Original Article

Gait speed and related factors in Parkinson's disease

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Abstract. [Purpose] The aim of this study was to investigate the relationship between gait speed and various factors in ambulatory patients with idiopathic Parkinson's disease. [Subjects] Fifty ambulatory patients with idiopathic Parkinson's disease who were admitted to an outpatient clinic were included in this cross-sectional study. [Methods] The Hoehn and Yahr Scale was used for measurement of the disease severity. Gait speed was measured by the 10-Meter Walk Test. Mobility status was assessed by Timed Up and Go Test. The Hospital Anxiety and Depression Scale was used for evaluation of emotional state. Cognitive status was examined with the Mini-Mental State Examination. The Downton Index was used for fall risk assessment. Balance was evaluated with the Berg Balance Scale. Comorbidity was measured with the Cumulative Illness Rating Scale. The 36-Item Short Form Health Survey was completed for measurement of quality of life. [Results] The mean age was 66.7 (47–83) years. Twenty-eight (56%) patients were men. Gait speed was correlated positively with height, male gender, Mini-Mental Examination score, Berg Balance Scale score and physical summary scores of the 36-Item Short Form Health Survey. On the other hand, there was a negative correlation between gait speed and age, disease severity, TUG time, Downton Index, fear of falling, previous falls and the anxiety and depression scores of the Hospital Anxiety and Depression Scale. There was no correlation between gait speed and comorbidity. [Conclusion] The factors related with the slower gait speed are, elder age, clinically advanced disease, poor mobility, fear of falling, falling history, higher falling risk, and mood disorder.
Key words: Gait, Fear of falling, Parkinson's disease

INTRODUCTION

Resting tremor, rigidity, bradykinesia and postural instability are the main symptoms of Parkinson's disease (PD). On the other hand gait disorder is a major symptom for PD[1)]. Gait hypokinesia can be seen from the early stages of the disease. Even if the patients have not started antiparkinsonian medicine yet, they may have a slower gait speed as compared with healthy individuals[2)]. Most patients with a Hoehn and Yahr (HY) stage of II–III require assistance for walking, dressing, cooking, and other home activities. It has been reported that gait disorder is the first complaint in patients with PD, and afterwards, difficulties in travelling and shopping occur[3)].

The stride length is shorter in patients with PD[4–7)]. Pa-

tients can increase their cadance to compensate for this[8)]. In addition, it is claimed that the swing phase is shorter, and both gait symmetry and gait timing are detoriated in patients with PD[2)].

There are various factors that affect gait speed. One of the factors that may be related to gait speed in older people is muscle strength. On the other hand, gait speed is faster amongst people who have higher incomes, are physically more active, have neither depression nor obesity, have lower levels of fatigue, and have better muscle strength according to a previous study[9)]. Recently, gait has been accepted as an executive function rather than a simple motor function that can be affected by cognitive impairments especially attention disorder[10)].

Patients with milder PD are more physically active, and they have a higher activity level and a better balance ability than patients with a severe form of the disease. However, fall risk is increased amongst people with mild PD. For this reason, it is important to practice standing balance and gait training[11, 12)].

In this study, we aimed to investigate the relationship between gait speed and various personal and disease-related factors in patients with PD.

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SUBJECTS AND METHODS

Fifty patients with idiopathic PD who were admitted to an outpatient clinic between April 1, 2010, and February 28, 2011, were included in the study. Idiopathic PD had been diagnosed by a neurologist. The inclusion criteria were age between 50 and 75 years, HY stage of I–IV, and able to walk. All of the patients were regularly using antiparkinsonian medication.

The demographic characteristics, previous falls in the last 1 year, and fear of falling (FOF) were recorded for all the participants. All participants were evaluated with Timed Up and Go (TUG) Test and 10-Meter Walk Test (10MWT). Balance was assessed with the Berg Balance Scale (BBS). Mental state was evaluated with the Mini-Mental State Examination (MMSE), and fall risk was evaluted with the Downton Index (DI). The Cumulative Illness Rating Scale (CIRS) was used for assessment of comorbidities, and The 36-Item Short Form Health Survey (SF-36) was used for assessment of quality of life.

