BRIDGING THE GAP: EQUITY, INCLUSION, AND WELLBEING FOR DIVERSE HEALTH STATUSES IN AGEING POPULATIONS

COLMARE IL DIVARIO: EQUITÀ, INCLUSIONE E BENESSERE RIFLETTONO DIVERSI STATI DI SALUTE NELLA POPOLAZIONE SENILE

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ABSTRACT
In a comparative study of patients with Parkinson's disease and geriatric frailty, we assessed motor and non-motor symptoms, anxiety, and social exclusion factors. Structural disparities increase isolation in both groups. Our findings show that robotics and telemedicine help reduce social stigma, anxiety, and negative illness perception. They also improve motor symptoms, supporting inclusion and emotional well-being and advancing a more equitable and connected model of care.

In uno studio comparativo su pazienti con malattia di Parkinson e fragilità geriatrica, abbiamo valutato sintomi motori e non motori, ansia e fattori di esclusione sociale. Le disparità strutturali aumentano l'isolamento in entrambi i gruppi. I nostri dati mostrano che robotica e telemedicina aiutano a ridurre lo stigma sociale, l'ansia e la percezione negativa della malattia, migliorando i sintomi motori e promuovendo inclusione, benessere emotivo e un modello di cura più equo.

KEYWORDS
Social avoidance, anxiety, Parkinson's Disease, Frailty, exclusion factors.
Prevenzione sociale, ansia, morbo di Parkinson, fragilità, fattori di esclusione.

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Introduction

People living with Parkinson's Disease often experience a profound reduction in social engagement. Fearing visible symptoms, such as tremors that could result in spilling a drink in public, can cause embarrassment and avoidance. Many people avoid going out because they risk falling and hesitate to engage in conversation, fearing they may forget words or lose track of thoughts. Individuals can be isolated, and their sense of dignity and connection can be diminished by the limitations imposed not just by the disease but also by the anticipation of judgment (Prenger et al., 2020). These limitations, imposed not just by the disease but by the anticipation of judgment, can isolate individuals and diminish their sense of dignity and connection (Crooks et al., 2025).

For many individuals, the visibility of motor symptoms in public settings evokes a persistent fear of being judged, misunderstood, or pitied. This fear is not unfounded; patients frequently report feeling scrutinised or avoided, particularly when their symptoms are misinterpreted as signs of intoxication, cognitive impairment, or frailty (Tibaud et al., 2020).

Such experiences contribute to a growing sense of inadequacy and self-consciousness, which can escalate into social anxiety. Over time, this anxiety fosters avoidance behaviours such as declining invitations, withdrawing from group activities, or limiting time spent in public spaces. The result is a gradual erosion of social participation, which diminishes quality of life and deprives individuals of critical emotional and cognitive stimulation (Gley et al., 2025).

Importantly, this process is not merely reactive. The anticipation of stigma, what some researchers term 'felt stigma,' can be just as debilitating as overt discrimination. It alters self-perception, undermines confidence, and can influence individuals' engagement with healthcare services. In this context, stigma becomes a compounding factor in disease progression, exacerbating psychological distress and potentially accelerating cognitive decline (Broersma et al., 2018).

Addressing stigma in PD, therefore, requires more than clinical management; it demands a broader, interdisciplinary approach that includes public education, patient empowerment, and structural changes in how society accommodates visible disability. Only by confronting these social dimensions can we hope to support the full well-being of people living with Parkinson's disease (Soilemezi et al., 2025).

"Stigma represents a critical, yet often underestimated, dimension of the Parkinson's disease (PD) experience. It is a socially constructed phenomenon that encompasses stereotypes, prejudice, and exclusion, and it exerts a profound influence on how individuals with PD perceive themselves and are perceived by others. Unlike shame, which arises from an internal sense of personal failure, stigma is externally imposed, shaped by cultural narratives, public misunderstanding, and the visibility of symptoms that deviate from normative expectations (Soilemezi et al., 2025).

