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Factors Associated with Medication Beliefs in Patients with Parkinson's Disease: A Cross-Sectional Study

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ABSTRACT

Objective   Medication beliefs are a significant determinant of medication adherence in chronic illness. This study aimed to identify demographic, clinical, and medication-related factors associated with medication beliefs in patients with Parkinson's disease (PD).

Methods   We used a descriptive cross-sectional design with a convenience sample of 173 PD patients who had been taking antiparkinson drugs for more than one year.

Results   The subjects who believed PD medication was more necessary had more severe illness, younger age of onset, longer illness duration, and longer duration of levodopa therapy. They had higher levels of non-motor symptoms and depression, number of medication uses, number of drugs, and levodopa equivalent dose, and they reported fluctuation of motor symptoms and dyskinesia. The subjects who used catechol-*O*-methyltransferase (COMT) inhibitors, dopamine agonists, amantadine, and monoamine oxidase-B (MAO-B) inhibitors had significantly higher necessity scores than those who did not use them. The subjects who had higher concerns about PD medications had higher levels of non-motor symptoms and depression. The subjects using amantadine and anticholinergics had significantly higher concern scores than those who did not use them. Positive necessity-concerns differentials were associated with severe illness, the presence of motor fluctuation and dyskinesia, and the use of COMT inhibitors. Based on stepwise multiple regression, the most significant factors influencing necessity beliefs were severe illness, followed by depression and motor fluctuation.

Conclusion   Severe illness, higher levels of depression, and motor fluctuation are independent factors influencing patients' beliefs regarding medication necessity. Therefore, these characteristics should be considered in medication belief assessment and interventions for PD patients.

Key Words   Parkinson's disease; Medication beliefs; Depression; Non-motor symptom.

Parkinson's disease (PD) is a chronic, progressive, incurable neurodegenerative disease, and the primary goal of PD treatment is to improve quality of life (QoL) and symptom management.[1] Because medical management is closely related to symptom management and QoL, optimal medication adherence is essential in PD.[2,3] The prevalence of and factors affecting medication nonadherence have been studied extensively in patients with PD. However, the prevalence of medication nonadherence

in PD varies significantly depending on the method used to measure it.[2,3] In a literature review, the prevalence of medication nonadherence varied from 10% to 90%. Medication adherence in PD was estimated to be 37.3% to 67% using the medication possession ratio, 12.5% to 20% using an electronic monitoring system, 40% to 44% using questionnaires, and 10% using pill counts.[2,3] A systematic review showed that medication adherence was 60% to 87% in most studies but as low as 10% in one study.[2]

Medication adherence in PD patients has been associated with demographic, clinical, and medication-related factors. Nonadherence could be affected by sociodemographic factors such as younger age,[2-4] not living with a spouse,[5] and lower income.[5] Among clinical factors, medication nonadherence has been associated with longer disease duration,[6,7] more significant depression,[5,7] poor clinical control,[2,5] and disease severity.[3,8] Additionally, nonadherence, such as overdosing with antiparkinson medications, may be related to dopamine dysregulation syndrome (DDS).[3,9] Medication-related factors, such as polypharmacy and complex regimens,[6,7] have also been associated with nonadherence in PD patients.

A recent growing interest in medication beliefs has been proposed as a strong determinant of medication adherence in chronic illness.[10-12] In a meta-analysis, higher adherence was associated with stronger perceptions of necessity and fewer concerns in medication beliefs.[13] Chronically ill patients' beliefs about prescribed medication can be grouped into two core categories based on cost-benefit analyses.[14] Necessity describes the belief that the prescribed medication is necessary to maintain health at present and concerns express the view that taking the drugs may have potential adverse effects in the future.[14] An integrative review reported that in cancer patients, lower physical function, a higher number of prescriptions, and satisfaction with information were associated with medication necessity beliefs. Furthermore, lower cancer stage, depression, side effects, and negative medication experiences were associated with medication concerns.[15] Patients with more concerns than necessity beliefs experienced higher somatosensory amplification and negative pretreatment appraisal in breast cancer.[16] In patients with atrial fibrillation or venous thromboembolism, high concerns regarding their medication were associated with poor control of the international normalized ratio.[17] In rheumatoid arthritis patients, significant concerns were associated with worsened disease activity, clinical status, and low QoL.[18] Additionally, low medication necessity beliefs and serious medication concerns were shown to be predictors of medication nonadherence in epilepsy,[19] asthma,[20] and rheumatoid arthritis patients.[18] Low necessity beliefs were also associated with nonadherence in patients with multiple sclerosis.[21] In contrast, patients with a history of substance abuse report stronger beliefs in opiate effectiveness in chronic pain.[22]

Although little research has examined medication beliefs in PD, a study was conducted to develop the Parkinson's Disease Medication Beliefs Scale, and beliefs about medication were considered a significant factor related to medication nonadherence in PD patients.[23] Regardless, studies of the factors associated with medication beliefs in PD patients are limited. Medication regimens for PD, unlike those for other chronic diseases such as stroke or coronary heart disease, are customized to meet the particular needs of the patient. Patients with PD often have concerns about their medications due to polypharmacy and complex regimens, and they may experience side effects, including motor fluctuation, dyskinesia, and hallucinations. An episode of medication nonadherence in patients with PD can be complex, and medication nonadherence can pose a difficult problem for healthcare providers.[24,25] Until recently, there have been few studies on demographic, clinical, and medication-related factors that influence medication beliefs in PD patients. Therefore, this study aimed to identify demographic, clinical, and medication-related factors correlated with medication beliefs and to identify independent factors influencing beliefs in medication necessity in patients with PD.

