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ORIGINAL SCIENTIFIC PAPER

Influence of Sociodemographic Variables on Patient and Practitioner Knowledge of Non-Pharmacological Management Options for Parkinson's Disease

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Abstract

Patients with Parkinson's Disease (PD) experience motor and non-motor symptoms that decrease their quality of life. The non-pharmacological management of PD is imperative to improve the quality of life for patients with the disease. Non-pharmacological management options such as exercise, medical, and surgical interventions can improve function and independence in patients with PD. Many non-pharmacological management options target specific symptoms commonly associated with PD. The Knowledge Attitude Practice (KAP) model was adapted to develop a questionnaire that assesses patient and practitioner knowledge of non-pharmacological management options for PD. The questionnaire consisted of 11 questions. To assess the relationship between sociodemographic variables and patient and practitioner knowledge of non-pharmacological management options likelihood-ratio chi-squared, Spearman's correlation, simple logistic regression, and multiple logistic regression analyses were performed on the collected data. Six hundred and forty-one participants completed the questionnaire. For patients (n = 492) and practitioners (n = 149), the most widely known non-pharmacological management option was regular exercise, and the least-known was subthalamotomy. Compared to patients, practitioners were more likely to have knowledge of most non-pharmacological management options (OR 1.73 - 7.36). Higher education level (OR 3.10 - 10.96), younger age (OR 0.09 - 0.32), geographical location (North America OR 0.05 - 0.49, Europe OR 2.24), employment status (OR 4.81 - 12.02), and sex (OR 0.59) had a significant relationship with patient and practitioner knowledge of non-pharmacological management options. Practitioners were more likely to have knowledge of most non-pharmacological management options for PD compared to patients. Several sociodemographic variables impacted one's ability to identify non-pharmacological management options in both populations. Increasing patient and practitioner knowledge of non-pharmacological management options could improve the care and quality of life of patients with PD.

Keywords: Parkinson's Disease · quality of life · exercise · non-pharmacological · physical therapy

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Introduction

Parkinson's Disease (PD) is a progressive neurodegenerative disorder characterized by motor and non-motor symptoms that worsen over time. The most common motor symptoms include bradykinesia, resting tremors, rigidity, and postural instability, which impair mobility and coordination (Kouli, Torsney, & Kuan, 2018). In addition to these movement-related issues, many patients with PD experience a range of non-motor symptoms, such as cognitive decline, mood disorders, sleep disturbances, and depression (Lee & Koh, 2015). The combination of motor and non-motor symptoms significantly impacts daily activities in patients with PD (Kurihara et al., 2020).

PD symptoms are primarily managed with medications, but pharmacological management of the disease has its limitations. Medications commonly prescribed to patients with PD have various side effects and efficacy issues, including but not limited to nausea, insomnia, and hallucinations, with some medications demonstrating a decrease in efficacy over time (Zahoor, Shafi, & Haq, 2018). The appearance of secondary symptoms, including dyskinesias and motor fluctuations, is not uncommon when medications such as Levodopa are taken for an extended time (Kikuchi, 2007). About one-half of patients with PD develop motor fluctuations four to six years after starting treatment with Levodopa (Kikuchi, 2007). Despite developing secondary symptoms, most medications improve the motor symptoms of PD yet lack effectiveness in improving the non-motor symptoms of the disease (Oliveira de Carvalho et al., 2018).

Given these limitations, non-pharmacological management plays a critical role in PD management. Various non-pharmacological interventions, including physical therapy, psychological support, occupational therapy, and surgical interventions, seek to complement pharmacological management by addressing both motor and non-motor symptoms (Guidetti et al., 2024). These management options not only provide alternative symptom management strategies but also help reduce dependence on medications. Among non-pharmacological management options, exercise is one of the most extensively studied management options for PD (National Institute for Health and Care Excellence [NICE], 2017). Exercise, including aerobic exercise and physical therapy, has been shown to improve motor function and overall independence (National Institute for Health and Care Excellence [NICE], 2017). Higher levels of exercise are associated with a slower progression of several PD-related impairments (Tsukita, Sakamaki-Tsukita, & Takahashi, 2022). Additionally, different intensities of exercise appear to have varying effects on disease progression. For example, moderate to vigorous exercise slows the decline in postural and gait function, work-related activity preserves cognitive processing speed, and household activity maintains activities of daily living performance (Tsukita, Sakamaki-Tsukita, & Takahashi, 2022). Evidence shows that engaging in regular aerobic exercise improves sleep quality, with participants demonstrating sustained improvements in insomnia symptoms after exercise (Almikhlafi, 2023).

Non-pharmacological management of PD also targets non-motor symptoms, which significantly affect patients' well-being. Cognitive decline, mood disorders, sleep disturbances, swallowing disorders, and depression are common in PD (Lee & Koh, 2015). Non-pharmacological interventions such as psychological counseling, meditation, occupational therapy, and speech therapy can help reduce these issues (National Institute for Health and Care Excellence [NICE], 2017). Evidence revealed there is a relationship between the non-motor symptoms of depression ($r = 0.45$, $p < 0.01$) and anxiety ($r = 0.63$, $p = 0.08$) with quality of life (Artigas et al., 2015). Despite this relationship, non-pharmacological management that included psychological therapy, whether through professional counseling or PD support groups, has been found to improve well-being (Artigas et al., 2015).