For many patients, the fear of being judged for tremors, facial masking, or speech difficulties leads to a progressive withdrawal from social life. This avoidance is not simply a behavioural adaptation; it reflects a deeper erosion of self-efficacy and social identity. Over time, the psychological burden of stigma can exacerbate core non-motor symptoms of PD, including anxiety, depression, and cognitive decline. In this sense, stigma does not merely accompany the disease; it actively contributes to its progression by undermining the individual's capacity to remain engaged, autonomous, and socially integrated (Institute of Medicine (US) 2006).

What emerges is a dual pathology: one neurological, the other social. The former affects motor and cognitive function, disrupting the relational and emotional fabric that sustains human well-being. The added weight of social exclusion can be devastating for a condition already marked by complexity. Addressing stigma, therefore, is not a peripheral concern but a central therapeutic imperative. It requires coordinated efforts across clinical care, public education, and policy to ensure that individuals with PD are treated medically and seen, heard, and valued within their communities (Khan et al., 2025)

1. Methods

We presented clinical data from the Parkinson's Disease Laboratory led by Dr. Antonella Peppe at the Santa Lucia Foundation in Rome.

The clinical study was designed as a randomised, double-blind, double-dummy crossover trial in accordance with international standards for therapeutic research in Parkinson's Disease. The protocol, developed by Martella and Peppe, outlines a rigorous methodological framework to ensure internal validity and patient safety throughout the intervention (Meringolo et al., 2025).

Participants were selected based on a defined set of inclusion and exclusion criteria to ensure the homogeneity and safety of the study population. Eligible individuals were required to be over 40 years of age and to have a confirmed diagnosis of idiopathic Parkinson's Disease (PD), established according to the United Kingdom Parkinson's Disease Society Brain Bank criteria and validated by two different neurologists (Peppe et al, 2019; Stefani et al., 2017). Only patients with a preserved ability to walk independently and maintain an upright posture were considered. Additional inclusion criteria included a low score on the Beck Anxiety Inventory, ongoing treatment with a stable dopaminergic medication regimen, and a disease duration exceeding five years. To minimise confounding variables, individuals with severe gastrointestinal disorders or other non-neurologic comorbidities were excluded.

Exclusion criteria were established to prevent risks and ensure the reliability of the data. Patients were excluded if they had non-idiopathic forms of Parkinson's Disease, were pregnant, or exhibited cognitive impairment as indicated by a Mini-Mental State Examination (MMSE) score below 24. Further exclusion criteria included the inability to walk autonomously, the presence of comorbidities that could compromise safe mobility (such as balance disorders or severe cardiac conditions), and the use of a cardiac pacemaker. Individuals with hypotension, malabsorption syndromes, or a history of abdominal surgery were also excluded. Finally, patients with a history of alcoholism were not eligible for participation.

All participants provided informed consent before enrolment and were covered by insurance for the duration of the study.

To assess the clinical and psychosocial dimensions of Parkinson's Disease (PD), we employed two internationally validated instruments: the Unified Parkinson's Disease Rating Scale (UPDRS) and the Parkinson's Disease Questionnaire-39 (PDQ-39). The Movement Disorder Society officially endorses both tools, which are widely used in clinical and research contexts to evaluate disease severity, symptom progression, and quality of life.

The UPDRS, particularly in its revised version (MDS-UPDRS), provides a comprehensive framework for evaluating both motor and non-motor aspects of PD. It includes clinician-rated components as well as patient-reported experiences. Of particular relevance to our study is the section dedicated to non-motor symptoms, which captures emotional and psychological states such as anxiety, agitation, panic, and fear. These symptoms are often triggered by everyday situations that become sources of distress for patients. For instance, many individuals report avoiding

drinking in public due to the fear that tremors will cause them to spill the contents of a glass, leading to embarrassment and social withdrawal. This anticipatory anxiety reflects the broader psychosocial burden of the disease and contributes to a progressive erosion of autonomy and social participation (Peto et al., 1995; Goetz et al., 2008).

