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Original Article

Factors affecting exercise adherence in patients with Parkinson's disease

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Purpose: Motor and non-motor symptoms can appear in the early stages of Parkinson's disease (PD). Regular exercise can reduce the risk of chronic progression and improve these symptoms. However, due to disease symptoms and motor limitations, some PD patients are not motivated or are reluctant to exercise. The purpose of this study was to explore the factors that affect exercise adherence in patients with PD.

Methods: This study was based on a cross-sectional design. A total of 49 PD patients were investigated. We divided the participants into the high-exercise group (high exercise adherence ≥ 150 minutes/week) and the low-exercise group (low exercise adherence < 150 minutes/week). The Unified Parkinson's Disease Rating Scale (UPDRS) (Parts II & III), Fatigue Severity Scale (FSS), Pittsburg Sleep Quality Index, Geriatric Depression Scale short form, Hospital Anxiety Scale, and 8-item Parkinson's Disease Questionnaire (PDQ-8) were used to collect data. Logistic regression model was applied to the analysis of the factors that affect exercise adherence.

Results: There were significant differences in UPDRS part III (motor skills), FSS (fatigue), and PDQ-8 (Health-Related Quality of Life, HRQOL) results between the high-exercise group and the low-exercise group at baseline (t=-2.349, p=0.023; t=-2.465, p=0.018; t=-2.071, p=0.044). There were also significant differences in the odds of exercise adherence, with the low-exercise group demonstrating lower exercise adherence odds than the high-exercise group, as well as for Levodopa dosage [OR=0.996, 95% CI= (0.992–0.999)], motor skills [(OR=0.693, 95% CI= (0.509–0.944)), and fatigue [OR=0.877, 95% CI=(0.796–0.967)]. Based on UPDRS part II (activity of daily living) scores, the low-exercise group had higher exercise adherence odds than the high-exercise group [OR=1.675, 95% CI= (1.101–2.548)]; (p < 0.05).

Conclusions: Levodopa dosage, activity of daily living, motor skills, and fatigue are independent factors for exercise adherence in PD patients. These findings should be considered when developing exercise programs and designing exercise interventions for patients with PD.

Keywords: Parkinson's disease, exercise adherence, motor symptoms, non-motor symptoms

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1. Introduction

Parkinson's disease (PD) is the most common age-related neurodegenerative disorder, mostly presenting in later life. [1,2] It is estimated that PD affects at least 1% of people aged over 60. [3] PD is a movement disorder with motor symptoms (MS) and non-motor symptoms (NMS). MS include tremors, rigidity, bradykinesia, and postural instability. [4] NMS include fatigue, sleep problems, depression, and anxiety, which affect health-related quality of life (HRQOL). [5, 6] Exercise is associated with PD severity, motor disability, and activity of daily living (ADL). Exercise interventions have been widely studied in PD patients and regular exercise has been shown to reduce the risk of chronic progression in PD patients, as well as to improve MS and NMS. [7,8,9,10]

Several factors have been reported to be related to exercise adherence in PD patients, such as age, gender, medication (Levodopa dose), adverse drug reactions, social support, and mental status. Moreover, the clinical characteristics of patients include chronic diseases, pain, ADL, and HRQOL. [11] The most important determinants of exercise adherence are the severity of disease, motor complications, bodily pain, postural instability, and gait disorder. [11-13] Depression, anxiety, fatigue, lower quality of life (QOL), lack of time to exercise, and fear of falling are also significant determinants of exercise adherence. [12,13] Although there is evidence to suggest that exercise is effective for relieving some MS and NMS in PD patients, due to the progression of the disease and MS, some PD patients are less willing and motivated to exercise. [11-13]

The World Health Organization (WHO) defines adherence as, "The extent to which patients follow medical instructions." Although most research has focused on medication, adherence encompasses numerous health-related behaviors. [14] Adherence comes from the Latin word adhaerere, which means to cling to, keep close, or remain constant. In the Oxford English Dictionary, it is defined as, "Persistence in a practice or tenet; steady observance or maintenance". This definition points to the tenacity that patients need to comply with a therapeutic regimen. [15]

