

Relationship Between Sit to Stand Ability, Cognition, Freezing of Gait and Activities of Daily Living in Parkinson's Patients: A Cross Sectional Study

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ABSTRACT

Background: "Sit to stand" being a prerequisite for walking, the inability of patients to perform it can result in institutionalization. Cognition and freezing of gait also impaired functioning and mobility in activities of daily living. There was a need to find out whether "sit to stand" ability correlates with cognition, and quality of life in Parkinson's patients.

Method: It was a cross sectional study in which thirty-three Hoehn & yhar stage 1,2, and 3 patients aged 50 to 70 years were included. Patients with musculoskeletal impairments of lower extremity which would affect walking were excluded from the study. Each patient performed five times sit to stand (5TSTS) from a chair and time taken was recorded. Mini mental scale was (MMS) taken for cognitive impairment. Freezing of gait questionnaire and Parkinson's disease activities of daily living scale (PDADLS) was also taken.

Result: Correlation between the outcomes of the variables was analysed using Pearson correlation co-efficient. The 5TSTS scores showed strong positive correlation to PDADLS and with MMS weak positive correlation. However, moderately positive relationship was found between freezing of gait and PDADLS.

Conclusion: The study concludes that change in the 5TSTS performance can affect motor functions and freezing gait like daily living activities of life but not any significant in cognitive functions. Exercise training focusing on sit-to-stand ability may also influence activities of daily living (ADLs) and freezing gait in Parkinson's patients.

Keywords: *Cognition, freezing gait, Parkinson's Disease, Sit to Stand Ability.*

INTRODUCTION

Parkinson's disease (PD) is a disorder of the central nervous system (CNS) which is progressive and has both motor and nonmotor symptoms. The cardinal motor symptoms include features of rigidity, bradykinesia, tremor and in later stages, postural instability. Constipation, Rapid eye movement (REM), sense of smell, sleep behaviour disorder, mood disorder, orthostatic hypotension are the early features of Parkinson's disease. The nonmotor symptoms include altered bladder function, excessive saliva, integumentary changes, difficulty speaking and swallowing, and cognitive problems (slowed thinking, confusion, and in some cases dementia) are included in non-motor early symptoms.¹

The term parkinsonism is a generic term used to describe a group of disorders with primary disturbances in the dopamine systems of basal ganglia (BG).¹ Parkinson's disease (PD) is a common disease that affects an estimated 1 million Americans and an estimated 7 to 10 million people worldwide. More than 2% of people older than 65 years of age have Parkinson's disease (PD).¹ The prevalence of the disease is expected to increase substantially in the coming years due to the aging of the population.¹ Difficulties with gait and balance in Parkinson's disease (PD) increase the risk of falls, institutionalization, and mortality.²

Pal, G., O'Keefe et al. study revealed that there is a correlation between reduced processing speed and impaired turning in Parkinson's disease. Identification of processing speed deficits is particularly important since this construct has the potential to be modified with cognitive training ³. Another Research of Brett W. Fling, Marian L. Dale et al. established that cortical input from areas involved with higher cognitive function is required for safe ambulation. The relationship of cognitive impairment, especially prefrontal lobe dysfunction, has been linked to motor disability in PD but the mechanism of relationship is still unclear.² With the Parkinson's disease (PD) progression other impairments occur, such as postural instability and gait dysfunctions . These impairments result in a greater propensity to falls, as well as a reduced capacity to walk , and lead to progressive functional restraints.⁴

These physical aspects contribute to worsen the quality of life in patients (QoL). QoL is a multidimensional concept that refers to an individual's subjective perception concerning their life and other aspects, such as familial relationships, the patient's own health, financial issues, housing, social life and leisure.⁵ A frequently observed symptom in advanced stages of Parkinson's disease (PD) is Freezing of Gait (FOG).The prevalence of FOG lies between 20% to 60%.⁶ This disabling clinical phenomenon is defined as follows: "brief, episodic absence or marked reduction of forward progression of the feet despite the intention to walk". Patients with PD generally describe FOG as "having the feeling as if their feet are glued to the ground."^{6,7} Patients with PD often describe that FOG is triggered in stressful conditions like Walking in crowded places or walking through narrow spaces, like crossing the doorstep. Furthermore, FOG is often associated with falls and reduced quality of life (QoL).^{7,8}

