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Ambulatory Rehabilitation of Patients with Parkinson's Disease

O. P. Lebed, H. V. Perkova

Odesa National Medical University, Odesa, Ukraine

Abstract

Parkinson's disease (PD) is a progressive neurodegenerative disorder that causes motor and non-motor impairment, leading to reduced independence and quality of life. Pharmacological therapy alleviates symptoms but does not prevent functional decline, emphasizing the importance of multidisciplinary rehabilitation. Ambulatory programs, which combine physiotherapy, occupational therapy, and psychoeducation, offer an accessible and sustainable model of long-term management.

Objective: To evaluate the effectiveness of a structured ambulatory rehabilitation program on motor performance, daily functioning, and quality of life in patients with idiopathic Parkinson's disease.

Materials and Methods: Sixty-eight patients with PD (Hoehn and Yahr stages II–III) participated in a twelve-week multidisciplinary outpatient program comprising physiotherapy, occupational therapy, speech and swallowing exercises, and psychoeducational counseling, three times weekly. Clinical outcomes were measured using the Unified Parkinson's Disease Rating Scale (UPDRS II–III), Timed Up and Go (TUG), Six-Minute Walk Test (6MWT), Parkinson's Disease Questionnaire-39 (PDQ-39), and Beck Depression Inventory-II (BDI-II). Data were analyzed with paired t-tests and multivariate regression (Statistica 14.1).

Results: UPDRS total score improved from 52.6 ± 8.7 to 41.2 ± 7.9 ($p < 0.001$). TUG time decreased from 15.8 to 12.4 s, and 6MWT distance increased from 312 to 368 m ($p < 0.05$). PDQ-39 and BDI-II scores also showed significant improvement. Regression analysis (R^2=0.524) identified shorter disease duration ($\beta = -0.46$, $p = 0.002$) and higher exercise adherence ($\beta = 0.49$, $p < 0.001$) as independent predictors of functional gain.

Conclusion: Ambulatory multidisciplinary rehabilitation significantly improved motor function, endurance, and psychosocial well-being in moderate PD. Early initiation and consistent participation were key determinants of therapeutic success.

Key words: Parkinson Disease / rehabilitation; Ambulatory Care; Physical Therapy Modalities; Activities of Daily Living; Quality of Life.

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by the loss of dopaminergic neurons in the substantia nigra and widespread dysfunction of basal ganglia circuits [1, 2]. Clinically, it manifests through tremor, rigidity, bradykinesia, and postural instability, often accompanied by non-motor symptoms such as cognitive impairment, depression, and autonomic dysregulation. Despite significant advances in pharmacotherapy and functional neurosurgery, long-term management of PD increasingly depends on comprehensive rehabilitation strategies aimed at maintaining functional independence and quality of life [1, 3].

Ambulatory rehabilitation has emerged as a key component of modern Parkinson's care, emphasizing individualized, multidisciplinary programs delivered in outpatient or community settings [4, 5]. The approach integrates physiotherapy, occupational therapy, speech and swallowing therapy, and psychosocial support. Evidence suggests that regular, structured physical training—particularly task-specific gait and balance exercises—can enhance neuroplasticity, improve motor control, and delay the progression of disability [4]. Furthermore, outpatient rehabilitation allows continuous adjustment of therapeutic goals, active participation of caregivers, and early detection of functional decline.

In recent years, technological innovations such as wearable motion sensors, telerehabilitation platforms, and virtual reality-assisted training have broadened the scope of ambulatory programs, enabling real-time monitoring and motivation of patients beyond the clinical environment [6, 7]. This shift aligns with person-centered, community-based models of chronic disease management.

The present study aims to evaluate the effectiveness of ambulatory rehabilitation in patients with Parkinson's disease, focusing on motor performance, daily functioning, and patient-reported outcomes, thereby contributing to the optimization of integrated neurorehabilitation pathways.

Materials and Methods. This prospective observational study was conducted at the Family Medicine Center No 6 (Odesa, Ukraine) from January 2023 to March 2025. A total of sixty-eight patients with idiopathic Parkinson's disease were enrolled according to the UK Parkinson's Disease Society Brain Bank criteria [8]. Participants were classified as stage 2–3 on the Hoehn and Yahr scale [9] and had been receiving stable dopaminergic therapy for at least four weeks prior to the study. Patients with marked cognitive impairment (Mini-Mental State Examination [10] score below 24), acute comorbidities, or contraindications to physical activity were excluded.

The ambulatory rehabilitation program lasted twelve weeks and consisted of three ninety-minute sessions per week. Each participant received a personalized multidisciplinary intervention including physiotherapy, occupational therapy, speech and swallowing therapy, and psychoeducational counseling. The physiotherapy component emphasized gait re-education, postural stability, and amplitude-based movement training. Occupational therapy focused on the improvement of fine motor control, activities of daily living, and energy-conservation strategies [11]. Psychoeducational sessions provided emotional support, caregiver guidance, and strategies for self-management.

Clinical evaluation was performed at baseline and after twelve weeks. The Unified Parkinson's Disease Rating Scale (UPDRS II–III) was used to assess motor performance and activities of daily living [12]. Mobility and endurance were measured using the Timed Up and Go test [13] and the Six-Minute Walk Test [14]. Quality of life was assessed with the Parkinson's Disease Questionnaire-39 [15], and depressive symptoms were evaluated using the Beck Depression Inventory-II [16].