The American College of Sports Medicine (ACSM) has suggested that adults perform at least 150 minutes of moderate-intensity exercise per week. ACSM guidelines include physical activity 3–5 days per week; with intensity reaching 60–90% of maximum heart rate or 50–85% maximum oxygen uptake; and 20–60 minutes of aerobic exercise. [16] To improve exercise adherence, patients with a chronic illness or the elderly can adjust these recommendations based on the FITT formula (frequency, intensity, type & time) under the supervision of medical staff. FITT guidelines are: 1. Frequency, only a few times per day or several times per week. 2. Intensity, low, below 60% of maximum heart rate. 3. Type, slow and short-distance flatland walking. 4. Time, less than 15 minutes. 5. If there is any discomfort, exercise must be stopped immediately. [16]

Although there is evidence to support the effectiveness of exercise, there have been few studies on exercise adherence or their factors in PD patients in Taiwan. The definition of exercise in this study is based on ACSM guidelines: (1) frequency of several times a week; (2) regular exercise for 10-15 minutes a day or ≥150 minutes a week; (3) regardless of intensity, type, and duration of exercise. [16] In addition, in our study, the definition of high exercise adherence was exercise ≥ 150 minutes/week and the definition of low exercise adherence was exercise < 150 minutes/week. [12,13] The purpose of this study was to explore the factors that affect exercise adherence of PD patients.

2. Methods

2.1. Study design and population

This was a cross-sectional study. All patients diagnosed with PD by a neurologist were recruited. Convenience sampling was conducted with data collection from March 2016 to January 2017. Finally, a total of 49 participants were enrolled in this study. Inclusion criteria were: (1) diagnosed with PD by a neurologist, (2) clinical stage I or II on Hoehn and Yahr (HY) scale, (3) stable medication use and treatment for at least 3 months, (4) age 18 to 99 years, (5) regular exercise several times a day or several times a week, (6) >15 minutes per exercise session, (7) low to moderate intensity, 20-90% of maximum heart rate, [14] (8) regardless of type of exercise, and (9) regardless of whether or not amount of exercise reached > 150 minutes a week. Exclusion criteria included: (1) severe cardiovascular disorder or cardiovascular accident, neuro-musculoskeletal disorder, or cognitive impairment and (2) participation in any physiotherapy or rehabilitation program during the past 3 months.

2.2. Measurement

HY scale was used to assess the clinical stage of PD patients (stage I: unilateral involvement only, stage II: bilateral or midline involvement, without impairment of balance). [17]

Demographic data included age and gender, while disease characteristics included disease duration, Levodopa dosage, disease stage, chronic illness, and pain score. We used the Unified Parkinson’s Disease Rating Scale (UPDRS Parts II & III) to measure MS. Structured questionnaires used to measure NMS included Fatigue Severity Scale (FSS), Pittsburgh Sleep Quality Index (PSQI), Geriatric Depression Scale short form (GDS-SF, 15 items), Hospital Anxiety Scale (HAS), and 8-item Parkinson's Disease Questionnaire (PDQ-8).

Movement Disorder Society-Unified Parkinson’s Disease Rating Scale

Movement Disorder Society (MDS)-UPDRS was developed in the 1980s. Since then, it has become the most widely used clinical rating scale for PD. The original four components (Parts I–IV) cover non-motor experiences of daily living (13 items), motor experiences of daily living (13 items), motor examination (18 items), and motor complications (6 items). In 2008, MDS adopted a new and validated version of the MDS-UPDRS, which includes several significant updates, such as new NMS of PD. MDS-UPDRS Part II is focused on MS related to ADL as assessed by the patient or caregiver and Part III on MS (motor skills) as assessed on objective neurological examination. Parts I to III are scored on a 0–4 scale, while Part IV is scored based on yes or no responses. Higher scores indicate increased severity, which means that the higher the UPDRS scores, the worse the ADL and motor skills. [18]

