

# Telemedicine Utilisation, Perceived Benefits, Barriers, and Patient Experiences among People with Parkinson's Disease in Tamil Nadu, India: An Exploratory Cross-sectional Study

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## ABSTRACT

**Introduction:** Parkinson's Disease (PD) is a chronic neurodegenerative disorder that requires continuous medical monitoring and multidisciplinary care over the long term. Telemedicine has emerged as a promising modality for improving healthcare access among persons with chronic neurological conditions, particularly in settings where specialist availability is limited.

**Aim:** To assess telemedicine utilisation and patient experiences among persons with PD in Tamil Nadu.

**Materials and Methods:** The present exploratory cross-sectional study was conducted among 57 patients with clinically diagnosed PD attending two movement rehabilitation centres in Chennai, Tamil Nadu, India, conducted between March 2025 and April 2025.. Participants aged 50 years and above were recruited by convenience sampling. Data were collected through face-to-face interviews using a semi-structured questionnaire covering sociodemographic characteristics, disease profile, healthcare accessibility, telemedicine awareness and utilisation, patient perceptions, and barriers to adoption. Descriptive statistics were used to summarise the data using Statistical Package for the Social Sciences (SPSS) version 24.0.

**Results:** The mean age of participants was 69.5 years, and the majority were male 44 (77.2%). Telemedicine awareness was reported by 87.7% of participants, and 75.4% had used telemedicine for PD management. The most commonly reported benefits were reduced travel burden 42 (97.7%), faster access to specialists 39 (90.7%), and lower cost relative to in-person visits 32 (74.4%). More than half of the participants 30 (52.6%) preferred telemedicine over in-person consultations, and 93% rated the quality of remote care as comparable to or better than conventional care. The most commonly reported barrier was difficulty operating digital technology due to Parkinson's-related motor symptoms 27 (47.4%) followed by lack of access to appropriate technology 11 (19.3%) and poor internet connectivity (14.0%).

**Conclusion:** The present study findings suggest that remote healthcare services may help address healthcare access challenges among patients attending specialised rehabilitation centres. Addressing technological barriers, strengthening digital infrastructure, and integrating caregiver-assisted service models are necessary steps toward broader adoption of telemedicine in chronic neurological care.

**Keywords:** Digital health, Healthcare accessibility, Rehabilitation centres

## INTRODUCTION

The PD is a chronic and progressive neurological condition that necessitates long-term, lifelong therapy of motor and non-motor symptoms, pharmaceutical, physical, and social support [1]. The global incidence of PD has increased rapidly. The World Health Organisation (WHO) estimated that over 8.5 million people have PD, and the number of disability and mortality is rising dramatically [2].

The PD is a severe, chronic, and increasingly prevalent condition, requiring complex and extensive care [3]. The rising need for prolonged medical and rehabilitative care highlights the growing burden of PD in the Indian setting. PD also needs proper management by frequent clinical examination, medication, physiotherapy management, as well as psychosocial reinforcement that may necessitate regular visits to certain healthcare institutions [4]. Telemedicine is the use of electronic or digital communication, such as video calls, mobile apps, and remote monitoring, to provide health care. It enables diagnosis, treatment, follow-up, and health education without requiring in-person visits [5]. In recent years, utilising information and communication technology to manoeuvre around distance challenges in healthcare delivery

has become increasingly prevalent globally. In the present setting, telemedicine has become a potential means of connecting patients with healthcare specialists. It provides remote consultations, monitoring, and treatments through digital platforms. Its application in the management of chronic neurological disorders, including PD, has demonstrated potential benefits such as improved access to specialist care, enhanced patient monitoring, reduced travel burden, and greater flexibility in scheduling appointments [6].

Telemedicine initiatives have been progressively integrated into public and private healthcare settings, supported by government policies advocating digital health and the expansion of internet connectivity [7]. Despite these advances, the adoption of telemedicine among Parkinson's patients remains variable, influenced by factors such as digital literacy, technological infrastructure, patient and caregiver acceptance, and healthcare providers' readiness [8].

Telemedicine offers numerous advantages for Parkinson's patients. There are several kinds of unique challenges associated with Parkinson's patients that may impact the adoption of telemedicine. Motor symptoms such as tremor, stiffness, and bradykinesia can make it difficult for patients to use mobile phones, tablets, and

computers independently [9,10]. Non motor symptoms such as cognitive impairment, poor concentration, depression and speech problems may further complicate effective communication in virtual consultations [11]. Furthermore, many aspects of the neurological exam such as measurement of muscle rigidity, postural stability, and specific motor skills are difficult to perform remotely and can limit the thoroughness of telemedicine-based examinations [12]. Reliance on caregivers for technology use and appointment administration is also a major factor in telemedicine involvement in patients with PD. Understanding these disease-specific hurdles is important in building patient-centred telemedicine services that may effectively fulfil the complicated healthcare needs of this population [6].