In addition to exercise and therapy-based management options, medical and surgical interventions provide further non-pharmacological management options. Deep brain stimulation is currently used to treat severe motor symptoms in the advanced stages of the disease (Groiss et al., 2009). Focused ultrasound has been used to open the blood-brain barrier (BBB) in patients with PD, which improves the delivery and concentration of medications in the brain (Gasca-Salas et al., 2021). Thalamotomy, pallidotomy, and subthalamotomy are lesioning surgeries that involve purposeful damage to some regions of the brain to improve motor symptoms of PD (Smith, 2015). These management options highlight the diverse range of non-pharmacological management options available for PD management.

Ultimately, non-pharmacological management options contribute to improved quality of life by addressing both motor and non-motor symptoms. The symptoms of PD make it difficult for patients to perform daily activities, leading to a decline in independence and well-being (National

Institute for Health and Care Excellence [NICE], 2017). A review found that in nearly 58% of studies, non-pharmacological management options improved the quality of life in patients with PD (Ahn et al., 2017). While variations exist in the literature, the overall evidence suggests that these strategies are beneficial for improving daily function and reducing PD symptom burden. Despite the evidence for non-pharmacological management options, there remain disparities in the awareness of the range of non-pharmacological management options among patients and practitioners.

Our primary aim of this study was to investigate the current knowledge of non-pharmacological management options in patients with PD and practitioners. Our secondary aim was to identify the influence of sociodemographic variables on patient and practitioner knowledge of non-pharmacological management options for PD. Determining whether patients and practitioners are aware of the various options for non-pharmacological management could improve patient outcomes, including motor and non-motor symptoms of PD and quality of life.

Method

This study was approved by the Institutional Review Board at the University of Jamestown (IRB #032PHDCR).

Questionnaire Design

The Knowledge Attitude Practice (KAP) model was adapted to develop a questionnaire that assesses patient and practitioner knowledge of non-pharmacological management options for PD. The KAP model is a valid instrument that assesses what people know, how they feel, and how they behave regarding a specific health topic (Aishwaryalakshmi et al., 2012).

The questionnaire consisted of 11 questions and included four sections: (1) standard sociodemographic data, (2) patient or practitioner knowledge of pharmacological and non-pharmacological management options, (3) patient or practitioner attitude toward trying or prescribing new emerging pharmacological management options, and (4) patient or practitioner attitude toward using pharmacological and non-pharmacological management options or their combination in the management of PD. In section two, non-pharmacological management options were listed to select from (the option to select yes if one knows the management option, or no if one does not know it), including the option to select "other" and self-report any non-listed non-pharmacological management options. This paper only included the data collected on the knowledge of non-pharmacological management options. Information on the pharmacological management options is reported in another paper (Abola, Lefebvre, & Wolden, 2025).

Recruitment of Participants

Participants included patients with PD and medical/health practitioners such as physicians, nurses, physical therapists, occupational therapists, speech-language pathologists, psychologists, and caregivers who treat or take care of patients with PD. The recruitment materials and strategies included (1) email communication to PD wellness programs, support groups, neurologists, and rehabilitation facilities worldwide; (2) flyers, including a QR code to the questionnaire handed out to participants or posted in waiting rooms of wellness programs, support groups, and hospitals; and (3) word-of-mouth. All recruitment materials and strategies included the purpose of the study, the participation benefits, the eligibility criteria, and the investigator's contact information. Informed consent was obtained from each participant before questionnaire completion, in electronic or paper form.

Using the Qualtrics power analysis, a total of 385 participants (patients and practitioners) were needed for 0.8 study power.

Data Collection and Confidentiality

Data was collected anonymously via Qualtrics questionnaires or through a paper questionnaire. Paper questionnaires were provided to participants who did not have access to or were unable to use online technology. The questionnaires were distributed in three languages (English, Latvian, and German). The KAP model has not been developed in Latvian or German. One investigator (PA), whose native language is Latvian and who has a C1 language certificate in German, translated the questionnaire into Latvian and German.

