ORIGINAL ARTICLE

IJPHY

A COMPARATIVE STUDY ON PREDICTION OF FALLS IN PARKINSON'S DISEASE SUBJECTS USING TIMED UP & GO TEST WITH TINETTI MOBILITY TEST

[*1]Pallabi Goswami
[2]Prof. Prabhu
[3]Ujwal Bhattacharya
[4]Kritica Boruah

ABSTRACT

Background: Subjects with moderate disability in Parkinson's disease experience difficulty when they are required to walk while attending to a complex activity. These subjects have a tendency to fall which is related to the disease symptoms and also may be due to age factor. This study is intended to predict the future falls in Parkinson's disease. Subjects with moderate disability were assessed with the Tinnetti mobility test and Timed up and go test, where the number of falls will be correlated with each test scores to check which test can predict the future falls better.

Method: The participants in the study were 30 Parkinson's Disease subjects, out of which 12 subjects did not meet the inclusion criteria, remaining 18 subjects were assessed with Tinnetti mobility test and Timed Up and Go test. For each subject scores were documented. The study was done for a duration of 1 year. During this time subjects were allowed to document the number of falls. These numbers of falls were correlated with each test scores for the prediction of falls.

Results: Pearson correlation test has been done to correlate the number of falls with each test score and found that Tinnetti mobility test is negatively correlated to the number of falls that is - .847 and Timed Up and Go test is positively related that is 0.924. The correlation result with each test score were statistically significant ($p < 0.01$) but Timed Up and Go test score was found to be more significant compared to Tinnetti mobility test scores.

Conclusion: The analysis shows that Timed Up and Go test is a better predictor of falls than Tinnetti mobility test which is showing statistical significance ($p < 0.01$) in case of Parkinson's disease patients.

Keywords: Parkinson's disease, Timed up & Go (TUG), Tinetti Mobility Test (TMT), fall in Parkinson's disease.

Received 25th September 2015, revised 15th November 2015, accepted 20th November 2015

www.ijphy.org

DOI: 10.15621/ijphy/2015/v2i6/80756

[2]Principal
Oxford college of Physiotherapy,
Bangalore, Karnataka, India
[3]Principal
College of Physiotherapy and Medical Sciences,
Guwahati, Assam, India
[4]Lecturer
College of Physiotherapy and Medical Sciences
Guwahati, Assam, India

CORRESPONDING AUTHOR

[*1]**Pallabi Goswami**

Assistant Professor,
College of Physiotherapy and Medical Sciences, Guwahati, Assam, India

INTRODUCTION

Parkinson's disease is a chronic progressive disease of the nervous system characterized by the cardinal features of rigidity, bradykinesia, tremor and postural instability[1]. In addition the disease may cause a variety of other symptoms including movement and gait disturbances and also sensory changes[1].

Along with postural instability Parkinson's subjects experience increasing difficulty in dynamic destabilizing activities such as self initiated movements (for e.g. functional reach, walking, turning etc.) [1].

Balance is defined as the ability to maintain body's center of mass over its base of support. In Parkinson's patients, balance is usually impaired because of an abnormal pattern of co-activation of muscles, resulting in a rigid body and an inability to utilize normal postural synergies to recover balance[1]. Balance control impairment has serious consequences for mobility and injury. It has been showed that 38% of PD patients had sustained a fall, 13% broken bones, 18% were hospitalized and 3% were confined to a wheel chair as a result. Despite of the severity of this problem there is lacking of a specific assessment tool for the prediction of falls in PD patients.

Frequent falls and fall injuries are the result of progressive loss of balance because of above-mentioned reasons[1].Previous falls, disease duration, dementia, loss of arm swing and loss of executive function were independent predictors of falling. There were also significant association between disease severity, balance impairment, depression and falling[2,3].

The risk of falling in people with Parkinson's disease, is greater than that of the general population[4,5]. Rehabilitation plays an important role in treatment of Parkinson's disease.[6] Gait hyperkinesias and freezing affects almost everybody in Parkinson's disease and increases in severity with the progression of the disease. The fundamental deficit in gait hyperkinesias is a step length regulation.

To decrease the risk of falls rehabilitation is one of the most effective way. Cognitive therapy along with physical treatment can help patients to a certain extent. Trunk sway may predict Parkinson's disease subjects balance problems. Parkinson's disease patients have greater trunk angle and angular velocity amplitudes which affects walking speed and balance[6]. Complex rehabilitation decreases the risk of falls and helps in improvement of other gait parameters in Parkinson's disease subjects[7].

Reliability of measurements obtained with the Timed up & go test in Parkinson's disease subjects is very high in detecting changes in mobility[8].

