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Correlation of trunk mobility with balance and gait in patients with Parkinsonism

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Abstract
Background and Objectives: It is evident from previous studies that trunk mobility is affected in Parkinsonism patients. Also it is shown that Balance and Gait parameters are also affected in Parkinson's disease Patients. Impairment of any of these parameters affects the activities of daily living (ADLs) and in turn affects the quality of life. A correlation in between these parameters can help in formulating better management of patients with Parkinson's disease. The aim of the study was to find whether any correlation exists between trunk mobility and balance and gait in patients with Parkinson's disease (PD).
Methodology: 50 subjects (18 females and 32 males) with PD (mean age 68.84) were included in the study. Inclusion criteria consisted of ambulatory subjects with Parkinson's disease, not having any orthopedic or neurological condition that could affect the trunk movements, balance and gait in these subjects. Trunk mobility scale was used to assess the trunk mobility and Tinetti Performance Oriented Mobility Assessment (Tinetti POMA) tool was used to assess the balance and gait parameters.
Results: there was a significant correlation found between the values of Trunk Mobility scale and Tinetti POMA score using the Pearson's correlation formula. (P = 0.01)
Conclusion: From the results, we can conclude that there exists a significant correlation between trunk mobility, balance and gait in patients with Parkinson's disease. So the more severe is the trunk mobility in the PD patient, more will be the difficulties with Balance and Gait.

Keywords: Parkinson's disease, trunk mobility scale, Tinetti POMA, trunk mobility, balance, gait, correlation

Introduction

Parkinson's disease (PD) is a chronic, progressive disease of the nervous system characterized by the cardinal features of rigidity, bradykinesia, tremor and postural instability. The term Parkinsonism is used to refer to a group of disorders that produce abnormalities of basal ganglia (BG) function. PD, or Idiopathic Parkinsonism, is the most common form, affecting approximately 78% of patients [1]. It is associated with degeneration of the basal ganglia of the brain and a deficiency of the neurotransmitter dopamine [2]. Decreased levels of dopamine, removes the inhibitory influence on the cholinergic pathway causing excessive excitation of the extrapyramidal system, which causes increased tone in the agonist and antagonist. This gives rise to rigidity and bradykinesia [3]. Other symptoms including shaking, movement and gait disturbances; sensory changes; speech, voice and swallowing disorders; cognitive and behavioural changes; autonomic nervous system dysfunction; gastrointestinal changes and Cardiopulmonary changes. In later stages thinking and behavioural problems, dementia and depression may also arise [1, 4]. Average age of PD onset is approximately 50-60 years. The incidence increases dramatically with increasing age[1]. According to a study conducted by M Gourie Devi in 2014, population based surveys (excluding Parsis) have shown a Crude Prevalence Rate (CPR) of Parkinson's disease varying from 6-53/100,000 population. The CPR of 328 and age adjusted rate of 192/100,000 population in the Parsis is considerably higher than in the other developing countries. Incidence and mortality rates of Parkinson's disease are available from one recent community based study; average age-adjusted incidence rate for the period 2003-2007 was 5.7/100,000 per year and average annual mortality rate during the same period was 2.9/100,000 per year [5].

The trunk being the center of the body plays a major role in maintaining the body posture for functional movements by preparing the body, for the movement of the extremities against gravity [6]. Trunk muscles play an important role in the support of our bodies in antigravity postures such as sitting, standing and stabilization of proximal body parts during voluntary limb movements as well as balance and gait during functional activities [7, 8]. Axial rigidity is an evident incapacitating trait responsible for abnormal walking in patients with Parkinson's disease [9], in whom it is typically accompanied by poor lateral trunk flexion [10]. A study conducted by Bridgewater *et al*, concluded that People with PD exhibit less axial range of motion and isometric and isoinertial ability compared with persons without PD. There is a loss of the ability to extend the trunk early in the disease [11]. Subtle postural changes become evident shortly after the onset of the illness. The most recognized type of static deformity is the classic stooped simian appearance, with flexion of the hip and knees and rounding of the shoulders. More severe abnormalities of the static posture disrupting spinal alignment and leading to significant disability include camptocormia, antecollis, Pisa syndrome and scoliosis [12, 13].