Data Analysis

Only fully completed surveys were included in the data analysis. One investigator (PA) reviewed the data for missing data, input errors, and inconsistencies. The data was analyzed using STATA 18 (StataCorp LLC Stata statistical software: release 18. College Station, TX: StataCorp LLC. 2023). Descriptive statistics were performed to identify measures of central tendency and dispersion. Basic frequency analysis was used to calculate the percentages of patients and practitioners who identified knowledge of non-pharmacological management options. Likelihood-

ratio chi-squared analysis was conducted to identify sociodemographic differences between patients and practitioners. Post hoc analysis of the likelihood-ratio chi-squared analysis was performed to identify the highest participating group for each sociodemographic variable. Spearman's correlation was performed to evaluate the relationship between sociodemographic variables and the number of non-pharmacological management options identified as patients and practitioners having knowledge of. The relationships were interpreted as trivial effect size ($r < 0.10$), small effect size ($0.10 \leq r < 0.30$), medium effect size ($0.30 \leq r < 0.50$), large effect size ($0.50 \leq r < 0.70$), and very large effect size ($r \geq 0.70$) (Maher, Markey, & Ebert-May, 2013). Simple logistic regression was conducted to compare patient and practitioner knowledge of each individual non-pharmacological management option. Multiple logistic regression was utilized to compare patient and practitioner knowledge of each individual non-pharmacological management option while controlling for sociodemographic variables that could influence a specific outcome. The reference factor variable for age was "18-45 years old", for ethnicity was "White/Caucasian", for education level was "less than high school", for employment status was "unemployed", and for geographical location was "North America". Odds ratios (ORs) were calculated to assess relationships between sociodemographic variables and patient and practitioner knowledge of each individual non-pharmacological management option. The ORs were interpreted as trivial effect size ($OR < 1.5$), small effect size ($1.5 \leq OR < 2.5$), medium effect size ($2.5 \leq OR < 4$), large effect size ($4 \leq OR < 10$), and very large effect size ($OR \geq 10$) (Maher, Markey, & Ebert-May, 2013). A p-value of less than 0.05 was considered a significant difference for all analyses.

Results

Characteristics of Participants

From February 2024 until May 2024, 641 participants (patients = 492; practitioners = 149) fully completed the questionnaire. Due to the nature of the study design, it was not possible to determine the survey response rate. Of the participants, 76.8% (n = 492) were patients with PD and 23.2% (n = 149) were practitioners. Of the patients with PD, the majority were male (50.4%), White/Caucasian (94.3%), aged 66 or above (64.4%), had graduate-level education (39.4%), were retired (75.8%), and resided in North America (70.9%). The practitioners included physicians, nurses, therapists, physical therapists, occupational therapists, speech-language pathologists, psychologists, and caregivers. Of the practitioners, the majority were female (79.9%), White/Caucasian (86.6%), aged 46 to 65 (39.6%), had graduate-level education (59.7%), were employed (68.5%), and resided in North America (84.6%) (Table 1).

Table 1. Results from Likelihood Ratio Chi-Squared Analysis with the Patient and Practitioner Groups

Sociodemographic Variable	Patients (n=492)		Practitioners (n=149)			
	n	%	n	%	chi2	Pr
Sex					45.6	< 0.01
Female	244	49.6	119	79.9		
Male	248	50.4	30	20.1		
Ethnicity					10.7	< 0.05
White/Caucasian	464	94.3	129	86.6		
Asian/Pacific Islander	9	1.8	10	6.7		
Hispanic/Latino	9	1.8	6	4.0		
Black/African American	3	0.6	1	0.7		
Other/Mixed	7	1.4	3	2.0		
Age					132.3	< 0.01
18-45	10	2.0	50	33.6		
46-65	165	33.5	59	39.6		
66 or above	317	64.4	40	26.8		
Education					40.8	< 0.01
Less than high school	33	6.7	1	0.7		
High school	100	20.3	10	6.7		
Undergraduate-level	165	33.5	49	32.9		
Graduate-level	194	39.4	89	59.7		

Profession					158.8	< 0.01
Unemployed	14	2.8	2	1.3		
Employed	77	15.7	102	68.5		
Retired	373	75.8	35	23.5		
Retired but employed	26	5.3	7	4.7		
Pursuing higher education	2	0.4	3	2.0		
Location					12.83	< 0.01
North America	349	70.9	126	84.6		
Europe	129	26.2	22	14.8		
Other	14	2.8	1	0.7		

There were statistically significant differences ($p < 0.01 – 0.05$) between patients and practitioners for all sociodemographic variables. There were significantly more ($p < 0.01 – 0.05$) female practitioners, White/Caucasian patients, 18- to 45-year-old practitioners, practitioners with graduate-level education, employed practitioners, and practitioners residing in North America (Table 1). The frequency distribution of patient and practitioner knowledge of non-pharmacological management options is presented in Figure 1.