2.3. Fatigue Severity Scale

FSS is a 9-item scale used to measure the severity of fatigue and its impact on the activities and lifestyles of patients with various diseases with excellent test-retest reliability (ICC = 0.91). The answers to each item are scored on a 7-point scale to indicate the seriousness of fatigue (1 = strongly disagree to 7 = strongly agree). The minimum score is 9 and the maximum score is 63. The higher the score, the more severe the fatigue and the more it affects the person's activities. A score of ≥ 36 indicates fatigue. [19]

2.4. Pittsburgh Sleep Quality Index

Buysse et al. (1989) developed PSQI, which is an important tool for measuring sleep quality in multiple populations. PSQI is a self-reporting questionnaire on sleep habits over the past month. The Chinese version is sensitive, reliable, and valid for assessing primary insomnia with Cronbach's alpha coefficients greater than or equal to 0.70. This measure consists of 7 components, including subjective sleep quality, sleep latency (how long it takes to fall asleep), sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each of the 19 items is scored on a 0–3 interval scale. The total score ranges from 0 to 21, with lower scores indicating better sleep quality. PSQI score of ≥ 5 indicates poor sleep quality. [20]

2.5. Geriatric Depression Scale Short Form

GDS, created by Yesavage et al. (1983), has been tested and used extensively in older populations. A GDS short form consisting of 15 questions (GDS-15) is used to identify depression in older adults, as well as in healthy, medically ill, and mild to moderately cognitively impaired adults. It is extensively used in community, acute, and long-term care settings. Patients are asked to respond by answering yes or no in reference to how they felt over the past week. GDS-15 scores range from 0–15, the higher the score, the more severe the depressive symptoms. [21] Scores of 0–4 are considered normal, 5–8 indicate mild depression; 9–11 indicate moderate depression, and 12–15 indicate severe depression.

2.6. Hospital Anxiety Scale

HAS was developed by Zigmond and Snaith (1983) and contains 7 items related to anxiety. HAS is a self-assessment tool for detecting anxiety in the hospital, with specificity of 0.78 and sensitivity of 0.9. Each item in the questionnaire is scored from 0–3, which means that the total score can be between 0 and 21. A score of ≥ 8 indicates anxiety. [22]

2.7. The 8-item Parkinson's Disease Questionnaire

PDQ-8 is the brief version of PDQ-39, formulated to reduce respondent burden and increase convenience of use in clinical settings. It is an 8-question instrument with a question taken from each of the following domains: mobility, ADL, emotional well-being, stigma, social support, cognition, communication, and bodily discomfort. The PDQ-8 is a brief disease-specific QOL instrument; a valid and reliable measure that can be appropriately and meaningfully used in cross-cultural studies and is available in both English and Chinese versions. The Chinese version of PDQ-8 has been proven to be reliable, with good internal consistency between the English and Chinese versions (Cronbach's alpha 0.81 and 0.87, respectively). Each item is scored from 0–4, with the scores of each item added to calculate the total score. The higher the total score, the worse the patients' perception of their HRQOL. [23]

2.8. Data collection

Data was collected from March 2016 to January 2017 at two medical centers in central Taiwan, by a research assistant using standardized procedures. The research assistant underwent training to measure all outcome variables and to ensure equal testing conditions for all participants. Participants were referred by a neurologist and maintained their daily lifestyle and exercise habits. We investigated patients who exercised regularly (low to moderate-intensity aerobic exercise, and intensity of 20–90% of the heart rate reserve (HR max)), no matter how many hours they exercised per week. [14] Participants completed questionnaires individually in the neurology clinic outpatient center. Demographic data (age and gender) and clinical data (disease duration, clinical stage of PD, daily dose of Levodopa, and chronic illnesses) were recorded from the patients' medical records. Furthermore, we designed a self-reporting sheet for participants to record their weekly exercise over the past 8 weeks. We instructed participants to recall and record the total number of exercise sessions, as well as how many times and how many minutes of exercise per week to understand their exercise adherence.