Remote consultations enable rapid pharmacologic adjustments and continuous symptom monitoring, which can be particularly beneficial for mobility-limited patients by reducing the need for in-person visits [13]. In addition, telemedicine platforms could provide long-term education for patients and caregivers to improve disease management and reduce the sense of isolation. Moreover, these modalities promise to reduce out-of-pocket spending, transportation costs, and absenteeism at work, and thus have a positive impact on economic outcomes [14]. Nevertheless, the so-called advantages of telemedicine must be offset, i.e., the data confidentiality, the diagnostic rigour of the remote neurological examination, the minimisation of technological inequalities, and the encouragement of an attitude towards the novel paradigm on the part of both the clinician and the patient [15].

Telemedicine has shown positive outcomes in the care of PD in some high-income nations, but evidence from low and middle-income settings is limited. In India, and more specifically in Tamil Nadu, there is a lack of data addressing the use of telemedicine among Parkinson's patients, their experiences with remote consultations, perceived benefits, barriers to adoption, and expectations for future telemedicine services. In this context, differences in the health care infrastructure, digital literacy, socioeconomic conditions, and access to neurological specialists may have a considerable impact on the acceptance and effectiveness of telemedicine. Therefore, generating regional data is crucial for informing the development of patient-centred telemedicine services and guiding digital health policy for chronic neurological care. The present research will contribute to the existing knowledge on digital health interventions in the context of chronic neurologic care in low and middle-income countries. It assists policymakers, healthcare workers, and tech developers in streamlining the potential of telemedicine for the treatment of PD in Tamil Nadu, India. Thus, the aim of the present study is to assess the telemedicine utilisation and patient experiences among Parkinson's patients.

## MATERIALS AND METHODS

The present exploratory cross-sectional study was conducted to assess the utilisation, perceived benefits, challenges, and patient experiences of telemedicine among Parkinson's patients in Tamil Nadu conducted between March 2025 and April 2025. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. The protocol was approved by the Institutional Ethical Review Committee at the SRM School of Public Health, SRM Institute of Science and Technology, 0110/IEC2024. Prior to participating in the present study, participants were provided with a concise explanation regarding the aims, objectives, potential risks, and benefits associated with the study. The study subjects were informed that participation is voluntary and that they could withdraw from the study at any time. The study was conducted at two movement rehabilitation centres in Chennai, Tamil Nadu, South India, comprising one public and one private rehabilitation centre. These centres were purposively selected because they serve a large number of patients with PD, many of whom regularly attend these centres for movement training and rehabilitation. The

centres also provided regular follow-up services and access to patients with varying disease durations. Because the study was exploratory, it was suitable to recruit from speciality care facilities to obtain preliminary data on telemedicine use and patient experience. However, data should be interpreted with caution, as those attending specialised rehabilitation clinics may have better access to healthcare services and digital technologies than the wider PD community.

**Inclusion and Exclusion criteria:** The study consisted of clinically confirmed PD patients aged 50 years and older who were undergoing continuous medication and follow-up care. Participants were eligible if they had: (i) a verified diagnosis of PD by a neurologist; (ii) were receiving routine in-person neurological care before enrolment; and (i) Patients exhibiting significant cognitive impairment, advanced dementia, or acute medical instability that restricted significant participation were excluded because the study relied on self-reported perceptions and experiences of telemedicine. Participants were permitted to receive assistance from caregivers during interviews, as needed, to support participation without compromising the dependability of responses and to mirror real-world use of telemedicine in people with PD. A total of 60 eligible patients with PD were approached for participation. Of these, 57 agreed to participate, while three declined to participate, resulting in a response rate of 95.0%.

As the present study was an exploratory study, no formal sample size calculation was performed. A total of 57 patients with PD were recruited using non probability convenience sampling from two movement rehabilitation centres. This approach was considered appropriate for generating preliminary evidence regarding telemedicine utilisation, perceived benefits, barriers, and patient experiences in a real-world clinical setting.

## Study Procedure

Data were collected using a semi-structured questionnaire developed by the research team based on a comprehensive review of the existing literature on telemedicine and PD management [16,17]. The questionnaire was specifically tailored to the healthcare context of Tamil Nadu. The content validity of the questionnaire was assessed by a panel of four experts in neurology, public health, and digital health. The experts evaluated the relevance, clarity, comprehensiveness, and cultural appropriateness of the questionnaire items, and their feedback was incorporated into the final version. The questionnaire was subsequently pre-tested among eight individuals with PD to assess its comprehensibility, feasibility, and acceptability. Minor modifications were made based on participant feedback before the commencement of the main data collection. As the questionnaire was designed as an exploratory survey comprising primarily descriptive and categorical items, rather than as a psychometric scale measuring a specific construct, internal consistency measures such as Cronbach's alpha and test-retest reliability were not assessed. The questionnaire comprised six major domains: i) Sociodemographic characteristics (age, gender, marital status, education, income, residence, caregiver support, occupation); ii) Disease profile (age at diagnosis, duration of disease, disease stage, symptom severity [18], co-morbidities); iii) Healthcare accessibility and conventional care challenges; iv) Telemedicine awareness and utilisation patterns; v) Perceptions, experiences, and perceived quality of life impact; vi) Barriers to telemedicine and desired service enhancements. Disease stage was confirmed by the treating neurologists using the Hoehn and Yahr staging system, with reference to participants' medical records and neurologists' clinical documentation. Multiple response options were given for variables related to barriers, enablers, and preferred telemedicine features. This shows the different factors that influence telehealth adoption among patients with chronic neurological conditions. A pilot study involving eight participants was excluded from data analysis.