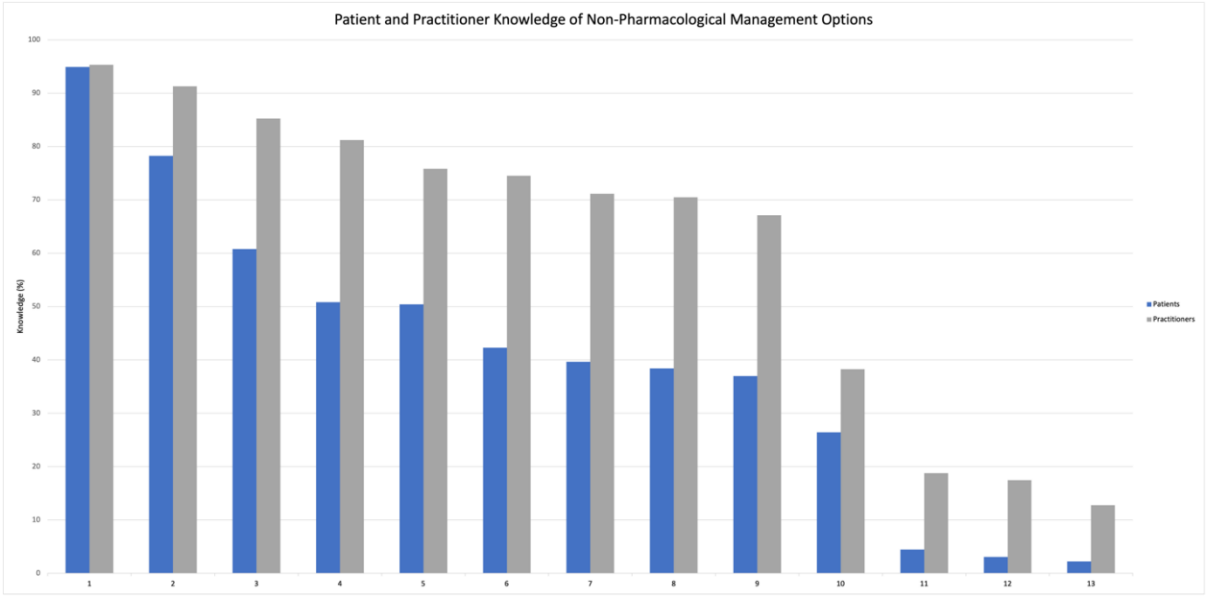

Figure 1. Patient and Practitioner Knowledge of Non-Pharmacological Management Options

The most widely known non-pharmacological management option by both populations was regular exercise, which was known by 94.9% of patients and 95.3% of practitioners. This was followed by physical therapy, which was known by 78.3% of patients and 91.3% of practitioners, and speech therapy, which was known by 60.8% of patients and 85.2% of practitioners. The least known non-pharmacological management option by both populations was subthalamotomy, which was known by 2.2% of patients and 12.8% of practitioners. This was followed by thalamotomy (4.5% of patients; 17.4% of practitioners), and then by pallidotomy (3.0% of patients; 18.8% of practitioners).

Sociodemographic Relationship with Non-Pharmacological Knowledge

There was a medium and statistically significant relationship between the number of non-pharmacological management options the participants were aware of and the type of participant (patient/practitioner; $r = 0.34$, $p < 0.01$) and education level ($r = 0.30$, $p < 0.01$). There was a small and statistically significant relationship between the number of non-pharmacological management options the participants were aware of and sex ($r = -0.16$, $p < 0.010$), age ($r = -0.29$, $p < 0.01$), employment status ($r = -0.21$, $p < 0.01$), and geographical location ($r = -0.19$, $p < 0.01$). There was a trivial and statistically non-significant

relationship between the number of non-pharmacological management options the participants were aware of and ethnicity ($r = 0.06$, $p = 0.11$).

Simple Logistic Regression of Patient and Practitioner Knowledge

Simple logistic regression revealed that statistically practitioners were significantly more likely to have knowledge of most non-pharmacological management options. Practitioners were significantly more likely to have knowledge of various non-pharmacological management options, with ORs ranging from 1.73 to 7.36. The highest OR was observed for pallidotomy (OR = 7.36), followed by subthalamotomy, psychological support, thalamotomy, and deep brain stimulation (ORs = 6.39, 4.98, 4.52, and 4.18, respectively). For all non-pharmacological options, the ORs were statistically significant ($p < 0.01$) (Table 2).

Table 2. Simple Logistic Regression of Non-Pharmacological Management Options (OR [95% CI])

Non-Pharmacological Option	Patient/Practitioner
Regular exercise	1.09 [0.46, 2.56]
Aerobic exercise	3.09** [2.04, 4.68]
Meditation	3.37** [2.26, 5.01]
Physical therapy	2.91** [1.58, 5.34]
Occupational therapy	3.63** [2.45, 5.40]
Speech therapy	3.73** [2.29, 6.07]
Psychological support	4.98** [3.30, 7.51]
Tai Chi	3.27** [2.22, 4.82]
Deep brain stimulation	4.18** [2.67, 6.54]
Focused ultrasound	1.73** [1.17, 2.54]
Thalamotomy	4.52** [2.47, 8.24]
Pallidotomy	7.36** [3.81, 14.21]
Subthalamotomy	6.39** [2.97, 13.77]

*$p < 0.05$; **$p < 0.01$

Sociodemographic Variables of Interest in Multiple Logistic Regression

Multiple logistic regression revealed that patients and practitioners with a higher education level were significantly more likely to have knowledge of most non-pharmacological management options. Patients and practitioners with a higher education level were significantly more likely to have knowledge of regular exercise (OR = 10.96, $p < 0.01$), aerobic exercise (OR 6.93, $p < 0.01$), meditation (OR 3.10, $p = 0.03$), psychological support (OR 3.41, $p = 0.01$), Tai Chi (OR 3.97, $p < 0.01$), deep brain stimulation (OR 3.46, $p = 0.01$), and focused ultrasound (OR 4.26, $p = 0.01$). Patients and practitioners with a lower education level were significantly more likely to have knowledge of occupational therapy (OR 0.25, 95% CI 0.08, 0.78; $p = 0.02$), thalamotomy (OR 0.33, 95% CI 0.14, 0.76; $p = 0.01$), pallidotomy (OR 0.29, 95% CI 0.12, 0.73; $p < 0.01$), and subthalamotomy (OR 0.19, 95% CI 0.06, 0.60; $p < 0.01$) (Table 3).