2.9. Data analysis

Statistical analysis was performed using SPSS version 22.0. Descriptive analysis (including frequency, mean, and standard deviation) of demographic and clinical characteristics of patients was carried out. Independent t-test and Chi-square test were used to compare the differences between the high-exercise group and the low-exercise group at baseline. Logistic regression analysis was performed to determine the factors affecting the exercise adherence of PD patients. Odds ratios were used to represent the odds of barriers to exercise in the low-exercise group when compared with the high-exercise group. The level of statistical significance was set at $p < 0.05$.

2.10. Ethical considerations

The study was approved by the institutional review boards of the research ethics committees of the two medical centers (CCH 151223 & TCVGH CG15272A). All participants signed an informed consent form and the researcher informed all participants of their right to withdraw from the study at any time without providing a reason.

3. Results

A total of 49 eligible patients were enrolled. We initially recruited 56 patients and excluded 7 patients who did not meet the inclusion criteria (n = 3), who declined to participate (n = 3), or for other reason(s) (n = 1). Among the participants, there were 27 patients in the high-exercise group and 22 patients in the low-exercise group (Figure 1).

3.1. Participant demographic and clinical characteristics

The demographic and clinical characteristics of the study subjects are shown in Table 1. Among them, 55.10% reported high-exercise adherence and 44.90% reported low-exercise adherence. The mean age of the 49 patients was 63.65 ± 6.02 years. Among them, there were 26 males (53.1%) and 23 females (46.9 %) and their mean disease duration was 4.97 ±

