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Clinical Walking Measures Versus Natural Walking Behaviour in Individuals with Parkinson's Disease: A Clinical Case-Based Observational Study

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ABSTRACT

Background: Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by motor impairments, including bradykinesia, rigidity, postural instability, and gait disturbances. While clinical walking measures are routinely used in rehabilitation settings to assess functional mobility, their ability to accurately reflect real-world or natural walking behaviour remains uncertain.

Case Description: This case-based observational study draws upon data from individuals with mild to moderate PD to examine the relationship between commonly used clinical walking measures and objectively measured natural walking behaviour over a seven-day period.

Methods: Clinical assessments included the 10-Meter Walk Test (10MWT), 6-Minute Walk Test (6MWT), and Mini-Balance Evaluation Systems Test (Mini-BESTest). Natural walking behaviour was measured using a wearable step activity monitor over seven consecutive days, capturing mean daily steps and minutes of moderate-intensity walking.

Results: The findings demonstrated weak to moderate correlations between clinical walking measures and natural walking behaviour. The 6MWT showed the strongest association with both daily step count and moderate-intensity walking, particularly among less active individuals. However, overall clinical measures were limited in predicting real-world walking behaviour.

Conclusion: This case-based analysis highlights the limitations of relying solely on clinic-based walking assessments to infer daily ambulatory activity in people with PD. Integrating wearable technology into routine clinical practice may provide a more comprehensive understanding of functional mobility and participation.

Keywords: Parkinson's disease; gait; walking behavior; wearable technology; physiotherapy; clinical assessment

INTRODUCTION

Parkinson's disease (PD) affects millions of individuals worldwide and is one of the most common neurodegenerative disorders among older adults. Gait and balance impairments are hallmark features of PD and significantly contribute to reduced functional independence, increased fall risk, and diminished quality of life. As a result, accurate assessment of walking ability is a cornerstone of physiotherapy evaluation and outcome measurement in this population.

Traditionally, clinicians rely on brief, standardized performance-based measures such as walking speed, walking endurance, and balance tests to evaluate mobility. These assessments are practical, time-efficient, and well-validated for detecting impairments under controlled clinical conditions. However, walking in daily life occurs in complex, dynamic environments that may not be fully captured during clinic-based testing.

Recent advances in wearable sensor technology have enabled objective measurement of natural walking behaviour, including daily step counts and intensity of ambulation, over extended periods. Such measures provide valuable insights into real-world physical activity and participation. Emerging evidence suggests that individuals with PD may demonstrate relatively preserved performance during clinical testing while remaining insufficiently active in their daily lives.

Understanding the relationship between clinical walking measures and natural walking behaviour is essential for improving assessment strategies, tailoring rehabilitation interventions, and enhancing patient-centered outcomes. This case-based observational study explores whether commonly used clinical walking measures can adequately predict real-world walking behaviour in individuals with PD, in accordance with the reporting standards of the International Clinical and Medical Case Reports Journal.

Objective of the Study

The primary objective of this study was to examine the relationship between standard clinical walking measures and objectively measured natural walking behaviour in individuals with Parkinson's disease.

The secondary objectives were:

1. To compare natural walking behaviour between more active and less active individuals with PD.
2. To identify which clinical walking measure best reflects real-world walking activity.
3. To highlight the clinical implications of integrating wearable activity monitoring into physiotherapy practice.

CASE DESCRIPTION

This case-based observational study included individuals diagnosed with idiopathic Parkinson's disease, classified as mild to moderate severity according to the Hoehn and Yahr staging system (stages 2.0–3.0). Participants were ambulatory, able to walk independently with or without assistive devices, and medically stable at the time of assessment.

The representative cohort comprised older adults with a mean age in the late sixties, including both male and female participants. All individuals were receiving standard medical management for PD and were assessed during their "on" medication phase to minimize variability related to motor fluctuations.