Table 3. Multiple Logistic Regression of Non-Pharmacological Management Options (OR [95% CI])

Sociode-mographic Variable	Regular exercise	Aerobic exercise	Meditation	Physical therapy	Occupatio-nal therapy	Speech therapy	Psychologi-cal support	Tai Chi	Deep brain stimulation	Focused ultrasound	Thalamo-tomy	Pallido-tomy	Subthala-motomy
Sex	0.75 [0.32, 1.62]	0.77 [0.53, 1.13]	0.59** [0.41, 0.85]	0.78 [0.50, 1.21]	0.76 [0.52, 1.11]	1.10 [0.76, 1.59]	0.74 [0.51, 1.07]	0.74 [0.52, 1.06]	1.02 [0.71, 1.46]	1.00 [0.68, 1.47]	1.07 [0.51, 2.27]	1.56 [0.69, 3.52]	2.07 [0.79, 5.42]
Age													
46-65	0.72 [0.11, 4.74]	0.54 [0.20, 1.46]	1.7 [0.80, 3.68]	0.20 [0.03, 1.13]	0.52 [0.21, 1.26]	0.60 [0.22, 1.60]	0.60 [0.24, 1.45]	0.71 [0.33, 1.53]	0.62 [0.25, 1.57]	0.58 [0.28, 1.18]	1.08 [0.42, 2.72]	1.01 [0.40, 2.57]	1.39 [0.46, 4.16]
66 or above	0.61 [0.08, 4.66]	0.26* [0.09, 0.78]	0.63 [0.26, 1.52]	0.09* [0.01, 0.57]	0.30* [0.11, 0.81]	0.26* [0.09, 0.76]	0.24** [0.09, 0.63]	0.32* [0.13, 0.77]	0.18** [0.07, 0.51]	0.25** [0.11, 0.59]	0.36 [0.09, 1.44]	0.31 [0.07, 1.39]	0.45 [0.07, 2.95]
Ethnicity													
Asian/ Pacific Islander	1.18 [0.09, 15.38]	1.71 [0.31, 9.41]	1.15 [0.31, 4.25]	0.72 [0.13, 3.95]	0.72 [0.20, 2.58]	1.81 [0.32, 10.43]	0.83 [0.21, 3.22]	0.54 [0.16, 1.81]	0.33 [0.09, 1.17]	0.53 [0.16, 1.82]	1.69 [0.44, 6.45]	2.38 [0.66, 8.61]	2.03 [0.46, 9.07]
Hispanic/ Latino		0.31 [0.08, 1.13]	1.35 [0.41, 4.49]	0.62 [0.15, 2.54]	0.75 [0.22, 2.53]	0.49 [0.15, 1.61]	0.82 [0.23, 2.90]	1.72 [0.51, 5.79]	0.99 [0.28, 3.47]	0.92 [0.28, 3.03]	2.26 [0.49,10.36]	2.78 [0.55, 13.97]	3.62 [0.71, 18.38]
Black/ African American		6.92 [0.27, 176.24]	0.97 [0.10, 9.42]			3.39 [0.20, 58.09]	1.14 [0.11, 11.85]		0.69 [0.07, 6.91]	1.10 [0.09, 13.75]	5.87 [0.20, 173.56]		17.26 [0.21, 1411.34]
Mixed/ Other		0.63 [0.16, 2.51]	3.09 [0.59, 16.11]	0.82 [0.16, 4.11]	2.60 [0.52, 12.93]	1.55 [0.31, 7.76]	1.36 [0.34, 5.36]	2.27 [0.53, 9.64]	1.22 [0.28, 5.29]	0.84 [0.20, 3.50]			
Education													
High School	2.46 [0.54, 11.18]	1.13 [0.34, 3.78]	1.38 [0.53, 3.64]	0.73 [0.20, 2.66]	0.25* [0.08, 0.78]	0.95 [0.40, 2.27]	0.77 [0.30, 1.98]	1.49 [0.55, 4.02]	1.07 [0.45, 2.60]	2.07 [0.69, 6.26]	0.10** [0.02, 0.48]	0.17* [0.03, 0.83]	0.08* [0.01, 0.71]
Undergra-duate	3.30 [0.69, 15.79]	2.28 [0.69, 7.47]	1.54 [0.60, 4.00]	0.82 [0.23, 3.00]	0.38 [0.12, 1.15]	1.03 [0.44, 2.45]	1.60 [0.64, 3.98]	1.76 [0.66, 4.69]	1.07 [0.45, 2.56]	2.24 [0.75, 6.65]	0.29** [0.13, 0.68]	0.29** [0.12, 0.73]	0.32* [0.12, 0.87]
Graduate	10.96** [1.95, 61.46]	4.73** [1.48, 15.15]	2.39 [0.94, 6.04]	1.25 [0.35, 4.52]	0.61 [0.21, 1.82]	2.06 [0.89, 4.81]	2.15 [0.89, 5.20]	2.81* [1.08, 7.29]	2.09 [0.90, 4.88]	2.55 [0.88, 7.41]	0.33* [0.14, 0.76]	0.42 [0.17, 1.03]	0.19** [0.06, 0.60]