Data collection was conducted through face-to-face interviews according to the participants' functional abilities and preferences. All interviews were conducted in the participant's preferred language (Tamil or English) by trained investigators using a structured questionnaire. Each interview lasted approximately 20-30 minutes. The questionnaire was pretested to ensure clarity, cultural appropriateness, and content validity before full-scale administration. Although caregivers accompanied some participants during the interviews to provide logistical support when required, all questionnaire responses were obtained directly from the patients, and caregivers did not respond on their behalf.

**Study outcomes:** Primary outcomes focused on telemedicine utilisation patterns and patient experiences, encompassing perceived benefits, barriers to adoption, preferences, satisfaction, and desired service enhancements. Secondary outcomes assessed participants' perceived impact of telemedicine on perceived quality of life and caregiver involvement during telemedicine consultations.

**Operational definition of telemedicine:** In the present study, telemedicine was used as an umbrella term referring to the remote delivery of healthcare-related consultation, communication, follow-up, or disease-management support through digital or telecommunications-based modalities. These included video consultations, messaging applications, and other digital platforms reported by participants. The current study did not assume that these modalities were clinically equivalent; therefore, findings concerning telemedicine utilisation and patient experiences should be interpreted as reflecting participants' experiences across these modalities rather than the effectiveness of any specific telemedicine platform.

## STATISTICAL ANALYSIS

Considering the exploratory nature of the study, descriptive statistics were used solely to summarise the gathered data, including sociodemographic and clinical characteristics, telemedicine utilisation, and patient experiences. The completed questionnaires were reviewed immediately after each interview for completeness. No missing data were identified; therefore, all 57 participants were included in the final analysis, and no imputation procedures were required. Categorical variables are presented as frequencies and percentages, whereas continuous variables are summarised using the mean and standard deviation.

## RESULTS

The mean age of the participants is 69.5 years, with a median of 69.5 years and an interquartile range of 65-75 years. Most participants were male 44 (77.2%), with females constituting about 22.8%. A majority are married 34 (59.6%) nearly one-third are widowed, 17 (29.8%) and a minority are single 6 (10.5%), Over half of participants are graduates 30 (52.6%), and most households reported monthly income between ₹10,000-₹50,000 30 (52.6%) A majority resided in urban areas 35 (61.4%), with the remainder mainly from semi-urban settings 22 (38.6%), Almost all participants are retired, homemakers, or housewives 53 (93%) [Table/Fig-1].

The mean age at diagnosis was 58.95±8.39 years (median: 57.0 years; IQR: 51.0-65.0 years). The mean duration of PD was 5.05±2.6 years (median: 5.0 years; Interquartile Range (IQR): 3.0-7.0 years). Early-stage cases account for 38.6% of patients, whereas moderate-stage cases are slightly more prevalent at 40.3%, and advanced-stage cases constitute 21% of patients. Severe symptoms are reported weekly by 38.6% of patients and occasionally by 40.3%, whereas only 21.1% experience them daily. Among the reported co-morbidities, hypertension was the most prevalent 46 (80.7%) followed by diabetes mellitus 41 (71.9%), cardiovascular disease 9 (15.8%), and other comorbid conditions 3 (5.3%) [Table/Fig-2].

| Variables                      | Category                           | n (%)        |
|--------------------------------|------------------------------------|--------------|
| Age (years)                    | Mean (SD)                          | 69.5 (8.63)  |
|                                | Median (IQR)                       | 69.5 (65-75) |
|                                | Range                              | 50-85        |
| Gender                         | Male                               | 44 (77.2)    |
|                                | Female                             | 13 (22.8)    |
| Marital status                 | Married                            | 34 (59.6)    |
|                                | Widowed                            | 17 (29.8)    |
|                                | Single                             | 6 (10.5)     |
| Education level                | No formal education/Primary school | 7 (12.3)     |
|                                | Secondary school                   | 20 (35.1)    |
|                                | Graduate                           | 30 (52.6)    |
| Monthly household income (INR) | < ₹10,000                          | 2 (3.5)      |
|                                | ₹10,000 - ₹50,000                  | 30 (52.6)    |
|                                | >₹50,000 - ₹1,00,000               | 21 (36.8)    |
|                                | > ₹1,00,000                        | 4 (7.0)      |
| Residence                      | Urban area                         | 35 (61.4)    |
|                                | Semi-urban area                    | 22 (38.6)    |
| Caregiver support              | Yes (family member)                | 40 (70.2)    |
|                                | Yes (professional caregiver)       | 13 (22.8)    |
|                                | No caretaker                       | 4 (7)        |
| Occupation                     | Retired/Homemaker/Housewife        | 53 (93)      |
|                                | Employed (private/government)      | 4 (7)        |

