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Fear, Perception and Architectural Space: A Stage-wise Study of Parkinson's Disease in the Indian Context

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Abstract - Parkinson's disease (PD) is a neurodegenerative disorder, meaning there is progressive loss of neurons, which affects both motor functions (movement, balance, gait) and non-motor functions (perception, cognition, anxiety). Hence, this research explores the relationship between these neurological symptoms and built environments. Architectural space is experienced "through brain and body", meaning space is not just physical but interpreted neurologically and psychologically. The movement, perception and spatial navigation are affected in people having Parkinson's, and that changes how they interact and experience spaces differently from neurotypical individuals. This research puts architecture as a tool to understand which built environmental factors acts as a barrier or facilitator for people with disorder throughout different stages of this progressive disease.

This research is situated in an Indian context where the spaces are not designed considering the neurological disorders. The patients are mainly based in Ahmedabad where their day-to-day built environments encountered are home, hospitals, clinics, migration to the workplace, physiotherapy centres, outdoor streetscapes circulation areas, etc.

This methodology is a qualitative, exploratory, and human-centred approach that covers interdisciplinary fields such as neuropsychology and architecture. The focus is on understanding the lived experience of architectural space rather than measuring performance through quantitative tools.

The findings indicate that the spatial complexity, level differences, lack of support elements etc. increases fear and reduces mobility from moderate to severe stages. Non-motor symptoms such as stress, anxiety or fear related to mobility were affected greatly and were the major driving factor for influencing movement behaviours. The research concludes with stage-wise design guidelines and minor changes that can help promote better participation of the patients and create supportive environments.

Keywords: Parkinson's Disease | Spatial Perception | Participation | Architectural Environment | Architectural Measures

INTRODUCTION:

Background and Motivation

Parkinson's disease (PD) offers an important opportunity to study the relationship between neuroscience, psychology, and architecture. PD is a **neurodegenerative disorder** caused by the gradual loss of dopamine-producing neurons, leading to problems with movement, perception, and cognition (Naz & Siddique, 2020). People with PD often experience difficulty in moving through spaces, understanding spatial cues, and feeling confident in unfamiliar environments. This makes PD a valuable case for understanding how neurological conditions change spatial experience (Nilsson et al., 2015). Interdisciplinary research of architecture and neuroscience gave rise to the field of neuroarchitecture that explores how brain function is influenced by built environment. Neuroarchitecture talks about understanding spatial qualities such as light, scale, material and layout affect cognitive processes and emotional states (Abbas, 2024; Mashchenko, 2025). "The brain continuously processes the spatial information" this is demonstrated through scientific studies. Brain learns and adapts through

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environmental conditions. For example, Maguire et al. (2000) found that spatial navigation can lead to structural changes in the hippocampus. This strongly suggests the physical changes in brain function by just moving through environments. Bodily and sensory experiences gained after space perception and engagement further enforces concept of embodiment and empathy. (Lucchini & Bonenberg, 2022). These examples establish a strong foundation that spaces influence not only well-being but also neurological conditions.

Parkinson's disease (PD) is a relevant context to understand this relationship of brain, body and environment. It affects motor and non-motor functions which finally affects how individuals interact with their surroundings. Motor symptoms such as FOG, tremors, Gait impairment, postural instability affects movement and balance while non-motor symptoms such as anxiety related to mobility, mood disturbances, cognitive issues, fear etc. affect the psychological aspects of built environment such as how the space is perceived. The progression of this disease is clinically rated from stages 1 – 5 depending upon the symptom severity.
In the early stages there is minor disturbances in the movement while the advance stages involve dependency during mobility. As the disease progresses, the complexity of the relationship between user and environment also increases. Everyday architectural elements such as flooring, circulation paths, lighting and spatial layout either facilitate or acts as a barrier for their day-to-day participation in life.