Doctorate	4.51 [0.78, 25.95]	6.93** [2.00, 23.96]	3.10* [1.13, 8.49]	1.77 [0.44, 7.18]	0.65 [0.20, 2.11]	1.53 [0.60, 3.86]	3.41* [1.30, 8.97]	3.97** [1.42, 11.07]	3.46* [1.34, 8.98]	4.26* [1.38, 13.13]			
Profession													
Employed	6.21* [1.16, 33.19]	7.53** [1.98, 28.62]	2.10 [0.63, 6.95]	0.82 [0.19, 3.48]	1.63 [0.47, 5.71]	1.49 [0.48, 4.65]	2.41 [0.70, 8.22]	0.86 [0.27, 2.73]	1.07 [0.33, 3.41]	0.87 [0.27, 2.81]	1.11 [0.12, 9.98]	1.39 [0.40, 4.87]	0.63 [0.06, 6.68]
Retired	6.50* [1.26, 33.48]	4.81* [1.27, 18.26]	2.30 [0.70, 7.62]	1.52 [0.36, 6.38]	2.02 [0.58, 7.04]	2.86 [0.91, 9.02]	2.53 [0.74, 8.68]	0.97 [0.31, 3.08]	2.30 [0.72, 7.42]	1.33 [0.41, 4.28]	0.81 [0.08, 7.72]		0.29 [0.02, 3.64]
Retired, but employed	5.42 [0.59, 49.73]	12.02** [2.46, 58.74]	6.05* [1.44, 25.43]	0.57 [0.12, 2.86]	1.06 [0.24, 4.60]	1.55 [0.40, 5.97]	2.17 [0.52, 9.13]	1.04 [0.26, 4.09]	1.69 [0.42, 6.78]	1.11 [0.27, 4.55]			
Pursuing higher education	0.57 [0.03, 11.67]	0.42 [0.03, 5.39]	2.47 [0.24, 25.62]	0.15 [0.01, 3.47]	0.38 [0.03, 4.41]	0.13 [0.01, 1.41]	1.17 [0.11, 12.49]	0.40 [0.04, 4.38]	0.64 [0.05, 7.64]				
Continent													
Europe	1.05 [0.32, 3.34]	0.16** [0.10, 0.27]	0.49** [0.31, 0.79]	2.24* [1.11, 4.53]	0.08** [0.04, 0.15]	0.71 [0.44, 1.15]	0.93 [0.58, 1.49]	0.68 [0.43, 1.08]	0.69 [0.43, 1.11]	0.95 [0.59, 1.52]	0.69 [0.29, 1.65]	0.63 [0.24, 1.64]	0.69 [0.22, 2.15]
Asia	0.05* [0.00, 0.86]	0.07* [0.01, 0.70]	0.09 [0.01, 1.14]	0.31 [0.03, 2.82]	0.92 [0.13, 6.67]	0.12 [0.01, 1.31]	0.20 [0.02, 2.33]		0.23 [0.02, 2.62]	0.63 [0.06, 6.98]			
Oceania		0.14 [0.01, 1.60]	0.39 [0.04, 3.89]	0.06* [0.00, 0.72]		0.55 [0.07, 4.24]		0.43 [0.04, 4.46]					
South America													
Africa		0.24 [0.02, 2.99]	0.30 [0.03, 3.27]	0.25 [0.03, 2.01]	0.32 [0.03, 3.53]	0.14 [0.01, 1.56]	0.60 [0.05, 7.09]	1.46 [0.18, 11.62]	0.69 [0.08, 5.98]	0.76 [0.07, 7.96]			

*p < 0.05; **p < 0.01

Patients and practitioners of a younger age were significantly more likely to have knowledge of some non-pharmacological management options, including aerobic exercise (OR 0.26, $p = 0.02$), physical therapy (OR 0.09, $p = 0.01$), occupational therapy (OR 0.30, $p = 0.02$), speech therapy (OR 0.26, $p = 0.01$), psychological support (OR 0.24, $p < 0.01$), Tai Chi (OR 0.32, $p = 0.01$), deep brain stimulation (OR 0.18, $p < 0.01$), and focused ultrasound (OR 0.20, $p < 0.01$) (Table 3).

