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Exploring the Interplay Between Motor Progression and Mental Health in Parkinson's Disease: A Pilot Study

Tarini Kovelamudi
tarini.kovelamudi@gmail.com

ABSTRACT

Parkinson's Disease (PD) is defined by physiological symptoms such as tremors and rigidity. However, non-motor symptoms, such as depression and anxiety, frequently precede those physiological symptoms, and exacerbate quality of life (QOL). Despite the high prevalence of mental disorders, they are often underdiagnosed, and their relationship with the onset of physical symptoms is inconsistently documented. This study intends to investigate the prevalence of mental health orders in PD, their impact on QOL, and evaluate the intertwined relationship between psychological and physiological. There were two methods utilized to collect data: a comprehensive literature review on prevalence and treatment, and a pilot survey (n=5) conducted among caregivers of PD patients to gather qualitative and quantitative insights. A meta-analysis of patients with PD with depression provides an estimate of 38% of 38,304 PD patients, compared to 15–18% in the general population (4). Data from the survey corroborated the literature, showing a universal presence of mental health symptoms, suggesting these conditions were made apparent during the progression of the disease. Notably, 100% of respondents reported that mental health worsens with motor decline, and 80% reported that psychological distress exacerbates physical symptoms. Mental health is an intrinsic facet of PD progression. This interconnected relationship highlights the need for multi-faceted care models, integrating psychiatric screening and psychological treatments alongside standard care.

INTRODUCTION

Parkinson's Disease (PD) is a neurodegenerative disorder characterized by physiological symptoms such as tremors, muscle stiffness, bradykinesia, and rigidity.[1] The symptoms start slowly, with barely noticeable tremors and evolve to cause stiffness, slowing of movement, and trouble with balance. In the early stages, the face will begin to show little to no expression, with speech becoming soft or slurred. Parkinson's disease causes a specific area of your brain, the basal ganglia, to deteriorate.

As this area deteriorates, you lose the abilities of those areas once controlled. A lack of dopamine slows down the movements that it normally fine-tunes as a neurotransmitter. As PD progresses, the symptoms expand and intensify, creating dementia-like symptoms and depression. Many changes also happen in the

brains of those who have PD. The presence of alpha-synuclein found within Lewy bodies is one of the signs. It occurs in a clumped form that cannot be broken down by cells. Other signs include the breakdown of mitochondria, the powerhouses of the cells that provide the body with the majority of its energy. The alterations to the mitochondria can cause cell damage, and these changes have been found in the brains of people with Parkinson's disease. These cellular changes contribute not only to physical decline but also to the neurochemical imbalances that regulate mood and cognition.

However, there is now more evidence suggesting that mental health disorders, such as depression and anxiety, can precede the motor symptoms of Parkinson's and affect a patient's quality of life.[2] Affective disorders often predate the onset of motor symptoms, about 4 to 6 years on average before the diagnosis of PD.[3] This early onset of psychological symptoms suggests that the neurodegeneration of PD is widespread, affecting emotional centers of the brain long before it impacts movement. Understanding this timeline is crucial for early intervention and for improving the overall trajectory of the patient's health.

Because the emotional burden often outweighs the physical symptoms in terms of patient distress, it is vital to examine how these factors interact in real-world settings. This study aims to bridge the gap between clinical theory and patient experience. By analyzing existing literature alongside preliminary survey data, we seek to identify how the progression of the disease affects the mental well-being of both patients and their primary caregivers.

METHODS

To gain a better understanding of the relationship between PD and mental health, an exploratory pilot survey was conducted.

Survey Structure

The survey that I designed and distributed was organized into two sections. It began with demographics, such as age and family situation. Family situations specifically referred to the people that they were currently living with or interacted with within their living space. While the form did not explicitly state this definition, the respondents listed the people that the patients consistently interacted with. The next section was in regards to the main physical symptoms the patient was exhibiting, and the steps taken to treat this. The mental health section was structured in a similar way, followed by a section discussing the intertwined relationship of the two, whether the worsening of one exacerbated the other. The form concluded with an optional space for additional comments. The target demographic for this particular survey was people who acted as caretakers to people with Parkinson's Disease, as they would be able to more accurately give the timeline of progression of the disease. Five of these caretakers participants completed the survey in total, providing the small sample data we used for reference. The survey form has been attached in the appendix section.