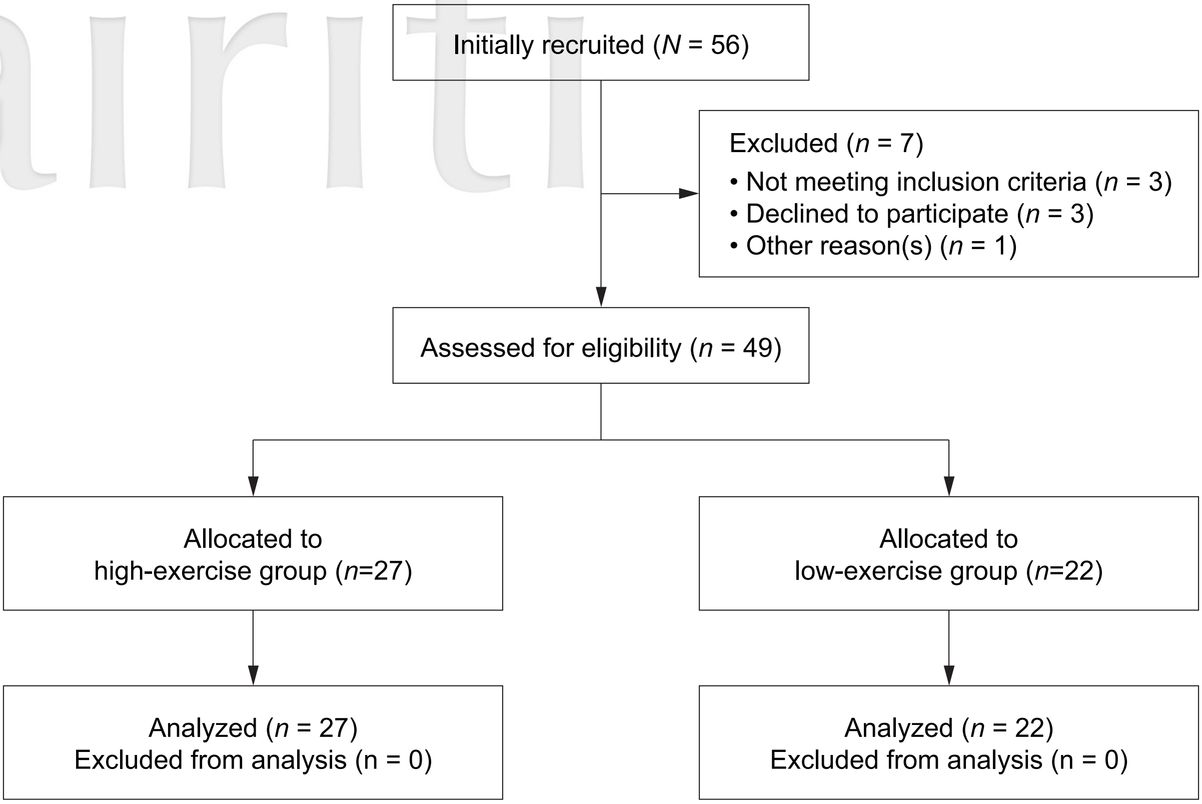

Figure. 1 Flow diagram of subject enrollment and analysis.

3.91 years. Regarding clinical characteristics, daily dose of Levodopa was 580.48 mg (± 425.47), and pain Visual Analog Scale (VAS) score was 1.90 (± 2.58). In addition, 33 patients had no chronic illness (67.3%) and 16 patients had chronic illness (32.7%). There were 31 patients (63.3%) with stage I and 18 patients (36.7%) with stage II PD.

3.2. Comparisons of motor symptoms and non-motor symptoms between the high-exercise group and the low-exercise group at baseline

There were significant differences between the high-exercise group and the low-exercise group on UPDRS part III (t = -2.349, p = 0.023), FSS (t = -2.465, p = 0.018), and PDQ-8 (t = -2.071, p = 0.044) at baseline. There were no significant differences in UPDRS part II, PSQI, GDS-15, or HAS scores between the high-exercise group and the low-exercise group (Table 2). In addition, the most prevalent NMS was fatigue (40.8%). Among the other NMS, the most frequently reported were sleep problems (71.4%), depressive symptoms (32.7%), depression (18.4%), and anxiety (mild 12.2%, moderate 4.1% and severe 2.0%, respectively). All 49 patients reported at least one type of NMS (Table 2).

3.3. Predictors of barriers to exercise adherence in PD patients

On univariate logistic regression analysis, three barriers - Levodopa dosage, motor skills, and fatigue – to exercise adherence were found in the low-exercise group (Table 3). The low-exercise group had significantly lower odds of exercise adherence than the high-exercise group. Logistic regression analyses showed that Levodopa dosage (OR=0.996, 95% CI= (0.992–0.999)], motor skills (UPDRS-III) [OR=0.693, 95% CI= (0.509–0.944)], and fatigue (FFS) [OR=0.877, 95% CI= (0.796–0.967)] are significant predictors of exercise adherence (p < 0.05). However, compared with the high-exercise group, the higher the ADL score (UPDRS-II) [OR = 1.675, 95% CI = (101.1–2.548)], the higher the

Table 1. Demographic and clinical characteristics at baseline (*n* = 49)

Variables	All (*n* = 49)		High-exercise group (*n* = 27)	Low-exercise group (*n* = 22)		
	n (%)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	*t*	*p*
Age (years)		63.65 (6.02)	65.11 (5.49)	61.86 (6.27)	1.932	0.059
Disease duration		4.97 (3.91)	5.11 (4.36)	4.79 (3.35)	0.286	0.776
Levodopa dosage		580.48 (425.47)	470.20 (333.92)	705.80 (488.03)	-1.951	0.065
Pain score		1.90 (2.58)	1.70(2.22)	2.14(3.01)	-0.579	0.565
			n (%)	*n* (%)	χ^2	*p*
Gender					0.150[a]	0.698
Male	26 (53.1)		11 (50.0)	11 (50.0)		
Female	23 (46.9)		15 (55.6)	12 (44.4)		
Disease stage					0.002[a]	0.961
Stage I	31 (63.3)		17 (63.0)	14 (63.6)		
Stage II	18 (36.7)		10 (37.0)	8 (36.4)		
Chronic illness					1.789[a]	0.181
Non	33 (67.3)		16 (59.3)	17 (77.3)		
Yes	16 (32.7)		11 (40.7)	5 (22.7)		
Cardiovascular disease	3 (6.1)		3(6.1)	0(93.9)	2.604[a]	0.107
Hypertension	11 (22.4)		7(63.6)	4(36.4)	0.418[a]	0.263
Respiratory system	1 (2.0)		0(98)	1(2.0)	1.253[a]	0.263
Diabetes mellitus	8 (16.3)		5(62.5)	3(37.5)	0.212[a]	0.346