Patient-reported assessments of freezing of gait (FOG) in Parkinson's disease (PD), such as the FOG questionnaire (FOGQ), would be needed because FOG is difficult to assess objectively.^{8,9} However, the measurement properties of the FOGQ have been sparsely assessed. The FOG-Q is one of the well-known and often used measurement tool in clinical settings. The FOG-Q is less time consuming and can be administered with ease.¹⁰ The FOG-Q has already shown high reliability(0.94) and validity for detection of FOG-Q in PD patients in previous studies.¹¹

The impact of disease on activities of daily living (ADL) as reported by patients themselves is an important measure of the disadvantage attributed to any disease state. The degree to which a disease interferes with the ability to carry on a normal life is likely to be

more important to the patient than formal measures of disease severity.¹² The PADLS is also found to be a valid and reliable(0.89) instrument to assess ADL in Parkinson's Disease(PD).¹³ It is a self-reported questionnaire. The PADLS introduces a new disease-specific measure in PD, which provides health professionals with a reliable index of self-rated ADL. The Parkinson disease activities of daily living scale (PADLS) is acceptable to patients and takes very little time or effort to complete.^{13,14}

The high number of falls and subsequent injuries, establishment of an outcome measure that reflects both lower extremity strength and balance deficiencies in individuals with PD. Sit-to-stand (STS) movement is considered a fundamentally required movement for mobility and functional independence, as the movement is part of many Activities of Daily Living (ADL).¹⁵ The Five times sit to stand (FTSTS) would appear to be very useful for assessing fall risk in individuals with PD, as strength and balance deficiencies are prominent. Five times sit to stand (FTSTS) in PD is most related to balance and fall risk.^{15,16} The FTSTS is reliable(0.95) and easy to administer, and may be useful as a quick means of assessing gross fall risk in individuals with Parkinson's Disease(PD).¹⁷

The full spectrum of cognitive impairment, from subjective cognitive decline to dementia, has been observed in Parkinson disease (PD).¹⁸ The Mini-Mental State Examination (MMSE) is the most commonly used brief cognitive tool in the assessment of a variety of cognitive disorders.^{19,20} It is reliable(0.90) and Relatively quick, easy to perform, Requires no additional equipment. It Can provide a method of monitoring deterioration over time.²⁰

The aim of study is to find out the relationship between freezing of gait, cognition, sit to stand and activity of daily living in Parkinson's patient. Patient with Parkinson's typically progress with cognitive impairment during the later stage of life which leads to further complication so, the need for this study is to examine the relationship between functional mobility, freezing of gait, cognition and activity of daily living. This correlation gives the idea about the specific deficit of patient which help to establish the proper rehabilitation protocol. Study hypothesized that all these components may correlate to one another or may not correlate.

Methodology

Study setting: Shree k k sheth physiotherapy college, Rajkot.

Study population: Parkinson's disease patients

Sampling technique: Purposive sampling

Sample size: 33 patients

Study design: Cross sectional observational study

Study design and Participants:

We had recruited 33 patients with the age group ranging from 50 to 70 years. All the patients were explained about the purpose of the study. Written consent was taken from the patients. Ethical clearance for the study was granted by institution committee. The patients were

purposely assigned for study. The sample size was calculated on the basis of Parkinson's symptoms reported previous study ($\alpha = 0.05$, $\beta = 0.20$, $r = 0.50$, power = 90, 95%CI). All the subjects were assessed fulfilling their inclusion and exclusion criteria. Patients were Included if they had 50 to 70 years age, male or female, Hoehn & yhar stage 1,2, and 3 and could follow instruction. Patients with any musculoskeletal injury or disease, neurological disease other than Parkinson's were excluded.

Procedure

After the enrolment of the patients 5 times sit to stand was performed and freezing of gait questionnaire (FOG-Q), Parkinson's disease activities of daily living (PADLS), Mini mental state examination (MMSE) was taken for every patient included in the study on the same day.