The timed up & go test is used to measure the ability of patients to perform sequential locomotor tasks that incorporate walking and turning. To increase the reliability of the measurement while ensuring that the test continued to be quick and easy to administer[8].Timed up & go(TUG) is useful for the measurement of mobility in people with mild to moderate PD. The TUG may be particularly well suited for the quantification of disorders resulting in poor sequencing of well learned motor skills, which is a problem in people with PD. Retest reliability and interrater reliability of the TUG measurements were high and the measurements reflected changes in performance according to levodopa use[8,9].

Another test to judge the fall risk in PD subject is performance oriented mobility assessment scale (POMA) or Tinetti mobility scale. In this scale there are two components, one is balance and other is gait. It includes different activities, where the subject is allowed to complete these activities and scores are there to judge the accuracy of each activity included in the test[1].

Interrater and intrarater reliability was good to excellent for Tinetti mobility scale. The sensitivity and specificity of the Tinetti mobility test to identity fallers were 76% and 66% respectively[10].

These different tests can judge the risk of falls in PD subjects according to the scores they get separately. But till now there is no specific scale which can predict the future falls in Parkinson's disease subjects.

This purpose of this study is to judge which test will be better predictor of falls in Parkinson's disease subjects.

MATERIALS AND METHODS

The ethical clearance was obtained from ethical committee of Padmashree Institute of Physiotherapy, Bangalore. Subjects were recruited from Parkinson's disease society of Karnataka, Bangalore, ESI hospital, Bangalore and KCG hospital, Bangalore. Subjects included were with the age between 50-70 years of age and both males and females who are able to walk at least 10 meter unassisted and without any orthosis. Subjects were categorised according to Hoehn & Yahr disability scale III.

The exclusion criteria in this study were subjects with visual impairments, musculoskeletal

disorders, other neurological disorders, cardiovascular disorder, contractures and subjects with a history of fall before the diagnosis of Parkinson's disease were excluded.

PROCEDURE

A written informed consent was taken from each of the subjects. Those fulfilling the inclusion and exclusion criteria were allowed to participate in the study. After evaluating the subjects baseline parameters of age and disability according to Hoehn and Yahr scale score III, subjects were assessed with Tinetti Mobility Test and Timed up and go test.

In Timed up and go test things used were chair, stop watch and a distance of total 6 m. Subject were first explained by the therapist about the whole test. Practice session was kept for the subjects to make them clearly know about the test. Subjects were instructed to cover a distance of total 6m. The test was initiated with the subject sitting on a chair. Therapist set the time in a stopwatch. As soon as the therapist said 'GO', subjects had to rise up from the chair, walk with the normal speed till a distance of 3 m, then will take a turn and come back to chair (3 m distance), turn and will sit.

Therapist stopped the stop watch as soon as the subject sat on the chair after covering the allotted distance for the test and therapist recorded the time. This full session was completed for 3 times and each time therapist recorded the timings. Average 20-29 secs is normal for frail elderly or disabled persons. More than 30 secs is dependent in mobility skills and ADL.

After taking Timed up and go test, Tinetti mobility test was done for each subject. Tinetti mobility scale is divided into 2 parts. One is Tinetti balance test and another is Tinetti gait test. Total score of TMT is 30. In Tinetti balance test, subject was allowed to do the following activities- Sitting balance, Arising, Immediate standing balance, Side by side standing balance, Pull test, Turn 360 degree, Able to stand on one leg for 5 secs, Tandem stand, reaching up, bending over, sit down.

Tinetti gait assessment contains following components –Initiation of gait (immediately after told to go), Path, Missed step, Turning while walking, Timed walk, Step over obstacles.

Tinetti balance assessment contains 21 points in total and gait assessment contains 9 points.

Subjects were first instructed about the test and then was allowed to do each step and therapist recorded the points. After taking each test points for each subject, the follow up has been done for 1yr.

Subjects were given a log book where they were instructed to mention the number of falls, in each month for 1 yr. At the end of 1 year, the number of falls for each subject were correlated individually with Timed up and go and Tinetti mobility test. The result of this co relational analysis describe which test will predict the falls more accurately in Parkinson's disease subjects.