Data Collection Goal

The goal of this structure was to see if the real-world experiences of the five participants matched the trends found in the literature review. By asking about both physical and mental health, we were able to look for relationships between factors that may be missed in a clinical setting.

Literature Review Methodology

To address the literature gap prevalent in the overall landscape of mental health and its association to Parkinson's, I collected papers, reviewed articles and other forms of media. This phase of the study was focused on synthesizing existing global data to provide a foundational understanding for our analysis.

Search Strategy and Keywords

The keywords used for the search included terms such as "Parkinson's", "Parkinson's disease and mental health". Utilizing these search terms across academic databases helped identify clinical trials and observational studies that were correlated to the psychological side of the disease.

Inclusion Criteria

Papers that discussed prevalence, quality of life, and effects on the caregivers and patients, were taken into consideration. I looked for sources that discussed "non motor" symptoms of PD to ensure the research wasn't limited to just physical tremors or rigidity.

Data Organization and Categorization

Portions of evidence, statistics and other information were obtained from those articles, selected, and then sorted into categories based on content to adhere to the structure of the paper. These categories are:

- Mental health disorder prevalence: statistical data on how many patients suffer from depression/anxiety
- Quality of life (QOL): How mental health influences daily functioning and patient satisfaction
- Treatment pathways: Research into different forms of intervention

By categorizing data in this way, we were able to compare the established scientific findings directly with the results from the pilot survey.

RESULTS AND DISCUSSION

Section A: Survey Findings & Analysis

The following data summarizes the results from our pilot study of five PD patients and their caregivers, providing a real-world mirror to the trends identified in the literature.

1. Demographics: The Caregiver Burden. The first section of the survey was regarding demographics. Of the five patients' data collected, all caregivers are female, with 60% of them in the 45-54 age range. The majority of them have been in the role of a caregiver for over 5 years. As for the patients, all are aged

above 65. Sixty percent are married, and 80 percent have children. All live with immediate family members, which could indicate strong family support.
2. Disease Progression and Motor Symptoms All patients were diagnosed via physical examination. 80% of the patients were diagnosed over 5 years ago. The dominant motor symptoms are tremors, rigidity, and fatigue (80%, respectively), with bradykinesia appearing in the majority as well (60%).

3. Mental Health Trends: Figure 1 reports the mental health symptoms observed amongst the patients. Mental health conditions are universal among these patients. Sadness, low moods, and concentration issues were marked in 60% of patients. Memory problems were also reported by 60%. Anxiety and hallucinations were each reported in 40% of patients, as were dementia-like symptoms. Diagnosis of these mental health conditions was based on caregiver observation in 60% of cases and formal psychiatric evaluation in the remaining 40%. Crucially, none of these patients had a family history of mental health conditions. This suggests that these symptoms are likely acquired through disease progression rather than pre-existing genetic factors. Onset timing varied across patients: in two cases, mental health symptoms emerged around the same time as the PD diagnosis, while in the remaining three, symptoms developed only later during disease progression.