[Table/Fig-1]: Sociodemographic characteristics.

| Variables                                    | Category               | n (%)      |
|----------------------------------------------|------------------------|------------|
| Age at diagnosis (years)                     | Mean (SD)              | 58.95±8.39 |
|                                              | Median (IQR)           | 57 (51-65) |
|                                              | Range                  | 48-79      |
| Duration of Parkinson's Disease (PD) (years) | Mean                   | 5.05±2.6   |
|                                              | Median (IQR)           | 5 (4)      |
|                                              | Range                  | 1-8        |
| Disease stage                                | Early-stage            | 22 (38.6)  |
|                                              | Moderate-stage         | 23 (40.3)  |
|                                              | Advanced-stage         | 12 (21.0)  |
| Frequency of severe symptoms                 | Daily                  | 12 (21.1)  |
|                                              | Weekly                 | 22 (38.6)  |
|                                              | Occasionally           | 23 (40.3)  |
| Comorbid conditions (multiple responses)*    | Hypertension           | 46 (80.7)  |
|                                              | Diabetes               | 41 (71.9)  |
|                                              | Cardiovascular disease | 9 (15.8)   |
|                                              | Other                  | 3 (5.3)    |

[Table/Fig-2]: Disease profile of participants.

\*Percentages for comorbid conditions are calculated using the total sample (N=57) as the denominator; as this was a multiple-response item, participants could report more than one condition, so percentages do not sum to 100%

Regular access to a neurologist or a movement disorder specialist is reported by 42 (73.7 %) of participants, yet 70.2% live more than 50 km from the nearest hospital with a neurologist. Nearly 70.2% of patients visit healthcare monthly for Parkinson's management, while only 2 (3.5%) visit only when needed. Personal vehicles were the predominant mode of transport, 38 (66.7%), and a considerable number of patients relied on assisted transport, 16 (28.1%), reflecting functional dependency and caregiver support. Nearly, 42 (73.7%) of them found distance-related travel difficulties, 43 (75.4%) had financial constraints, and 25 (43.9%) had limited availability of specialists. Notably, 45 (78.9%) of participants had missed at least one healthcare appointment due to logistical barriers [Table/Fig-3].

| Variables                                                      | Category                                            | n (%)     |
|----------------------------------------------------------------|-----------------------------------------------------|-----------|
| Regular access to neurologist/movement disorder specialist     | Yes                                                 | 42 (73.7) |
|                                                                | No                                                  | 15 (26.3) |
| Distance to nearest hospital with neurologist                  | <10 km                                              | 4 (7)     |
|                                                                | 10-50 km                                            | 13 (22.8) |
|                                                                | >50 km                                              | 40 (70.2) |
| Frequency of in-person visits for Parkinson's management       | Monthly                                             | 40 (70.2) |
|                                                                | Every 3-6 months                                    | 15 (26.3) |
|                                                                | Only when needed                                    | 2 (3.5)   |
| Mode of transport to hospital                                  | Personal vehicle                                    | 38 (66.7) |
|                                                                | Assisted transport (ambulance, caregiver's vehicle) | 16 (28.1) |
|                                                                | Public transport                                    | 3 (5.3)   |
| Major challenges in accessing healthcare (multiple responses)* | Distance and travel difficulties                    | 42 (73.7) |
|                                                                | Financial constraints                               | 43 (75.4) |
|                                                                | Limited availability of specialists                 | 25 (43.9) |
|                                                                | Others (e.g., time, family)                         | 28 (49.1) |
| Ever missed an appointment due to logistical challenges        | Yes                                                 | 45 (78.9) |
|                                                                | No                                                  | 12 (21.1) |

**[Table/Fig-3]:** Healthcare accessibility and conventional challenges.

\*Multiple-response item; percentages do not sum to 100%

In the present study, 50 (87.7%) of participants had heard of telemedicine, and 75.4% had used telemedicine services for PD management. Among telemedicine users, 22 (51.2%) reported regular monthly use, 17 (39.5%) reported occasional use, and 4 (9.3%) reported using telemedicine only during emergencies. Doctors or hospitals were the primary source for 42 (73.7%), social media, TV, and news were 24 (42.1%), and family or friends were 16 (28.1%). Among telemedicine users (75.4%), the largest proportion (51.2%) reported regular use and accessed telemedicine services monthly. Occasional use was reported by 39.5% of participants, while only 9.3% used telemedicine only during emergencies. Among telemedicine users, different remote-care modalities were reported. Video calls were used by all users (100%), while 93.0% reported using WhatsApp or other messaging platforms and 6.9% reported using apps. These modalities represent different forms of remote healthcare delivery and were therefore described separately rather than considered clinically equivalent. Among telemedicine users, 55.8% preferred hospital-based telemedicine services, while 44.2% preferred private apps [Table/Fig-4].