The PDQ-39 complements the UPDRS by offering a patient-centred perspective on health-related quality of life. It explores how PD affects various domains of daily living, including emotional well-being, social interaction, stigma, and communication (Bushnell & Martin,2014). Through its structured format, the PDQ-39 captures the subjective impact of the disease, highlighting how motor symptoms and their social consequences shape patients' lived experiences.

These instruments allow for a multidimensional understanding of Parkinson's Disease, integrating clinical observation with patient-reported outcomes. Their combined use supports a more holistic and person-centred approach to care, particularly in addressing chronic neurodegenerative conditions' emotional and social dimensions (Peppe et al., 2019; Figure 1).

Statistical Analysis

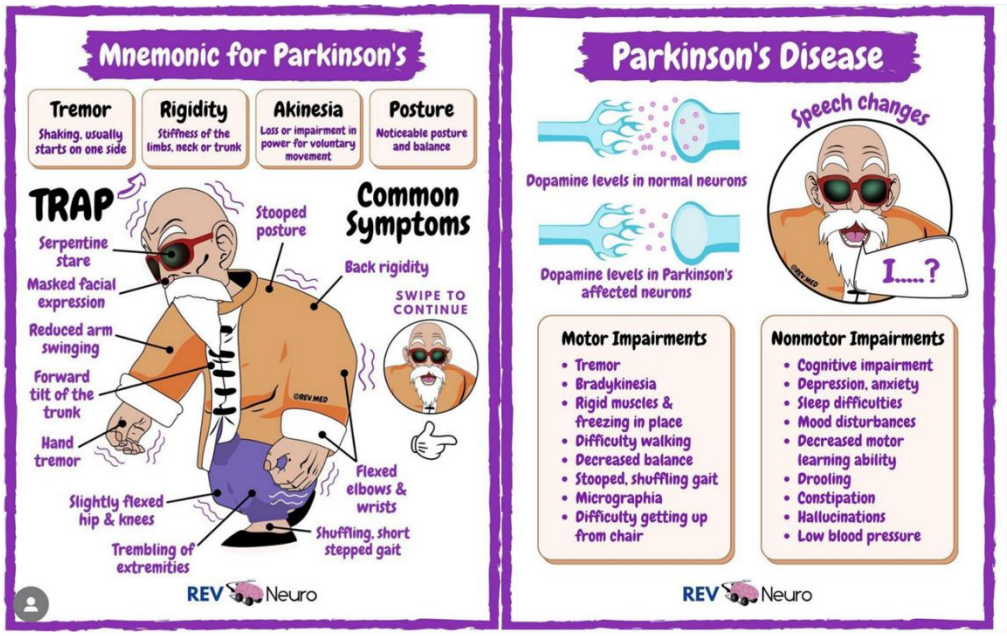
A combination of parametric and non-parametric statistical tests was employed to evaluate the longitudinal data collected through the UPDRS and PDQ-39 scales. Paired-sample t-tests were used to compare pre- and post-intervention scores within subjects, particularly about motor and non-motor symptom changes. Repeated measures ANOVA was applied to assess the effect of time and intervention across multiple monthly assessments, allowing for the detection of trends and treatment effects over the observation period (Peppe et al, 2019; Rigon et al., 2025; Alessandro et al., 2010; Meringolo et al., 2025).

In cases where normality and sphericity assumptions were not met, the Friedman test was used as a non-parametric alternative to repeated measures ANOVA. Correlation analyses (Pearson or Spearman, depending on data distribution) were conducted to explore the relationships between emotional variables (e.g., anxiety, fear of judgment) and clinical scores.

To further explore patient profiles and symptom trajectories, unsupervised learning techniques such as k-means clustering were considered to identify subgroups with similar emotional and functional patterns. Additionally, supervised machine learning models, including Random Forest and Support Vector Machines (SVM),

were explored to classify patients based on their risk of social isolation or emotional deterioration, using longitudinal scale data as input features.

All statistical analyses were performed using standard software packages, and significance was set at $p < 0.05$. Machine learning models were trained and validated using cross-validation techniques to ensure robustness and generalizability.