Patients and practitioners in North America were significantly more likely to have knowledge of aerobic exercise (OR 0.16, $p < 0.01$), meditation (OR 0.49, $p < 0.01$), and occupational therapy (OR 0.08, $p < 0.01$) compared to those in Europe. In contrast, patients and practitioners in Europe were significantly more likely to have knowledge of physical therapy (OR 2.24, $p = 0.03$) compared to those in North America. Patients and practitioners in North America were significantly more likely to have knowledge of physical therapy (OR 0.06, $p = 0.03$) compared to those in Oceania. Patients and practitioners in North America were also significantly more likely to have knowledge of regular exercise (OR 0.05, $p = 0.04$) and aerobic exercise (OR 0.07, $p = 0.02$) compared to those in Asia (Table 3).

There was no significant relationship between ethnicity and patient and practitioner knowledge of non-pharmacological management options (Table 3).

Employed and retired patients and practitioners were significantly more likely than unemployed patients and practitioners to have knowledge of regular exercise (OR 6.21, $p = 0.03$ and OR 6.50, $p = 0.03$, respectively). Employed, retired, and retired but employed patients and practitioners were significantly more likely than unemployed patients and practitioners to have knowledge of aerobic exercise (OR 7.53, $p < 0.01$, OR 4.81, $p = 0.02$, and OR 12.02, $p < 0.01$, respectively). Retired but employed patients and practitioners were significantly more likely than unemployed patients and practitioners to have knowledge of meditation (OR 6.05, $p = 0.01$) (Table 3).

Female patients and practitioners were significantly more likely than male patients and practitioners to have knowledge of meditation (OR 0.59, $p < 0.01$) (Table 3).

Discussion

This study investigated the knowledge of non-pharmacological management options for PD among patients and practitioners, revealing important insights into disparities and influencing sociodemographic variables. The study found that practitioners were significantly more likely than patients to have knowledge of most non-pharmacological management options. Sociodemographic variables, including sex, age, education level, employment status, and geographical location, significantly influenced knowledge of non-pharmacological management options. The results highlight the need for targeted educational strategies to even the knowledge gap between patients and practitioners and improve awareness of effective non-pharmacological strategies.

Knowledge Disparities Between Patients and Practitioners

Practitioners were significantly more likely to have knowledge of all non-pharmacological management options compared to patients, as shown by the higher ORs across most non-pharmacological management options. These findings align with prior literature suggesting that practitioners are more exposed to diverse disease management options through their training and clinical experience (Blanchard, 2023). The most widely known non-pharmacological management options were regular exercise, physical therapy, and speech therapy, which have established efficacy and importance in disease management guidelines (Ellis et al., 2021; Maas et al., 2024). These interventions are known to improve motor and non-motor symptoms, thereby enhancing quality of life (Schwab, Dugan, & Riley, 2021).

In contrast, non-pharmacological options, such as medical or surgical interventions, including pallidotomy, subthalamotomy, and thalamotomy, were less known among patients and practitioners. This suggests a lack of widespread education and awareness regarding medical and surgical interventions as non-pharmacological management options for patients with PD. Incorporating medical and surgical non-pharmacological management options into practitioner medical training and patient education materials could promote knowledge of these types of non-pharmacological management options for patients with PD. In other medical fields, real-life patient success stories of medical and surgical interventions have helped improve the visibility and acceptance of such interventions among patients (Flynn et al., 2024; Novak et al., 2020). Sharing real-life success stories for deep brain stimulation, pallidotomy, subthalamotomy, and thalamotomy in patients with PD may help other patients with PD choose medical or surgical interventions to improve their quality of life and outcomes.

Sociodemographic Influences on Knowledge

Patients and practitioners with higher education levels (graduate or doctorate) were significantly more likely to have knowledge of standard non-pharmacological management options, such as regular exercise, aerobic exercise, and psychological support. Although those with higher education levels were also significantly more likely to have knowledge of deep brain stimulation and focused ultrasound, those with lower education levels presented contrasting findings. Patients and practitioners with lower education levels were more likely to have knowledge of pallidotomy, subthalamotomy, and thalamotomy. These findings were surprising because others have found that patients with lower education levels have lower health literacy. Lower health literacy has been found to be associated with being less likely to have knowledge of advanced medical or surgical non-pharmacological management options (De Oliveira et al., 2015). The findings of low health literacy among patients are important for practitioners, as they highlight the need to proactively assess and address gaps in patients' knowledge, particularly regarding less commonly known non-pharmacological management options, to ensure informed decision-making and better care. The findings of lower health literacy suggest that education may influence not only specific knowledge of disease management options but also broader health literacy, which can impact a patient's ability to access, understand, and apply health-related information, ultimately affecting their overall health outcomes (Coughlin et al., 2020).