[a] Chi-Square

likelihood of exercise adherence in the low-exercise group. The low-exercise group had 1.675 times the odds of ADL as the high-exercise group, which means that the higher the ADL score, the higher the exercise adherence of the low-exercise group. In addition, the low-exercise group had 0.996 times the odds of Levodopa dosage, 0.693 times the odds of motor skills, and 0.877 times the odds of fatigue as the high-exercise group. This means that the higher the Levodopa dosage, the higher the motor skills score, and the higher the fatigue score, the lower the exercise adherence in the low-exercise group (Table 3).

4. Discussion

The purpose of this study was to survey the factors that affect exercise adherence in PD patients. We found that the significant predictors of exercise adherence are Levodopa dosage, ADL, motor skills, and fatigue (Table 3). [24] The higher the dose of Levodopa, the higher the motor skills score, and the more severe the fatigue, the lower the exercise adherence in the low-exercise group. However, higher ADL score was associated with higher exercise adherence in the low-exercise group.

Very few PD patients exercise more than 150 minutes per week. Therefore, it was not easy to recruit a large number of participants, especially for the high-exercise group. Moreover, the attrition rate of the low-exercise group was higher (*n* = 6). There were

Table 2. Comparisons of the motor and non-motor symptoms between the high-exercise group and the low-exercise group at baseline (*n* = 49)

Variables	All (*n* = 49)		High-exercise group (*n* = 27)	Low-exercise group (*n* = 22)		
	n (%)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	*t*	*p*
MDS-UPDRS						
Part II (ADL)		6.52 (4.62)	6.07(4.80)	7.10(4.44)	-0.756	0.454
Part III (Motor ability)		7.80 (4.41)	6.52(3.67)	9.36(4.81)	-2.349	0.023
FSS		30.31 (15.71)	25.63(15.49)	36.33(14.15)	-2.465	0.018
PSQI		9.48 (4.55)	9.59(4.90)	9.33(4.16)	-0.194	0.847
GDS		5.40 (3.61)	4.48(3.71)	6357(3.19)	-2.055	0.046
HAS		6.46 (4.92)	5.33(4.38)	7.90(5.31)	-1.840	0.072
PDQ-8		35.94 (22.02)	30.33(21.53)	43.16(21.00)	-2.071	0.044
			n (%)	*n* (%)	χ^2	*p*
FSS					0.000[a]	0.990
FSS (score < 36)	29 (59.2)		16 (59.3)	13 (59.1)		
FSS (score ≥ 36)	20 (40.8)		11 (40.7)	9 (40.9)		
PSQI					0.033[a]	0.856
Good (score < 5)	14 (28.6)		8 (29.6)	6 (27.3)		
Poor (score ≥ 5)	35 (71.4)		19 (70.4)	16 (72.7)		
GDS					5.463[a]	0.065
Non	24 (49.0)		16 (59.3)	8 (36.4)		
Depressive symptoms (score ≥ 7-9)	16 (32.7)		5 (18.5)	11 (50.5)		
Depression (score 10)	9 (18.4)		6 (22.2)	3 (13.6)		
HAS					2.920[a]	0.404
Non	40 (81.6)		22 (81.5)	18 (81.8)		
Mild anxiety	6 (12.2)		3 (11.1)	3 (3.6)		
Moderate anxiety	2 (4.1)		2 (7.4)	0 (0)		
Severe anxiety	1 (2.0)		0 (0)	1 (4.5)		