2. Results

To investigate the emotional and psychological dimensions associated with Parkinson's disease (PD), we analysed patient-reported outcomes using a series of visual tools.

Data were systematically tabulated and analysed to identify consistent patterns rather than isolated fluctuations.

Importantly, transient emotional responses—such as anxiety, fear, or social insecurity—reported during a single visit within the one-year observation period were not considered indicative of persistent psychosocial distress. These isolated episodes were excluded from the analysis, as they did not reflect the patient's stable clinical condition or sustained emotional state.

The analysis focused on emotional and social variables including anxious mood, concern about the future, embarrassment in public, and perceived social judgment. These dimensions were integrated with UPDRS Part I and PDQ-39 scores, highlighting the co-occurrence of emotional and social symptoms and their cumulative impact on quality of life. Notably, the data also provided an indirect estimate of each patient's level of social isolation, as reflected by their responses to items related to avoidance, stigma, and reduced participation in social contexts. Figure 2 presents two pie charts illustrating the distribution of responses related to anxious mood and worries about the future. In both charts, 47% of responses were missing, while among the available data, 33% of patients reported slight symptoms, 13% mild, and 7% moderate. These missing (or misplaced) data likely reflect the emotional and cognitive burden experienced by patients during clinical assessments. Factors such as fatigue, reduced attention span, emotional discomfort, or difficulty in self-reflection may have contributed to incomplete responses. In some cases, patients may have avoided answering items related to anxiety or future concerns due to denial, fear, or lack of insight. Rather than treating these omissions as random, we interpret them as clinically meaningful indicators of disengagement or emotional overload. This interpretation is supported by previous findings in the literature (e.g., Peppe et al., 2019; Gryfe et al., 2022), and aligns with our broader hypothesis that social withdrawal and emotional avoidance are integral components of the non-motor symptomatology in Parkinson's Disease. These distributions provide a preliminary overview of the emotional burden experienced by patients, particularly concerning anxiety and future-oriented concerns.

Figure 2 expands on these findings by integrating multiple psychological and social variables, including anxious mood, UPDRS I scores, concerns about others' reactions, worries about the future, and embarrassment due to the disease. This composite visualisation highlights the presence and co-occurrence of these factors within the patient population. The figure contextualises PD's emotional and social dimensions, as captured through validated clinical and self-report measures.

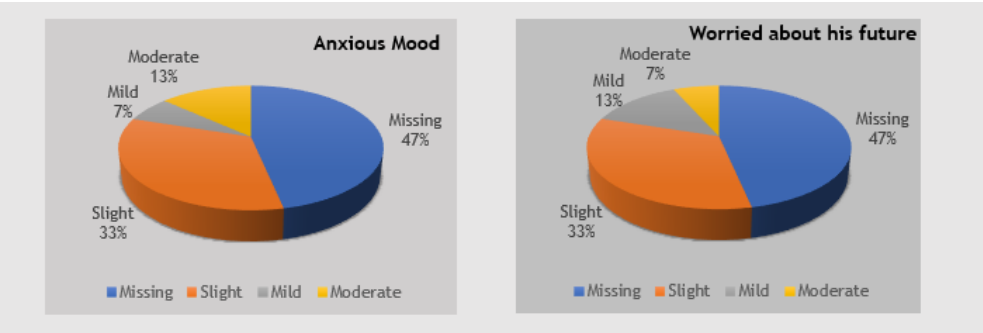


Figure 2. Emotional responses in patients with Parkinson's disease

The figure presents two pie charts illustrating the distribution of emotional responses. The first chart, titled "Anxious Mood", shows that 47% of responses were missing (blue), 33% reported slight anxiety (orange), 7% mild (yellow), and 13% moderate (grey). The second chart, titled "Worried about his future", displays identical categories with slightly different proportions: 47% missing (blue), 33% slight (orange), 13% mild (yellow), and 7% moderate (grey).

