17
	FR ankle	-0.16	21.43	0.369	0.09	0.008
	FR ankle; FOF	0.31; 0.96	19.46	0.121; <0.001	0.43	0.17
Communication	FR hip	-0.22	26.32	0.407	0.08	0.007
	FR hip; FOF	0.42; 1.26	23.68	0.128; <0.001	0.47	0.21
	FR ankle	-0.23	26.34	0.312	0.10	0.01
	FR ankle; FOF	0.42; 1.32	23.66	0.090; <0.001	0.48	0.22
Bodily discomfort	FR hip	-0.78	24.97	0.003	0.28	0.08
	FR hip; FOF	0.21; 1.20	22.34	0.428; <0.001	0.54	0.21
	FR ankle	-0.71	24.87	0.002	0.30	0.09
	FR ankle; FOF	-0.15; 1.20	22.52	0.516; <0.001	0.53	0.20
PDQ39-SI	FR hip	-0.52	18.41	0.007	0.26	0.07
	FR hip; FOF	0.12; 1.22	14.31	0.476; <0.001	0.67	0.38
	FR ankle	-0.47	18.27	0.004	0.28	0.08
	FR ankle; FOF	-0.16; 1.26	14.21	0.258; <0.001	0.68	0.38

Effect of FRT with hip and ankle strategy on the relation between QOL and FOF in drug On-phase of patients with idiopathic

Multiple regression analysis in drug On-phase indicated that after controlling for function of balancing based on hip and ankle strategy, FOF remained significantly related to different dimensions of QOL. According to ΔR^2 column in Table 2, FOF explained 11% to 47% and 12% to 43% of variance in dimensions of QOL after controlling for function of balancing based on hip and ankle strategy, respectively. The greatest relation was found between FOF and mobility dimension of QOL while the least relation was observed between FOF and social support dimension. The function of balancing using FRT with hip as well as ankle strategy did not show a significant association with emotional wellbeing, stigma, social support, cognition and communication. However, a significant association was found between the function of balancing using FRT with this strategy and mobility, ADL and bodily discomfort as well as total score of QOL (which explained 7% to 25% and 8% to 29% of variance based on hip and ankle strategy, respectively) in the drug On-phase (Table 2). Multiple regression analysis with simultaneous controlling for balance impairments based on hip and ankle strategy showed that FOF was significantly associated with all dimensions of QOL in the drug On-phase while the function of balancing based on hip and ankle strategy did not show significant association with any of the QOL dimensions (Table 3).

Effect of FRT with hip and ankle strategy on the relation between QOL and FOF in drug Off-phase of patients with idiopathic PD

Multiple regression analysis in the drug Off-phase showed that after controlling for function of balancing based on hip and ankle strategy, FOF remained significantly associated with all dimensions of QOL with the exception of cognition and bodily discomfort. As indicated in ΔR^2 column of

Table 3. A summary table of simultaneous multiple regression analyses, with PDQ39-SI as the dependent variable and the functional reach with hip and ankle strategy as the independent variable in drug On-phase of patients with Parkinson' disease.

Dependent variable	Independent variable	Coefficient (B)	SE	p	R	Adjusted R^2
Mobility	FR hip	-0.36	14.08	0.340	0.85	0.71
	FR ankle	-0.04		0.889		
	FOF	1.82		<0.001		
ADL	FR hip	-0.46	19.32	0.368	0.62	0.37
	FR ankle	0.19		0.679		
	FOF	1.27		<0.001		
Emotional wellbeing	FR hip	-0.11	23.94	0.853	0.46	0.19
	FR ankle	0.46		0.413		
	FOF	1.28		<0.001		
Stigma	FR hip	-0.26	25.23	0.694	0.44	0.17
	FR ankle	0.75		0.213		
	FOF	1.31		<0.001		
Social support	FR hip	-0.23	23.71	0.712	0.36	0.10
	FR ankle	0.56		0.323		
	FOF	0.96		<0.001		
Cognition	FR hip	0.05	19.61	0.913	0.43	0.16
	FR ankle	0.25		0.580		
	FOF	0.95		<0.001		
Communication	FR hip	0.10	23.76	0.872	0.47	0.20
	FR ankle	0.32		0.574		
	FOF	1.30		<0.001		
Bodily discomfort	FR hip	-0.42	22.44	0.485	0.54	0.27
	FR ankle	0.21		0.696		
	FOF	1.23		<0.001		
PDQ39-SI	FR hip	-0.22	14.31	0.318	0.68	0.44
	FR ankle	0.34		0.560		
	FOF	1.26		<0.001		

Table 4. The relationship between quality of life measures and fear of falling controlling for ankle and hip functional reach in drug Off-phase of patients with Parkinson' disease: results of multiple regression analysis