In the present study, 52.6% preferred telemedicine over physical visits, indicating a generally favourable attitude toward remote consultations, while 24.6% still preferred in-person care. An additional 22.8% reported that their preference depended on the severity of the condition. A high proportion of participants 73.7% reported being comfortable or very comfortable discussing symptoms and treatment via telemedicine. However, 17.5% expressed discomfort, highlighting the need for patient-centred support and reassurance. More than half of the participants (59.6%) reported requiring caregiver assistance during telemedicine use, indicating that access to remote healthcare may not always translate into independent use among patients with PD.

Overall experiences with telemedicine consultations were predominantly positive, with 81.4% rating their experience as excellent or very good. Only a small minority 4.7% reported poor or very poor experiences. Most of the participants (93%) perceived the quality of care delivered through telemedicine to be comparable to or better than in-person consultations, indicating favourable perceptions of the quality of remote care among telemedicine users. Regarding perceived quality-of-life impact, 49.1% of participants believed that telemedicine improved their quality of life significantly, while 26.3% believed that it improved their quality of life to some

| Variables                                                                              | Category                          | n (%)     |
|----------------------------------------------------------------------------------------|-----------------------------------|-----------|
| Awareness of telemedicine                                                              | Yes                               | 50 (87.7) |
|                                                                                        | No                                | 7 (12.3)  |
| Source of information about telemedicine*                                              | Doctor/Hospital                   | 42 (73.7) |
|                                                                                        | Family/Friends                    | 16 (28.1) |
|                                                                                        | Social media/News/TV              | 24 (42.1) |
|                                                                                        | Other                             | 20 (35.1) |
| Ever used telemedicine for Parkinson's management                                      | Yes                               | 43 (75.4) |
|                                                                                        | No                                | 14 (24.6) |
| Frequency of telemedicine use (among users, n=43)                                      | Regularly (every month)           | 22 (51.2) |
|                                                                                        | Occasionally (once in 3-6 months) | 17 (39.5) |
|                                                                                        | Rarely (only in emergencies)      | 4 (9.3)   |
| Remote healthcare modalities used among telemedicine users (multiple responses, n=43)* | Video calls                       | 43 (100)  |
|                                                                                        | WhatsApp/Messaging services       | 40 (93)   |
|                                                                                        | Apps                              | 3 (6.9)   |
| What platform do you prefer for telemedicine? (n=43)                                   | Hospital-based services           | 24 (55.8) |
|                                                                                        | Private apps                      | 19 (44.2) |

**[Table/Fig-4]:** Telemedicine awareness and utilisation.

N=57 (n=43 for telemedicine users). \*Multiple-response item; percentages do not sum to 100%.

extent; 24.6% did not perceive any improvement. Nearly 88.4% of the participants recommend telemedicine to other Parkinson's patients [Table/Fig-5].

| Variables                                                              | Category                         | n (%)     |
|------------------------------------------------------------------------|----------------------------------|-----------|
| Preference for telemedicine over physical visits                       | Yes                              | 30 (52.6) |
|                                                                        | Depends on severity              | 13 (22.8) |
|                                                                        | No                               | 14 (24.6) |
| Comfort in discussing symptoms and treatment via telemedicine          | Very comfortable/ comfortable    | 42 (73.7) |
|                                                                        | Neutral                          | 5 (8.8)   |
|                                                                        | Uncomfortable/Very uncomfortable | 10 (17.5) |
| Need for caregiver assistance during telemedicine use                  | Yes                              | 34 (59.6) |
|                                                                        | No                               | 23 (40.4) |
| Experience with telemedicine consultations (n=43)                      | Excellent/very good              | 35 (81.4) |
|                                                                        | Good/average                     | 6 (14.0)  |
|                                                                        | Poor/very poor                   | 2 (4.7)   |
| Perceived quality of care in telemedicine vs. in-person (n=43)         | Same/better level of care        | 40 (93)   |
|                                                                        | Lower level of care              | 3 (6.9)   |
|                                                                        | No opinion/not sure              | 0         |
| Belief that telemedicine improves quality of life                      | Yes, significantly               | 28 (49.1) |
|                                                                        | Yes, to some extent              | 15 (26.3) |
|                                                                        | No                               | 14 (24.6) |
| Would you recommend telemedicine to other Parkinson's patients? (n=43) | Yes                              | 38 (88.4) |
|                                                                        | No                               | 5 (11.6)  |

**[Table/Fig-5]:** Perceptions, experiences, and Quality of Life (QoL) beliefs.

N=57 (n=43 for telemedicine users).

Nearly half of the participants reported difficulty operating digital technology owing to Parkinson's-related motor symptoms (47.4%), which was the most frequently identified barrier to telemedicine use. Additional barriers included lack of access to appropriate technology (19.3%) and poor internet connectivity (14%). Less frequent reasons for not using online consultation were language challenges (8.8%), high consultation expenses (5.3%) and worries about trustworthiness of online consultation (5.3%).