METHODOLOGY:

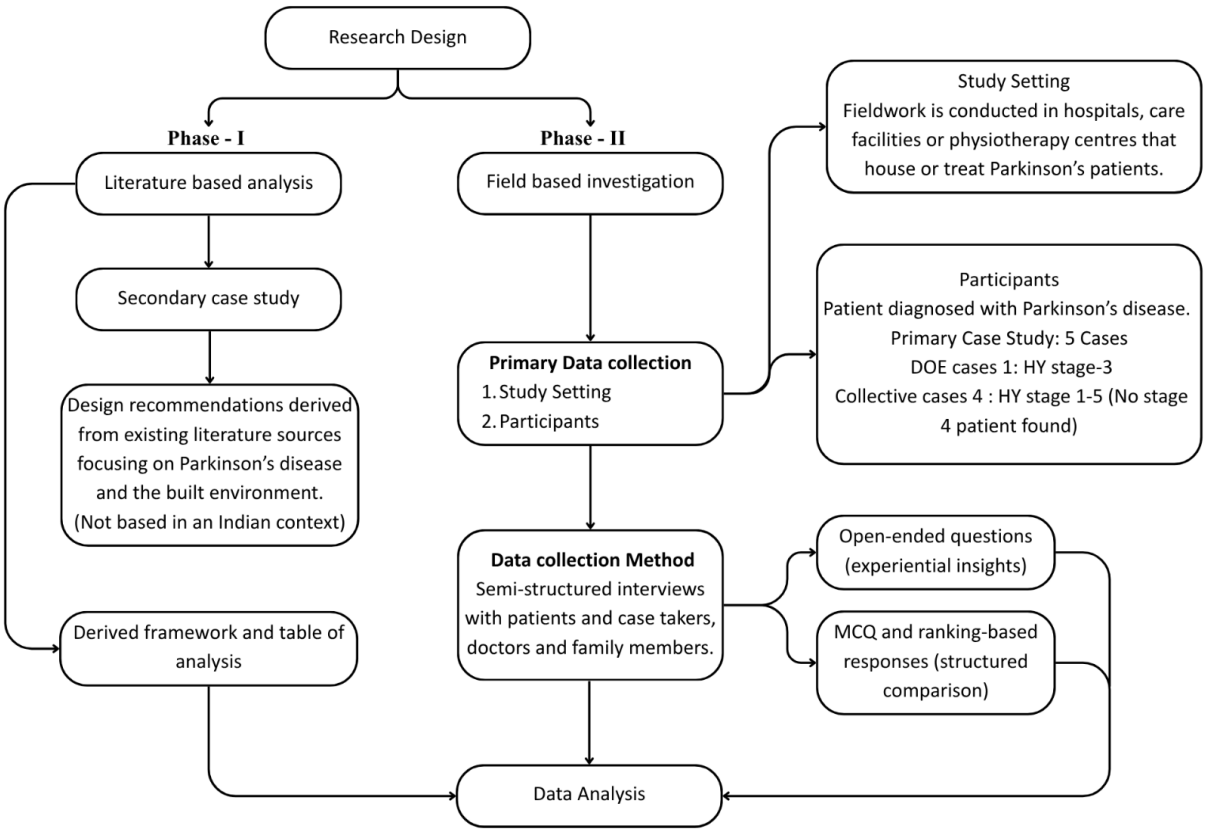

Figure 1 Methodology
(Source: Author's Work)

Research Questions:

1. How can certain architectural design decisions promote daily life participation for Parkinson patients?

Scope:

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- Covers perception and mobility of Parkinson's patients across ***all stages***
- Includes both *indoor and outdoor* architectural elements
- Extends beyond home to *everyday built environments* (public buildings, streets etc.)
- From a neurological perspective how architectural elements influence *motor and non-motor symptoms* during movement

Limitations:

- Findings may *not directly apply* to other neurological or cognitive disorders.
- The study is based on a limited number of case studies and interviews; hence, the data collection is *qualitative and exploratory.*
- The study mainly evaluates *existing environments* rather than designing or testing new architectural interventions.
- The research is conducted within an *Indian social and built-environment* context, so the results may vary across other regions.
- The research relies partly on *self-reported experiences and perceptions,* which can vary depending on individual health conditions, stage of the disease, and personal interpretation of spaces.