Balance and gait disorder as well as bradykinesia are strongly

correlated with disability in PD [14]. The term 'balance control' refers to a multisystem function that strives to keep the body upright while sitting or standing and while changing postures. Faulty balance control mechanisms may contribute to fall-related injuries, restriction of gait patterns, and decreased mobility. These disabilities lead to loss of functional independence and social isolation [15]. Parkinsonian gait is now widely recognized by a characteristic stooped and shuffling appearance. This includes a reduction in extension during late stance phase and a reduction in flexion during mid-swing coupled with forwards inclination of the trunk. The 'shuffling' gait occurs because the foot is still moving forward at the time of initial contact. In some patients initial contact is made by flat foot; in others there is a heel strike but with the foot being much more horizontal than usual. Unlike most gait patterns, which stabilize within the first two to three steps, the gait of patients with Parkinsonism often 'evolves' over the course of several strides [16].

So it is evident from previous studies that trunk mobility is affected in Parkinsonism patients. Also it is shown that Balance and Gait parameters are also affected in Parkinson's Patients. The study aims to find correlations between trunk mobility and balance and gait in patients with Parkinsonism. Impairment of any of these parameters affects the activities of daily living (ADLs) and in turn affects the quality of life. A correlation in between these parameters can help in formulating better management of patients with Parkinson's disease.

Materials and methods

A. Research Design

A single group Correlational study

B. Source of data

Participants within Bangalore were selected. Some of the centers include:

- Outpatient department of R V College of Physiotherapy
- Basal Ganglia support group, Jahangir, Bangalore

C. Sample and Sampling technique

- Sample size was determined through power calculation based on previous studies on patients with Parkinson's disease.
- For an outcome variables with correlation co-efficient of 0.50, 90% statistical power, 5% level of significance, the sample size of 50 is adequate
- Sample was collected using systemic random sampling

D. Inclusion criteria

- Patients with Parkinson's disease
- Both genders
- Ambulatory patients

E. Exclusion criteria

- Any post fracture condition of trunk, upper limb or lower limb
- Subject with back pain, knee pain etc
- Parkinson's disease patients with associated orthopedic or neurological conditions which may affect mobility, balance and Gait.

F. Materials Required

- hard armless chair
- chair with backrest
- 15 feet walk way
- Pen / pencil
- Recording sheet
- Measuring Tape

G. Method of collection of data

The subjects were randomly selected based on the inclusion and exclusion criteria.

H. Methodology

Subjects with Parkinson's disease of both genders were recruited for the study as per the inclusion and exclusion criteria. The entire Procedure was explained to the subjects in the language best understood by them and informed consent forms were obtained from them. The testing place was arranged prior to the test. A demonstration was done to explain the procedure to the subject. Demographic data of the participants were collected and recorded.

I. Procedure

Procedure for trunk mobility

The trunk mobility was assessed using the Trunk Mobility Scale (TMS). The TMS is based on six dynamic tests that involve the trunk movements in the sagittal plane (extension/ flexion), transversal (rotation) and coronal (side inclination) and one static test that evaluates the sitting posture. The tests were performed with the patient sitting on a chair, with no arm support, feet on the floor and the back kept 10 cm from the chair. All movements were first demonstrated by the study investigator to the patient.

Scores of dynamic items ranges from 0 to 3. The patient that performs the movement with no compensation receives score 0. The patient that is unable to make the requested movement receives score 3. Scores 1 and 2 are attributed to individuals that perform the movements, but with compensations. The score is 1 for small compensations, and 2 for great compensations. Great compensations are exaggerated movements, easily noticed by an investigator (for instance, when inclining sideways, the patient associate trunk rotation and/or flexion and/or extension movements). Small compensations are subtle movements, but that are present when the movement is performed. In the static aspect, the sitting posture analysis may range from 0 (upright sitting position) to 4 (strong flexion and/or side inclination with extreme posture abnormality). In the other aspects, the posture may be severely, moderately and slightly inclined, items 3, 2 and 1, respectively [9].

Procedure for measurement of Balance and Gait parameters

The Balance and Gait of the subject was assessed according to the Tinetti POMA tool. The Tinetti POMA tool is a task oriented test that consists of 2 parts – Balance and Gait assessment. The Tinetti POMA is a task oriented test that measures an older adult's gait and balance abilities by an ordinal scale of 0 to 2.

1. **For Balance assessment**
   - Sitting balance
   - Arises
   - Attempts to arise
   - Immediate standing balance (first 5 seconds)
   - Standing balance
   - Nudged (Subject at max position with feet as close together as possible. The examiner pushes lightly on subject's sternum with palm of hand 3 times)
   - Eyes closed (at maximum position #6)
   - Turning 360 degrees
   - Sitting down

The total score of the balance part was calculated based on the findings and was recorded. The maximum score can be 16.