Regarding the communication of symptoms, 77.2% of the participants had no problem in describing their symptoms during telemedicine consultations. The main reasons for the telemedicine utilisation were

less travel burden (97.7%) and immediate access to the specialist treatment (90.7%). Other common reasons included lower cost than an in-person visit (74.4%), and better management of symptoms (65.1%). The most commonly mentioned facilitators that would most likely promote the adoption of telemedicine were caregiver aid (71.9%), better availability of online specialists (56.1%), lower consultation prices (52.6%), and systematic training on the use of telemedicine (49.1%). Regarding service growth, 66.7% of participants were interested in getting physiotherapy and rehabilitation advice remotely, and 59.6% were interested in medication management with reminders. These preferences reflect the need for multidisciplinary virtual care beyond standard clinical visits. The most preferred technical features were virtual reality-based physiotherapy (66.7%), home-based diagnostic tools with physician connectivity (59.6%), and AI-based symptom monitoring (43.9%) [Table/Fig-6].

| Variables                                             | Category                                                | n (%)     |
|-------------------------------------------------------|---------------------------------------------------------|-----------|
| Major challenges in accessing telemedicine            | Poor internet connectivity                              | 8 (14)    |
|                                                       | Lack of smartphone/necessary technology                 | 11 (19.3) |
|                                                       | Difficulty using technology due to Parkinson's symptoms | 27 (47.4) |
|                                                       | Lack of trust in online consultations                   | 3 (5.3)   |
|                                                       | High consultation costs                                 | 3 (5.3)   |
|                                                       | Language barriers                                       | 5 (8.8)   |
| Difficulty in explaining symptoms via telemedicine    | Yes                                                     | 13 (22.8) |
|                                                       | No                                                      | 44 (77.2) |
| Main reasons for using telemedicine* (n=43)           | Reduced travel burden                                   | 42 (97.7) |
|                                                       | Faster access to a specialist                           | 39 (90.7) |
|                                                       | Cost-effective compared to physical visits              | 32 (74.4) |
|                                                       | Better management of symptoms                           | 28 (65.1) |
| Key enablers to increase telemedicine use*            | Training on how to use telemedicine                     | 28 (49.1) |
|                                                       | Lower consultation fees                                 | 30 (52.6) |
|                                                       | More specialist availability online                     | 32 (56.1) |
|                                                       | Assistance from caregivers                              | 41 (71.9) |
| Desired additional services in telemedicine*          | Physiotherapy and rehabilitation guidance               | 38 (66.7) |
|                                                       | Mental health and counseling support                    | 35 (61.4) |
|                                                       | Medication management and reminders                     | 34 (59.6) |
|                                                       | Nutrition and lifestyle advice                          | 32 (56.1) |
|                                                       | Speech therapy                                          | 23 (40.4) |
| Desired features to improve telemedicine*             | Home-based diagnostic tools connected to doctors        | 34 (59.6) |
|                                                       | Online support groups for patients                      | 12 (21.1) |
|                                                       | AI-based symptom tracking                               | 25 (43.9) |
|                                                       | Virtual reality (VR)-based physiotherapy                | 38 (66.7) |
| Major challenges in accessing telemedicine* (n=43)    | Poor internet                                           | 22 (51.2) |
|                                                       | Difficulty using technology                             | 24 (55.8) |
|                                                       | Lack of trust                                           | 15 (34.9) |
|                                                       | High consultation cost                                  | 2 (4.7)   |
|                                                       | Language barrier                                        | 25 (58.1) |
| Encouragement of telemedicine to use more frequently* | Training                                                | 28 (49.1) |
|                                                       | Lower fees                                              | 30 (52.6) |
|                                                       | More specialists                                        | 32 (74.4) |
|                                                       | Caregiver assistance                                    | 41 (71.9) |

**[Table/Fig-6]:** Barriers to telemedicine access and desired enhancements. N=57 (n=43 for telemedicine users). \*Multiple-response item; percentages do not sum to 100%. AI: Artificial intelligence

## DISCUSSION

The present study contributes primary evidence on telemedicine utilisation among persons with PD in an urban South Indian setting,

a population and context that have been largely absent from the existing literature. The high rates of awareness and utilisation observed are not incidental; they reflect a convergence of disease-specific access constraints, a post-pandemic consolidation of digital health behaviours, and the particular vulnerability of PD patients to the travel and scheduling demands of conventional neurological care. The findings are broadly consistent with international evidence, yet differ in important respects that reflect the structural realities of healthcare delivery in India.