Literature Review:

Parkinson's Disease (PD) is the second most common neurodegenerative disease after AD. It is a progressive CNS disorder that affects mainly the movement of the body. It affects both motor as well as non-motor functions. (Naz & Siddique, 2020).

2.3.1 Braak's Hypothesis

Although the exact cause of how Parkinson disease is started inside the body is unknown; few researchers believe that it is a combination of genetic and environmental factors. In 2003, Heiko Braak, MD gave a hypothesis regarding the same. He stated that a pathogen enters the body via nose or is swallowed and reached inside the gut. This is where it begins. The bacteria or the virus comes into the contact with gut bacteria which leads to the formation of α-Synuclein (called Lewy body) and it spreads through the CNS. This causes degradation of dopamine neurons in an area called substantia nigra. (Parkinson's Foundation, n.d.)

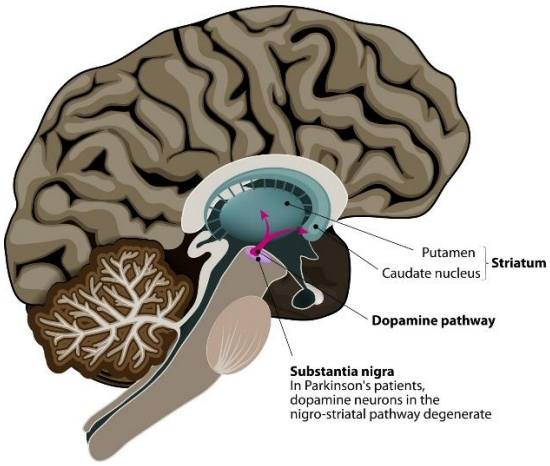

Figure 2 Location inside brain where the loss of dopamine neurons takes place (source: https://healthjade.com/what-is-parkinsons-disease/#What_is_Parkinsons_disease)

2.3.2 Progression of Parkinson's

In 1967, Hoehn & Yahr defined five stages of PD based on the level of clinical disability. Clinicians use it to describe how motor symptoms progress in PD. On this scale, stages 1 and 2 represent early-stage, 2 and 3 mid-stage, and 4 and 5 advanced-stage PD. (Parkinson's Foundation, n.d.)

Hoehn & Yahr Stage 1 to Stage 5 of Parkinson's Disease:

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Table 1 Author's Understanding

Stage (Hoehn & Yahr)	Scale	Symptoms
Stage 1	Early	Mild symptoms, Body affected on one side; Some visible symptoms: postural instability, changes in walking pattern, facial expression stuck, tremor etc.
Stage 2	Early	Both side of the body affected, Posture changes and symptoms start getting worse. Person is able to live alone but daily tasks become slightly difficult
Stage 3	Mid	Loss of balance, Unsteady movements, Frequent falls and rest motor symptoms worsen. Person can still manage independent daily tasks.
Stage 4	Advanced	Symptoms fully developed, disability persistent, assistance required (such as cane/walker), unable to live alone and need care taker for daily activities.
Stage 5	Advanced	Impossible to walk or stand, bedridden, 24hr care required

2.3.3 Rating Scales

There are 8 identified rating scales (In addition to Hoehn & Yahr scale) to measure and categorize the symptoms of PD and its progression mentioned by Parkinsons's Foundation, Center of Excellence. (Parkinson's Foundation, n.d.)

1. Unified Parkinson's Disease Rating Scale (UPDRS)
2. Movement Disorder Society-Unified Parkinson's Disease Rating Scale (MDS UPDRS)
3. Unified Dyskinesia Rating Scale (UDysRS)
4. Schwab and England Activities of Daily Living Scale
5. Parkinson's Disease Questionnaire (PDQ-39)
6. Non-Motor Symptoms Questionnaire (NMSQ)
7. Non-Motor Symptoms Scale for Parkinson's Disease (NMSS)
8. Patient Diaries and/or Kinematic Sensor

2.3.4 Motor and Non-Motor Symptoms

James Parkinson has accurately listed down the motor symptoms and problems faced by the patient but he also gave few non-motor symptoms. As extensively the motor problems have been researched and identified; the non-motor symptoms are equally poorly recognized and inadequately treated.

