

# Association of Depression with Balance and Mobility in Patients Suffering from Parkinson's Disease: A Cross-Sectional Study

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## Author's Contribution

<sup>1,4,5</sup> Substantial contributions to the conception or design of the work for the acquisition, analysis or interpretation of data for the work. <sup>1,3,5,6</sup> Drafting the work or reviewing it critically for important intellectual content, Final approval of the version to be published, <sup>1,2,5</sup> Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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## A B S T R A C T

**Background:** Parkinson's disease (PD) represents a gradual neurodegenerative process that involves motor and non-motor functions including the emotional state and the ability to move. One of the main non-motor symptoms of PD is depression and it might seriously affect both the physical performance and the patient's life quality.

**Objective:** To determine the correlation between depression and mobility problems in the patient population with PD.

**Methodology:** The study was performed in Lahore, Pakistan, over a course of six months (Jan 2025-Jun2025) at four different tertiary care hospitals. Non-probability convenience sampling was the method used by the researchers which led to the selection of a total of seventy-three (73) individuals with Parkinson's disease who were between the ages of 45-65, had a confirmed diagnosis and were scoring 24 or more on MMSE. The depression levels were assessed using the Beck Depression Inventory (BDI), while mobility was evaluated by the Timed Up and Go (TUG) test. A TUG time of over 13.5 seconds was considered to indicate an increased risk of falling. The connection between depression and mobility was explored using Chi-square analysis.

**Results:** The research highlighted a clinically meaningful link between the level of depression and the mobility test scores ( $\chi^2 = 11.989$ ,  $p = 0.017$ ). Those patients with moderate to borderline depression diagnosis were slower in the TUG test performing and their longer time was indicating that they were at a higher risk of falling. The Cramér's V value was 0.405, which corresponded to a medium degree of connection.

**Conclusion:** Patients with PD who have more depressive symptoms show less mobility. The mental health screening and intervention that is no longer part of PD care can result in better mobility outcomes and decreased fall risk. Longitudinal studies are suggested to determine causality and assess the combined treatment methods.

**Keywords:** Beck Depression Inventory, Fall Risk, Mental Health, Parkinson's disease, Timed Up and Go Test

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## Introduction

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The description of the illness that is a long-term condition impacting the brain and spinal cord, Parkinson's disease (PD), is identical to its source, namely, James Parkinson who, two centuries ago, was the first to report the clinical condition. In pathology terms, PD is marked by the downfall of the dopamine-neurons in the Substantia Nigra area of the brain which are responsible for producing dopamine. Consequently, there is a fall of dopamine in the part of the brain known as the striatum and thus motor dysfunction appears.<sup>1</sup>

Parkinson's Disease (PD), commonly referred to as idiopathic Parkinson's disease, is one of the neurodegenerative diseases that are very gradual in their progression and primarily affect the elderly, so it is among the most common diseases of that kind. The patients exhibit a very broad range of motor symptoms which include besides the already named, for instance, a resting tremor, along with some other PD-specific motor symptoms that are attributed to the pathological changes such as dopaminergic neuron death in the substantia nigra and the Lewy body formation. What is more, these patients go through the non-motor disorders like sleep disturbances, cognitive slowing, tiredness, worry, and despair which are often as hard to bear as the motor symptoms.<sup>2</sup>

Parkinson's disease (PD) is a global health problem that is primarily associated with aging. A meta-analysis of North American populations showed that the global prevalence rate goes up to approximately 2% in men and 4% in women aged 85 years or older from the early stages of less than 1% in men and women aged 45–54 years. The same age-related trends were noted in Europe and Asia, showcasing the global effect of demographic change on the risk of developing PD. In South Asia, including Pakistan, the available epidemiological data give a prevalence rate of about 0.5–1% for people aged 60 and over, however, the actual burden may be higher because of underdiagnosis and very few population-based studies. The prevalence of PD is going to increase sharply worldwide; as populations get older, the forecasts predict that the number of cases will more than double in the next two decades.<sup>3</sup>