Figure 1 Tinnetti Mobility Test Sitting Balance

Figure 2 Timed up and Go

RESULTS AND TABLES

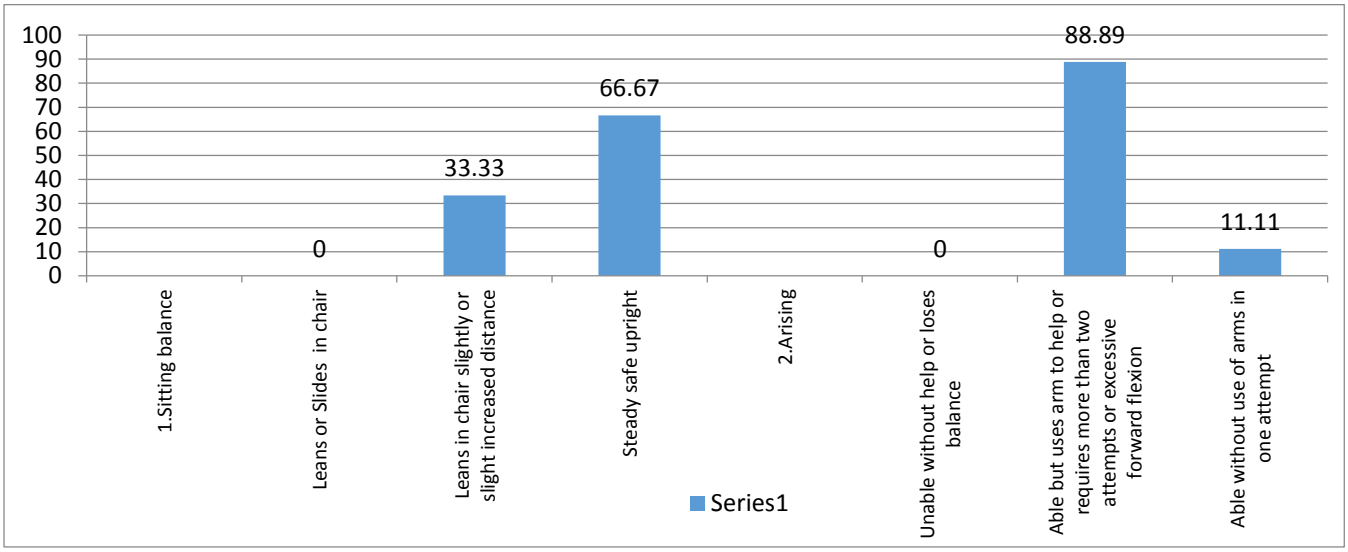
Descriptive statistical analysis has been carried out in the present study, Results on continuous measurements are prescribed on Mean ± SD (Min-Max) and results on categorical measurements are presented to number (5). Significance is assessed at 5% level of significance. Pearson correlations has been used to find the correlations between the number of falls and TMT and TUG, Linear regression analysis has been used to find the predictability of TMT and TUG in predicting the number of falls[11].

Table 1: TINETTI Mobility Test

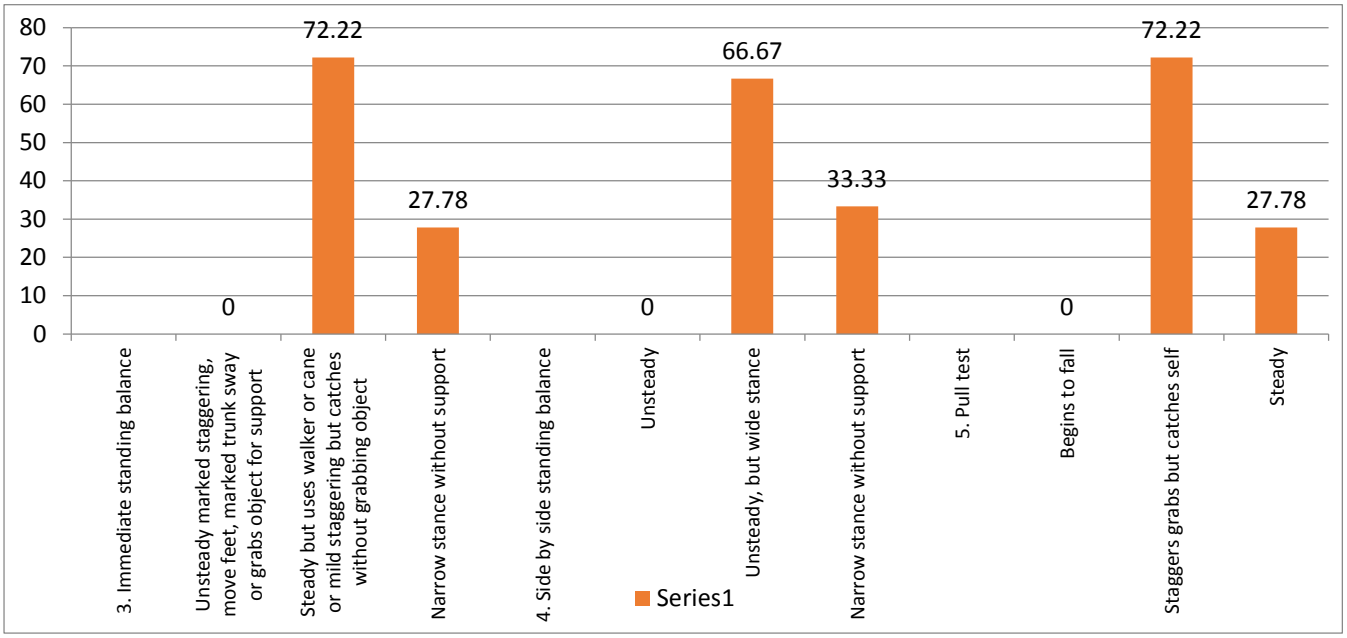
Balance	Number (N = 18)	%
I Sitting balance		
Leans or Slides in chair	0	0.00
Leans in chair slightly or slight increased distance	6	33.33
Steady safe upright	12	66.67
2, Arising		
Unable without help or loses balance	0	0.00
Able but uses arm to help or requires more than two attempts or excessive forward flexion	16	88.89
Able without use of arms in one attempt	2	11.11
3. Immediate standing balance		
Unsteady marked staggering, move feet, marked trunk sway or grabs object for support	0	0.00