MATERIALS & METHODS

Study design, sample, and setting

A descriptive cross-sectional design was used. A total of 173 PD patients were recruited from Asan Medical Center in Seoul, South Korea. The inclusion criteria for this study were as follows: 1) PD as a primary diagnosis confirmed by a neurologist; 2) age 20 years or older; 3) a history of more than one year of taking antiparkinson drugs; and 4) no history of other major health problems that could potentially influence PD medication beliefs, including cardiac and/or pulmonary disease. Patients with atypical parkinsonism, Parkinson-plus syndrome, or secondary parkinsonism were also excluded. We included subjects who could complete self-report questionnaires despite cognitive decline because it is a non-motor symptom. Subjects diagnosed with dementia by a neurologist were excluded.

The Institutional Review Board (IRB) of Asan Medical Center approved this study (IRB No. 2015-0396), and all subjects were required to provide informed consent in compliance with IRB regulations. Subjects had the option to voluntarily withdraw their participation at any time.

Measurements

Beliefs about medication

Beliefs about medication were assessed using the Beliefs about

Medicines Questionnaire-Specific (BMQ-Specific).[14] The BMQ-Specific consists of two subscales: the necessity of prescribed medication for controlling illness and concerns about the potential adverse consequences of medications. The total scores for the necessity and concerns scales range from 5 to 25, with higher scores indicating stronger beliefs.

Additionally, this tool can assess the balance between perceived benefits and costs associated with prescribed medication. The necessity-concerns differential indicates the results of a cost-benefit analysis by each patient, in which perceived costs (concerns) are weighed against perceived benefits (necessity). If the differential is positive, the patient perceives the benefits of the medication to outweigh the costs. We calculated this as the difference between necessity and concern scores, and the possible range was -20 to 20.[14] Examples of necessity items are as follows: "My health, at present, depends on my medicines" and "My medicines protect me from becoming worse." Examples of concerns items are as follows: "I sometimes worry about the long-term effects of my medicines" and "I sometimes worry about becoming too dependent on my medicines."[14] The reliability and validity of the Korean version of the BMQ-Specific have been established.[26]

Non-motor symptoms

Non-motor symptoms were measured using the Non-Motor Symptoms Scale (NMSS).[27] The NMSS consists of 30 items in nine domains. Each item is scored by multiplying a severity score (from 0 to 3) by a frequency score (from 1 to 4). The total score can range from 0 to 360, and the higher the score is, the more the non-motor symptoms occur. Good reliability and validity have been established for the Korean version of the NMSS.[28]

Depression

Depression was measured using the Korean version of the Beck Depression Inventory (BDI).[29,30] The BDI includes 21 questions. Scores range from 0 to 63, with higher scores reflecting greater levels of depression. Good reliability and validity have been established for the Korean version of the BDI.[31]

Demographic, clinical, and medication-related characteristics

The demographic, clinical, and medication-related characteristics measured in the present study were included based on factors previously found to be associated with medication beliefs.[15,21] Demographic characteristics included age, sex, education level, marital status, and family income. Clinical characteristics included age at onset of PD; duration of PD; Hoehn and Yahr (H&Y) stage for disease severity; and the presence of motor fluctuation, dyskinesia, hallucination, orthostatic hypotension, and comor-

bidities. Medication-related characteristics included the number of medication uses (the number of times the patient takes the drug per day), the number of drugs (the number of drugs the patient takes per day), the duration of levodopa therapy, daily levodopa equivalent dose (LED), and type of antiparkinson medication. We collected medication-related characteristics through interviews based on medical records.

Data collection

We collected data between May and August 2015. The nurses in the neurologic clinic selected patients who met the inclusion criteria for this study and fully informed them of its aims and procedures after checking the doctor's diagnosis. The research assistant (nurse) performed data collection on the patients selected by the nurses in the neurologic clinic. The coordinator nurse in neurology reviewed the medical records. After we reviewed the medical records, we scored the presence of motor fluctuation and dyskinesia as 1 and the absence of motor fluctuation and dyskinesia as 0.

Statistical analysis

We performed statistical analysis using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). To identify demographic, clinical, and medication-related factors associated with medication beliefs (necessity, concerns, and necessity-concerns differential), independent t-tests, chi-square tests, and Kruskal-Wallis tests were used, as appropriate. Furthermore, we tested the relationships of the variables with medication beliefs using Pearson's correlation coefficients. To identify the most significant factors influencing medication necessity beliefs, we performed stepwise multiple regression analysis and included the statistically significant variables specified in the univariate analyses as covariates ($p < 0.10$). A two-tailed value of $p < 0.05$ was considered statistically significant.