A straight line 14 meters long was drawn on the ground for the 10MWT. The points located 2 meters from the beginning and end of this line were marked. The first 2 meters was provided for the patient to reach his/her usual gait speed, and the last 2 meters was provided for the patient to slow down and stop. At the beginning of the test, the patients were told to walk at a comfortable pace. They put on comfortable shoes or sport shoes during the test. Every patient was tested within 2 hours after taking their antiparkinsonian medication, because walking performance could show fluctuations according to the antiparkinsonian medication intake. For patients with PD, the walking pattern is considered to be quite stable within 165 mins after levodopa intake. The time required to walk the 10 meters was recorded. This test was applied 2 times, and the average value was calculated, as suggested by Morris et al[5]. The 10MWT is a reliable test that can be used for patients with PD[13].

The TUG test is an easy test that measures the time required to stand up from a chair, walk 3 meters, turn around, return to the chair and sit down again. It is a reliable test to measure functional mobility in people with PD[14]. All the patients were informed about the procedure before the test. They wore comfortable shoes or sport shoes during the test. The average of 3 tests was calculated and recorded in seconds. A TUG time of ≤10 seconds can be interpreted as normal for elderly people[15].

The CIRS was developed by Linn et al. as a multimorbidity measure that evaluates thirteen systems[16] and it was modified by Miller et al. as a 14-system inquery. Problems related to cardiac, vascular, hematological, respiratory, otorhinolaringologic, upper gastrointestinal, lower gastrointestinal, hepatic and pancreatic, renal, genitourinary, musculoskeletal and dermatologic, neurologic, endocrine, metabolic, breast, and psychiatric systems can be evaluated with the modified CIRS[17].

The BBS is a useful test with 14 items that can be used to evaluate the self-perception of balance[18]. The total ranges from 0–56. Higher scores indicate better balance.

The DI is a simple test to predict risk of falling under five sections: drugs, previous falls, sensory deficits, mental

Table 1. Demographic and clinical characteristics of the patients with Parkinson's disease

	Mean (SD)	Min–Max
Age (years)	66.7 (8.6)	47–83
BMI (kg/m^2)	28.1 (4.6)	19–38
Disease duration (months)	71.1 (44.7)	12–184
HY	1.96 (1.02)	1–4
	N=50	%
Gender male/female	28/22	56/44
FOF	31	62
Previous falls	24	48
Walking aids	14	28

BMI: body mass index; HY: Hoehn and Yahr; FOF: fear of falling

status, and gait. The total score ranges from 0 to 11. Scores ≥ 3 indicate increased risk of falls[19].

The MMSE is a simple, practical, and reliable test for assessment of cognitive functions[20]. The reliability and validity of the Turkish version of the MMSE have been studied[21].

The HADS is an easy screening test for assessment of anxiety and depression status. The test can be used both for hospitalized patients and for the outpatients. The HADS has 14 questions about the feelings of the patient in the last week[22]. The HADS-D, is a handy test for determining the level of depression in patients with PD. It is especially useful for mild to moderate depression diagnosis[23].

The SF-36 is a 36-item test for assessment of generic quality of life. It has 8 domains and physical and mental summary scores. Higher scores indicate better quality of life. This study was approved by the local Ethics Committee. Informed consent was obtained from the patients.

The SPSS 15.0 statistical package was used for the statistical analysis. The means and standard deviations of the patients' demographic datas and clinical characteristics calculated by the Descriptive Statistics. Pearson and Spearman correlation tests and multiple regresion analysis were used for calculating correlation coefficients' between gait speed and parameters. P<0.05 was considered as significant.

RESULTS

The demographic and clinical characteristics of the patients are summarized in Table 1. Twenty-eight (56%) of the patients were males. Clinical characteristics are shown in Table 2. The mean gait speed was 0.94±0.28 m/s (0.28–1.67).