One possible explanation for the finding that those with lower education levels were more likely to have knowledge of pallidotomy, subthalamotomy, and thalamotomy is that individuals with lower education levels may have had personal or community exposure to these specific surgical procedures. This could be through informal sources, localized clinical practices, or word-of-mouth within certain regions or healthcare systems where these interventions were historically more common or offered as primary surgical options. It is also possible that these individuals are overrepresented in regions where such procedures are more accessible or promoted due to resource constraints, thus influencing knowledge patterns. Further qualitative research could explore how patients learn about specific interventions to better understand the channels through which knowledge is acquired, especially among lower-education groups.

Geographical location also influenced knowledge of non-pharmacological management options, with patients and practitioners in North America being more likely to have knowledge of aerobic exercise, meditation, and occupational therapy. This could reflect regional variations in healthcare practices, resource availability, and cultural attitudes toward the management of PD. Interestingly, patients and practitioners in Europe were more likely to have knowledge of physical therapy. Increased knowledge of physical therapy aligns with prior research that found regional variations may exist when recommending specific non-pharmacological management options for PD (Schiess et al., 2022).

Patients and practitioners of a younger age were more likely to have knowledge of a wider range of non-pharmacological management options for PD, including physical therapy, speech therapy, and Tai Chi. This may be due to younger patients and practitioners having more access to digital health resources and modern educational materials (Yuen et al., 2023). Employment status also influenced knowledge, with employed and retired patients and practitioners being more likely to have knowledge of non-pharmacological management options for PD. This may be due to the incomes of employed patients leading to greater healthcare access or increased availability of retired patients leading to greater participation in support programs (Kikano, Goodwin, & Stange, 1998; Zhang, Salm, & van Soest, 2018). Understanding the relationship between knowledge and sociodemographic variables is important for practitioners, as it can help identify patients who are less likely to be aware of specific management options and allow for targeted education and support to bridge patients' knowledge gaps.

Implications for Patient Care

The significant knowledge gap between patients and practitioners suggests a compelling need for improved communication and patient education. Improved communication during patient-practitioner consultations, patient-friendly resources, and the inclusion of non-pharmacological management education in support groups could enable patients to explore a wider range of non-pharmacological options for their PD (King & Hoppe, 2014; Bhattad & Pacifico, 2022). Furthermore, targeting underrepresented populations for patient education, such as those from geographically isolated locations, may help reduce disparities in knowledge and access to non-pharmacological management options for PD. Initiatives such as community workshops, telehealth consultations, and partnerships with local

organizations could bring resources to these underrepresented populations (Li, Cai, & Duan, 2023). Practitioners should also consider routinely assessing patients' knowledge and preferences to ensure personalized recommendations that align with their circumstances (Tringale et al., 2022). Importantly, improved patient education and knowledge of non-pharmacological management options may lead to improved health literacy and subsequently improved quality of life (Shahid et al., 2022).

To effectively address the identified knowledge gaps, targeted educational strategies should be personalized to specific sociodemographic factors, such as age, education level, and geographic location. For example, simplified educational and visual materials could be developed for patients with lower health literacy, while digital modules or mobile apps could engage younger or technology proficient patients. Practitioners working in rural or underserved areas might be provided with toolkits to facilitate patient education during routine visits. Additionally, culturally and linguistically adapted materials should be used to reach diverse populations and reduce disparities in access to non-pharmacological care. These targeted approaches can help ensure that all patients, regardless of background, are equipped with the knowledge needed to make informed decisions about their care.

Study Limitations

This study surveyed practitioners, including physicians, nurses, physical therapists, occupational therapists, speech-language pathologists, psychologists, and caregivers. Since these practitioners practice in their field (e.g., physical therapists in physical therapy and speech therapists in speech therapy), this might have affected the results of the knowledge of various non-pharmacological management options among practitioners. While the study included participants from different ethnic and geographic backgrounds, some ethnicities and geographies were underrepresented. Knowledge awareness was a dichotomous (yes or no) variable, which does not provide an indication of the level of knowledge. This was beyond the scope of our investigation.

Future Research

Future research should explore the efficacy of personalized educational strategies in improving patient knowledge of non-pharmacological options in PD. For instance, randomized controlled trials could investigate the impact of personalized educational programs on patient knowledge of non-pharmacological management options, compliance to their disease management plan, and clinical outcomes. Longitudinal studies could investigate how knowledge of non-pharmacological management options influence disease management compliance, symptom management, and quality of life.

Conclusion

This study highlights significant disparities in knowledge of non-pharmacological management options for PD among patients and practitioners. Sociodemographic variables, including sex, age, education level, employment status, and geographical location, significantly influence knowledge of non-pharmacological management options. Addressing these disparities through personalized educational strategies could improve the quality of life and outcomes for patients with PD. By improving communication between patients and practitioners, the community may work toward a more equitable and effective approach to the management of PD. Clinicians are encouraged to incorporate routine assessments of patient knowledge and preferences into consultations and to provide informational resources, particularly for underserved or low health literacy populations. Furthermore, interdisciplinary collaboration with physical therapists, occupational therapists, and caregivers should be strengthened to ensure comprehensive, individualized non-pharmacological care.

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