The role of non-motor symptoms is as important as the motor symptoms as it affects the quality of life, health economics, institutionalisation rates etc. However, how these non-motor symptoms are developed inside the body is unknown. There is also a prevailing research gap of whether there is a role for dopaminergic treatment?

Following table shows some common motor and non-motor symptoms identified during the literature study.

Table 2 Author's findings

Motor Symptoms	Non-Motor Symptoms
• FOG (Freezing of Gait) • Postural instability • tremors • stiffness	• sleep disorder • depression • genitourinary problems • constipation • anxiety related to mobility

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• dyskensia • falls/ near falls • balance impairment • shuffling gait • freezing episodes • muscle rigidity • slowness of movement	• psychosis • isolation • poor mental health • mood disturbances • boredom • dementia • olfactory problems • rapid eye movement disorder • daytime drowsiness • stress • cognitive decline • fatigue

Case Study:

Primary case study: The primary cases are selected to evaluate the applicability of existing design theories within the Indian context.

Table 1. Participant characteristics

Patients (Men/Women)	5(3/2)
Age, Years, Mean (SD)	67.4
PD Duration, Mean (SD)	11.2
Living Arrangement	
With Family >2 people	4
With Family <2 people	1
Disease severity (HY)	
HY 1	1
HY 2	1
HY 3	2
HY 4	-
HY 5	1
PD severity based on symptoms affected	Mild (2) Moderate (2) Severe (1)

SD: Standard derivation HY: Hoehn & Yahr

Primary Case Study Analysis:

About Patients

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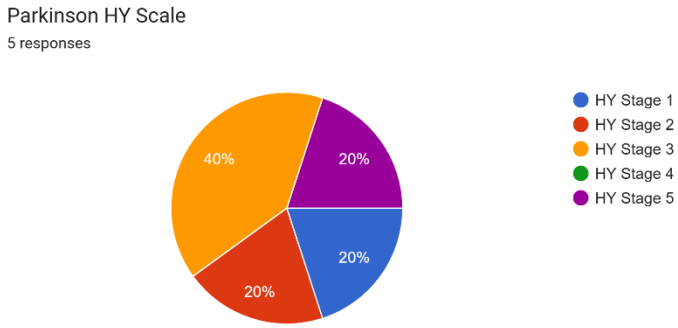
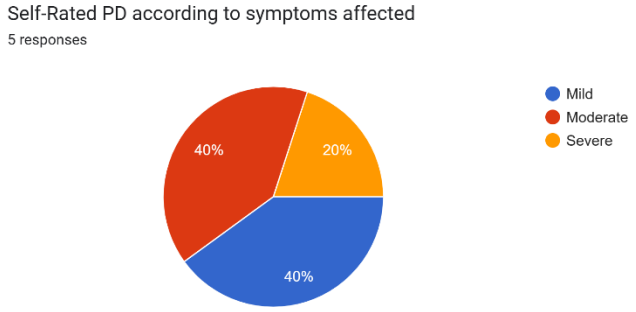


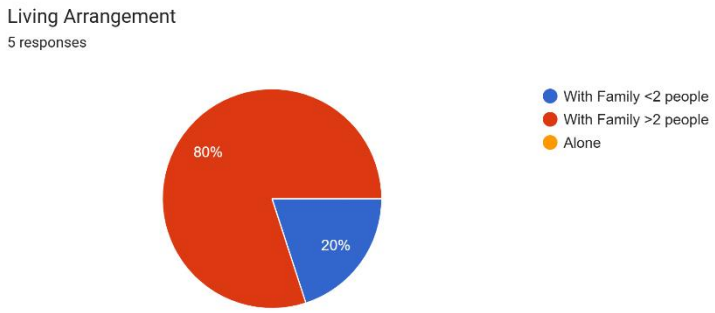
Parkinson HY Scale

Most patients fall in Stage 3 (40%), with remaining distributed across Stages 1, 2, and 5 (20% each), showing a mix of mild to severe conditions.