Dependent variable	Independent variable	Coefficient (B)	SE	p	R	ΔR^2
Mobility	FR hip	-1.32	25.83	<0.001	0.51	0.26
	FR hip; FOF	-0.31; 1.47	17.58	0.205; <0.001	0.82	0.41
	FR ankle	-1.19	25.65	<0.001	0.51	0.26
	FR ankle; FOF	-0.28; 1.44	17.55	0.204; <0.001	0.82	0.41
ADL	FR hip	-1.09	27.74	0.546; <0.001	0.41	0.17
	FR hip; FOF	-0.15; 1.44	18.43	<0.001	0.79	0.45
	FR ankle	-0.88	28.40	0.002	0.37	0.13
	FR ankle; FOF	0.04; 1.51	18.68	0.846; <0.001	0.78	0.48
Emotional wellbeing	FR hip	-0.40	27.64	0.175	0.16	0.03
	FR hip; FOF	-0.12; 0.60	25.30	0.719; 0.024	0.38	0.11
	FR ankle	-0.42	27.90	0.612; 0.028	0.19	0.04
	FR ankle; FOF	-0.16; 0.59	25.65	0.120	0.39	0.11
Stigma	FR hip	-0.17	30.22	0.596	0.06	0.004
	FR hip; FOF	0.43; 0.74	29.37	0.296; 0.018	0.31	0.08
	FR ankle	-0.09	30.15	0.755	0.04	0.001
	FR ankle; FOF	0.45; 0.74	29.23	0.214; 0.016	0.31	0.09
Social support	FR hip	0.02	22.89	0.917	0.01	0.00
	FR hip; FOF	0.48; 0.77	19.94	0.086; <0.001	0.44	0.19
	FR ankle	0.03	23.11	0.882	0.02	0.00
	FR ankle; FOF	0.44; 0.76	20.22	0.082; <0.001	0.44	0.19
Cognition	FR hip	-0.31	22.23	0.191	0.16	0.03
	FR hip; FOF	-0.06; 0.39	20.18	0.826; 0.061	0.31	0.07
	FR ankle	-0.25	22.06	0.237	0.14	0.02
	FR ankle; FOF	-0.03; 0.38	20.03	0.903; 0.070	0.30	0.07
Communication	FR hip	-0.49	26.62	0.085	0.21	0.04
	FR hip; FOF	0.09; 0.82	24.32	0.791; 0.002	0.45	0.16
	FR ankle	-0.44	26.77	0.093	0.20	0.04
	FR ankle; FOF	0.09; 0.80	24.71	0.771; 0.002	0.44	0.15
Bodily discomfort	FR hip	-0.54	27.86	0.072	0.22	0.05
	FR hip; FOF	-0.19; 0.49	26.54	0.611; 0.076	0.33	0.06
	FR ankle	-0.54	27.90	0.049	0.24	0.06
	FR ankle; FOF	-0.22; 0.47	26.73	0.504; 0.090	0.33	0.05
PDQ39-SI	FR hip	-0.52	18.68	0.011	0.31	0.09
	FR hip; FOF	0.02; 0.84	14.72	0.917; <0.001	0.66	0.34
	FR ankle	-0.46	18.83	0.014	0.30	0.09
	FR ankle; FOF	0.04; 0.83	14.87	0.807; <0.001	0.65	0.33

Table 4, FOF explained 8% to 45% and 9% to 48% of variance in mobility, ADL, emotional wellbeing, stigma, social support, communication as well as total score of QOL after controlling for balance function based on hip and ankle strategy, respectively. The greatest association was found between FOF and mobility as well as ADL dimension of QOL. Function of balancing based on hip strategy was significantly associated with mobility, ADL and total score of QOL (which explained 9% to 26% of variance). Function of balancing based on ankle strategy was significantly related to mobility, ADL, bodily discomfort and total score of QOL (which explained 6% to 26% of variance) (Table 3). Multiple regression analysis with simultaneous controlling for balance function based on hip and ankle strategy indicated that FOF was significantly related to all dimensions of QOL with the exception of cognition and bodily discomfort. However, function of balancing based on hip and ankle strategy did not show a significant association with any of QOL dimensions (Table 5).

Discussion

To the best of authors' knowledge, this is the first study investigating the effect of function of balancing with a hip and ankle strategy on the relation between FoF and QOL in drug- On and Off phase of patients with PD. The results of this study showed that balance function with hip and ankle strategy has not a significant effect on the relation between FOF and QOL in these patients. This result may be explained by

Table 5. A summary table of simultaneous multiple regression analyses, with PDQ39-SI as the dependent variable and the functional reach with hip and ankle strategy as the independent variable in off-drug phase of patients with Parkinson' disease

Dependent variable	Independent variable	Coefficient (B)	SE	p	R	Adjusted R^2
Mobility	FR hip	-0.09	17.70	0.904	0.82	0.65
	FR ankle	-0.20		0.769		
	FOF	1.44		<0.001		
ADL	FR hip	-1.93	17.92	0.016	0.81	0.63
	FR ankle	1.63		0.019		
	FOF	1.44		<0.001		
Emotional wellbeing	FR hip	0.40	28.84	0.722	0.39	0.11
	FR ankle	-0.50		0.618		
	FOF	0.61		0.027		
Stigma	FR hip	-0.71	29.41	0.580	0.32	0.06
	FR ankle	1.06		0.358		
	FOF	0.71		0.022		
Social support	FR hip	0.20	20.38	0.823	0.44	0.15
	FR ankle	0.27		0.730		
	FOF	0.77		0.001		
Cognition	FR hip	-0.18	20.20	0.834	0.30	0.04
	FR ankle	0.12		0.873		
	FOF	0.37		0.082		
Communication	FR hip	0.00	24.92	0.998	0.44	0.15
	FR ankle	0.08		0.928		
	FOF	0.80		0.003		
Bodily discomfort	FR hip	0.32	26.94	0.784	0.33	0.07
	FR ankle	-0.49		0.637		
	FOF	0.48		0.089		
PDQ39-SI	FR hip	-0.27	14.98	0.681	0.65	0.39
	FR ankle	0.27		0.640		
	FOF	0.82		<0.001		