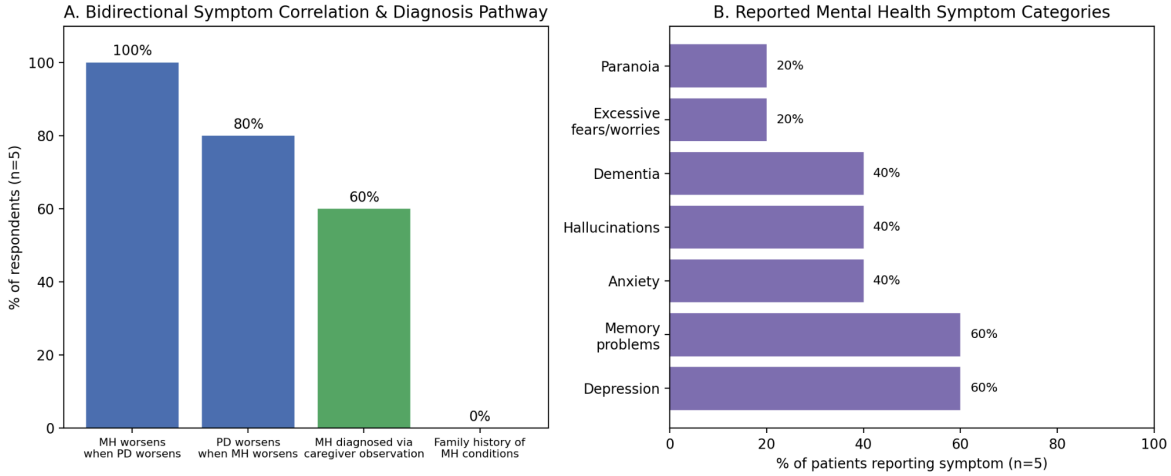


Figure 1. Reported mental health symptoms and symptom patterns among surveyed PD patients (n=5).

4. The Bidirectional Relationship The final section regarding the physiological and psychological symptoms is together. All caregivers reported that mental health symptoms worsen when PD symptoms worsen, and 80% of caregivers observed the reverse. As for PD medications, higher doses of L-DOPA are consistently associated with more hallucinations and confusion. This highlights a trend where PD symptoms and mental health decline are inextricably linked in a bidirectional cycle.

A second pattern involved medications rather than symptoms directly: higher or longer-term doses of Parkinson's medications (e.g., Levodopa) were linked to increased hallucinations and confusion in some caregivers' reports, while mental health medications were associated with changes in motor symptoms, including reduced tremors in one case and increased dyskinesia in another. This mirrors literature findings that dopaminergic medications can worsen psychiatric symptoms while mood-related

medications can carry motor side effects, suggesting PD and mental health are linked through treatment as well as disease progression.

Section B: Discussion

The clinical onset of PD has been demonstrated by several studies, which suggest that psychological reactions might not just be due to motor symptoms. A meta-analysis of patients with PD with depression provides an estimate of 38% of 38,304 PD patients, compared to 15–18% in the general population.[4] Additionally, such disorders impact quality of life significantly for both patients and caregivers.[5] However, due to a lack of longitudinal repeated measurements of depressive symptoms, we do not have enough information. PD is a progressive neurodegenerative disease due to the erosion of neurons that produce dopamine in the substantia nigra.[6] Despite the high prevalence of depression in PD patients, it remains underdiagnosed and undertreated, as both the physical and emotional symptoms complicate clinical evaluation. Studies reporting the effects of motor and non-motor symptoms on depression in PD often yield inconsistent results, with some supporting associations, while others have not .[5]

Current literature and research have largely focused on the physiological aspects of Parkinson's and the treatment of its motor symptoms. While some studies explored the prevalence of the two combined, there is not much research investigating the progression of these mental symptoms and how they impact disease progression, medication regimens, and social support. To remedy this, we are conducting a study to prove our hypothesis. We hypothesize that mental health outcomes in individuals with PD are not just byproducts, but rather are a dynamic facet of the disease, impacted by psychological, social, and neurological factors. This study aims to bridge that literature gap through an analysis of literature review, and an analysis of the literature review and an analysis of a small sample of the relationship between symptoms and treatments of five patients.

Prevalence of Mental Health Conditions in PD

1. Prevalence of Depression

Depression is a mood disorder that causes a persistent feeling of sadness and loss of interest. It's also known as major depressive disorder, or clinical depression. It affects how you think, feel, and behave. Many common symptoms include feelings of sadness, angry outbursts, loss of interest in normal activities, and slowed thinking, speaking, or body movements.