2. **For Gait assessment**
   - Initiation of gait (immediately or after told to 'go')
   - Step length and height
   - Step symmetry
   - Step continuity
   - Path (estimated in relation to floor tiles, 12- inch diameter; observe excursion of 1 foot over about 10 feet of the course)
   - Trunk
   - Walking stance

The total score of gait assessment was calculated based on the finding and was recorded. The maximum score of gait assessment can be 12.
The total scores of balance and gait components were then summed up and a net total score of the Tinetti POMA tool for balance and gait was calculated.

Based on the scoring the subjects were classified as
- High fall risk subjects (<19)
- Medium fall risk subjects (19-24)
- Low fall risk subjects (25-28)

The scores obtained from Trunk Mobility Scale and Performance Oriented Mobility Assessment (POMA) were statistically analyzed using Pearson's Correlation to find whether any correlation exists between Trunk Mobility and Balance and Gait in Subjects with Parkinson's disease.

Results

a. Statistical Analysis

The data was analyzed using SPSS software (version 16) and MS Excel 2010. Data was expressed in terms of mean and standard deviation. Pearson's Correlation was used to correlate between the parameters. $P < 0.05$ is considered statistically significant.

b. Results

The results obtained showed statistically significant correlation with P value less than 0.05. ($P = 0.01$)There was negative correlation found between the values of Trunk Mobility Scale and Tinetti Performance Oriented Mobility Assessment (Tinetti POMA). Thus it indicates that trunk mobility is related to balance and gait in Patients with Parkinson's disease. So decrease in trunk mobility will have a negative impact on balance and gait of patients with Parkinson's disease. Total 50 subjects were included in the study out of which 32 were males and 18 were females. The mean age of the subjects was 68.84 and standard deviation was 7.212.

Table 1: Demographic data

Parameters		
Number of subjects		50
Age (in years)	Mean	68.84
	Standard deviation	7.212
Gender (%)	Male	64%
	Female	36%

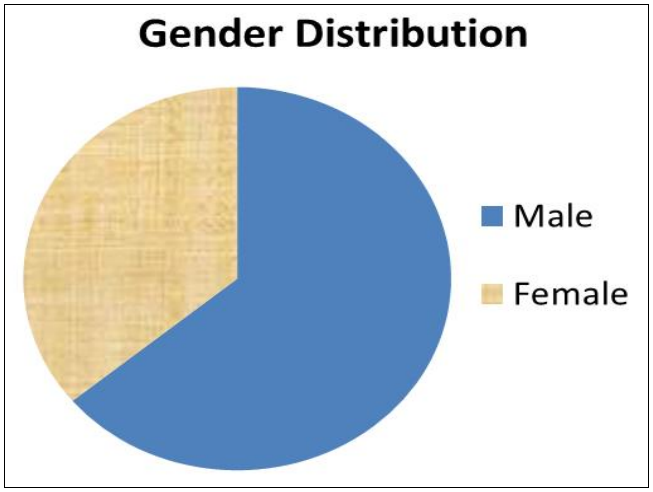

Fig 1: Gender Distribution

Table 2: Frequency distribution of the age (in years) of the subjects

AGE (in years)	Number of subjects	Percentage
45-54	1	2
55-64	11	22
65-74	27	54
75-84	11	22
Total	50	100

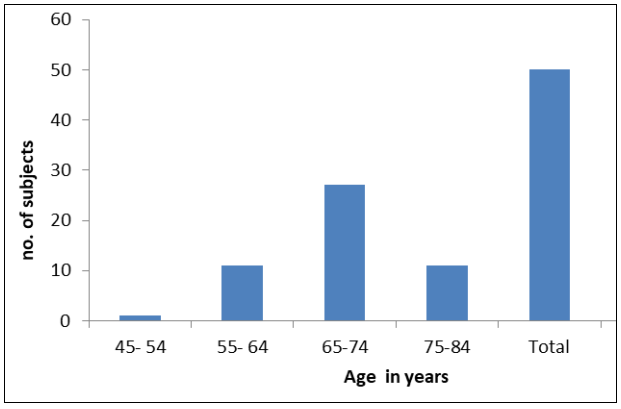

Fig 2: Age wise subject's frequency distribution

The above table and graph shows that out of 50 subjects, 2 % were between 45-54 years, 22 % were between 55- 64 years, 54 % were between 65-74 years and 22 % were between 75-84 years

Table 3: Correlation of the data collected

Correlations			
		TMS	**POMA**
TMS	Pearson Correlation	1	-.865**
	Sig. (2-tailed)		.000
	N	50	50
POMA	Pearson Correlation	-.865**	1
	Sig. (2-tailed)	.000	
	N	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