Steady but uses walker or cane or mild staggering but catches without grabbing object	13	72.22
Narrow stance without support	5	27.78
4. Side by side standing balance		
Unsteady	0	0.00
Unsteady, but wide stance	12	66.67
Narrow stance without support	6	33.33
5. Pull test		
Begins to fall	0	0.00
Staggers grabs but catches self	13	72.22
Steady	5	27.78
6. Turn 3600		
Unsteady	9	50.00
Steady but steps discontinuous	9	50.00
Steady but steps continuous	0	0.00
7 Able to stand on one leg for 5 seconds		
Unable or holds onto any object	9	50.00
Some staggering swaying or moves foot slightly	9	50.00
Able	0	0.00
8 Tandem Stand		
With one foot on front of other or beings to fall	2	11.11
Some staggering swaying	14	77.78
Able to tandem stand 5 seconds	2	11.11
9. Reaching up		
Unable or holds onto any object	0	0.00
Some Staggering, swaying or moves	12	66.67
Able	6	33.33
10 Bending over		
Unable	0	0.00
Able and is steady	18	100.00
11. Sit down		
Unsafe	0	0.00
Uses arms not smooth motion	17	94.44
Safe or smooth motion	1	5.56
Safe or amooth motion	1	5.56
12. Initiation of gait		
Any hesitanvy	3	16.67
No hesitancy	15	83.33
13. Path		
Marked deviation	1	5.56
Mild/ moderate deviation	1	5.56
Straight without walking aid	16	88.89
14 Missed step		
Yes and an inappropriate attempt	1	5.56
No	9	50.00
15. Turning		
Staggers	1	5.56
Discontinuous but no Staggering	15	83.33
Steady, continuous	2	11.11
16. Step over obstacle	1	5.56
Able uses walking and some staggering	5	27.78
Able and Steady	12	66.67

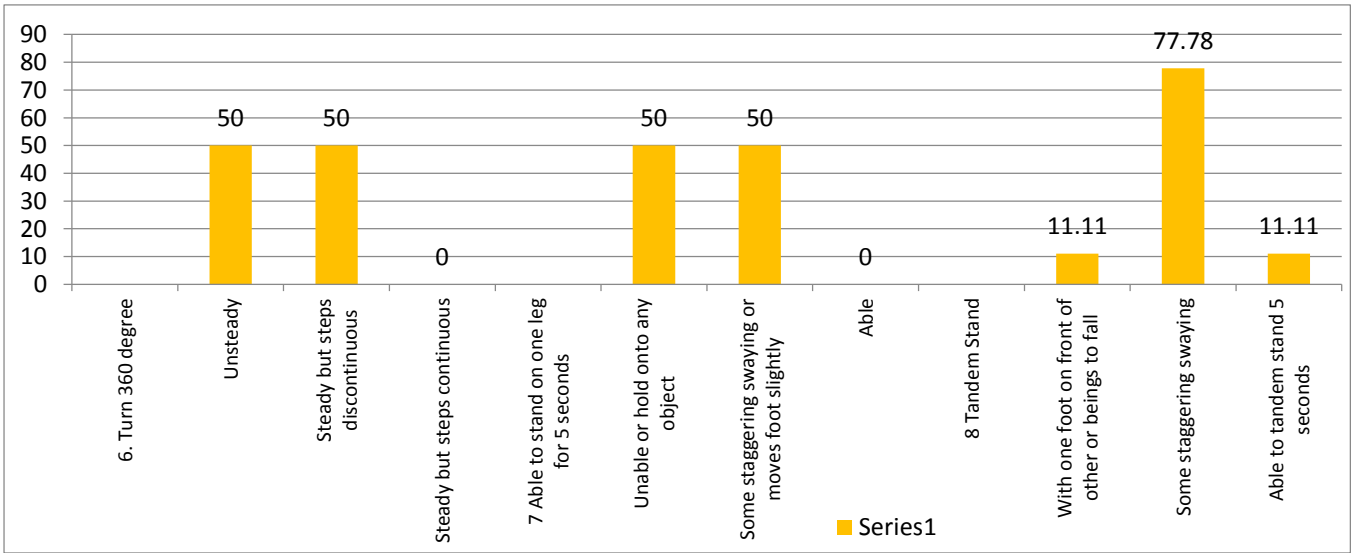
In this table different components of TINNETTI MOBILITY TEST are described, Here for each component 100% has been taken for total and according to that each subtest has been marked with different percentages for the first component sitting balance out of total 18 subjects, 6 subjects were able to do the could sit on a chair steady safe upright with a percentage of 66.67. The next task attempts or excessive forward flexion with a percentage of 88.89 and other 2 subjects were able to arise without the use of arm and had a percentage of marked staggering or grabbing objects with 72.22% and 5 subjects could do the balance was done unsteadily but with stance by 12 subjects with 66.67 % and 6 subjects could do it with narrow stance without support and the percentage is 33.33. In the pull test 13 subjects could do the task with staggers with 72.22 % and 5 subjects could do the task steadily with 27.78%. In the task turn 360 deg. Out of 18,9 subjects could do the task unsteadily and 9 subjects could do it with steps discontinuous with the percentages of 50 for each. In the task standing on one leg for 5 secs, 50% subjects could do the task with step discontinuous and 50% subjects could do with step continuous. Next task that is tandem stand contains 11.11% subjects who could stand with some imbalance or begins to fall and other 77.78% could maintain the posture with some staggering swaying, another 11.11% could maintain the task for 5 secs. In reaching up 12 subjects that is 66.67% could do the task with some staggering and swaying and other 6 subjects that is 100%. In the task sit down 17 subjects or 94.44 % could the task with using arms and the motion was not smooth and I subject could do the task safely and smoothly. In the initiation of gait 16.67% that is 3 subjects could do the task with some hesitancy and 15 subjects could do it with no hesitancy and the percentage divided as 16.67 and 83.33 respectively. In the task path, I subject could complete the task with marked deviation. I subject could do the task with mild to moderate an 17 subjects could do complete the task in the straight way without aid. The task missed step I subject could do the task with inappropriate attempt, 8 subjects could do it with appropriate attempt and 9 subjects could complete the task with no missed step. The task turning was completed by I Subject with staggering. Discontinuously by 15 subject and steady and continuo's by 2 subjects. The last task step over obstacles was done by I subject with begins to fall, 5 subjects did it with some staggering and 12 subjects could do it steadily.