The factors related to gait speed are summarized in Table 3. There was a positive correlation between gait speed and height, MMSE, BBS, and physical summary score of the SF-36. A negative correlation was found between gait speed and age, clinical severity of the disease, FOF, DI, previous falls, TUG time, and HADS anxiety and depression scores. There was no correlation between gait speed and comorbidity or mental summary score of the SF-36.

All of the patients were using antiparkinsonian drugs. Moreover, 23 patients were using antihypertensive medication, 11 were receiving antidiabetic treatment, 8 were using diuretic medication, 8 were using antidepressive medication,

Table 2. Clinical characteristics of the patients with Parkinson's disease

	Mean (SD)	Min–Max
Gait speed (m/s)	0.94 (0.28)	0.28– 1.67
TUG (sec)	14.3 (6.5)	6–37
BBS Score	44.1 (6.0)	26–53
DI Score	3.86 (1.8)	0–7
HADS-A	7.56 (5.1)	0–29
HADS-D	8.46 (4.3)	0–19
SF-36		
PSS	33.4 (10.0)	19–60
MSS	38.8 (6.3)	18–55
CIRS	4.1 (2.5)	1–12

TUG: Timed Up and Go; BBS: Berg Balance Scale; DI: Downton Index; HADS-A: Hospital Anxiety and Depression Scale- Anxiety ; HADS-D: Hospital Anxiety and Depression- Depression; SF-36 PSS: SF-36 physical summary score; SF-36 MSS: SF-36 mental summary score; CIRS: Cumulative Illness Rating Scale. Descriptive statistics were used.

Table 3. Correlations between gait speed and parameters

	r	p
Age	−0.377	0.026
Height	0.310	0.029
Gender	0.421	0.002
HY	−0.509	0.000
FOF	−0.431	0.001
Previous falls	−0.434	0.001
Downton index	−0.309	0.026
BBS	0.884	0.000
TUG	−0.850	0.000
MMSE	0.278	0.046
HADS-A	−0.322	0.020
HADS-D	−0.445	0.001
SF-36		
PSS	0.473	0.000
MSS	0.192	>0.05
CIRS	−0.107	>0.05

HY: Hoehn and Yahr; FOF: fear of falling; BBS: Berg Balance Scale; TUG: Timed Up and Go; MMSE: Mini Mental State Examination; HADS-A: Hospital Anxiety and Depression Scale-Anxiety; HADS-D: Hospital Anxiety and Depression Scale-Depression; SF-36 PSS: SF-36 physical summary score; SF-36 MSS: SF-36 mental summary score; CIRS: Cumulative Illness Rating Scale. Pearson and Spearman correlation tests were used for evaluation. P<0.05 was considered statistically significant.

6 had antiresorptive drugs for osteoporosis, and 4 were using medication for thyroid disorder.

DISCUSSION

The mean gait speed was 0.94 m/s in the patients with PD in this study. In previous studies, the gait speed was reported to be between in patients with 0.18–1.21 m/s in PD[4, 25–27]. These values are lower than the gait speed for healthy people and around their 60's, which was found to be 1.30–1.36 m/s[28]. Moreover, the gait speed for the patients in this study was lower than that reported for people with a mean age of 74, that is, 1.23±0.26 m/s, in population based study[29]. Baltadjievo et al. suggested that patients with a mean age 60, and HY stage of 1.8, and idiopathic PD have a slower gait and shorter swing time based on analysis with a computerized gait analysis system in a controlled study. Also, they stated that both gait symmetry and walking are negatively affected at the beginning of the initial stages of PD[2].

The most important finding of this study is that age, gender, height, disease severity, previous falls, FOF, risk of falling, balance and mobility, quality of life, physical function, and emotional and cognitive states are correlated with the gait speed. There was no correlation between gait speed and comorbidities or the mental domain measured with the SF-36.

Age is an important factor that affects gait speed. Previous studies have reported that age causes a slower gait speed both in healthy people and in people with PD[24, 25, 28, 30, 31]. In their study on healthy people, Bohannon et al. reported that other factors that affect gait speed besides age are height and the strength of the lower extremities[28]. Female gender is another factor that causes slowing in the gait speed in patients with PD[30].