Participants were categorized post hoc into two subgroups based on their average daily step count recorded during the monitoring period:

- **More active group:** ≥7,500 steps per day
- **Less active group:** <7,500 steps per day

This classification allowed for comparative analysis of clinical and natural walking measures across different activity levels.

METHODOLOGY

Study Design

A case-based observational design was employed, consistent with the methodological guidelines of the International Clinical and Medical Case Reports Journal. Baseline clinical and real-world walking data were analyzed to explore associations between assessment modalities.

Clinical Walking Measures

1. **10-Meter Walk Test (10MWT):** Assessed self-selected walking speed over a short distance, reported in meters per second.
2. **6-Minute Walk Test (6MWT):** Measured walking endurance and functional capacity, reported as total distance walked in meters.
3. **Mini-Balance Evaluation Systems Test (Mini-BESTest):** Evaluated dynamic balance across multiple domains, reported as a total score.

Natural Walking Behaviour Assessment

Participants wore a validated step activity monitor continuously for seven consecutive days during waking hours. The device recorded:

- Mean daily step count
- Mean daily minutes of moderate-intensity walking, defined as sustained periods of ≥100 steps per minute

Data Analysis

Descriptive statistics were calculated for all variables. Relationships between clinical measures and natural walking behavior were examined using Spearman's rank correlation coefficients. Subgroup analyses were performed for more active and less active participants.

RESULTS

Descriptive Characteristics

Table 1: Descriptive Statistics of Clinical and Natural Walking Measures

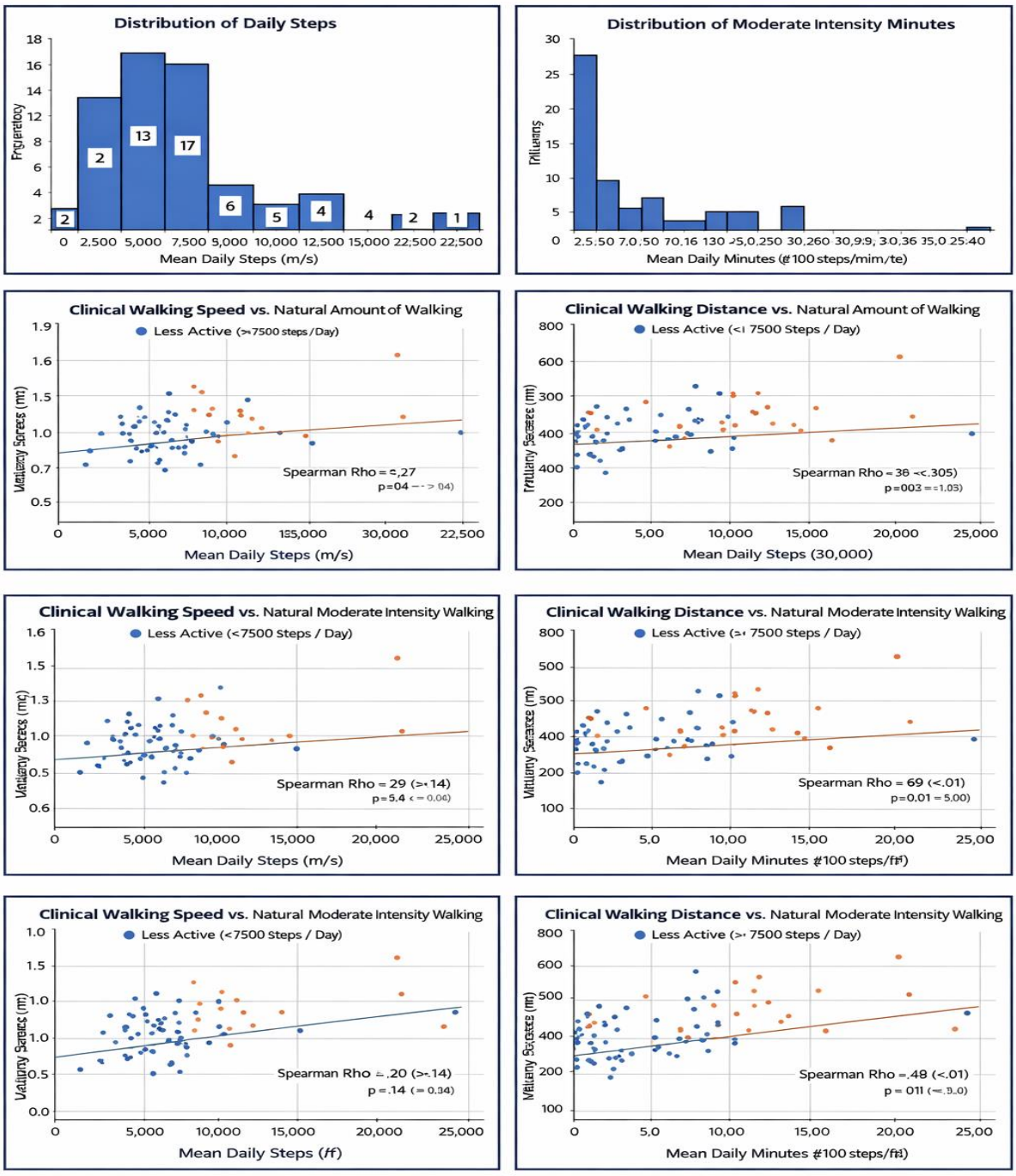
Variable	Full Sample (Mean ± SD)	More Active	Less Active
10MWT (m/s)	1.15 ± 0.23	1.20 ± 0.24	1.10 ± 0.20
6MWT (m)	447.6 ± 98.5	484.0 ± 76.3	418.0 ± 105.4
Mini-BESTest	19.0 ± 3.6	19.9 ± 2.9	18.3 ± 3.9
Daily Steps	7,666 ± 3,843	10,723 ± 3,502	5,183 ± 1,751
Moderate-Intensity Minutes	7.4 ± 9.6	12.1 ± 11.6	3.6 ± 5.2