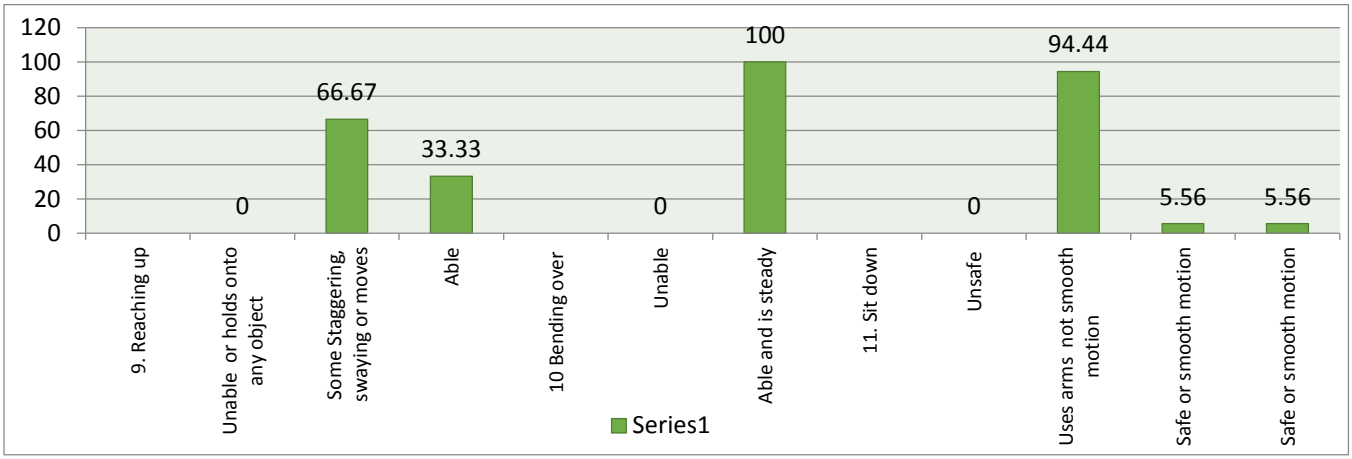
Graph – 1 TMT (Setting Balance & Arising)