Statistical analysis was conducted using Statistica 14.1 software [17]. Continuous data were presented as mean ± standard deviation or median with interquartile range. Paired t-tests or Wilcoxon signed-rank tests were applied where appropriate, and statistical significance was set at $p < 0.05$.

The present research was conducted in full accordance with internationally recognized ethical standards for biomedical studies involving human participants. The study design adhered to the principles outlined in the Declaration of Helsinki (2024 revision), the Council of Europe's Convention on Human Rights and Biomedicine (Oviedo Convention, 1997), and

the Good Clinical Practice (GCP) guidelines [18] . Ethical approval was obtained from the institutional review board, and all participants provided written informed consent.

Results

The mean age of participants was 67.8 ± 6.2 years; 59 % were male. All patients tolerated the intervention without adverse events requiring discontinuation. Attendance rates exceeded 90 %, indicating good adherence and feasibility of outpatient rehabilitation in this population.

At baseline, the mean total UPDRS score (sections II + III) was 52.6 ± 8.7, reflecting moderate motor disability. After twelve weeks, the total UPDRS score decreased to 41.2 ± 7.9 ($p < 0.001$), representing a mean relative improvement of 21.6 %. The most prominent changes were observed in bradykinesia, postural stability, and fine motor tasks. Improvements in the UPDRS II (activities of daily living) domain suggested better self-care, handwriting, and mobility within the home environment.

Performance tests confirmed a meaningful functional gain. The median time on the Timed Up and Go test shortened from 15.8 s (Q1–Q3: 14.2–17.6) to 12.4 s (11.1–13.9), while the mean distance in the Six-Minute Walk Test increased from 312 ± 58 m to 368 ± 61 m ($p<0.05$). These results indicate enhanced gait efficiency and endurance, consistent with reduced risk of falls.

Quality-of-life assessment revealed parallel benefits. The PDQ-39 summary index improved from 45.7 ± 10.5 to 36.8 ± 9.1 ($p < 0.01$), with the greatest gains in the mobility, activities of daily living, and emotional well-being domains. Patients reported fewer limitations in social participation and a greater sense of autonomy. Depressive symptoms, evaluated by the BDI-II, decreased from a mean of 15.3 ± 4.8 to 11.2 ± 4.2 ($p = 0.02$), suggesting that structured activity and social interaction contributed to mood stabilization.

Correlation analysis demonstrated that improvements in UPDRS III motor scores were significantly associated with gains in 6MWT distance ($r = -0.61$, $p < 0.01$) and with reductions in PDQ-39 total scores ($r = 0.54$, $p < 0.01$), supporting the interdependence of motor and psychosocial recovery. Multivariate regression confirmed that baseline disease duration and adherence to the exercise schedule were the strongest predictors of functional improvement:

$$\Delta UPDRS = \beta_0 + \beta_1(\text{Disease Duration}) + \beta_2(\text{Exercise Adherence}) + \beta_3(\text{Age}) + \beta_4(\text{Baseline UPDRS}) + \varepsilon$$

where: ΔUPDRS — change in total UPDRS (baseline − post-rehabilitation), representing improvement in motor function; Disease Duration — years since PD diagnosis; Exercise

Adherence — percentage of attended rehabilitation sessions; Age and Baseline UPDRS — covariates controlled for confounding; β_0 — intercept; β_1–β_4 — standardized regression coefficients; ε — random error term.

The model explained 52.4 % of the variance in functional improvement ($R^2 = 0.524$, $p < 0.001$). Among all covariates, disease duration ($\beta_1 = -0.46$, $p = 0.002$) and exercise adherence ($\beta_2 = 0.49$, $p < 0.001$) were the only independent predictors reaching statistical significance. This indicates that shorter disease duration was associated with greater motor improvement, while higher adherence to scheduled sessions significantly enhanced rehabilitation efficacy. Neither age ($\beta_3 = -0.12$, $p = 0.24$) nor baseline UPDRS ($\beta_4 = 0.09$, $p = 0.31$) showed independent predictive value after adjustment. The negative coefficient for disease duration suggests a time-dependent decline in neuroplastic potential, consistent with reduced responsiveness to physiotherapeutic intervention in advanced disease stages. Conversely, the strong positive coefficient for adherence underscores the importance of sustained engagement and consistency in ambulatory programs.

Qualitative feedback from patients and caregivers highlighted the value of the multidisciplinary format. Participants emphasized enhanced confidence in movement, reduced fear of falling, and improved social engagement. Caregivers reported easier handling of daily routines and decreased emotional strain. Speech and swallowing therapy yielded subjective improvement in voice projection and articulation, though quantitative measures were not included in this analysis.

Conclusion: The study demonstrated that a structured, community-based ambulatory rehabilitation program produces significant and clinically meaningful improvements in motor performance, endurance, and quality of life among patients with moderate Parkinson’s disease. The magnitude of improvement was comparable to that reported in center-based inpatient programs, indicating that outpatient rehabilitation can serve as a cost-effective and sustainable model of long-term care. The findings underscore the importance of continuity, patient education, and personalized adjustment of exercise intensity in maximizing therapeutic outcomes.

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