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Original Research Article

Comparison of mini-bestest and dynamic gait index for prediction of fall susceptibility in old individuals

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ABSTRACT

Background: Emphasis on early identification, prevention, and intervention of fall risk in elderly people is becoming increasingly important in the fields of physical therapy and rehabilitation.
Methods: Various scales are currently used for assessment of balance and fall risk. We have selected, MiniBESTest and DGI for our present study. We compared scores of Mini-BESTest and DGI in 30 elderly subjects with mean age of 62.23±4.38yrs. These subjects included 17 completely normal individuals, whereas 13 subjects were having early clinical features of fall-related disorders. Example: Parkinsonism, vertigo and paresis.
Results: The data indicated that Mini-BESTest is more superior than DGI to indicate the fall risk in normal elderly population. Similarly, in cases of paresis and Parkinsonism, results are indicating that Mini-BESTest is better suited than the DGI. But in cases of vertigo, the results indicate that DGI is more superior than Mini-BESTest.
Conclusions: An interesting finding is that the DGI scale seems to be more superior in subjects having vertigo (Refer Table-4), which is to be verified by further studies in a larger sample. The point which justifies the above conclusion is that the DGI scale includes many items which test the vestibular apparatus.

Keywords: Dynamic gait index, Falls, Mini-BESTest

INTRODUCTION

A fall is defined as any event that leads to an unplanned, unexpected contact with a supporting surface.[1]

It is important to prevent fall in elderly people as it continues to be the leading cause of injury and a frequent cause of morbidity in elderly people. Falls produce a threat to quality of life and independence secondary to impaired mobility and loss of function. Approximately 33% of people over the age of 65 years fall at least 1 time per year, and approximately 50% over the age of 85 years fall each year.[2-6]

Fall-related injuries

Among people over the age of 65 years, are the leading cause of death from injury. Forty percent of hospital admissions among people over the age of 65 years are reported to be the result of fall-related injuries, resulting in an average length of stay of 11.6 days. Approximately

one half of older adults hospitalized for fall-related injuries are discharged to nursing homes.

Emphasis on early identification

Prevention, and intervention of fall risk in elderly people is becoming increasingly important in the fields of physical therapy and rehabilitation.[7-13]

Anatomic-physiological basis of balance

For predicting the fall, it is essential to have a brief review of the structures which keep balance and equilibrium of the body and thus prevent the occurrence of fall. These structures are,

Vestibular apparatus includes

- Semi-circular canals for circular motion
- Utricle and saccules for linear acceleration.

All the three portions of Cerebellum

- Vestibulo-cerebellum for posture and equilibrium
- Spino-cerebellum for tone of the muscles
- Ponto-cerebellum for force, direction, range and rate of movement.

Basal Ganglia control initiation, maintenance and termination of movements.

Motor system includes the motor areas in frontal lobe and the descending pyramidal and extra pyramidal tracts. The former tracts are concerned with fine movements whereas the later tracts are concerned with maintenance of postural tone.

Sensory system includes the Dorsal columns and Spino-thalamic tracts together with sensory cortex in the parietal lobe. The proprioceptive sensations keep the person aware of the orientation of body. The visual sensation also assists in sensing the orientation. Defects in any one of the above system make the person prone for fall. Various scales are currently used for assessment of balance and fall risk. We have selected, MiniBESTest and DGI for our present study

Mini-BESTest developed by Horak-et-al is a 3-point (0 to 2 grades) ordinal scale with 14-items (Dubbed Mini-BESTest) which focuses on dynamic balance, can be conducted in 10-15 minutes. This test is a brief clinical rating scale for dynamic balance that has excellent psychometric characteristics.[14]

Content validity of this scale is high, since many items included in the test are part of well-known balance batteries

- Sit to stand -from Berg balance scale
- Stand on one leg- from Ataxia test battery
- Stance (eyes open) and stance (foam surface with eyes closed)- from modified clinical test of sensory integration of balance
- Gait assessment - dynamic gait index
- Get up and go with cognitive task - a standalone test

Dynamic gait index (DGI) is a performance-based test developed as part of a profile of tests and measurements that are effective in predicting likelihood for falls in community-dwelling older adults. It is a four-point ordinal scale (0-3 grades) with 8 items which determine eight different facets of gait, can be conducted in 15 minutes.[15,16]