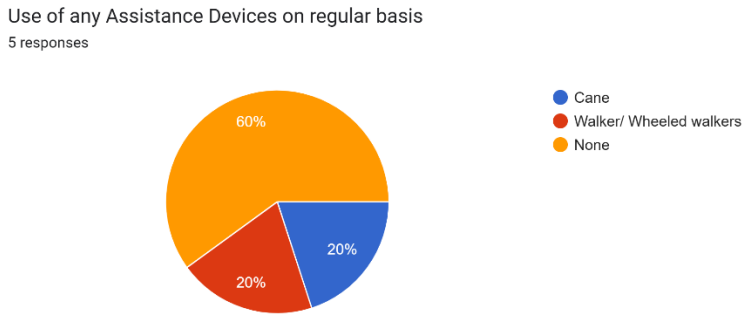
Self-Rated Parkinson's Severity

Responses are evenly split between mild (40%) and moderate (40%), with fewer severe cases (20%).



Living Arrangement

Majority (80%) live with family (>2 people), while 20% live in smaller households; none live alone.



Use of Assistance Devices

60% do not use assistive devices, while 40% rely on canes or walkers, indicating partial dependency.

Figure 3 All Above Figures are response charts (Source: Google Forms; Author's Work)

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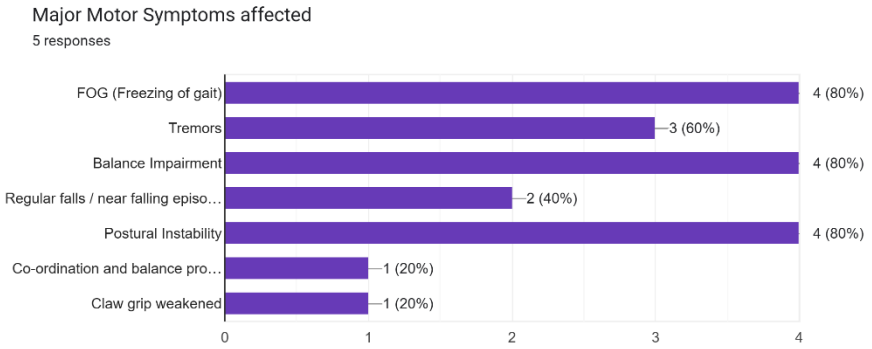
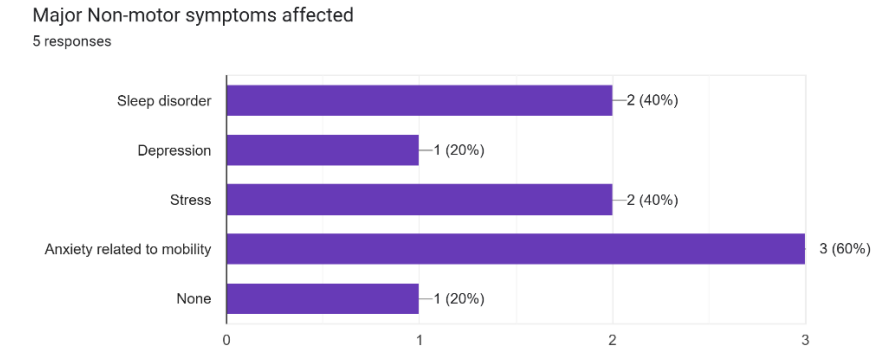


Prevailing symptoms are FOG, Balance impairment, postural instability (80%) followed by tremors (60%).

This proves movement related problems are faced indoors and outdoors.



Most dominant non-motor symptom faced is anxiety related to mobility (80%, 3/5)

This highlights the psychological impact.