### Telemedicine Awareness and Utilisation

The utilisation rate observed in this study substantially exceeds pre-pandemic benchmarks but is broadly consistent with post-pandemic surveys. The Parkinson's Foundation reported a rise in telehealth use from 10% before Coronavirus Disease 2019 (COVID-19) to 64% during the pandemic [19], and the present study suggests these gains have been sustained and extended in the urban Indian context. This trajectory is better explained by structural factors than by pandemic effects alone: with 70.2% of participants residing more than 50 km from the nearest neurologist, telemedicine addresses a persistent access deficit rather than a temporary convenience. The awareness and uptake levels observed here also exceed those reported in high-income settings with more established telemedicine infrastructure: Qiang JK and Marras C, in a Toronto tertiary-care cohort, found that only 53% of non users expressed interest in telemedicine once it was offered, and that even among users, most preferred a combination of telehealth and in-person visits rather than telemedicine as a substitute for conventional care [20]. Dissatisfaction in that cohort was attributed primarily to inexperienced telehealth nursing staff rather than to patient-side barriers. This contrast suggests that the higher awareness (87.7%) and utilisation (75.4%) observed in the present study reflect a different underlying driver of acceptance: where the Toronto cohort's satisfaction hinged on provider-side service quality, uptake in this Tamil Nadu sample appears shaped more by the severity of unmet access needs than by confidence in service delivery infrastructure. Saboorizadeh N et al., identified ease of use and physician recommendation as the primary determinants of telemedicine acceptance among PD patients, a finding that points toward modifiable supply-side levers, namely, provider endorsement and patient education, that health system can act upon to sustain utilisation gains in the post-pandemic period [17].

### Patient Satisfaction and Quality of Care

The high satisfaction rates reported in this study are consistent with randomised trial evidence from high-income settings, but carry a different explanatory logic in the Indian context. Dorsey ER et al., demonstrated that patient satisfaction with PD video telehealth was equivalent to in-person care, with telemedicine exceeding in-person scores on convenience and access dimensions [21]. A systematic review of telemedicine in neurological diseases similarly documented improvements in quality of life, functional status, and healthcare utilisation when remote consultations supplemented usual care [22]. In the present cohort, satisfaction is likely amplified by the counterfactual: for patients who had previously missed healthcare appointments because of logistical barriers, as reported by 78.9% of participants, the ability to access care remotely may carry greater perceived value. This suggests that satisfaction metrics in access-constrained populations should be interpreted alongside structural indicators such as appointment continuity and travel burden, rather than as standalone measures of care quality.

### Travel Burden and Access to Specialist Care

The near-universal identification of reduced travel burden as the primary motivator for telemedicine use in this cohort reflects a pattern documented across geographically dispersed PD populations, but is particularly pronounced in the Indian context. O'Shea E et al., reported a mean one-way travel distance of approximately 45.6 km

to outpatient neurology clinics in an Irish cohort [23], while Peacock D et al., found that 52% of Canadian PD patients travelled more than 50 km for specialist care [24]. The distances observed in the present study are comparable, but occur against a background of more limited public transport infrastructure, greater household economic vulnerability, and substantially fewer movement disorder specialists per capita. In this context, telemedicine is not a convenience innovation for this population; it functions as a structural enabler of care continuity for patients who would otherwise face systematic exclusion from specialist management [25,26].

### Barriers to Telemedicine Adoption

The predominance of motor symptom-related barriers over infrastructure barriers in this cohort inverts the hierarchy commonly reported in general Indian telemedicine literature, where poor connectivity and device access are typically the primary obstacles [27]. This pattern also diverges from PD-specific evidence from India; Garg D et al., found that slow internet speed was the dominant barrier to tele-neurorehabilitation among Parkinson's patients in Delhi, reported by 61.9% of participants, alongside shared-phone access within families (76.2%) [28]. In the present study, among the overall study population (N=57), the most frequently reported barrier was difficulty operating digital technology due to Parkinson's-related motor symptoms (47.4%), followed by lack of access to appropriate technology (19.3%) and poor internet connectivity (14.0%) suggesting that disease-specific physical limitations, rather than digital infrastructure, are the dominant constraint in an urban, rehabilitation-centre-attending population. This distinction is clinically important: infrastructure barriers are addressable through policy and investment, whereas motor barriers are intrinsic to the disease and require interface-level and caregiver-mediated solutions. Shalash A et al., noted that components of the neurological examination dependent on physical contact, such as rigidity testing and postural stability assessment, cannot be replicated remotely, which constrains the clinical comprehensiveness of telemedicine in PD regardless of platform quality [29]. The relatively low proportion reporting internet connectivity as a barrier (14%) likely reflects the urban, rehabilitation centre-attending nature of the sample, and should not be taken as representative of PD patients in rural Tamil Nadu, where infrastructure deficits remain substantial [30].