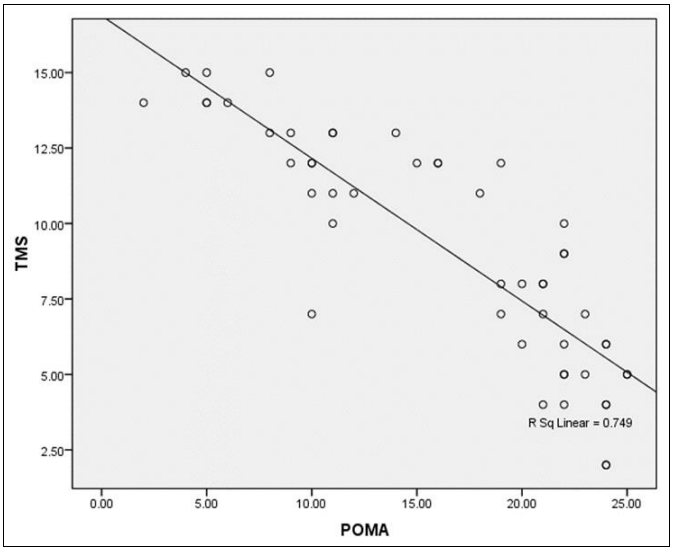

Fig 3: Scattered Plotting of the Trunk mobility scale and Tinetti POMA values showing a negative correlation between the scores

Discussion

Parkinson's disease (PD) is the second most common neurodegenerative disease after Alzheimer disease [17]. Evidence has shown that there is a deterioration of trunk mobility in patients with PD. Also there have been studies done to find out the effect on balance and gait in patients with PD.

The present study was conducted as a correlation study to find out the correlation of Trunk Mobility with Balance and Gait in patients with Parkinson's disease.

The outcome measures used were Trunk Mobility Scale and Tinetti Performance Oriented Mobility Assessment (Tinetti POMA). 50 subjects with Parkinson's disease were examined. The data was analyzed using SPSS software.

The results thus obtained concluded that trunk mobility has a correlation with balance and gait in Parkinson's disease patients. So impaired trunk mobility also affects the balance and gait pattern in Parkinson's disease patients.

Sufficient trunk stability and control of trunk movements is essential for postural stability and normal gait as the upper body constitutes two thirds of the total body weight. The majority of falls in individuals with PD and elderly occur due to an inability to control the body mass during activities such as turning around, standing up and bending forward. These are all activities where trunk postural control is necessary [19].

N. R Artigas *et al.* (2016) [18] believes that functional movements require the combined mobility of several parts of the body. Mobility in bed, for instance, involves thorax rotation relative to the pelvis. Thus, they suggest that fallers are likely to experience greater difficulty in performing daily activities. Patients with Parkinson's disease have great difficulty maintaining balance and frequently fall. This difficulty is a result of the combination of several deficiencies, including loss of reflexes and postural adjustments, the rigidity of the trunk/ ends and akinesia. They concluded that Parkinson's disease fallers show greater difficulty with rolling over in bed and have worse trunk mobility when assessed by Trunk Mobility Scale [18].

Gait disturbances are a common feature of late onset or advanced Parkinson's disease. The patient with Parkinson's disease demonstrates a number of significant gait changes resulting from impoverished movement. An abnormal stooped posture contributes to development of a festinating gait, characterized by a progressive increase in speed with a shortening of stride. Thus, the patient takes multiple short steps to catch up with his\her center of mass (COM) to avoid falling, and may eventually break into a run or trot. Turning or changing direction is particularly difficult and typically accomplished by taking multiple small steps. Patients with Parkinson's disease typically demonstrate difficulty attaining and sustaining walking speed and may have difficulty with foot clearance onto foot plates with shuffling gait patterns seen in advanced disease [1].

A study conducted by M, Matinolli *et al.* (2009) [20] concluded that advanced age and severity of the disease are related to impaired mobility and balance in Parkinson's disease patients [20].

As seen from the previous literature, it is clear that PD does have a negative impact on trunk mobility, balance as well as gait in these patients. Also from the results obtained it is evident that these components are further correlated to each other. Hence these finding along with the previous studies can help formulate a better treatment approach for patients with PD as well as can help take better measures to prevent/ manage the postural complication with the further progression of the disease.

Conclusion

Thus there is a significant correlation between trunk mobility with balance and gait in patients with Parkinson's disease. So severe the trunk mobility, more will be the problems seen in balance and gait parameters in Parkinson's disease patients.

Thus, it improves our understanding of the disease progression and the various components involved in it. Also, this new insight can help us to formulate a better approach towards the management of the condition. Precautionary measures can also be taken from an early stage of the disease to delay the postural complications and in turn the balance and Gait detoriation in the future.

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