RESULTS

Subjects' demographic, clinical, and medication-related characteristics and medication beliefs

Table 1 summarizes the subjects' demographic, clinical, and medication-related characteristics. Of the 173 PD patients, 92 were men, the mean disease duration was 9.5 years, and the median H&Y stage was 3. The average number of medication uses and the number of drugs used were 3.8 and 4.6, respectively. All subjects used levodopa, and 71.7% of subjects used dopamine agonists. Additionally, 47.4% used catechol-O-methyltransferase (COMT) inhibitors; 49.1%, amantadine; and 22.0%, monoamine oxidase-B (MAO-B) inhibitors. Additionally, 7.5% of the subjects reported hallucinations, and 49.1% reported ortho-

Table 1. Subjects' demographic, clinical, and medication-related characteristics and medication beliefs (n = 173)

Variables		Mean ± SD or n (%)	Range
Demographic characteristics			
Age (years) (range: 37–84)		65.81 ± 9.30	
Sex	Male	92 (53.2)	
	Female	81 (46.8)	
Education level	≤ Elementary school	48 (27.7)	
	Middle school	27 (15.6)	
	High school	50 (28.9)	
	≥ College	48 (27.7)	
Married	Yes	148 (85.5)	
	No	25 (14.5)	
Family income (10,000 won/month)	< 100	72 (41.6)	
	100–199	31 (17.9)	
	200–299	33 (19.1)	
	≥ 300	37 (21.4)	
Clinical characteristics			
Age at onset (years) (range: 24–84)		56.42 ± 11.63	
Duration of PD (years)		9.51 ± 6.19	
Disease severity (H&Y stage)	1	6 (3.5)	0–5
	2	41 (23.7)	
	3	95 (55.0)	
	4	29 (16.8)	
	5	2 (1.2)	
Motor fluctuation	No	76 (43.9)	
	Yes, not disabling	83 (48.0)	
	Yes, disabling	14 (8.1)	
Dyskinesia	No	93 (53.8)	
	Yes, not disabling	53 (30.6)	
	Yes, disabling	27 (15.6)	
Hallucination	Yes	13 (7.5)	
	No	160 (92.5)	
Orthostatic hypotension	Yes	85 (49.1)	
	No	88 (50.9)	
Non-motor symptoms		27.45 ± 14.28	0–360
	Cardiovascular	0.94 ± 1.49	0–24
	Sleep/fatigue	6.40 ± 4.57	0–48
	Mood/cognition	5.08 ± 5.08	0–72
	Perceptual problems	0.77 ± 1.77	0–36
	Attention/memory	2.04 ± 2.91	0–36
	Gastrointestinal	3.81 ± 3.58	0–36
	Urinary	4.50 ± 5.10	0–36
	Sexual dysfunction	0.65 ± 1.13	0–24
	Miscellaneous	3.25 ± 3.02	0–48
Depression		10.71 ± 6.08	0–63
Comorbidities	Yes	73 (42.2)	
	No	100 (57.8)	
Medication-related characteristics			
Number of medication uses		3.82 ± 1.32	
Number of drugs		4.57 ± 2.03	

Table 1. Subjects' demographic, clinical, and medication-related characteristics and medication beliefs (*n* = 173) (continued)

Variables		Mean ± SD or *n* (%)	Range
Duration of levodopa therapy (years)		8.08 ± 5.72	
Daily LED (mg)		760.14 ± 382.48	
Antiparkinson medication	Levodopa	173 (100)	
	Standard	172 (99.4)	
	Slow release	13 (7.5)	
	COMT inhibitor	82 (47.4)	
	Dopamine agonist	124 (71.7)	
	Ropinirole	62 (35.8)	
	Pramipexole	61 (35.3)	
	Rotigotine	14 (8.1)	
	Amantadine	85 (49.1)	
	MAO-B inhibitor	38 (22.0)	
	Rasagiline	37 (21.4)	
	Selegiline	1 (0.6)	
	Anticholinergics	3 (1.7)	
	SSRI	6 (3.5)	
	Quetiapine	14 (8.1)	
Medication beliefs			
Necessity		18.59 ± 3.99	5–25
Concerns		13.29 ± 3.62	5–25
Necessity-concerns differential		5.29 ± 5.62	-20–20
	Positive (benefits)	138 (79.8)	
	Negative (costs)	27 (15.6)	

PD: Parkinson's disease, H&Y: Hoehn and Yahr, LED: levodopa equivalent dose, COMT inhibitor: catechol-*O*-methyltransferase inhibitor, MAO-B inhibitor: monoamine oxidase-B inhibitor, SSRI: selective serotonin reuptake inhibitor. 10,000 won: 8.78 US dollars.

static hypotension. Orthostatic hypotension was associated with the use of dopamine agonists and amantadine (Supplementary Table 1 in the online-only Data Supplement).

With respect to medication beliefs, the mean scores for necessity and concerns were 18.59 and 13.29, respectively; 79.8% of subjects had a positive necessity-concerns differential, and 15.6% had a negative differential.