DGI [10(pg405–406),] is a standardized clinical assessment tool that aids in evaluating a person's ability to modify gait in response to changing gait task demands.[17] The DGI correctly classifies 59% of people with a history of falls (sensitivity) while correctly classifying 64% of those without a history of falls (specificity). This shows that this test has good specificity and sensitivity.[1]

Given that the DGI has many tasks that allow for testing under multitask conditions (E.g.: walking with head turns or stepping over obstacles), it should be a more sensitive indicator of balance problems than other commonly used balance assessment tools that do not incorporate multiple tasks into the evaluation. Hence the efficacy of Mini-BESTest will be assessed by using Dynamic Gait Index as a gold standard tool.

The objective of this study was to compare the efficacy of Mini-BESTest with Dynamic Gait Index for predicting the risk of fall in elderly people by analysing the correlation of their scores.

METHODS

Scales used

- Mini-BESTest scale
- Dynamic gait index.

Procedure

Study rated each subject by using both the scales one after another on the same day. The scores were recorded on the specific proforma for Mini-BESTest and DGI. The parameters used and their scoring are as per original scales. In this study included 30 patients from age 50 years to 70 years. There were 24 males and 6 females. 17 subjects were having no difficulty in walking and no history of the falls. Whereas the remaining 13 cases, although didn't have any history of fall but showing mild signs and symptoms of Paresis (7 cases), Parkinsonism (4 cases), and Vertigo (2 cases) (Table 1).

Table 1: Distribution of cases.

Normal	**17**
With fall tendency	
Paresis	7
Parkinsonism	4
Vertigo	2
Total	30

The Mini-BESTest which is having 16 parameters with a 3-point scale ranging from 0-2 for each item. The DGI is having 8 items with a 4-point scale ranging from 0-3 for each item. The total scores are 32 and 24 for Mini-BESTest and DGI respectively.

Table 2: Comparison of results between DGI and MiniBESTest for normal subjects

Parameters	DGI	Mini-bestest
Total score	23±1.32	28.53±2.6
Percentage Score	95.83±5.51	89.15±8.13
Ratio of % score		0.93
Pearson's correlation coefficient		0.8

We calculated the score and its percentage for each individual. We also calculated the ratio of mini-BESTest percentage with that of DGI. The Pearson's correlation coefficient for normal and abnormal cases was also calculated.

The final scores, their percentages, their ratios, and person's correlation coefficient are presented in Table 2 and 3 for normal and abnormal subjects respectively.

Table 3: Comparison of results between DGI and MiniBESTest for abnormal subjects.

Parameters	DGI	Mini-bestest
Total score	19±2.04	23.08±3.82
Percentage Score	79.17±8.51	72.12±11.93
Ratio of % score		0.91
Pearson's correlation coefficient		0.68

RESULTS

The analysis of results for scores, percentage of scores and ratio between the percentages is as follows,

Scores

- Scores are less in both scales in abnormal subjects
- The scores (in both the scales) are very less in Parkinsonism
- They are moderately decreased in paresis cases
- Interestingly in vertigo cases the scores are remaining as same as normal in Mini-BESTest, but there is decrease in scores of DGI, which indicates that DGI is more sensitive for predicting falls in vertigo cases.

Table 4: Comparison of results between DGI and MiniBESTest for different conditions.

Condition	Parameters	DGI	Mini-bestest
Paresis	Total score	20.29±1.38	23.57±2.44
	Percentage score	84.52±5.75	73.66±7.62
	Ratio of % score	0.87	
	Pearson's correlation coefficient	0.83	
Parkinsonism	Total score	16.75±1.26	19.5±3
	Percentage score	69.79±5.24	60.94±9.38
	Ratio of % score	0.87	
	Pearson's correlation coefficient	0.84	
Vertigo	Total score	19±1.4	28.5±0.71
	Percentage score	79.17±5.89	89.06±2.21
	Ratio of % score	1.13	
	Pearson's correlation coefficient	1	