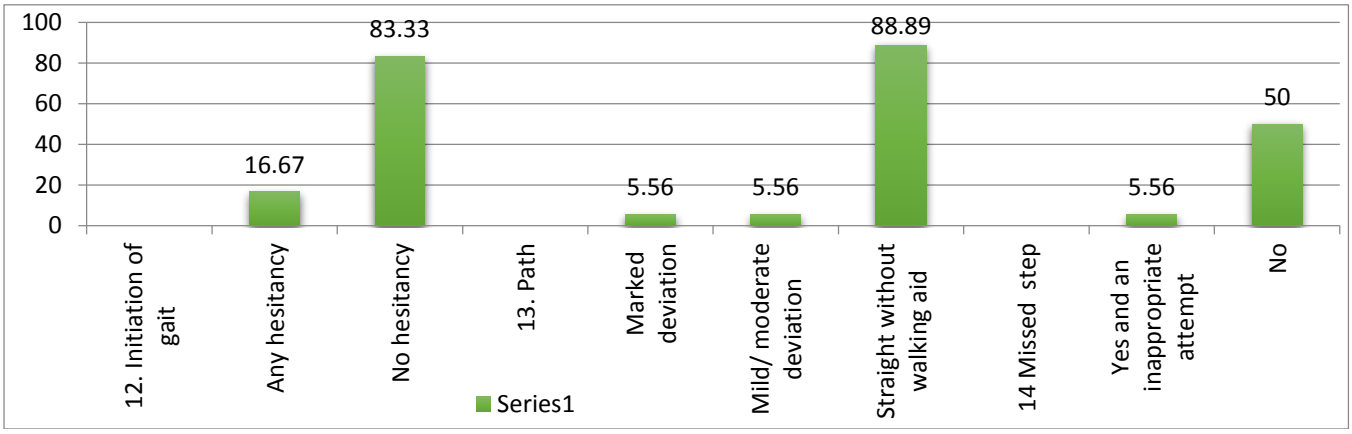
Graph – 2 (Standing Balance & Pull Test)



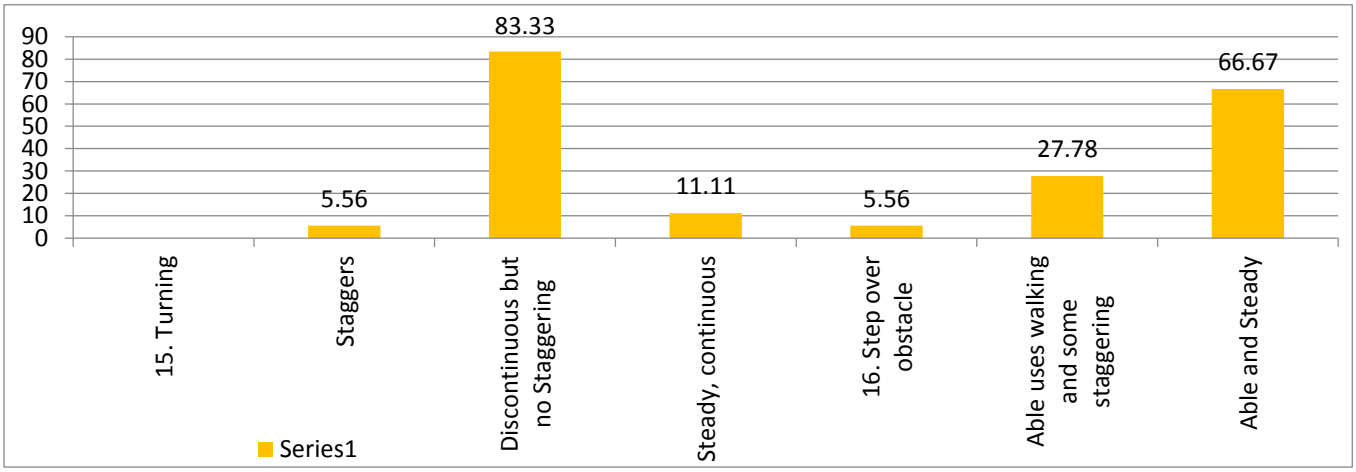
Graph -3 TMT (Turning 1, Leg Stand & Tandem Stand)



Graph – 4 TMT (Reaching up, Bending over & Sit down)



Graph – 5 TMT (Initiation of Gait, Path & Missed Step)

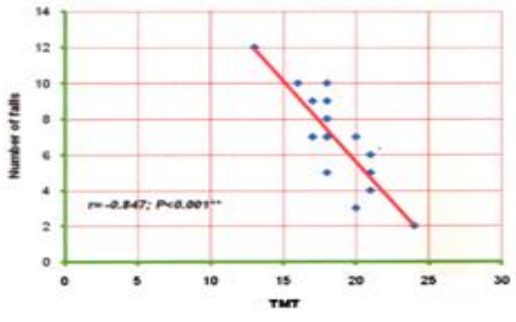


Graph – 6 TMT (Turning and Step Over Obstacles)