Medication necessity and concerns according to demographic, clinical, and medication-related characteristics

The medication beliefs of necessity and concerns according to demographic, clinical, and medication-related characteristics are presented in Tables 2 and 3. Higher necessity belief scores were associated with higher disease severity; necessity scores in H&Y stages 3 and 4−5 were higher than those in H&Y stage 1 ($p < 0.001$); and necessity scores were higher in subjects with motor fluctuation and dyskinesia ($p < 0.001$ and $p = 0.002$, respectively) than in subjects without. The participants who believed their PD medication was more necessary had more severe illness, younger onset age, longer illness duration, and longer duration of levodopa therapy.

The subjects who used COMT inhibitors, dopamine agonists, amantadine, and MAO-B inhibitors had significantly higher necessity scores than those who did not use these medications ($p < 0.001$, $p = 0.001$, $p = 0.035$, and $p = 0.001$, respectively). The subjects who used amantadine and anticholinergics had significantly higher concern scores than those who did not use amantadine and anticholinergics ($p = 0.023$ and $p < 0.001$, respectively).

Correlations between medication beliefs and these variables are shown in Table 3. Higher necessity scores were associated with younger age at onset of PD ($p = 0.002$), longer duration of PD ($p = 0.003$), higher levels of non-motor symptoms ($p = 0.009$), higher levels of depression ($p = 0.002$), longer duration of levodopa therapy ($p = 0.001$), higher number of medication uses ($p = 0.002$), higher number of drugs ($p = 0.004$), and higher daily LED ($p < 0.001$). Higher concern scores were associated with higher levels of non-motor symptoms ($p = 0.005$) and depression ($p = 0.021$).

Necessity-concerns differential according to demographic, clinical, and medication-related characteristics

The results regarding the necessity-concerns differentials ac-

Table 2. Necessity and concern beliefs according to demographic, clinical, and medication-related characteristics

Variables		Necessity	t, F, or Z	p	Concerns	t, F, or Z	p
Sex	Male	18.53 ± 4.28	-0.20	0.842	12.87 ± 3.76	-1.65	0.100
	Female	18.65 ± 3.65			13.78 ± 3.41		
Education level	≤ Elementary school	18.65 ± 4.04	0.19	0.978	14.14 ± 3.20	5.25	0.155
	Middle school	18.85 ± 4.06			13.41 ± 3.87		
	High school	18.80 ± 3.31			13.10 ± 3.97		
	≥ College	18.17 ± 4.60			12.58 ± 3.41		
Married	Yes	18.73 ± 3.91	-1.19	0.233	13.39 ± 3.57	-0.98	0.324
	No	17.72 ± 4.38			12.72 ± 3.93		
Family income (10,000 won/month)	< 100	18.67 ± 4.04	0.11	0.953	13.19 ± 3.59	0.49	0.686
	100–199	18.51 ± 4.74			12.81 ± 4.02		
	200–299	18.81 ± 3.58			13.88 ± 2.98		
	≥ 300	18.30 ± 3.69			13.38 ± 3.91		
Disease severity (H&Y stage)	1	12.67 ± 4.88[a]	19.74	< 0.001	11.83 ± 5.23	2.08	0.556
	2	16.88 ± 4.66[b]	(a < b < c)		12.81 ± 3.99		
	3	19.18 ± 3.28[c]			13.36 ± 3.48		
	4–5	20.19 ± 3.15[c]			13.97 ± 3.18		
Motor fluctuation	Yes	19.66 ± 3.17	4.17	< 0.001	13.56 ± 3.50	1.07	0.284
	No	17.22 ± 4.51			12.96 ± 3.77		
Dyskinesia	Yes	19.58 ± 3.06	3.17	0.002	13.81 ± 3.24	1.78	0.077
	No	17.74 ± 4.49			12.85 ± 3.88		
Hallucination	Yes	18.92 ± 3.23	-0.49	0.623	13.46 ± 4.05	-0.56	0.573
	No	18.56 ± 4.06			13.28 ± 3.60		
Orthostatic hypotension	Yes	19.00 ± 3.53	1.34	0.183	13.51 ± 3.16	0.76	0.451
	No	18.19 ± 4.38			13.09 ± 4.01		
Comorbidities	Yes	18.27 ± 4.58	-0.85	0.396	12.90 ± 3.76	-1.22	0.226
	No	18.82 ± 3.51			13.58 ± 3.50		
Levodopa–slow release	Yes	19.54 ± 3.36	0.89	0.374	13.69 ± 3.40	0.41	0.682
	No	18.51 ± 4.04			13.26 ± 3.65		
COMT inhibitor	Yes	19.72 ± 3.20	3.72	< 0.001	13.66 ± 3.56	1.26	0.211
	No	17.57 ± 4.36			12.97 ± 3.66		
Dopamine agonist	Yes	19.19 ± 3.70	3.25	0.001	13.40 ± 3.44	0.63	0.532
	No	17.06 ± 4.31			13.02 ± 4.07		
Ropinirole	Yes	19.69 ± 3.48	2.91	0.004	12.98 ± 3.80	-0.84	0.400
	No	17.97 ± 4.14			13.47 ± 3.51		
Pramipexole	Yes	18.48 ± 3.95	-0.28	0.782	13.87 ± 2.95	1.68	0.095
	No	18.65 ± 4.03			12.98 ± 3.92		
Rotigotine	Yes	19.86 ± 1.51	2.63	0.012	13.57 ± 3.18	0.30	0.766
	No	18.48 ± 4.12			13.27 ± 3.66		
Amantadine	Yes	19.24 ± 3.34	2.12	0.035	13.93 ± 3.14	2.30	0.023
	No	17.97 ± 4.47			12.68 ± 3.95		
MAO-B inhibitor-rasagiline	Yes	20.10 ± 2.78	3.32	0.001	14.05 ± 3.70	1.44	0.151
	No	18.18 ± 4.18			13.09 ± 3.58		
Anticholinergics	Yes	16.00 ± 3.60	-1.13	0.258	16.67 ± 0.58	5.71	< 0.001
	No	18.64 ± 3.99			13.24 ± 3.62		
SSRI	Yes	16.00 ± 3.79	-1.62	0.106	14.17 ± 3.66	0.60	0.550
	No	18.68 ± 3.97			13.26 ± 3.63		
Quetiapine	Yes	19.21 ± 3.24	0.61	0.543	12.21 ± 4.51	-1.17	0.245
	No	18.53 ± 4.06			13.39 ± 3.53		

