Epidemiological Distribution of Parkinson Disease by Age and Gender in Pakistan: A Population-Based Approach

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Abstract

Background:

Parkinson disease is a progressive neurological disorder with motor and non-motor symptoms, posing a rising health burden in Pakistan. This study aimed to investigate the age and gender wise distribution of Parkinson disease in Pakistan using a population-based approach.

Methods:

A cross-sectional study was conducted on 437 clinically diagnosed PD patients in twin cities; Rawalpindi and Islamabad from June 2024 to February 2025. Patients presenting with classical symptoms of Parkinson disease (PD) were identified. Those with essential tremor, drug-induced Parkinsonism, extrapyramidal syndromes, or a history of stroke were excluded. Data were collected on patient age, gender, residency, disease severity (based on the Hoehn and Yahr scale), and classical motor symptoms. Statistical analysis was performed to evaluate associations between demographic variables and disease prevalence using chi-square tests, with a p-value <0.05 considered statistically significant.

Results:

Of the 437 patients, 340 (77.8%) were male and 97 (22.2%) were female (p = 0.003). Urban residents comprised 296 (67.7%) of the cohort, while rural residents accounted for 141 (32.3%) (p = 0.001). The majority of PD cases occurred between 51–70 years of age. Stage 3 was the most common severity level in both genders. Rigidity and gait disturbance were the most frequently observed motor symptoms, with significant gender-specific differences noted.

Conclusion:

This study highlights significant age, gender, and residency-based disparities in Parkinson disease prevalence in Pakistan. These findings provide essential baseline data for national-level planning, emphasize the need for early diagnosis, and support the development of targeted interventions, particularly for underserved rural populations.

Index Terms- Parkinson Disease, Epidemiology, Age and Gender Distribution, Neurological Disorder, Prevalence, Population based study

I. Introduction

Parkinson disease (PD) is a progressive neurodegenerative disorder primarily characterized by motor dysfunctions such as bradykinesia, rigidity, resting tremor, and postural instability [1]. In addition to motor symptoms, patients may experience a broad range of non-motor features including cognitive decline, mood disorders, sleep disturbances, and autonomic dysfunction, all of which contribute to substantial morbidity and diminished quality of life [2-3]. PD is the second most prevalent neurodegenerative condition after Alzheimer disease, and it poses a significant burden on individuals, families, caregivers, and healthcare systems worldwide [4]. The etiology of PD is multifactorial, involving complex interactions between genetic predisposition and environmental exposures. With advancing age identified as the most consistent risk factor, the global prevalence of PD has increased significantly in recent decades, primarily due to aging populations [5].

Globally, it is estimated that more than 10 million people live with Parkinson disease, with incidence rates rising in both developed and developing regions [6]. According to the Global Burden of Disease (GBD) study, the number of individuals living with PD more than doubled between 1990 and 2016, with projections indicating continued growth. In high-income countries such as the United States, Canada, and members of the European Union, substantial epidemiological data have helped shape health policies, inform early detection strategies, and guide therapeutic innovations [7-10]. However, in many low- and middle-income countries, especially in South Asia, epidemiological data on Parkinson disease remain sparse or

under-reported. This paucity of data hinders the development of effective, context-specific public health responses and clinical interventions [1].

Age and gender are critical variables in understanding the epidemiological trends of Parkinson disease. Numerous studies from Western countries have shown a clear association between increasing age and the risk of PD, with peak incidence typically observed between 60 and 80 years of age. Furthermore, gender-specific patterns have been consistently observed, with males having a higher risk of developing PD compared to females. These gender disparities have been attributed to hormonal, genetic, and environmental differences, yet such conclusions are largely based on data from Western populations. The applicability of these findings to the Pakistani context remains unclear due to limited epidemiological investigations at the national level [4-7].

Pakistan, a lower-middle-income country with a population exceeding 240 million, is currently undergoing a demographic transition characterized by increased life expectancy and a growing elderly population [7]. Consequently, the burden of age-related neurological diseases such as Parkinson is expected to rise. Despite this epidemiological shift, there is a lack of robust, population-based data on the prevalence and demographic distribution of Parkinson disease in the country. Most existing studies are hospital-based and often limited to urban centers, potentially leading to underestimation of disease prevalence in rural and underserved regions. Moreover, cultural stigma, limited awareness, and inadequate access to neurological services contribute to delayed diagnosis and underreporting of PD cases, complicating efforts to estimate the true burden of the disease [1].