Percentage of scores

When we consider percentage of scores we find that,

- Percentage of score decreases in both the scales
- In cases of Parkinsonism the Mini-BESTest percentage of scores is decreasing much more than DGI (about 8.85 %)
- This may be because the Mini-BESTest includes the items which are related to the posture, stepping correction, and walking with turns and these parameters are mostly affected in Parkinsonism
- In cases of Paresis the Mini-BESTest percentage of scores is decreasing much more than DGI (about 10.8 %)

- This may be because the Mini-BESTest also includes items like single leg stance, rising to toes and sit to stand which are mostly affected in paresis
- In cases of vertigo the DGI percentage of scores is decreasing much more than Mini-BESTest (about 9.89) indicating that DGI scale is more predictive for vertigo
- This may be because the DGI includes the items which are related to gait, stepping over obstacles, and gait with head turns which are mostly affected in vertigo.

Ratio of percentages

When we calculated the ratio of percentages of scores between the two scales (% of Mini-BESTest scores / % of DGI scores) the following observations are noted.

- The data indicates that Mini-BESTest is more superior than DGI to indicate the fall risk in normal population. The ratio of percentages i.e. % of Mini-BESTest scores % of DGI scores is 0.93
- In cases of paresis and Parkinsonism the ratio of percentages i.e. % of Mini-BESTest scores % of DGI scores is 0.87 again indicating that former scale is better suited than the later
- In cases of vertigo the ratio of percentages i.e. % of Mini-BESTest scores % of DGI scores is 1.13 indicating that DGI is more superior than Mini-BESTest
- When we calculated the Pearson's correlation coefficient between the two scales, it was 1, 0.84, 0.83 for vertigo, parkinsonism and paresis cases respectively indicating that both the scales are correlating linearly.

Thus, study can conclude that Mini-BESTest is more suitable in Parkinsonism and Paresis whereas DGI is more predictive in vertigo.

DISCUSSION

We can classify the conditions which are producing the fall risk, into two main categories.

- Conditions which are developing suddenly due to some CVA E.g.: paresis, paralysis, etc in which it is not possible to predict the risk of fall before the development of the disease
- Conditions which develop gradually due to disorders of basal ganglia, cerebellum, and vestibular apparatus, etc in which the fall risk gradually increases and we can predict the fall risk in the initial stages itself.

Deficiency of the Mini-BESTest when compared to DGI is that it doesn't include the following criteria

- gait level surface
- gait with vertical head turns
- stepping around obstacles
- stepping up and down the stairs.

But this deficiency is partially substituted in the form of other test items. Eg: stance on firm and foam surface, gait with horizontal head turns and stepping over obstacles.

Deficiency of the DGI when compared with Mini-BESTest is that,

- It doesn't include some of the static tests which are relevant for assessing the fall risk. eg: Stance with eyes open and eyes closed
- It doesn't include test which are assessing the change of posture, which again can increase the risk of fall, eg: from sitting to standing, rising to toes, standing on one leg
- It doesn't include some of the correction activities which may affect the fall risk. For example: stepping correction forward, backward and lateral.

This is evident from above comparison that Mini-BESTest is having more criteria for predicting the fall than DGI.

The comparison of the result data clearly shows that the percentage score of the Mini-BESTest is less than that of DGI in normal elderly subjects, indicating that Mini-BESTest is more suitable for assessing the fall risk in normal elder population (Table 2).

Another finding in our study is that Mini-BESTest seems to be more superior for finding the fall risk in Parkinson's patients. This may be because this scale includes many criteria which are related to posture. (Refer Table-4)

An interesting finding is that the DGI scale seems to be more superior in subjects having vertigo (Table 4), which is to be verified by further studies in a larger sample. The point which justifies the above conclusion is that the DGI scale includes the many items which test the vestibular apparatus.

Limitations of this study was the sample size is adequate except, that the cases of vertigo are only 2. The number of female subjects is also inadequate i.e. only 6. There is no follow up to substantiate the risk of falls which is predicted for various categories of subjects in our study Both the scales are deficient in some parameters which may be useful for prediction of falls, as pointed out in our discussion. There is a difference in rating system in the two scales. The Mini-BESTest is having 3-point (0-2) and DGI having 4-point (0-3) rating system.

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