H&Y: Hoehn and Yahr, COMT inhibitor: catechol-O-methyltransferase inhibitor, MAO-B inhibitor: monoamine oxidase-B inhibitor, SSRI: selective serotonin reuptake inhibitor. 10,000 won: 8.78 US dollars.

Table 3. Correlations between medication beliefs and demographic, clinical, and medication-related characteristics

Variables	Necessity r (p)	Concerns r (p)
Age (years)	-0.15 (0.057)	-0.05 (0.558)
Age at onset of PD (years)	-0.24 (0.002)	-0.05 (0.482)
Duration of PD (years)	0.23 (0.003)	0.04 (0.650)
Non-motor symptoms	0.20 (0.009)	0.21 (0.005)
Depression	0.24 (0.002)	0.18 (0.021)
Duration of levodopa therapy (years)	0.26 (0.001)	0.05 (0.514)
Number of medication uses	0.23 (0.002)	0.01 (0.860)
Number of drugs	0.22 (0.004)	0.09 (0.266)
Daily LED (mg)	0.32 (< 0.001)	0.07 (0.396)

PD: Parkinson's disease, LED: levodopa equivalent dose.

cording to demographic, clinical, and medication-related characteristics are presented in Table 4. Positive necessity-concerns differentials were associated with higher disease severity (H&Y stage) ($p = 0.019$), the presence of motor fluctuation ($p = 0.001$) and dyskinesia ($p = 0.017$), and the use of COMT inhibitors ($p = 0.026$). Negative necessity-concerns differentials were associated with anticholinergic use ($p = 0.048$).

Factors influencing necessity beliefs based on stepwise multiple regression

We performed stepwise multiple regression analysis to identify factors influencing beliefs in the necessity of medication and included as covariates the statistically significant variables ($p < 0.10$) identified in the univariate analyses shown in Tables 2 and 3 (Table 5). The results showed that disease severity (H&Y stage) had the most significant influence on necessity, with an explanatory power of 13.8% (adjusted $R^2 = 0.138$, $p < 0.001$). When depression was added, the explanatory power increased by 2.1% (adjusted $R^2 = 0.021$, $p = 0.032$), and when motor fluctuation was added, it increased by 1.7% (adjusted $R^2 = 0.017$, $p = 0.035$). The total explanatory power for beliefs in medication necessity was 17.6% ($p < 0.001$).

To check for multicollinearity among the independent variables in the regression analysis, tolerance and variation inflation factors (VIFs) were calculated. Tolerance was above 0.10, with a range of 0.82−0.96, and VIFs were all below 10, with a range of 1.049−1.239, ruling out multicollinearity. The Durbin-Watson statistic was 1.715, close to 2.0, indicating that the error terms were independent from each other, without any autocorrelation.

DISCUSSION

This study aimed to identify demographic, clinical, and medication-related characteristics linked to medication beliefs in

PD patients. The results showed that disease severity, higher levels of depression, and motor fluctuation were independent factors influencing beliefs in medication necessity. In this study, the mean scores for necessity and concern beliefs were 18.59 ± 3.99 and 13.29 ± 3.62, respectively. These scores are similar to the findings of previous studies, which reported mean necessity scores ranging from 17.72 ± 3.75 to 21.26 ± 2.98 and mean concern scores ranging from 12.91 ± 3.38 to 15.76 ± 4.09 in patients with chronic disease, including asthma, diabetes, and renal and cardiac disease.[14] Because the scores of concerns about and beliefs in the necessity of their medications in PD are similar to the beliefs of patients with other chronic diseases,[14] health professionals need to understand that PD patients are aware of the need for antiparkinson medications but that there is a significant level of concern regarding the medications.[13] This study showed that 79.8% of the subjects had a positive necessity-concerns differential, and 15.6% had a negative differential, indicating that only 15.6% of the subjects perceived the costs of medication to outweigh the benefits. Additionally, the study found that negative necessity-concerns differentials were correlated with lower disease severity and no motor fluctuation or dyskinesia. Patients with lower disease severity and no motor fluctuation or dyskinesia may be less conscious of the necessity of PD medications than patients with higher disease severity and motor fluctuation and/or dyskinesia. Thus, identifying patients' beliefs in the necessity of and concerns about PD medication and providing them with accurate information about the medication, if necessary, may help patients form correct and informed beliefs about their medication, especially patients with low disease severity and without motor fluctuation or dyskinesia. Additionally, medication education and counseling tailored to the specific needs of the patient may reduce unnecessary concerns and improve medication beliefs, as necessity beliefs and concerns about PD medications may vary by patient.