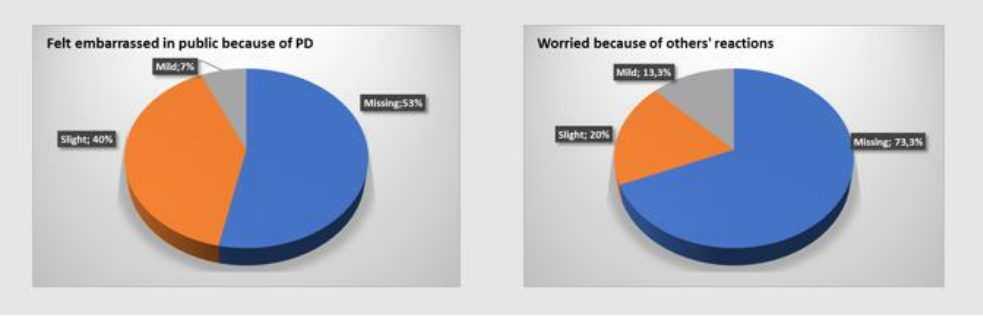


Figure 3. Social and emotional responses related to Parkinson's disease.

The left pie chart shows the distribution of responses to the item "Felt embarrassed in public because of PD", with 53% missing data (blue), 40% reporting slight embarrassment (orange), and 7% mild (grey). The right chart illustrates responses to "Worried because of others' reactions", with 73.3% missing (blue), 20% slight (orange), and 13.3% mild (grey)

To complement these observational data, we examined the impact of technological interventions on motor and non-motor symptoms. Figure 4 summarises the results of two randomised controlled trials. The left panel shows that patients undergoing gait training with a wearable robotic exoskeleton experienced improvements in non-motor symptoms, enhanced walking capacity and reduced UPDRS-III motor scores. The right panel compares telerehabilitation with home-based physical

therapy. Both interventions led to statistically significant improvements in motor function, as measured by UPDRS-III. However, the telerehabilitation group reported higher satisfaction and greater perceived flexibility. Notably, both groups also demonstrated improvements in non-motor domains, as assessed by the PDQ-39. Collectively, these results support the integration of robotics and telemedicine into PD care pathways.

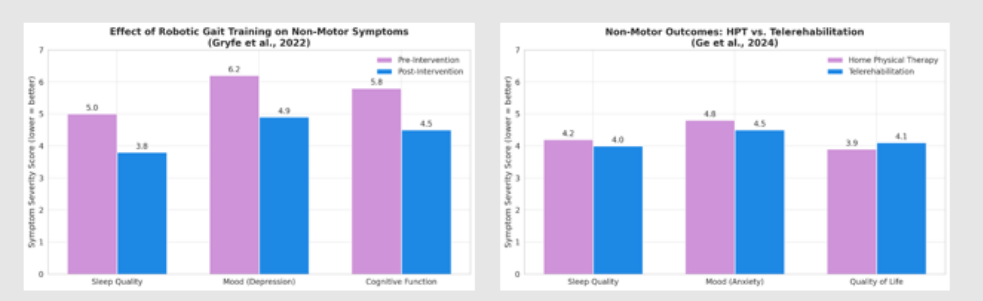


Figure 4. Effects of robotic gait training and telerehabilitation on non-motor symptoms in Parkinson's disease.

The left panel shows pre- and post-intervention scores for sleep quality, mood (depression), and cognitive function following robotic gait training (Gryfe et al., 2022). Improvements were observed across all domains: sleep quality improved from 5.0 to 3.8, mood from 6.2 to 4.9, and cognitive function from 5.8 to 4.5. The right panel compares non-motor outcomes between home physical therapy (HPT) and telerehabilitation (Ge et al., 2024). Telerehabilitation resulted in slightly better outcomes for sleep quality (4.0 vs. 4.2), mood (anxiety) (3.9 vs. 4.8), and quality of life (4.1 vs. 3.9).

The data suggest that such technologies may contribute to motor rehabilitation and mitigate emotional and social challenges, promoting a more comprehensive and patient-centred approach to disease management.