Tremor, or involuntary shaking, is one of the classic manifestations of PD. Initially, it is often limited to one side of the body affecting the hand or fingers in most cases. The tremor, which is mainly observed at rest, may become weaker or go away altogether during voluntary movement. Bradykinesia, which is the characteristic of slowness of movement, is seen as a problem of starting voluntary gestures, less facial expressiveness (the so-called "masked

face"), and a general slowing down of the daily activities. Functional Parkinsonism (FP) is basically the same condition as Parkinson's disease as it has tremor, stiffness, or bradykinesia as its main symptoms but differs fundamentally from idiopathic PD. FP usually has variable stiffness patterns and other motor signs that may change or be less noticeable with distraction, indicating abnormal motor control linked to frontal lobe or psychological factors rather than the progressive dopaminergic neuron loss in the case of idiopathic PD. On the other hand, idiopathic PD is a neurodegenerative disease with a predictable progression of both motor and non-motor symptoms mainly caused by the degeneration of the substantia nigra.<sup>4</sup>

Parkinson's disease has the potential to considerably change non-motor and motor abilities, whereby these non-motor symptoms mainly include mood, sleep, and autonomic processes and cognition (the capacity to think). The importance of NMSs has been acknowledged just recently, with studies pointing to the fact that these symptoms might come up long before the motor symptoms. NMSs, because of their early occurrence, can possibly be considered for the diagnosis of subjects at risk of developing Parkinson's disease (PD). Among the preclinical symptoms, depression, fatigue, rapid eye movement sleep behavior disorder (RBD), and olfactory disorders are the most prominent.<sup>5</sup>

Parkinson's disease (PD) was recently diagnosed as one of the direct causes of depression along with its interference with limbic networks and the monoaminergic systems; imaging techniques have confirmed this diagnosis both structurally and functionally. On the other hand, the literature points to a causative relationship of depression among PD-related anxiety, apathy, RBD, dementia, and cognitive deterioration during these times by indicating the same factors. The altered pathways for serotonin, norepinephrine, and dopamine along with the affected brain regions such as the thalamus, anterior cingulate cortex, orbitofrontal cortex, amygdala, and ventral striatum, all of which are part of the limbic circuit, are where the antidepressant effect in PD patients is produced.<sup>6</sup>

Parkinson's disease (PD) has various ways of assessing balance, among which the Berg Balance Scale (BBS) and Timed Up and Go (TUG) test are the most appropriate ones. The BBS assesses balance by means of tasks like reaching, turning, stepping, and maintaining posture, thus mirroring daily functional abilities. It is a very common method employed in PD because it is fast, needs very little equipment, and is successful in spotting balance disturbances and evaluating fall risk in this group of patients.<sup>7</sup>

The main aim of this study was to determine whether there was a connection among depression, balance and

mobility in patients suffering from Parkinson's Disease (PD). The issue bears significance from the clinical point of view and also supports the research interest particularly in the subcontinental area where the population is higher but the available evidence is still meager. The disease produces both motor and non-motor symptoms and among them depression, balance, and mobility suffer the most. This indicates the necessity of understanding the connection between them.

## Methodology

The present study was conducted in the Shadman Medical Centre, Lahore, Service Hospital and Sir Ganga Ram Hospital, Pakistan for six months (January, 2025 to June 2025), post approval of the study protocol. A total of 73 people was part of the study. Sample size for the study was computed for a 95% confidence interval using the formula  $n = e^2 z^2 \times p \times (1-p)$ , with  $z=1.96$ , an assumed prevalence proportion  $p=0.5$  (as prevalence proportion to maximize sample size) and the error margin  $e=0.1$ . The investigators used convenience sampling to select the participants, which implies drawing the patients from the hospitals participating in the study who are most accessible during the study, thus making it less burdensome to carry out the study within a limited time. The inclusion criteria were set for patients between the ages of 45 and 65 who had clinical diagnosis of Parkinson's disease and sufficient ( $\geq 24$  on MMSE) mental capability.

A neurologist's consultation, based on clinical criteria such as the UK Parkinson's Disease Society Brain Bank Criteria, was the method for diagnosing Parkinson's Disease. The exclusion criteria included patients with concurrent neurological diseases (e.g., stroke, multiple sclerosis) and hip or leg fractures within the last six months, as well as those who had undergone major surgeries or suffered peripheral injuries that affected balance or mobility, and spinal cord injuries. The Beck Depression Inventory II (BDI-II) was employed for assessing the patient's depression and the validated Urdu version of the instrument was used for the local population. The Timed Up and Go (TUG) test was the device for detecting balance and movement skills with a cut-off point of over 13.5 seconds set for the high-risk threshold. A statistical analysis was performed using SPSS 24 to determine the relationship that exists between levels of depression and mobility status using categorical terms at a significance level of  $\alpha = 0.05$ , with effect sizes calculated using Cramer's V.