Depression is highly prevalent in Parkinson's disease. The overall rate of depression in Parkinson's is 38%.[4] Earlier research also shows that major depressive disorders occur in 17% of patients, and minor depression in 22%.[7] The clinical difference between minor and major depression is how symptoms are present. Minor depression, or subclinical depression, has all the symptoms of major depressive disorder (MDD), but does not have enough to qualify as a major depressive disorder (for someone to be diagnosed with MDD, at least five symptoms must be present most days for at least two weeks). More recent

systematic reviews continue to confirm high global prevalence, indicating that this is an intrinsic part of the disease, one that needs consistent and thorough attention.[5]

2. Anxiety Prevalence

Anxiety disorders encompass generalized anxiety disorder, social anxiety disorder, specific phobias, and separation anxiety disorder. These disorders are characterized by feelings of anxiety and panic that interfere with daily activities, are difficult to control, are out of proportion to actual danger, and can last a long time. Those with these mental disorders often display a sense of impending doom, trouble concentrating, and feeling nervous, restless, or tense.

Anxiety is shown to vary widely, ranging from 6% up to 55%. The average point prevalence of anxiety disorders in PD was 31%, with non-episodic anxiety being more prevalent than episodic anxiety. Generalized anxiety (14%) was the most frequent, followed by social phobia/anxiety (13.8%), then unspecified anxiety (13.3%), and specific phobias at 13%.[8] Similar rates were also found in other studies, with 43% and 49% lifetime prevalence.[9] The severity of PD was found to be positively related to anxiety. PD patients with gait dysfunction were more likely to experience anxiety compared to tremor-dominant patients. The anxiety disorders decreased with age, and young-onset PD patients were more likely to experience anxiety than late-onset subjects.[10] Anxiety often fluctuates with motor cycles, and standard DSM criteria may underrepresent PD-specific anxiety, leading to variability in estimates depending on assessment methods. Even so, it is crucial to note that it is quite prevalent, in one form or another, in PD patients.

Atypical anxiety disorders specific to PD include anxiety not otherwise specified (14.9%), fluctuating anxiety (34.19%), and a fear of falling (51.5%) .[10] These PD-related anxiety disorders differ from primary anxiety symptoms and presentation, but are equally as prevalent, and something to consider when thinking of treatment.

QOL

PD patients experience substantial Quality of life deficits compared to healthy controls regarding physical, psychological, social, and environmental functioning. Many of the 2,707 PD patients displayed significant impairments in overall quality of life measures.[12]Qualitative data and the subsequent analysis revealed a wide range of facilitators and barriers to proper quality of life, and identified seven overarching themes: illness experience, health care, everyday life, identity, spirituality/religion, and environment.[13]

Depression consistently emerges as the strongest predictor of poor quality of life in PD, outweighing the impact of motor symptom severity. Depression, anxiety, apathy, etc., have also been identified as something directly related to the health-related quality of life, and it is imperative to identify and treat these symptoms. Treating these non-motor symptoms may improve QOL.[14] The consistency of this finding indicates that mood disturbances play an intrinsic role in how patients experience their disease. Even patients with relatively mild motor symptoms could report severely impaired quality of life,

especially if they are experiencing significant depression.

The impact of psychiatric symptoms extends beyond depression alone. A systematic review examining psychiatric comorbidity largely found that any psychiatric condition, including anxiety, apathy, psychosis, and impulse control disorders, significantly worsens clinical outcomes and Quality of Life.[15] A large-scale PRIAMO study, which assessed non-motor symptoms in a multicenter Italian cohort, demonstrated that non-motor symptoms have a greater impact on quality of life than motor symptoms. The study reported that 96.8% of patients with PD reported the presence of NMSs (nonmotor symptoms). The most common were: fatigue (58%), anxiety (56%), leg pain (38%), insomnia (37%), urgency and nocturia (35%), drooling of saliva and difficulties in maintaining concentration (31%).[16] The cumulative effect of multiple psychiatric symptoms can also be detrimental, and patients can often have comorbid disorders, with depression, anxiety, and apathy reporting the poorest QOL outcomes. Quality of life in PD is shown as multifaceted and generally influenced by numerous interacting factors. The findings of many of these meta-analyses highlight that optimizing QoL in PD requires addressing many of the nonmotor symptoms, which could exponentially propel patients' well-being.