In this study, medication beliefs were different according to the type of antiparkinson medication. The subjects using COMT inhibitors, dopamine agonists, amantadine, and MAO-B inhibitors had significantly higher necessity scores than those who did not use those medications, and the subjects using amantadine and anticholinergics had significantly higher concern scores than those who did not use those medications. The use of COMT inhibitors was associated with positive necessity-concerns differentials, and the use of anticholinergics was associated with negative necessity-concerns differentials. In particular, the relationship between the use of anticholinergics and negative necessity-concerns differentials may be due to the side effects of anticholinergics. Additionally, patients with PD may be more aware of the need or more concerned about antiparkinson medications depending on the type of medications. Therefore, clini-

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cians should consider the type of antiparkinson medication when assessing the patient's medication beliefs.

Additionally, the relationship between levodopa and medication beliefs could not be identified in this study since all subjects were taking levodopa. It has been reported that dopamine plays a key role in reward, signaling, and addiction.[9] In particular, the nigro-mesolimbic dopaminergic pathway has been implicated in the addictive properties of many drugs of abuse.[9,32] The behavioral changes described in PD, DDS, call for increasing doses of dopamine replacing therapy in excess of those normally

Table 4. Necessity-concerns differential according to demographic, clinical, and medication-related characteristics

Variables		Positive (*n* = 138) n (%)	Negative (*n* = 27) n (%)	Equal (*n* = 8) n (%)	χ^2	*p*
Sex	Male	74 (53.6)	15 (55.5)	3 (37.5)	0.86	0.650
	Female	64 (46.4)	12 (44.5)	5 (62.5)		
Education level	≤ Elementary school	38 (27.6)	8 (29.6)	2 (25.0)	6.83	0.337
	Middle school	22 (15.9)	2 (7.5)	3 (37.5)		
	High school	42 (30.4)	8 (29.6)	0 (0.0)		
	≥ College	36 (26.1)	9 (33.3)	3 (37.5)		
Married	Yes	121 (87.7)	20 (74.1)	7 (87.5)	3.41	0.182
	No	17 (12.3)	7 (25.9)	1 (12.5)		
Family income (10,000 won/month)	< 100	56 (40.6)	13 (48.1)	3 (37.5)	2.26	0.894
	100–199	26 (18.8)	3 (11.1)	2 (25.0)		
	200–299	28 (20.3)	4 (14.8)	1 (12.5)		
	≥ 300	28 (20.3)	7 (26.0)	2 (25.0)		
Disease severity (H&Y stage)	1	3 (2.1)	2 (7.5)	1 (12.5)	15.22	0.019
	2	27 (19.6)	9 (33.3)	5 (62.5)		
	3	80 (58.0)	13 (48.1)	2 (25.0)		
	4–5	28 (20.3)	3 (11.1)	0 (0.0)		
Motor fluctuation	Yes	87 (63.0)	9 (33.3)	1 (12.5)	14.56	0.001
	No	51 (37.0)	18 (66.7)	7 (87.5)		
Dyskinesia	Yes	71 (51.4)	8 (29.6)	1 (12.5)	8.17	0.017
	No	67 (48.6)	19 (70.4)	7 (87.5)		
Hallucination	Yes	10 (7.2)	2 (7.5)	1 (12.5)	0.30	0.860
	No	128 (92.8)	25 (92.5)	7 (87.5)		
Orthostatic hypotension	Yes	71 (51.4)	9 (33.3)	5 (62.5)	3.56	0.168
	No	67 (48.6)	18 (66.7)	3 (37.5)		
Comorbidities	Yes	55 (39.9)	15 (55.5)	3 (37.5)	2.36	0.308
	No	83 (60.1)	12 (44.5)	5 (62.5)		
COMT inhibitor	Yes	72 (52.2)	9 (33.3)	1 (12.5)	7.31	0.026
	No	66 (47.8)	18 (66.7)	7 (87.5)		
Dopamine agonist	Yes	104 (75.4)	16 (59.3)	4 (50.0)	4.83	0.090
	No	34 (24.6)	11 (40.7)	4 (50.0)		
Amantadine	Yes	72 (52.2)	11 (40.7)	2 (25.0)	3.14	0.208
	No	66 (47.8)	16 (59.3)	6 (75.0)		
MAO-B inhibitor-rasagiline	Yes	34 (24.6)	2 (7.5)	1 (12.5)	4.38	0.112
	No	104 (75.4)	25 (92.5)	7 (87.5)		
Anticholinergics	Yes	1 (0.7)	2 (7.5)	0 (0.0)	6.07	0.048
	No	137 (99.3)	25 (92.5)	8 (100.0)		
SSRI	Yes	3 (2.2)	2 (7.5)	1 (12.5)	3.89	0.143
	No	135 (97.8)	25 (92.5)	7 (87.5)		
Quetiapine	Yes	12 (8.7)	1 (3.7)	1 (12.5)	0.98	0.614
	No	126 (91.3)	26 (96.3)	7 (87.5)		