The study was ethically approved by the Research Ethics Committee of The University of Lahore (REC-UOL-/342/08/24). All participants were recruited voluntarily with a

written informed consent was taken, and their data were handled with strict confidentiality.

## Results

Initially, Mini-Mental State Examination (MMSE) was used for screening of eight subjects. Out of the total, 7 people (8.75%) were not allowed to participate further due to the fact that their MMSE scores were lower than 24 which also meant that those subjects could not be counted as reliable ones for depression and mobility assessments. The cognitive function of the remaining 73 subjects was good enough on the level of the evaluation that they were included in the analysis. Results from the analysis using the Chi-square test showed that there was a significant connection between the severity of depression (according to BDI-II categories) and mobility status based on TUG cut-off of 13.5 seconds ( $\chi^2 = 11.989$ ,  $df = 4$ ,  $p = 0.017$ ). Among those participants characterized as having moderate or borderline clinical depression, 68-72% were placed in the high-risk mobility group ( $>13.5$  s) whereas only 23-30% of the participants having minimal or mild depression were placed in the same group. The distribution indicates that the likelihood of an individual with a more severe case of depression being impaired in his movement was greater. The effect size turned out to be moderate (Cramer's  $V = 0.405$ ), we use Cramer's V instead of Pearson correlation  $r$  because our data is categorical not continuous in BDI and TUG and it was an indicative of an important and clinically significant linkage between increasing depressive symptoms and declining mobility performance.

**Table 1: Sociodemographic Characteristics of Participants**

Variable	Category	Frequency (n=73)	Percent (%)
Cognition	MMSE > 24	73	91.3
Cognition	MMSE < 24	7	8.8
Gender	Male	46	57.5
Gender	Female	27	33.8
Age (years)	Mean $\pm$ SD	54.27 $\pm$ 5.33	
Age (years)	Range	45–65	

**Table 2: Distribution of Beck Depression Inventory Factors**

Factor	Response	Frequency	Percent (%)
Sadness	I feel sad	64	80.0
Sadness	Not sad	1	1.3
Anxiety	Discouraged	57	71.3
Failure	Failed more than average	43	53.8
Satisfaction	No satisfaction anymore	30	37.5
Guilt	Guilty a good part of the time	32	40.0
Punish	Feel may be punished	48	60.0
Disappointment	Disappointed in myself	35	43.8

Criticism	Critical of self	26	32.5
Suicidal Thoughts	Thoughts but won't act	32	40.0
Crying	Cry more than usual	38	47.5
Irritation	More irritated than usual	59	73.8
Interest	Less interested in people	25	31.3
Indecisiveness	Put off decisions	31	38.8
Personality	Worried about appearance	37	46.3
Active Lifestyle	Extra effort to start work	39	48.8
Sleep	Not as good as before	32	40.0
Tiredness	Tired more easily	41	51.3
Appetite	Worse than usual	30	37.5
Weight	Lost >5 pounds	35	43.8
Health	Worried about aches/pains	36	45.0
Sexual Interest	No change	55	68.8

**Table 3: Correlation Between Depression and Mobility (TUG Test)**

BDI Category	<13.5 sec (Low Fall Risk)	>13.5 sec (High Fall Risk)	Total
Normal (1-10)	6 (100%)	0 (0%)	6
Mild Mood Disturbance (11-16)	21 (100%)	0 (0%)	21
Borderline Clinical Depression (17-20)	16 (69.6%)	7 (30.4%)	23
Moderate Depression (21-30)	14 (63.6%)	8 (36.4%)	22
Severe Depression (31-40)	1 (100%)	0 (0%)	1

**Table 4: Correlation between Depression and Mobility**

Test	Value	p-value
Pearson Chi-Square	11.989	0.017
Likelihood Ratio	17.046	0.002
Linear-by-Linear Association	8.386	0.004
Cramer's V	0.405	0.017

## Discussion

The present study explored the correlation between depression and mobility in patients with Parkinson's disease using the Beck Depression Inventory and the Timed Up and Go (TUG) test.<sup>8</sup> The results indicate a strong link between the severity of depression and the degree of mobility impairment with p-value as 0.017. In particular, the research found that 30.4% of borderline clinical depression patients and 36.4% of moderate depression patients were categorized as high-risk in mobility (>13.5 s) in contrast with 0% in the case of normal or mild mood disturbance patients. The above results can quantitatively interpret to mean that with the increase in depression symptoms, there is also a

corresponding increase in the risk of falls and poor mobility outcomes. Individuals suffering from moderate to borderline clinical depression have always been shown to take longer TUG test times which indicates a decline in motor performance and balance. Thus, this data supports the earlier findings of the interrelation between depression and motor dysfunction in Parkinson's disease (PD). Schrag et al. (2000), Richard et al. (2012), and recent authors (e.g., Cummings, 2020) have also reported the same doctor-patient interaction where non-motor symptoms like depression, apathy, or loss of interest are always coupled with motor impairment.<sup>9</sup>