Freezing of gait questionnaire

The Freezing of gait is 6 questions questionnaire used to help assesses freezing of gait severity unrelated to falls in patients. It is sub divided in to 4 of the items assessing FOG severity and 2 of the items assessing gait. Questions included are during worst state you're walking like, your gait difficulties affect your activities, do your feet feel while turning or initiate gait, how longest this episode, how longest typical hesitation, how longest typical turning hesitation. Total score ranges from 0 to 24 and high score correspond to more severe FOG. FOG questionnaire which is highly reliable and valid tool has high test-retest reliability for score (ICC 0.94).¹¹

Parkinson's disease activities of daily living scale

The Parkinson's disease ADL scale is self-rated questionnaire used to help assesses severity of affection of ADL due to disease. It has 13 items with daily living like dressing, speech, hygiene, salivation, swallowing, handwriting, cutting food, turning bed, falling, freezing when walking, waking, tremors, sensory compliant related to Parkinson's. Total score ranges from 0 to 52 high score indicate more affected ADL. We have used Parkinson's disease activities of daily living scale which is reliable and valid tool has test-retest reliability ICC 0 .89.¹³

Five times sit to stand test (5×SST)

The 5xSST scoring is based on the amount of time (to the nearest decimal in seconds) a patient takes to transfer from a seated to a standing position and back to sitting for five times. The equipment needs in performing 5xSST test includes: Stopwatch and standard height chair with straight back (43-45 cm, 17-18 inches high). The patients were given a practice trial for this test and a minute of rest was given before the actual performance. Patients sat comfortably with leg well supported on the standard chair with a backrest. It was ensured the patient stood up completely and sat down in the procedure. Also, patients were instructed to fold their arms across their chest. (fig.1) Then the patients were instructed to do sit-to-stand five times, as quickly as possible, at the count of go and without their back or leg resting on the chair between the interval of repetition and time was taken. The results were interpreted as the lesser the time taken by the patient to complete the test the better was

the outcome of the test. The normal score is 11.4 seconds for elderly age groups. The 5xSST test has excellent intra-rater reliability (ICC) range: 0.914–0.933) and excellent test-retest reliability (ICC range: 0.988–0.995).



Fig. 1 five times sit to stand test

Mini-mental state examination

The Mini-mental state examination is used to measure cognitive impairment in older adults. it can be used for screening of cognitive impairment, to estimate the severity of cognitive impairment at a given point in time, to follow the course of cognitive changes in an individual over time, and to document an individual's response to treatment. It is used to assess different subset of cognitive status including attention, language, memory, orientation, visuospatial proficiency. Orientation to time has 5 questions and 5 points, orientation to place has 5 questions and 5 points, Registration like repeating the name prompt has 3 points, attention and calculation subset have 5 points, recall subset has 3 points, language subset has 2 points, repetition subset has 1 point and complex commands subset like drawing an object has 6 points. The total scored on a scale of 0-30 with scores > 25 interpreted as normal cognitive status. The MMSE has higher specificity (95%) with ICC .90.²⁰

Statistical analysis

The data was analysed using statistical package for social science (SPSS), version 26. The Kolmogorov Smirnov test was used to verify normality of the distribution of variables.

The values for variables showed a normal distribution, so parametric tests, Pearson correlation co-efficient was used to analyse the data.

Results

The mean age of the patients was 62.03 ± 4.45 years. The characteristics of the patients are shown in Table 1. After analysis, as shown in Table 2, the 5TSTS score showed strong positive correlated with ADL ($r = 0.838$, $P < .001$) and moderately strong positive relationship between 5TSTS and freezing of gait ($r = 0.246$, $P = .168$). However, there was a low negative relationship.