Treatments

Cognitive behavioral therapy leads to improvements in cognition, quality of life, anxiety, and depression in PD patients across the respective meta-analyses.[17] Cognitive Behavioral Therapy (CBT) is a form of psychological treatment that has been demonstrated to be effective for a range of problems, including depression, anxiety disorders, substance problems, eating disorders, and severe mental illness. Numerous research studies suggest that CBT leads to significant improvement in functioning and quality of life. CBT is founded on three basic psychological principles: that psychological problems are based on faulty or unhelpful ways of thinking, that they are based on learned patterns of unhelpful behavior, and that people suffering from those problems can learn better coping mechanisms, relieving their symptoms. A randomized controlled trial demonstrated substantial effects, with a reduction in the symptoms of both anxiety and depression.[18] Additional studies support CBT's effectiveness in various formats, such as multiple baseline experiments and group therapy formats, indicating strong and growing evidence for CBT as a first-line non-pharmacological treatment.

Major clinical trials have shown that antidepressant medications, such as paroxetine and venlafaxine XR, significantly improve depression in PD, while another medication, nortriptyline, demonstrated superior efficacy compared to paroxetine and placebo.[19,20] Desipramine and citalopram have been compared in controlled trials in studies such as Devos *et al.*, and meta-analyses including thousands of patients have evaluated antidepressant efficacy.[21-23] Clinical guidelines recommend specific agents, including nortriptyline, venlafaxine, and citalopram.[24-26]

Early evidence supported psychosocial interventions for depression and anxiety in PD, with more recent research documenting the benefits of exercise and multidisciplinary care approaches. Comprehensive treatment guidelines have been developed based on clinical experience and evidence synthesis, with

organizations like the Parkinson's Foundation and the NHS providing protocols that include exercise, CBT, and medications. [27-29] A multifaceted approach appears to be the best approach, accounting for the various sides of the disease, allowing QoL to be improved significantly, and for symptoms to be alleviated.

LIMITATIONS

Limitations of this study are concentrated mainly in the survey. The sample size (n=5) is not large enough to be statistically representative, with a single response shifting reported percentages 20 points. Five responses were as many as were available within the network that existed for this study. While the intention was to have more data to make it more statistically viable, it was logistically challenging to collect more data due to physical distance, clinical and legal issues. The study was not able to utilize random sampling or systematic recruitment, so selection bias and response bias may be present: there is potential of inflating prevalence. The statistical power, ability to establish correlation, and generalizability of the results are therefore tenuous. The data relied on caregiver perception, without any standardized assessment tools, meaning symptoms may have been under or over reported, despite the supplement of literature. Generalizability is difficult to establish, as the small sample size is unable to account for gender, socioeconomic status, ethnicity, or location. The literature review also relied on a smaller scope set of search terms across limited databases, rather than a systematic multi-database search with defined inclusion criteria, so a few relevant studies may have been missed.

The study wants to highlight and emphasize the relationship between motor progression and mental health symptoms within a small group of people. Despite these limitations, this pilot study offers preliminary findings that helps corroborate with the trends identified within the literature itself. Its initial findings further analysis emphasize the need for larger and longitudinal studies with validated psychiatric and psychological standards to more rigorously test the relationship between mental health and motor symptoms in PD.

CONCLUSIONS

This study has explored the intertwined relationship between Parkinson's Disease and mental health .Through a consolidation of literature and a focused pilot survey, it is evident that psychiatric symptoms like depression and anxiety are not merely secondary reactions to physical deterioration, but are intrinsic to the disease itself.

1. Summary of Findings: The literature review established that depression affects nearly 38% of the PD population, often acting as the single greatest predictor of a poor QOL. Our survey findings corroborated this, with 100% relations between the worsening of motor symptoms and the decline of mental well-being. The survey highlighted that these challenges occurred in patients who do not have a reported

family history of psychiatric illness, reinforcing the theory symptoms are acquired through the progression of the disease.