On the other side, the high anxiety about falling accompanied by the lack of physical activity could make the situation worse by increasing the depressive symptoms. The major impact of the findings concerns the medical practice within these limits. Severe physical restrictions, which are often linked to the mental conditions such as depression, is one of the prime factors responsible for disability and poor quality of life in Parkinson's patients. Therefore, the treatment of depression in Parkinson's disease patients should be viewed as an essential coequal to the rehabilitation process. Nevertheless, the study's cross-sectional design did not give the opportunity to establish causation. Still, the moderate effect size (Cramer's V = 0.405) indicates a very strong association that definitely needs further investigation. The results hence suggest that routine, the mental health assessment and treatment should be included in the care plan for Parkinson's disease patients as it might turn out to be an exceptional way of uplifting their psychological and functional well-being.<sup>10</sup>

This age difference has important ramifications because, in the prior study conducted by E. De Pablo-Fernández, age at diagnosis was determined to be a statistically significant variable. Comparing younger with older patients, there may be differences in the course and results of the disease. Because age has a significant role in determining the dynamics of disease, the current study's smaller age range may have produced different conclusions on the course and turning points of the illness. Therefore, to gain a deeper understanding of the age-related differences in illness development and outcomes, future research should think about grouping results according to age.<sup>11</sup>

The results are in line with another study that showed group cognitive behavioral therapy (CBT) can successfully lower anxiety and depression in PD patients conducted by S. A. R. Yazd et al. In contrast, the findings of our study shed more light on the particular cause of the participants' indecision. Although indecisiveness was not specifically

addressed as a separate outcome in the prior study, the general decrease in anxiety and depression may have a knock-on effect that enhances decision-making skills.<sup>12</sup>

A complex association between depression and self-perception in people with Parkinson's disease (PD) is suggested by the confluence of past and present studies. The current study clarifies specific issues pertaining to body image and self-perception, while the first study emphasizes the significant prevalence and severity of depression according to m. Mayeli et al. These worries may either cause or worsen depressive symptoms, indicating that treatments focused on enhancing one's own image and resolving problems with body image may help PD sufferers feel less depressed.<sup>13</sup>

While a small percentage continue to be as active as they were previously, the majority find it difficult to lead an active lifestyle, which is consistent with the high rates of anxiety and sadness shown in the earlier study conducted by f. Chuquilín- arista. The results of prior studies on sadness and anxiety have emphasized the potential wider impact of Parkinson's disease on physical and mental health, which may be reflected in the extra work and challenges our study participants had in maintaining an active lifestyle. This comparison emphasizes how crucial it is to treat mental and physical health issues in order to enhance the overall quality of life for Parkinson's disease patients.<sup>14</sup>

The current study's results reinforce the already-existing notion that there is a strong correlation between the severity of depression and the disturbances caused by sleep, in line with the so-called earlier studies. Though sleep was not treated as an independent factor, the respondents commonly manifested the signs of the problem in the form of difficulty in staying asleep and early-morning awakenings which were all included in the sleep-related items of the BDI-II. The BDI-II trends of depressive symptoms give a more detailed picture of how depression manifests in Parkinson's disease (PD) and are consistent with the findings of D. B. Kay et al. regarding the interaction between sleep and mood in PD. It is important for the clinicians to acknowledge these pattern of symptoms as they indicate the necessity of treating sleep quality while treating depression in PD even if it is not the primary variable under study.<sup>15</sup>

**Limitations:** The constraints of the study were caused by the small number of participants (n=73), and the use of non-probability convenience sampling; these factors may limit the applicability of the findings to wider populations (from tertiary care hospitals in Lahore). Moreover, since it was a cross-sectional design, the research could only detect relations but not cause-and-effect links between depression and mobility.

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## Conclusion

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There is a strong link between depression and limited mobility as well as increased risk of falls for patients suffering from PD. Therefore, it is necessary to routinely screen and manage depressive symptoms at an early stage as part of the PD care pathway in order to improve the patient's mobility and quality of life.

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