[a] Chi-Square

significant differences at baseline between the high-exercise group and the low-exercise group on UPDRS-III (*t* = -2.349, *p* = 0.023), FSS (*t* = -2.465, *p* = 0.018), and PDQ-8 (*t* = -2.071, *p* = 0.044). In previous studies, only patients treated in hospitals were sampled, which may have led to admission bias. [25] Admission bias can have many causes (burden of symptoms, access to medical care, prevalence of disease, diseases that are rare or late) and is potentially important in hospital or practice-based research. [25] Sampling biases present

Table 3. Predictors of barriers to exercise adherence in PD patients (*n* = 49)

Predictors	*B*	*S.E.*	*Wals*	*EXP(B)*	95% CI for *OR*		*p* value
				(OR)	Lower	Upper	
Age	-5.253	4.421	1.412	0.005	0.987	1.282	0.235
Gender	0.225	0.691	0.106	1.253	0.323	4.855	0.744
Disease duration	0.226	0.163	1.933	1.254	0.911	1.726	0.164
Disease stage	-0.798	0.937	0.724	0.450	0.072	2.827	0.395
Levodopa dosage	-0.004	0.002	5.762	0.996	0.992	0.999	0.016
Pain score	0.331	0.360	0.844	1.392	0.751	1.167	0.358
Chronic illness	0.004	0.130	0.001	1.004	0.777	1.295	0.978
MDS-UPDRS							
Part II (ADL)	0.516	0.214	5.807	1.675	1.101	2.548	0.016
Part III (Motor ability)	-0.367	0.158	5.403	0.693	0.509	0.944	0.020
FSS	-0.131	0.050	6.992	0.877	0.796	0.967	0.008
PSQI	0.251	0.139	3.272	1.285	0.979	1.686	0.070
GDS	0.123	0.278	0.195	1.131	0.655	1.952	0.659
HAS	-0.173	0.131	1.733	0.841	0.650	1.088	0.188
PDQ-8	-0.050	0.040	1.569	0.951	0.879	1.029	0.210

Δ odds: OR = EXP(B)

a much more difficult problem. Some biases can be prevented and measured. For example, the non-respondent bias can be resolved by high response rates. In other words, increasing the number of samples can resolve deviations.

It has been reported that dose of Levodopa, a dopamine agonist or agent, affects exercise adherence of PD patients. [26] Anti-PD medications may cause psychotic side effects, which can impact ADL and QOL scores more than motor disabilities. [27] Anti-PD medications should be reduced as much as possible to improve the side effects of psychosis without drastically worsening MS. [28] In this study, patients reported that drug side effects reduce their exercise motivation and willingness to exercise.

In the present study, the higher the ADL score, the better the exercise adherence (*EXP(B)* = 1.675) in the low-exercise group. Restricted functional status and ADL in PD patients often lead to loss of independence. Bradykinesia, tremors, and stiffness severely impact the flexibility of the hands and affect simple daily activities and tasks, such as taking pills, dressing, eating, and bathing. These symptoms worsen under emotional stress. [29]. As MS affect ADL, patients seek to improve their ability to cope with daily tasks. Therefore, they hope to benefit from exercise. In the early stage of the disease, the most common symptoms are rigidity, slowness of movement or bradykinesia, difficulty walking, postural instability, impaired balance, and loss of automatic movements. [4] The literature indicates that PD patients lack motivation to exercise or adherence to exercise. This is due to disease progression, disease symptoms, or falls. However, lack of exercise can lead to weakness of the lower limbs, insufficient strength, and inability to stand for a long time. [7, 12, 13, 24] The MS factors in the literature are consistent with those of this study.