H&Y: Hoehn and Yahr, COMT inhibitor: catechol-*O*-methyltransferase inhibitor, MAO-B inhibitor: monoamine oxidase-B inhibitor, SSRI: selective serotonin reuptake inhibitor. 10,000 won: 8.78 US dollars.

Table 5. Factors influencing beliefs of medication necessity based on stepwise multiple regression

Variables	Step 1				Step 2				Step 3			
	Unstandardized coefficient		Standardized coefficient	t (p)	Unstandardized coefficient		Standardized coefficient	t (p)	Unstandardized coefficient		Standardized coefficient	t (p)
	B	95% CI	β		B	95% CI	β		B	95% CI	β	
Constant	12.70	10.455–14.951		11.16 (< 0.001)	12.06	9.769–14.343		10.41 (< 0.001)	12.43	10.143–14.724		10.71 (< 0.001)
Disease severity (H&Y stage)	2.05	1.291–2.807	0.378	5.34 (< 0.001)	1.87	1.104–2.633	0.344	4.83 (< 0.001)	1.51	0.688–2.338	0.279	3.62 (< 0.001)
Depression					0.11	0.016–0.202	0.166	2.32 (0.021)	0.10	0.009–0.193	0.153	2.16 (0.032)
Motor fluctuation									1.31	0.096–2.516	0.163	2.13 (0.035)
Adjusted R²			0.138				0.159				0.176	
F			28.47				17.30				13.28	
p			< 0.001				< 0.001				< 0.001	

CI: confidence interval, H&Y: Hoehn and Yahr.

required to relieve symptoms of PD.[9,32,33] DDS may manifest as an addiction to L-dopa and behavioral disturbances associated with the impulse control system, including gambling, excessive spending (shopping), hypersexuality and binge eating.[9,32,33] Since DDS may be associated with medication adherence of overdosing, patients with DDS are likely to have a higher level of drug necessity beliefs than those who do not. Therefore, further studies are needed on the relationship between DDS, obsessive-compulsive behaviors, and medication beliefs in PD.

This study showed that the higher H&Y stage was the most significant factor influencing beliefs in the necessity of medication. This finding is consistent with a previous study, which established a correlation between lower physical function and medication necessity beliefs in cancer patients.[15] As levodopa dosage and the number of medications are increased to manage symptoms along with increased severity of PD,[34,35] awareness of the need for medications increases with the H&Y stage. Therefore, to help patients correctly recognize the necessity of PD medications, health professionals should provide sufficient, correct information about the drugs when new medications are added or when dosages are increased to address aggravated PD.

In this study, higher levels of depression were correlated with higher necessity beliefs and higher concerns, although the significance of the correlations was weak. Depression has also been found to correlate with medication concerns in cancer patients.[15] Motor fluctuation is one motor complication experienced in PD.[36] Patients with motor fluctuation may experience nonconstant effects of medication. Therefore, patients with motor fluctuation may be more aware of the necessity of PD medication because they perceive its lack during periods with no drug effect (off-time). In this study, dyskinesia was also associated with medication beliefs. Although differences in medication beliefs between patients with and without dyskinesia have only recently been reported, this finding may indicate why patients with dyskinesia have a higher awareness of their symptoms and medications. Patients may be able to reduce dyskinesia by monitoring their symptoms and taking appropriate medication; they may thus perceive the necessity of the medication. Medication education and counseling in PD should include not only the type, effects, and possible side effects of PD medications but also the time to take them. Conducting depression intervention, managing symptoms including motor fluctuation and dyskinesia, and providing education about PD symptoms may thus be an essential strategy to improve medication beliefs in PD patients. In this study, non-motor symptoms were correlated with both necessity and concern beliefs. Accurately recognizing the necessity of PD medication is important; however, excessive concerns are unproductive. Therefore, health professionals need to assess medication concerns in patients with a high level of non-motor

symptoms.

In this study, hallucinations and orthostatic hypotension were not related to the medication necessity and concern beliefs. However, 14 of the subjects (8.1%) were using quetiapine, and seven of them (50.0%) had no hallucinations within one month of the survey. Additionally, orthostatic hypotension was not measured by actual blood pressure but was surveyed by a self-report questionnaire, and 49.1% reported that they experienced symptoms of orthostatic hypotension. Therefore, the relationship between hallucinations and orthostatic hypotension and medication beliefs needs further study.

The explanatory power of this study's regression model was small. This finding was likely because the model did not include some variables known to relate to medication beliefs. Medication adherence is known to be associated with medication beliefs in PD patients,[11,12] and personality traits are known to be associated with beliefs about medicines in asthma patients.[37] Therefore, further studies involving medication adherence and personality traits are needed, and additional research should identify other variables potentially related to medication beliefs.