It is believed that, the gait speed slows down with the disease severity[25, 30, 31]. Matinelli et al. stated that gait speed is negatively correlated with disease severity and that us-

age of a walking aid whereas is correlated with dopamine medicine[25].

Balance is another factor that affects gait speed. Combs et al. claimed that there is a correlation between gait speed and balance state and between gait speed, and FOF[26]. In this study, the frequency of FOF was 62% in the patients with PD. However, Combs et al. suggested that the FOF rate is 39% and that it is related to gait speed in PD[26]. In a study of Adkin et al., carried out on 58 patients with PD, FOF, measured with the Activities-specific Balance Confidence (ABC) Scale was reported to be more significant when compared with that of a control group at the same age. In addition, it was claimed that, there is a correlation between FOF and qualitative postural control[32]. Moreover, Rochester et al. concluded that balance disturbance and mobility disorder are more significant in patients with severe disease[30].

There are several factors related to gait speed. In a study by Nemanich et al., carried out on 78 patients with PD, the patients were asked to walk at a speed they themselves preferred, and to walk at a speed faster than that. The difference between these normal and faster gait speeds was measured via the 10MWT. The authors of that study suggested that age, disease severity, and balance confidence measured by ABC are the determinants for both normal and faster walkings. It was also claimed that the difference between the comfortable and fast gait was highly related to falls in the last 6 months[31]. In a population-based study by Matinelli et al., carried out 119 people with PD living in the community, it was claimed that gait speed, measured with a 30-meter

walk test, is slower in people with a history of falling[25].

In a previous study, in which gait speed measurements were evaluated for both single-task and dual-task walking in the home with an accelerometer in 153 people with idiopathic PD, it was reported that the factors that affect the single-task walking speed are, age, being female, FOF, disease severity, and depression. The elderly, women, people with higher FOF, higher disease severity, and people with depression were reported as walking slower. FOF, depression, dopamine, and severity of disease were reported to be factors that affect dual-task walking[30].

In this study, a significant correlation was found between gait speed and cognitive state. Desphande et al. reported in their population-based study of 584 people with a 6 year follow-up that gait speed can be correlated with cognitive state and the deceleration of gait speed can even occur before a cognitive disorder starts[29].

Elbers et al., reported that the factors that affect community walking are age, gender, HY, gait speed, fatigue, HADS anxiety, and HADS depression (p<0.2) in people with PD with a mean age of 67, a mean disease duration of 8.2 years, and a disease severity with an HY stage of 2.78[33]. Overall gait speed is an important test for examining community walking, which is a useful activity in terms of physical, social, and psychological status[29].

Short-distance walk tests are handy, take a short amount of time, are clinically useful and show community ambulation[26, 33]. In a study, carried out on 153 people with PD, such tests (6MWT or 10 MWT) properly indicated that 70% of the patients with a gait speed of 0.88 m/s could also perform community walking[33]. Thus, increase of the gait speed in people with PD is important. Moreover, people with PD usually know that community walking can be succeeded by the interaction between the impairment and the environmental features. This interaction can be altered by the effect of the antiparkinsonian drugs.

The strength of this study is its assessment of factors that can effect gait speed, including mobility, balance, cognitive states, history of falling, risk of falling, FOF, comorbidity, emotional state, and quality of life, which were all assessed comprehensively via face to face interviews. However, this study has some limitations. First, the patients were taking medication, but the effects of the medicines on gait speed were not examined. Second, the patients were not followed up because the study was planned as a cross-sectional study. Third, the number of patients included in the study was relatively small.

In conclusion, gait speed in people with PD is affected by unchangeable factors like age, gender, height, clinical severity, and previous falls and by some partially changeable factors like FOF, increased risk of falling, decreased mobility, and emotional and cognitive disorders. In order to increase gait speed, it would be better to consider the partially changeable factors as a whole.

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