### Caregiver Involvement and Digital Inclusion

The high degree of caregiver involvement observed in this study highlights that access to telemedicine does not necessarily imply independent access for patients with PD. Gately ME et al., demonstrated that caregivers serve as active digital intermediaries managing scheduling, facilitating platform navigation, and mediating symptom communication in ways that extend well beyond technical assistance [31]. Ogawa M et al., reported higher telemedicine satisfaction among patients accompanied by caregivers, suggesting that caregiver involvement improves consultation quality rather than merely enabling access [32]. However, this differs in an important respect from evidence out of better-resourced telemedicine programs: Gurevich et al., in a multinational observational study of video-assisted support for PD patients on levodopa-carbidopa intestinal gel therapy, found that video-based telenursing *reduced* caregiver strain relative to audio-only support over 12 weeks, within a structured program offering trained support staff and dedicated caregiver-facing services [33]. In the present cohort, by contrast, 59.6% of participants required caregiver assistance during telemedicine use, indicating that caregiver involvement here functions as a precondition for access rather than as an outcome that telemedicine itself improves. This distinction has direct implications for service design: where Gurevich T et al., findings suggest telemedicine can be engineered to reduce caregiver burden once infrastructure and training are in place, the present

findings suggest that in resource-limited settings, caregiver support must first be built into implementation frameworks before such relief can be realised [33]. The identification of caregiver support as the leading enabler of telemedicine in this cohort reinforces Van Den Bergh et al., observation that digital exclusion among patients with PD may reflect capability constraints in addition to willingness to adopt telemedicine [10].

### Quality of Life Implications

In the present study, 75.4% of participants reported a perceived improvement in quality of life with telemedicine, either significantly or to some extent. This finding should be interpreted as a patient-reported perception rather than as an objective measurement of quality of life, as no validated quality-of-life instrument was administered. The perceived benefit may reflect reduced travel burden, improved continuity of care, or greater convenience; however, the present cross-sectional design does not allow the underlying mechanisms or causal effects on quality of life to be determined. Previous studies have reported improvements in quality of life and related outcomes following telehealth-based interventions in PD, but these findings may not be directly comparable with the perception-based measure used in the present study. Latella D et al., demonstrated improvements in emotional health and caregiver well-being through telehealth-based cognitive and psychological interventions in PD [34], while the network meta-analysis by Dou J et al., established significant benefits across motor symptoms, cognitive function, anxiety, depression, and overall quality of life [35]. In the present cohort, however, the quality-of-life benefit is more plausibly attributable to improved continuity of care and reduced appointment attrition than to the clinical content of individual telemedicine sessions. Fleisher JE et al., found that telehealth-enhanced home care sustained quality of life over time in patients who would otherwise have experienced decline; a protective effect analogous to reduced appointment dropout may confer in access-constrained Indian settings [36].

### Limitation(s)

A number of limitations should be considered when interpreting these findings. Firstly, the convenience sample size of 57 individuals of two urban movement rehabilitation centres in Chennai restricts the extrapolations of the results to the rural and semi-urban groups with PD where the barriers and usage patterns might be significantly different. Further, recruitment from specialised movement centres for rehabilitation may have introduced selection bias, with participants more likely to be engaged in ongoing specialist care, have greater health-seeking behaviour and prior experience with telemedicine facilities than the general PD population. Additionally, the inclusion of only urban and semi-urban participants limits the generalisability of the findings to rural populations. Secondly, the cross-sectional nature of the study makes it impossible to make causal conclusions concerning the correlation between telemedicine utilisation and the quality of life outcomes. Furthermore, quality of life was assessed only through participants' perceived impact of telemedicine and was not measured using a validated quality-of-life instrument; therefore, the reported perceptions should not be interpreted as objective changes in quality of life. Third, there is the possibility of social desirability and recall bias in self-reported perceptions of the quality of telemedicine. Fourth, there are no validated neurological outcome scales to enable the measurement of the relation between the use of telemedicine and objective clinical improvement. Lastly, non-adopters who may not have attended rehabilitation centres were not included in the research, thereby having an inflated impact on the estimates of utilisation.

### CONCLUSION(S)

The present study exploratory cross-sectional study provides insights into the awareness, utilisation, perceived benefits, and challenges of

telemedicine among patients with PD in Tamil Nadu. The findings indicate high levels of awareness and reported use of telemedicine among participants, with most reporting favourable experiences and positive perceptions of the quality of remote consultations. This is particularly relevant given that many participants lived more than 50 km from a hospital with neurological services and experienced logistical challenges in accessing healthcare. The findings suggest that telemedicine may support healthcare access and continuity of care for people living with chronic neurological conditions, particularly in resource-limited settings. However, these findings reflect self-reported experiences across different remote-care modalities and should not be interpreted as evidence of comparative clinical effectiveness. The findings support the potential role of telemedicine as a complementary approach for routine follow-up, medication-related communication, symptom monitoring, and caregiver education, while recognising the continued need for in-person assessment when comprehensive neurological examination or advanced clinical management is required. Rehabilitation facilities may consider extending interdisciplinary virtual services, including physiotherapy, speech therapy, medication counselling, and structured caregiver training, recognising that caregiver involvement may be necessary to support participation in telemedicine among some patients with PD. Caregiver-inclusive service models, user-friendly digital platforms, improved digital infrastructure, and better access to specialist-supported telemedicine may help address barriers to remote care. Larger multicentre studies, particularly involving rural and semi-urban populations, are needed to assess the generalisability of these findings and evaluate the longer-term implications and cost-effectiveness of telemedicine in PD care.

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