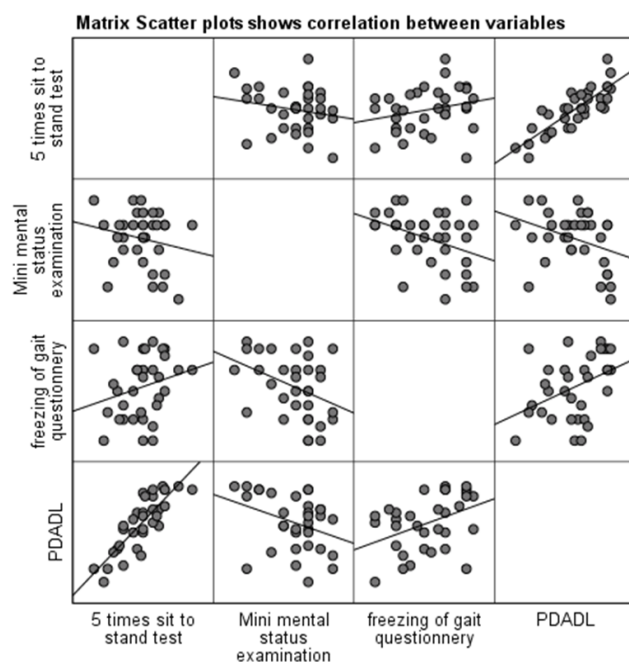
Variables	Mean \pm SD
Age	62.03 ± 4.45
5 times seat to stand	13.4 ± 1.108
MMSE	24.91 ± 2.199
Freezing of gait	13.58 ± 4.395
ADL	37.94 ± 8.303
Male female ratio	17: 16

Table 1. Patient characteristics Values are expressed in mean \pm SD mention between 5TSTS and MMSE ($r = -0.197$, $P = .271$). Also, MMSE was moderately negatively correlated with freezing of gait ($r = -0.382$, $P = .028$) and negative correlated with ADL ($r = -.344$, $P = .050$) whereas freezing of gait and ADL were moderately positive correlated with each other ($r = 0.410$, $P = .018$).

		Sit to stand	MMS	Freezing of gait	ADL
Sit to stand	Pearson correlation	-	-.197	.246	.838**
	P value	-	.271	.168	.000
MMS	Pearson correlation	-.197	-	-.382*	-.344**
	P value	.271	-	.028	.050
Freezing of gait	Pearson correlation	.246	-.382*	-	-.410*
	P value	.168	.028	-	.018
ADL	Pearson correlation	.838**	-.344*	.410*	-
	P value	.000	.050	.018	-

Table 2 shows correlation between variables

**Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level



graph 1. Matrix Scatter plots shows correlation between variables

Discussion

The STS transition is one of the most important activities of daily living because people frequently use it as they move from sitting to standing and then often to walking. There are very few literatures available on relationship between sit-to-stand ability and other measures of functional independence. Therefore, the purpose of this study was to investigate relationship of 5TSTS, freezing of gait, cognition and activity of daily living in Parkinson's patients. For a successful performance of the 5TSTS test, lower limb strength and balance reactions of either or both lower extremities are required although contributions from individual legs cannot be differentiated. The results of this study revealed a strong positive relationship between 5TSTS test and activity of daily living ($r = .838$). Susanna Mezzarobba et al. found out that PD + FoG show postural control differences in STW, compared with PD-FoG and healthy. Different spatial distribution of COP trajectories, between two PD groups are probably due to a deficit to plan postural control during a more demanding motor pattern, such as STW.²¹ Dawn M. Tan et al. found Freezing of Gait and Activity Limitations in People With Parkinson's Disease in that FOG severity and gait hypokinesia were associated with reduced levels of activity after adjusting for disease severity.²² Mon S. Bryant, et al. found that Many persons living with Parkinson's disease (PD) have difficulty rising from a chair. Low physical activity levels and reduced ability to perform activities of daily living (ADL) may be associated with Impaired ability to perform the chair rise in persons with PD. The patients with PD may have difficulty

in living independently and engaging in physical activities of daily living due to impaired ability to rise from chair.²³ Altered anticipatory postural control and consequently a failure to bring the COM adequately forward over the feet prior to the lift-off of the buttocks from the chair may be a result of inability to rise from a chair in persons with PD. Ryan p duncan et al. suggested that sit-to-stand performance is also correlated with balance confidence (ABC) and mobility-related quality of life (PDQ-Mobility) in PD, with those who take longer to perform the FTSTS having lower balance confidence and poorer quality of life.²⁵ Ashley Harrie at all found that the link between dual tasking and fall risk in PD may be caused by cognitive features other than executive dysfunction and may vary based on the ambulatory task in question. These findings refer to on the cognitive contributions to falls in PD.²⁴