Figure 4 Both of the above bar charts are responses (Source: Google forms; Author's Work)

Literature-Based Analysis:

Table 3 General Design Recommendations for PD patients (Source: Author's Work)

Safety & Accessibility	Circulation paths/ Passageways: Avoid closed spaces with 180-degree tight turns [23] Avoid uneven pavements, curbs, steps, skirting boards, doorways and carpets [22] Removing obstructions in walkway [22] Avoid narrow entrances [22] Signalled pedestrian crossing [22] Transverse lines on walkways [22] Handrails along the corridors to increase gait confidence [22] Doors: Sliding pocket doors [27] Single door width opening should be roughly doubled [23] Glass sliding door with garden view [23] Flooring: Curless entry inside shower space from bathroom [27] Clear edge definition [27] Staircase: Short flight of stairs equipped with handrails, step lights and accommodation for future stairs [27]
Light & Visibility	Colors: Contrasting border in a raised curb or handrail [27] Reduction in high contrast materials and colors where possbile [23] Visual cues: Simple piece of art at the end of a corridor pr window [23]

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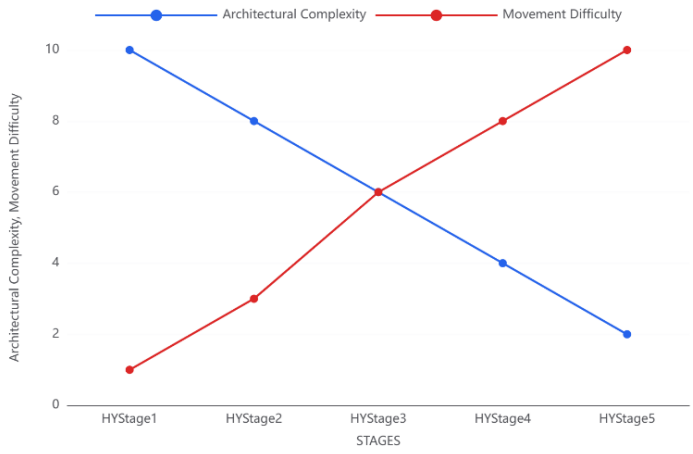
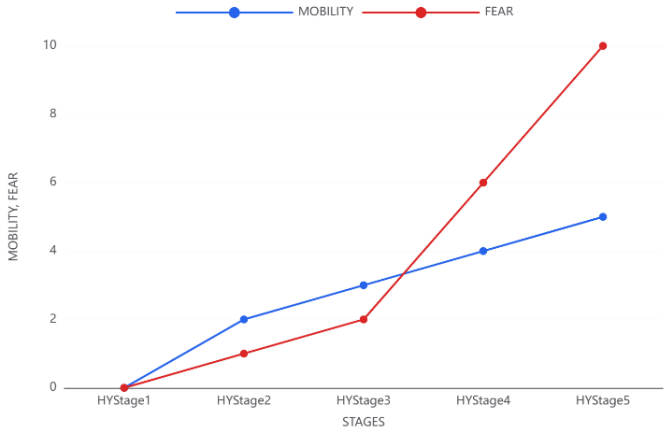
	Provision of traffic lights as an audio-visual cue [22 Light: Lighting the path from the bed to a washroom [27] Directional lighting along the corridor[27] Battery-operated LED ceiling [34] Pattern: Simple banded floor pattern like miniature crosswalk [23]
Spatial Legibility and Wayfinding	Unobstructed views across rooms and spaces (such as living room to kitchen) [27] Seating nooks in large spaces [23] Uncluttered environment, simplification of decor[23] Positioning of furniture and buying more steady/ fixed pieces [23]
Biophilic Design	Expanding backyard or balcony spaces [27]

4/8 Analysis Inferences:



Even as the architectural complexity decreases, movement difficulty gradually increases with stage progression
Architectural complexity: 1 = Complex flooring pattern, 10 = large open spaces
Movement Difficulty: 1 = No FOG, 10 = Fear of falling; falls