Medication beliefs may change over time and should be assessed regularly, especially when symptoms and treatment plans change.[15] If patients have a poor understanding of the benefits and risks of their medications, they may form incorrect beliefs about the medications, and these beliefs may affect their medication adherence. Therefore, healthcare professionals should periodically assess patient medication beliefs and identify the factors involved. Additionally, healthcare professionals must provide clear information about the benefits and risks of medications, if needed, so that patients can form correct and informed beliefs.[15]

In recent years, medication belief intervention studies have been conducted to improve medication adherence. In an educational intervention based on the model of health beliefs, the intervention group showed improvements in knowledge and perceived benefits and reductions in perceived barriers.[38] Similarly, an education intervention in uncontrolled diabetes patients reported significantly better mean changes in knowledge regarding medication use, medication beliefs, and medication adherence in the intervention group.[39] Another study had already attempted to improve medication adherence by promoting medication beliefs in PD patients.[40] Therefore, various intervention programs targeting medication beliefs in patients with PD may be needed.

This study has some limitations. First, the percentage of participants with H&Y stages 1 and 5 in this study's sample was low (3.5% and 1.2%, respectively). Second, correlation coefficients between medication beliefs and other variables were low, and the regression analysis showed low explanatory power.

Therefore, there is a need for further investigation of factors affecting medication beliefs, including variables not examined in this study, such as medication adherence, personality traits, and DDS. Third, H&Y stage and the presence of motor fluctuation and dyskinesia were investigated as motor symptom characteristics in this study, however, UPDRS III scores and motor subtype were not included. In future studies, reflecting on various motor symptom characteristics of PD, including UPDRS III scores and motor subtype, is necessary. Finally, the study's cross-sectional design did not allow for identifying a link between medication beliefs and the other variables in terms of a longitudinal outcome, such as adherence or progression in symptoms, morbidity, or mortality. Further study using a longitudinal design is needed to identify the link between medication beliefs and other variables. Despite these limitations, this study is the first to identify factors affecting medication beliefs in patients with PD.

In conclusion, this study found that higher disease severity, higher levels of depression, and motor fluctuation were factors influencing beliefs in the necessity of medication in PD patients. As medication beliefs are related to medication adherence, these characteristics should be considered in medication belief assessment for PD patients.

Supplementary Materials

Conflicts of Interest

The authors have no financial conflicts of interest.

Acknowledgments

Author Contributions

Conceptualization: Sung Reul Kim, Sun Ju Chung. Data curation: Ji Young Kim, Hui Young So. Formal analysis: Sung Reul Kim, Hye Young Kim. Methodology: Sung Reul Kim, Ji Young Kim, Hye Young Kim. Project administration: Sung Reul Kim, Hui Young So, Sun Ju Chung. Writing—original draft: Sung Reul Kim, Sun Ju Chung. Writing—review & editing: all authors.

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Supplementary Table 1. Hallucination and orthostatic hypotension according to use of antiparkinson medication

Variables		Hallucination n (%)		χ² (p)	Orthostatic hypotension n (%)		χ² (p)
		Yes	No		Yes	No	
COMT inhibitor	Yes	8 (61.5)	74 (46.3)	1.13 (0.389)	41 (48.2)	41 (46.6)	0.05 (0.879)
	No	5 (38.5)	86 (53.7)		44 (51.8)	47 (53.4)	
Dopamine agonist	Yes	10 (76.9)	114 (71.3)	0.19 (> 0.999)	71 (83.5)	35 (39.8)	11.56 (0.001)
	No	3 (23.1)	46 (28.7)		14 (16.5)	53 (60.2)	
Amantadine	Yes	5 (38.5)	80 (50.0)	0.64 (0.567)	51 (60.0)	34 (38.6)	7.90 (0.006)
	No	8 (61.5)	80 (50.0)		34 (40.0)	54 (61.4)	
MAO-B inhibitor- rasagiline	Yes	3 (23.1)	35 (21.9)	0.01 (> 0.999)	24 (28.2)	14 (15.9)	3.83 (0.066)
	No	10 (76.9)	125 (78.1)		61 (71.8)	74 (84.1)	
Anticholinergics	Yes	0 (0.0)	3 (1.9)	0.25 (> 0.999)	2 (2.4)	1 (1.1)	0.38 (0.616)
	No	13 (100.0)	157 (98.1)		83 (97.6)	87 (98.9)	
SSRI	Yes	0 (0.0)	6 (3.8)	0.50 (> 0.999)	4 (4.7)	2 (2.3)	0.77 (0.438)
	No	13 (100.0)	154 (96.2)		81 (95.3)	86 (97.7)	
Quetiapine	Yes	7 (53.8)	7 (4.4)	39.56 (< 0.001)	6 (7.1)	8 (9.1)	0.24 (0.782)
	No	6 (46.2)	153 (95.6)		79 (92.9)	80 (90.9)	

COMT inhibitor: catechol-O-methyltransferase inhibitor, MAO-B inhibitor: monoamine oxidase-B inhibitor, SSRI: selective serotonin reuptake inhibitor.