PD progresses over time and this progression is significant in the first 15 years of the disease.

That is, MDS-UPDRS scores increase significantly with every HY stage and in 5-year increments in the first 15 years of the disease. [33] In the present study, patients mentioned that progression of the disease, physical discomfort due to the disease, and MS affect their exercise adherence and motivation. Although patients understand that exercise is good for their physical and mental health, they feel that the more they exercise, the more tired they are and the more energy they consume. Therefore, they are unable to endure or tolerate it and do not want to spend much effort on it. [11-13]

Patients' self-reported factors that affect exercise adherence included progression of the disease, physical discomfort due to the disease, general weakness, lower limb weakness, lack of strength and energy, reduced mobility, slowness of motion and movement, difficulty walking, walking slowly, feeling as if dragging, shuffling, lower limb heaviness (iron legs) or freezing of gait, limb stiffness, postural instability, shaking, continuous tremor, impaired balance and fear of falling, pain (headache, back pain, foot pain, muscle pain), tightening (sense of stretching), lower back soreness, limb numbness and tingling, lower limb cramps, moving and leaning forward, festination (rapid shuffling steps with a forward-flexed posture when walking), lack of time, loss of confidence, and feeling that exercise is not beneficial.

From the above list, progression of disease may be the main factor for disability, affecting employment and social participation. Patients lose the ability to perform daily activities and independence, which also affects their HRQOL. This may also impact on their motivation and willingness to exercise.

Furthermore, some factors affected exercise adherence of PD patients in the early stage of the disease, such as lack of expectation of benefit from exercise, lack of motivation, lack of time, fear of falling, duration of disease, severity of pain, feeling as if in good condition or possessing a good level of well-being, thinking that exercise is time-consuming, fatigue, and depression. [12, 13, 24] Fatigue and other NMS often occur in the early stage of PD. The prevalence of fatigue in PD patients was 33.8–42.7%. Fatigue is more likely to be reported in older patients and patients with longer duration of disease. [30] The severity of fatigue is related to motor impairment, which increases severity of posture-gait symptoms and causes cardiovascular and sympathetic dysfunction. There is also a comorbid relationship with sleep disorders, depression, and anxiety, [30, 31]. Higher UPDRS part II (ADL), UPDRS part III (mobility), and HRQOL (PDQ-39) scores are associated with fatigue in patients with PD. [31] Fatigue in PD can be influenced by multiple factors, including MS, and is reflected in the patient's physical energy, which in turn affects the underlying psychology. [32] Previous studies have shown that fatigue leads to difficulty maintaining mental and physical functions. [30, 32] Due to fatigue, patients may believe that they need to rest and to have increased energy before they can exercise.

Limitations

There are several limitations to this study. First, 49 participants were enrolled, which is a relatively small sample size, making it difficult to draw general conclusions. Second, in this cross-sectional study, only patients treated in hospitals were selected, meaning that there may be admission bias. [25] We have explained this and other types of bias in the Discussion section. Third, we provided participants with a record sheet and asked them to recall and record their amount of exercise over the past 8 weeks, to understand their exercise adherence and intensity. Such subjective data may be biased. There is a need for more rigorous research to explore factors related to exercise adherence or exercise motivation among PD patients. We suggest that randomized control trials (RCT) of appropriate exercise programs be conducted in the future. Research is also required to find a suitable exercise program or prescription to increase patient exercise adherence and motivation.

Conclusion

This study provides information about exercise adherence in PD patients. Our results indicated that dose of Levodopa, ADL, motor skills, and fatigue affect the exercise adherence of PD patients. At present, there is sufficient evidence to support the effectiveness of exercise intervention in PD patients. According to the results of this study on the factors affecting exercise adherence, to improve MS and NMS, we can design and implement exercise guidelines for PD patients. Even if there are barriers to exercise adherence, we can continue to encourage patients to exercise as they are likely to benefit from it.

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