the fact that FOF has not episodic effect on the patients behavior (4). Moreover, function of balancing may be affected by the task, environment and person; therefore some aspects of the function of balancing may not affect the relation between FOF and QOL. In addition, it is possible that factors other than balance impairments may also be involved in FOF and its effect on QOL in patients with PD. Thomas et al. (2010) suggested that FOF in patients with PD may be caused by impairments of functional mobility due to disease progression (37). Nilsson et al. (2011) showed that FOF in these patients may be due to medical and surgical interventions (38). Moreover, Rubino et al. (2002) reported the FOF caused by inability to perceive balance impairments in patients with PD (39). In addition, previous studies have shown that FOF may have been caused by a history of falling, near fall experience (40, 41) and psychologic responses due to the PD (42). Another possible explanation for this result might be the tests (FRT with hip and ankle strategy) used to evaluate function of balance in this study. Previous studies have shown that turning, Timed Up and Go test has more relation with FOF (18,43,44). Thus it is possible that a balance evaluation by these tests has more effect on the relation between FOF and QOL in patients with PD and is suggested for further investigation in future studies.

The most interesting finding of the current study showed that even after controlling for the function of balancing (FRT) based on the hip and ankle strategy, FOF was significantly associated with QOL in patients with PD. Hence, it could be suggested that FOF has a negative association with QOL in patients with PD regardless of function of balancing based on hip and ankle strategy. This result is consistent with previous studies which showed that an increased FOF is associated with less ability to perform activities in patients with PD (43). The current study shows that after controlling for function of balancing based on the hip and ankle strategy, FOF showed

the strongest association with mobility and ADL dimensions of QOL in patients with PD. This finding is in agreement with Brozove et al. (2009) findings which showed that mobility and ADL were strongly related to FOF in patients with PD compared to other dimensions of QOL (4). This result may be due to the fact that patients with PD prefer to limit their activities in order to avoid falling-induced injuries and social embarrassment (45). Psychologic effects of FOF also may be involved in decreasing physical and functional activities (46,47). So it can be suggested that FOF results in limited activity of patients with PD thus they prefer to adopt a more sedentary lifestyle. In the long term, this lifestyle could result in muscle weakness and decrease in mobility and ADL of patients with PD (48).

The results of this study showed that the function of balancing based on hip and ankle strategy in FRT has a moderate association with mobility, ADL and bodily discomfort while it has no~~t~~ significant relation with other dimensions of QOL in patients with PD. This result is in accordance with the findings of Rahman et al. (2008) and Gomez-Esteban et al. (2007), who showed that balance impairments such as postural instability and gait disorders are the main variables affecting QOL (13, 37). Brozova et al. (2009) also reported the significant relation between gait disorders and mobility, ADL, bodily and discomfort dimensions of QOL in patients with PD (4).

We found that after controlling the balance function based on hip and ankle strategy, the association between FOF and different dimensions of QOL was similar in the drug On- and Off-phase with the exception that only in the drug Off-phase, a significant association was not observed between FOF and cognition as well as bodily discomfort. Previous studies have shown that Levodopa has significant effects on QOL. Therefore, the mobility function of patients with PD who are in progressed level of the disease is dependent on Levodopa thus they tend to perform their ADL only in drug On-phase (49). The observed similar results in drug On- and Off-phase in this study might be explained in this way that patients who participated in this study were in the initial stages of the disease.

Limitations

One of limitations of this cross-sectional study was that it is not possible to about the casual relationship between FOF and QOL based on these results. Therefore, further studies should be done to investigate whether decreasing FOF results in improving QOL in patients with PD. Another limitation of this study was that the patients who participated in this study were in the initial stages of the disease according to the Hoehn and Yahr Scale; thus the results of this study could not be generalized to all the levels of PD progression. Moreover, FOF is associated with different factors and we have only investigated the relation between FOF and QOL in the current study. Despite these limitations, to the best of our knowledge, this is the first study which investigated the effect of FOF on QOL with controlling function of balancing based on a hip and ankle strategy of patients with PD in both drug On- and Off-phase.

Conclusion

Regardless of balance impairments, QOL was lower in patients with PD who had higher level of FOF compared to patients who had lower level of FOF. The results of this study could help ~~to~~ future investigations needed to design therapeutic interventions about FOF in order to improve the QOL. The results of this study will be useful for clinicians to inform them about the association between FOF and the QOL in patients with PD.

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