3. Discussion

The results presented in Figures 1 through 4 offer a multidimensional view of the emotional, psychological, and functional challenges faced by individuals with Parkinson's Disease (PD). As illustrated in Figure 1, a substantial proportion of patients report feelings of anxiety, embarrassment, and concern about how others perceive them. These emotional responses are deeply rooted in the daily struggles imposed by motor symptoms. Patients often experience intense shame and

frustration when they are unable to perform basic tasks such as cutting food, bringing a fork to their mouth without spilling, or walking across a room without freezing. The fear of falling, of staining their clothes, or of being unable to control their movements in public spaces leads many to avoid social situations altogether (Martinez-Martin et al., 2009).

This avoidance is not merely a coping mechanism; it reflects a profound erosion of autonomy and self-worth. Many patients report feeling like a burden to their partners or children, as they increasingly depend on others for dressing, eating, or even using the bathroom. The inability to carry out these fundamental activities without assistance contributes to a sense of uselessness and invisibility. In moments of acute motor block or tremor, some patients describe the desire to "disappear" from wherever they are, overwhelmed by embarrassment and helplessness (Da Silva et al., 2023).

Figure 2 further highlights the co-occurrence of emotional variables, including anxious mood, UPDRS Part I scores, and social concerns. These factors are not isolated but interrelated, suggesting that emotional distress and perceived stigma are integral components of the PD experience. Recent studies confirm that stigma in PD is associated with reduced self-esteem, increased social avoidance, and lower engagement with healthcare services 1. The anticipation of judgment, what researchers term "felt stigma", can be as debilitating as overt discrimination, influencing not only emotional well-being but also treatment adherence and social functioning (Peppe et al., 2019).

Our findings support the need for integrated care strategies that address both motor and non-motor symptoms, including the psychosocial dimensions of PD. The use of validated instruments such as the UPDRS and PDQ-39 allowed us to quantify not only clinical severity but also the emotional and social burden of the disease. These tools revealed patterns of anxiety, fear, and social insecurity that correlate with reduced participation and perceived exclusion.

Importantly, the data also provide insight into the degree of social isolation experienced by patients. Responses related to embarrassment in public and concern about others' reactions suggest that many individuals internalise stigma, leading to avoidance behaviours and diminished social identity. This aligns with broader theoretical frameworks on health equity and inclusion, which emphasise the importance of relational and environmental factors in shaping disease outcomes 1.

Technological interventions such as robotic gait training and telerehabilitation, as shown in Figure 4, offer promising avenues for restoring autonomy and reducing stigma. These approaches not only improve motor function but also enhance emotional resilience and perceived social belonging. By integrating clinical and psychosocial support, such models promote a more equitable and inclusive approach to care that recognises the full spectrum of patient needs.

Conclusions

The perception of being judged or socially exposed due to visible symptoms such as tremor, drooling, or difficulty handling objects often leads patients with Parkinson's disease to withdraw from social life. This isolation generates a vicious cycle in which fear of stigma reinforces disengagement, worsens quality of life, and contributes to the progression of both motor and non-motor symptoms. The resulting alienation becomes a secondary burden, compounding the primary disease. Technological interventions such as robotic rehabilitation and telemedicine offer promising solutions. Robotics can improve motor function and restore confidence in daily activities, while telemedicine provides continuous psychological and physical support, helping patients re-establish a sense of agency and social belonging. These tools represent a strategic target for breaking the cycle of disease, isolation, and decline, and for promoting reintegration and well-being in people living with Parkinson's disease.

Author contributions

All the authors contributed to all the paragraphs of the final version of this paper, their roles being specified below.
Conceptualization, Mo.M and G, M; methodology, Mo.M; Me, M., SL, D., and G, M; formal analysis, Mo.M; Me, M., SL, D.; investigation, Mo.M; Me, M., SL, D., and G, M; writing—original draft preparation, Mo.M; visualization, Me, M., SL, D., and G, M. All authors have read and agreed to the published version of the manuscript.

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