While international studies have extensively explored the epidemiology of Parkinson disease with well-documented age and gender-specific trends, there is a notable absence of similar population-based research within the Pakistani context [7]. Most available data in Pakistan are derived from small-scale clinical audits or hospital registries, which are inherently limited in scope, generalizability, and methodological rigor. Moreover, no comprehensive national-level study has systematically examined the age and gender specific distribution of PD using a population-based approach. This lack of reliable epidemiological data restricts the ability of healthcare planners, policymakers, and clinicians to make informed decisions regarding the allocation of resources, the development of screening programs, and the provision of specialized care services for PD patients. A structured, data-driven understanding of PD epidemiology in Pakistan is urgently needed to bridge this critical gap.

In light of the growing international emphasis on neurodegenerative disease surveillance and pressing need for context-specific data in Pakistan, this study aims to determine the epidemiological distribution of Parkinson disease in Pakistan across different age groups and genders, assess gender-based differences in disease prevalence and age of onset, and provide population-level data to support evidence-based public health planning and policy development.

II. MATERIALS AND METHODS

An observational cross-sectional study was conducted from June 2024 to February 2025 across outpatient department of public and private hospitals, as well as rehabilitation centers situated in various areas of Islamabad and Rawalpindi, Pakistan. 2,350 individuals were screened using non-probability consecutive sampling technique. A total of 1037 individuals were included; 437 confirmed PD patients and 600 age and gender matched healthy controls. 1313 were excluded from the study among which 343 were excluded due to secondary and atypical Parkinsonism (drug-induced & vascular forms). Since this was a population-based survey utilizing all available data from the target population during the specified period, no prior sample size calculation was required. Study included adults aged 40 years and above who were clinically diagnosed with idiopathic Parkinson's disease (PD) by a neurologist using the UK Brain Bank Criteria [11]. Participants were required to provide informed consent and be willing to participate. Individuals with essential tremor, drug-induced Parkinsonism, extrapyramidal syndromes, Wilson disease, Hallervorden-Spatz syndrome, and history of cerebrovascular events were excluded.

Study followed a three-phase recruitment and evaluation process. In the first phase, patients exhibiting classical symptoms of PD were registered, and those with overlapping conditions such as essential tremor, extrapyramidal syndromes, drug-induced Parkinsonism, and stroke were excluded. Second phase involved detailed interviews with enrolled patients to gather sociodemographic information (age, gender, residence, occupation, ethnicity, and family history) and relevant medical history. In the third and final phase, clinical and neurobehavioral assessments were performed by a qualified neurologist using standardized and validated instruments: Unified Parkinson Disease Rating Scale (UPDRS) for disease severity [12], Hoehn and Yahr Scale for motor and non-motor symptoms severity at a certain stage of disease with respect to age and gender [13], Mini-Mental State Examination (MMSE) [14] for cognitive status, and the Hamilton Depression Rating Scale (HAM-D) [15] for depressive symptoms. Differential diagnoses such as Wilson's disease and Hallervorden-Spatz syndrome were ruled out through pathological evaluations to eliminate overlapping movement disorders. All PD patients were already receiving standard pharmacological treatment, including Levodopa, Carbidopa, Ropinirole, Amantadine sulphate, and Clonazepam.

Descriptive statistics were used to summarize demographic and clinical variables, stratified by age and gender. Categorical variables were expressed as frequencies and percentages. Chi-square test was applied to assess associations between variables. Statistical analysis was performed using SPSS version 27.0, and a p-value less than 0.05 was considered statistically significant.

III. RESULTS

Out of 437 patients, 340 were male (77.80%) and 97 were female (22.20%), with a statistically significant gender difference (p = 0.003). Regarding residency, 296 patients (67.73%) were from urban areas, while 141 (32.27%) were from rural settings. The association between residency and Parkinson's disease was also statistically significant (p = 0.001) as mentioned in Table 1.