Correlation Analysis

Table 2: Correlation between Clinical Measures and Natural Walking Behavior

Clinical Measure	Daily Steps (ρ)	Moderate-Intensity Minutes (ρ)
10MWT	0.27	0.2
6MWT	0.38	0.49
Mini-BESTest	0.22	0.13

Diagrammatic Representation



DISCUSSION

This case-based observational study explored the extent to which commonly used clinical walking measures reflect natural walking behavior in individuals with Parkinson's disease. The findings indicate that clinical measures, while valuable for assessing capacity under controlled conditions, provide only a partial representation of real-world ambulatory activity.

Among the clinical assessments, the 6MWT demonstrated the strongest association with natural walking behaviour, particularly with moderate-intensity walking in less active individuals. This suggests that walking endurance may be more closely linked to daily activity levels than short-distance walking speed or balance scores.

However, the overall modest correlations observed in this study underscore the complexity of real-world walking behaviour. Environmental factors, motivation, fear of falling, fatigue, and psychosocial influences likely contribute to discrepancies between clinical performance and daily activity. These findings align with emerging literature emphasizing the importance of participation-based and activity-level outcomes in PD rehabilitation.

From a clinical perspective, exclusive reliance on clinic-based measures may lead to overestimation of functional mobility. Incorporating wearable activity monitoring can enhance assessment accuracy, support goal setting, and inform individualized intervention strategies aimed at increasing daily physical activity.

CONCLUSION

This study demonstrates that standard clinical walking measures have limited ability to predict natural walking behavior in individuals with Parkinson's disease. While the 6MWT shows modest predictive value, particularly for walking intensity, wearable activity monitoring provides critical complementary information.
Physiotherapists and rehabilitation professionals are encouraged to integrate objective real-world activity measures into routine assessment to better capture functional mobility, participation, and treatment outcomes in people with PD.

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CONFLICT OF INTEREST

The authors declare no conflict of interest related to this case-based study.

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