Motor symptoms increase gradually, while anxiety related to mobility increases twice at each stage.
Hence, perception matters as much as the symptoms

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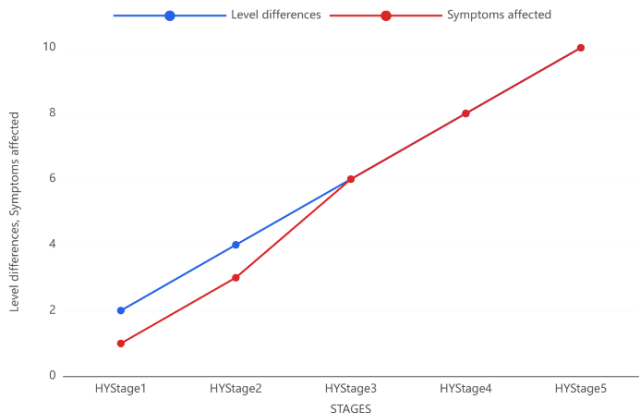
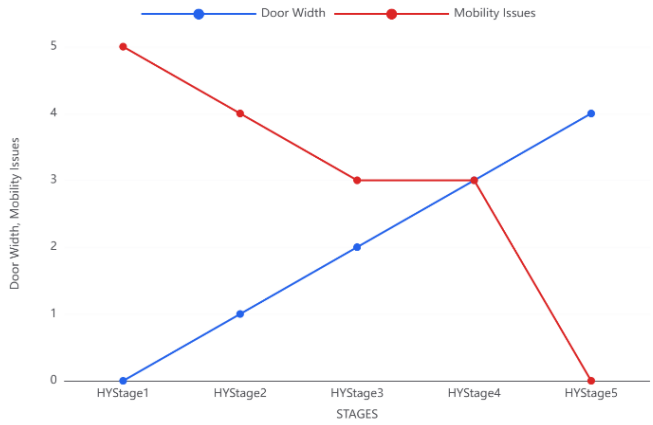


As the complexity of abrupt level differences increases, so do the affected symptoms.

Level difference: 2 = Height difference in staircase riser, 10 = Unpaved roads & pathways

Symptoms affected: 1 = Mild balance disturbance (only motor), 10 = Severe imbalance and anxiety related to gait (motor & non-motor symptoms affected)



Door design is one of the crucial aspects for parkinson patients. As the door width increases, issues related to mobility decrease.

Vice versa for patients in early-stage.

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Annexures:

Sample interview questions

1. Open question → lived experience
2. Scale question → comparability across stages
3. Mcq Based question → Preference

Doors

1. "Do doors make you pause or hesitate? Which types are more difficult for you?" *Open-ended*

2. Do narrow doors make you feel stressed while walking through them? ☐ *Yes* ☐ *No*
3. Which type of door do you find most difficult to use?

   ☐ *Heavy push/pull doors*
   ☐ *Narrow doors*
   ☐ *Automatic doors*
   ☐ *Glass doors*
   ☐ *No difficulty*

Flooring

- "Are there floor surfaces that make you uncomfortable or cautious while walking? If yes, which?"
  Open-ended

- Confidence when flooring surfaces change:
  1 (Not confident) – 5 (Very confident)

- Which flooring surface makes walking most uncomfortable for you?

  ☐ *Smooth / polished flooring*

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☐ *Patterned flooring*
☐ *Uneven flooring*
☐ *Carpeted flooring*
☐ *No difficulty*

Staircases

- "How do you feel when using stairs that is wider indoors or outdoors?"
  Open-ended

- Fear or difficulty on stairs (all types):
  1 (Very high) – 5 (Very low)

- *Which type of staircase induces more fear when encountered tor given to climb?*
  ☐ *L-shaped*
  ☐ *Circular staircase*
  ☐ *Without hand-rail*
  ☐ *Public entrances staircase*
  ☐ *Public transport staircase*
  ☐ *No difficulty*