Table 1: Demographic Distribution of Parkinson Disease Patients (N = 437)

Variable	Category	PD Patients (n)	PD Patients Percentage (%)	*p*-value
Gender	Male	340	77.80	0.003
	Female	97	22.20	
Residency	Urban	296	67.73	0.001
	Rural	141	32.27	

Table 2 outlines the age-wise distribution of Parkinson's disease cases across genders. In the ≤40 age group, 25 males (5.72%) and 8 females (1.83%) were affected (p = 0.041). In the 41–50 age group, 45 males (10.30%) and 36 females (8.24%) had PD (p = 0.215). The highest prevalence among males was in the 61–70 age group with 79 cases (18.08%), while among females, the 51–60 age group showed the highest count with 51 cases (11.67%). Significant gender differences were observed in the ≤ 40 (p = 0.041) and 61–70 (p = 0.004) age brackets.

Table 2: Age-wise Prevalence of Parkinson's Disease by Gender (N = 437)

Age Group	Male (n)	Male (%)	Female (n)	Female (%)	*p*-value
≤40	25	5.72	8	1.83	0.041
41–50	45	10.30	36	8.24	0.215
51–60	68	15.56	51	11.67	0.118
61–70	79	18.08	38	8.70	0.004
71–80	44	10.07	27	6.17	0.091
>80	9	2.06	7	1.60	0.635

Figure 1 represents disease severity based on the Hoehn and Yahr rating scale. The most common stage was Stage 3, affecting 149 patients total, with 149 males (34.2%) and 33 females (34%). This indicates that moderate disease severity is prevalent in both genders.

Figure 1: Distribution of Parkinson's Disease Severity According to the Hoehn and Yahr Rating Scale

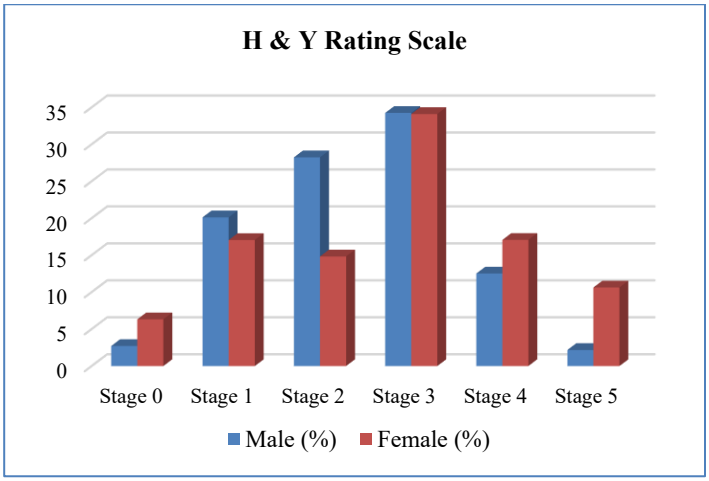
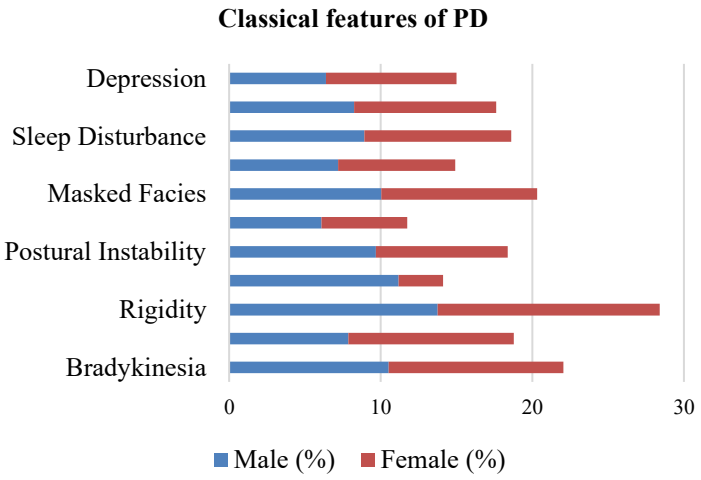


Figure 2 shows the frequency and percentage of key classical motor symptoms in male and female Parkinson's disease patients. Rigidity was the most frequently reported symptom, seen in 316 males (92.9%) and 97 females (100%), with a statistically significant difference (p < 0.05). Other common features included bradykinesia (71.1% males, 78.7% females), rest tremor (53.2% males, 74.4% females), and gait disturbance (75.5% males, 20.1% females), highlighting notable gender-specific symptom variations.