Sarah Vercruyssen et al. suggested that One of the cognitive hypotheses of FOG states that freezing is a consequence of frontal executive dysfunction based on evidence that freezers demonstrated reduced cognitive flexibility and verbal fluency, compared to non-freezer. Cognitive decline in freezers was unrelated to freezing severity. This suggest that freezing of gait have a minimal influence on cognition and vice versa. The cognitive and motor contributions to ADLs are different which suggests that interventions targeted at motor control may result in selective improvements in independent functioning. Deborah A. Cahn and Edith V. Sullivan et al. suggested that specific components of simple motor functioning and executive functioning mediate performance on ADLs. He found that some cardinal signs of PD influence ADL suggesting a selective relationship with fine motor control and speed, rather than with severity of rigidity. The current results support the findings that cognitive screening measures are predictive of ADL functioning or cognition is corelated with ADL functioning.²⁶

Orna Moore, et al. suggested that FOG has an independent and significant impact on QoL in PD patients, beyond its effect on gait and mobility. Our results also suggest the positive corelation of freezing of gait and activities of daily living. The possible explanation can be as such, the patient cannot be prepared for the event, which frequently catches him/her in the most uncomfortable and sometimes very unpleasant situation. Such an event is a clear demonstration of the loss of control the PD patient has on his/her own body with regard to a very basic function, mobility. Loss of control, even if transient, is one of the most important fears PD patients express at any stage of the disease. Another aspect of FOG is its social consequences. FOG episodes are frequent in crowded situations like at the theatre or social events, as well as in time restricted situations like crossing the street at a green light or entering an elevator. Getting stuck to the ground or performing ineffective shuffling steps in those situations leads to much embarrassment and frustration, with emotional consequences that can be reflected in QoL assessment.²⁷

From the result of our study, we found that sit to stand is important factor associated with motor function and daily living activities in Parkinson's disease. Also freezing of gait has its impact on activities of daily living and therefore needs to be considered. Altered Cognition may not

be associated with the sit to stand ability but may have impact on activities of daily living and thus quality of life in Parkinson's disease.

Conclusion

It was concluded that the activity of daily living is affected by alteration in any of the above parameters but motor activity like sit to stand is not affected by alteration in cognition in Parkinson's disease. The changes in STS ability can affect balance and walking. Also freezing of gait has its effect on activities of daily living and thus quality of life in Parkinson's disease. Due to strong correlation between these variables, the 5TSTS performance can be used as an indicator of the independence in Parkinson's patients. Therapeutic interventions that focused on the "sit-to-stand" ability might give benefits in dynamic balance and quality of life.

Clinical implication

The sit to stand activities in Parkinson's disease has a correlation with freezing of gait and activity of daily living, the physiotherapy rehabilitation should include exercises improving the sit to stand ability. Also exercises to improve freezing of gait would help to improve ADL and thus QOL in PD. Sit to stand used as a test can also be used as for treatment purpose like standing up from high chair, low chair, swiss ball and in later stages if patient is bed ridden this exercise can help making transfer activities more easier for patients and care taker. So, physiotherapy rehabilitation should include sit to stand exercises, gait training and dual task training to improve ADL in PD.

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Authors' contributions

Authors have contributed in literature search, data analysis, and review. authors have contributed in data collection, manuscript preparation, and editing. The authors have read and approved the final manuscript.

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Availability of data and materials

The data collected and/or analysed related to the study are available from the corresponding author on reasonable request and after institutional approval.

Consent for publication

Yes, all the authors provide consent for the publication of this study in this journal. Authors declare that the abovementioned manuscript has not been published or considered for publication elsewhere.

Competing interests

The authors declare that they have no competing interests.

Abbreviation

PD = Parkinson's disease

BG = Basal ganglion

5STS = Five times sit to stand test

PDADL = Parkinson's disease activities of daily living scale

ADL = activities of daily living

MMSE = mini mental status examination scale

FOGQ = freezing of gait questionnaire

STW = Sit to walk

COP = control of posture

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