TABLE 2: PEARSON CORRELATION BETWEEN NUMBER OF FALLS AND TMT & TUG

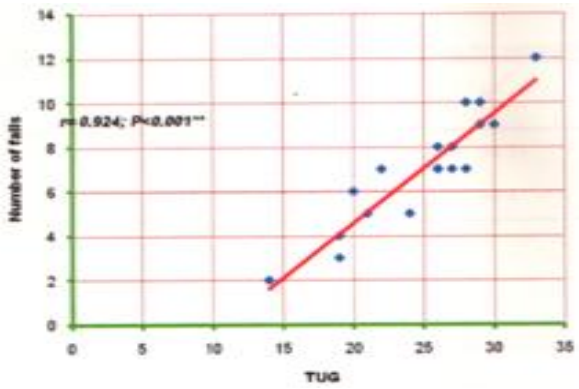
PAIR	PEARSON CORRELATION	P VALUE
Number of falls vs TMT	-0.847	< 0.001**
Number of falls vs TUG	0.924	< 0.001**

Pearson correlation test has been used to correlate the number of falls of each subject with Tinetti Mobility Test and Timed Up &Go Test.It has been found -0.847 and 0.924 respectively.In this test it has been found that P value is significant for both the scores as it less than .05



Number of falls are negatively correlated with TMT in the graph.

Correlation Graph 1



Correlation Graph 2

In this correlation graphs its has been shown that as number of falls increases TMT score decreases and at the same time TUG score increases along with number of falls. It has been proved that TMT is negatively correlated with number of falls and TUG is positively correlated with number of falls which has been shown in correlation graph 1 and 2.

TABLE 3: PERFORMANCE OF TMT AND TUG IN PREDICTING THE NUMBER OF FALLS

Serial number	Regression Equation	R^2	Significance
1.	Number of falls = -0.904*TMT + 23.726	84.7	< 0.001**
2.	Number of falls = 0.493*TUG-5.262	92.4	< 0.001**

In table 3 it has been found that in every 1 unit increase in TMT score there is 0.904 decrease in no of falls and in every 1 unit increase in TUG score there is 0.49 increase in no of falls. Both TMT and TUG are good predictor of number of falls, however the TUG is the better predictor of number of falls when compared to TMT, TMT is negatively related to the number of falls and TUG is positively related to number of falls and the correlation is statistically significant.

DISCUSSION

This study aims to correlate the number of falls with Tinetti mobility test and TUG test for each of the subject with Parkinson's disease (PD).

In this study the age group of subjects was found between 54-70 years of age Maximum subjects were found in the age group of 61-65 years of range which is again considerable in this study. PD is common in between 50-70 years which is supporting the age group of this study[1]. Also a known fact, that as the person grows older there is decline in physical performance and other superimposed difficulties like balance disorders, muscle weakness etc increase the prevalence of falls.

Also A.H Myers, Y. Young and J.A. Langlois stated in their study about the impairments in gait and balance as well as neuromuscular and musculoskeletal impairments frequently underlie changes in physical activity in old age. Reduced activity level may occur as a result of these impairments, leading to further declines in physical functioning and increased risk of falls. Parkinson related rigidity and balance problems may be adjoined with elderly physical problems which may again be causing more number of subjects to be categorized in this age group having falls[12].

In this study, two assessment tools has been used to assess the prediction of falls in subjects with Parkinson's disease.
: Tinetti Mobility Test. (TMT)
: Timed up & go Test. (TUG)

TMT scale which is meant to assess the balance and gait was found to have a correlation of -0.847 with the number of falls.

With regard to balance component, subjects were able to achieve the maximum score, but it is possible only when all activities were supported or support was always assured while carrying the balance task. This may be because subjects had a fear of fall, which is attributed due to PD related instability and rigidity. (Supporting article on balance)

In reference to gait components of TMT scores, although components are difficult for PD subject when clubbed together, while performing all the 5 components of gait separately makes the task easier for the subjects, which is also supported by the results obtained by the subjects of the study[13]. Considering the overall TMT score, showed a negative correlation of -0.847 with the number of falls which explains that as the TMT score increases, the number of falls will decrease and vice versa. They have concluded that interrater and intrarater reliability of TMT is good with interclass correlation coefficient > .80[9].

TUG is correlated with the number of falls and it was found to be 0.924 which is positively correlated that is as the TUG score increases, number of falls will increase. Both the correlated scores were compared and it was found that both are highly significant but comparatively TUG scores are giving better results of correlation than TMT with the no of falls.

This may be because of the following reason-
In case of TUG test, subject completed the whole task in one attempt which again contains the components of balance and gait as a whole. TUG

contains commands like, "get up," walk, "turn," walk, "turn," and "sit". Here the subject had to follow all the commands along that has to complete the task without any break. These multiple commands makes the task a complex one for the subjects hence the risk more number of falls. PD subjects has usually difficulty in planning, sequencing and execution of commands. When extrinsic command will be more in TUG, automatically there will be more muscle firing, hence more muscle rigidity and falls.

In Tinetti mobility test, subject has to do tasks one by one which will give the subjects more time to give concentration in each task to complete. During this period subject would have tried to complete each task with more accuracy and hence the fall risk is reduced. In this task, rate of extrinsic command is less compared to TUG.