Figure 2: Gender-wise Distribution of Classical Motor Features in Parkinson's Disease Patients



IV. DISCUSSION

Parkinson disease (PD) remains a major public health challenge globally, with its burden expected to rise due to aging populations and increasing life expectancy [16]. In Pakistan, the projected increase in PD cases from over one million currently to approximately 1.2 million by 2030 reflects this demographic [17]. Our study contributes to the growing body of local epidemiological data essential for tailoring healthcare strategies

to regional needs. Consistent with global trends, our findings reveal a statistically significant gender disparity, with 77.8% of patients being male and 22.2% female (p = 0.003). This aligns with previous studies suggesting higher PD prevalence among men [18]. Possible explanations include environmental exposures (e.g., pesticides), lifestyle factors, and the neuroprotective effects of estrogen in females [19]. However, the precise mechanisms remain unclear, warranting further investigation.

Residency also showed a significant association with PD (p = 0.001), with 67.73% of patients from urban areas and 32.27% from rural regions. This urban predominance may reflect better diagnostic access, while the rural representation highlights potential underdiagnosis and environmental risk factors such as agrochemical exposure [17]. Moreover, cultural stigma and limited healthcare infrastructure in rural Pakistan may contribute to delayed diagnosis and poorer outcomes. Age wise distribution revealed that 76.3% of cases occurred between 51 and 70 years, reinforcing the established link between aging and PD pathogenesis [16]. Among males, highest prevalence was in the 61–70 age group (18.08%), while females peaked in the 51–60 bracket (11.67%). Significant gender differences were noted in the ≤40 (p = 0.041) and 61–70 (p = 0.004) age groups. These findings suggest that age of onset may vary by gender and influence disease progression, with late-onset PD often associated with faster motor decline [20]. Using the Hoehn and Yahr scale, Stage 3 was the most common diagnosis, affecting 34.2% of males and 34% of females. This stage indicates moderate disease severity and may reflect delays in seeking care or limited access to specialized neurology services [21]. Earlier-stage diagnoses are more common in countries with robust screening programs and higher health literacy. Motor symptom analysis showed rigidity as the most prevalent feature, present in 92.9% of males and 100% of females (p < 0.05). Other symptoms included bradykinesia (71.1% males, 78.7% females), rest tremor (53.2% males, 74.4% females), and gait disturbance (75.5% males, 20.1% females). These gender-specific variations may be influenced by biological susceptibility, symptom perception, and reporting behaviors. The dominance of motor symptoms underscores reliance on clinical diagnosis in Pakistan, where advanced imaging and genetic testing remain limited [22].

While this study provides important insights into the epidemiological landscape of Parkinson disease in Pakistan, certain limitations must be acknowledged. The study was confined to the twin cities and may not be fully representative of national trends and cross-sectional design limits causal inferences. Diagnostic confirmation was primarily clinical, with limited use of genetic testing or neuroimaging, which may have introduced classification bias. Future research should aim to conduct multicenter, longitudinal studies that include diverse geographical regions and utilize advanced diagnostic modalities.

V. Conclusion

This study highlights critical role of age, gender, and residency in shaping the epidemiological profile of Parkinson disease in Pakistan. By identifying key demographic and clinical patterns, it provides a foundation for improved diagnostic accuracy, patient care, and public health strategies. Future national-scale studies are essential to capture the full spectrum of disease burden and inform evidence-based policymaking tailored to the evolving demographic landscape of Pakistan.

APPENDIX

None

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Authors Contributions

1. **Conceptualization, Methodology, Data Collection:** Muhammad Hammad, Khadija Shakoor, Sadaf Fardoos
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Ethics Approval

Ethical review board of Riphah International University, Islamabad, granted approval under letter no: (MS-HCM-35197/21). Research was conducted in compliance with ethical standards, adhering to the Declaration of Helsinki and relevant national regulations.

Informed consent

Verbal consent was obtained from the subjects.

Availability of Data and Materials

Datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request. Due to ethical and privacy concerns, the data are not publicly available.

Competing Interests

Authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

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