2. The Challenges of Treatment: While medications like L-DOPA are essential for motor control, our findings suggest that higher doses are consistently associated with increased concussion and hallucination. Similarly, antidepressants can stabilize mood, but side effects include dyskinesia. This complexity makes the single method treatment approach insufficient.

3. Recommendations for a Multidisciplinary Approach: to optimize patient well-being, a multifaceted approach is the best approach, required to account for the various sides of the disease.

- Integrated Psychological Support: Cognitive Behavioral Therapy (CBT) should be considered a first line non pharmacological treatment to help patients break the cycle of anxiety and motor tremors.
- Proactive Screening: Caregivers are often the first to observe mental health changes (60% reported in pilot survey), clinical evaluations should more heavily involve caregiver observations to ensure symptoms go underdiagnosed.
- Holistic Interventions: Beyond medication, evidence supports the benefits of exercise and multidisciplinary care protocols, such as those provided by the NHS and Parkinson's Foundation

Final Thoughts: In conclusion, treating Parkinson's Disease requires more than managing tremors. It requires treating the symptoms and the person as one whole unit. By addressing non-motor symptoms with the same urgency and priority, we can alleviate the burden on patients, exponentially increasing their quality of life.

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AUTHOR INFORMATION

Tarini Kovelamudi is a junior at Mission San Jose High School. She enjoys reading and writing in her free time.

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APPENDIX: SURVEY INSTRUMENT

Section A: Consent

1. I am willing to participate in this survey.
2. Are you a Caretaker/ Family member/ doctor of a Parkinson's disease patient?

Section B: Demographics

3. What is your age?
4. What is your gender?
5. How long have you been the primary caretaker of the patient?
6. What is the age of the patient in your care?
7. What is the patient's gender?
8. What is the patient's current living arrangement? (e.g. with immediate family, in care center, living alone.)
9. Is the patient currently married?
10. Does the patient have children?
11. Does the patient live with or care for their elderly parents?
12. Does the patient live with any pets?

Section C: PD Related Questions:

13. How was the patient diagnosed with Parkinson's disease?
14. How long ago was the patient diagnosed?
15. What major symptoms of Parkinson's disease does the patient currently experience?
16. What types of medications is the patient currently taking for treatment?
17. How long has the patient been receiving these treatments?
18. Is there a family history of Parkinson's disease?
19. Would you like to share anything else not covered in the above questions**?**

Section D: Mental Health Questions

20. Has the patient been diagnosed with a mental health condition?
21. If so, how was the diagnosis made?
22. How long ago was the mental health condition diagnosed?
23. What are the main symptoms of the mental health condition that you have observed in the patient?
24. What forms of treatment is the patient currently receiving for their mental health condition?
25. How long has the patient been receiving this treatment?
26. What medications is the patient currently taking for their mental health condition?
27. How long has the patient been on these medications?
28. Is there a family history of mental health conditions?
29. Would you like to share anything else not covered in the above questions?

Section E: PD and Mental Health Questions

30. What mental health symptoms have appeared alongside Parkinson's disease in the patient?
31. When did these mental health symptoms first appear in relation to the Parkinson's disease diagnosis?

32. Do the patient's mental health symptoms tend to worsen when their Parkinson's symptoms are more severe?
33. Do the patient's Parkinson's symptoms tend to worsen when their mental health symptoms are more severe?
34. Have you observed any changes in the patient's mental health symptoms as a result of Parkinson's medications? If so, what changes?
35. Have you observed any changes in the patient's Parkinson's symptoms as a result of mental health medications? If so, what changes?
36. In your opinion, how do the patient's Parkinson's disease and mental health condition interact in daily life?
37. Please enter any other details/ remarks/ feedback/ advice you would like to provide.
38. Can we contact you for any other questions? If yes, kindly provide your contact details.