Most falls are 'intrinsic' and occur under seemingly harmless circumstances, such as turning around etc. attempts to simultaneously perform multiple tasks during walking or standing are commonly responsible for falls, apparently because patients cannot lend priority to maintaining balance during complex circumstances[14,15].

LIMITATION

To check the number of falls actually the time limit should be longer than this study.In a longer period, the falls judgement will be better as this disease is a progressive one. The study duration is short. This study included only the moderate disability according to HoeHn and Yahr scale III, so the results cannot be generalized to all people of Parkinson's disease. In this study the test group was not compared with other group the comparison with other group could have given the better results regarding the correlation.

FUTURE RECOMMENDATIONS

Prediction of falls with comparison to controlled group can be studied further. Falls related to more complex activities and use of other balance scales can be emphasized in future studies. Studies on long term follow up can be performed. Studies using on and off phase of PD with these scales can be recommended.

CONCLUSION

It was evident from the results, TUG and TMT scores both were found statistically significant in prediction of falls in Parkinson's disease patients. However TUG scores were found to be better predictor of falls than TMT. Hence experimental hypothesis is excepted which states that "There is significant difference in Timed up & go test and Tinnetti Mobility Test scoresnon prediction of falls in PD subjects".

Acknowledgement

Authors were expressing their sense of gratitude's to Vinodbabu K. and the people who helped and encouraged them for the guidance and completion of this study.

REFERRENCES

1. O'Sullivan SB, Schmitz TJ, Physical Rehabilitation, assessment and Treatment, 5th edi; 2007.
2. B H Wood, J A Bilclough, A Bowron, R W Walker. Incidence and prediction of falls in Parkinson's disease. Journal of Neurology Neurosurgery and Psychiatry 2002;72(6):721-5.
3. Galit Yogev, Nir Giladi, Chava Peretz, Shmuel Springer, Ely S. Simon and Jeffrey M. Hausdorff, Dual tasking gait rhythmicity, and Parkinson's disease: Which aspects of gait are attention demanding? Eur J Neurosci. 2005; 22(5):1248-1256.
4. Susan L. Vaught. Gait Balance and fall prevention. The Ochsner Journal, 2001;3(2):94 -97.
5. Dennison, Andrew C. MD; Noorigion, Joseph V. MPM; Kuth M. MD; Fismon, David .N MD, MPM; cionic, Heaiher J. MA; Moherg, Paul Phd., Falling in Parvinson's discose, identifying prioritizing muscle factors in baclers, 2007;86(8): 621-632
6. Ann Ashburn, Emma Stack, Ruth M. Pickering, Christopher D.ward. Predicting fallers in a community based sample of people with Parkinson's disease. Gerontology 2001;47(5): 277-281
7. Stozek J,Rudzinska M, Longawa K,Szczudlik A.- the effect of complex rehabilitation on posture and gait in parkinson's disease. Neurol Neurochir Pol.2003;37(5):67-81
8. Susan Morris, Meg E Morris, and Robert Iansek. Reliability of measurements Okbtained with the Timed Up and GO test in people with Parkinson's disease. Phys Ther .2001;81(2):810-818
9. Stack E., Jupp, K. and Ashburn, A. Developing methods to evaluate how people With Parkinson's disease turn 180 degree; an activity frequently associated With falls.Disabil Rehabil. 2004 Apr 22;26(8):478-84.
10. Deb a Kegelmeyer, Anne D Kloos, Karen M Thomas and Sandra K Kostyk, Reliabillity and validity of the Thinetti mobility test for individuals with Parkinson's disease. Phys Ther. 2007;87(10):1369-1378.

11. Bernared R. Fundamentals of biostatistics.3rd edi; 2000.
12. A. M. Mayers, Y. Young and T. A. Langcois, prevention of falls in the elderly, 2003
13. Andrea L Behrman, Kathye E Light, Gloria M Miller. Sensitivity of the Tinetti Gait Assessment for detecting change in individuals with Parkinson's disease. Clinical Rehabili-tation, 2002;16(4):399-405.
14. Graham K Kerr, Charles Wrringham and Peter Silburn, sensoriomotor And clinical factors in the prediction of future falls in Parkinson's disease, School of Human Movement studies, Queensland University of Technology, Brisbane, Australia, 2006.
15. Dr. Bastian R. Blaern, heavy Parkinson's patient falls, 2003; 16:15-26.

Citation
Pallabi Goswami, Prabhu, Ujwal Bhattacharya, & Kritica Boruah. (2015). A COMPARATIVE STUDY ON PREDICTION OF FALLS IN PARKINSON'S DISEASE SUBJECTS USING TIMED UP & GO TEST WITH TINETTI MOBILITY TEST. *International Journal of Physiotherapy*, 2(6), 972-980.