International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979
Impact Factor: RJIF 5.72
Received: 09-10-2018; Accepted: 05-11-2018
www.allsubjectjournal.com
Volume 5 Issue 11; November 2018; Page No. 85-90

Primarily affected cognitive linguistic ability in Alzheimer's disease

Girija PC[1], Nayana N[2], Thesli S[3]
[1-3] Department of Audiology and Speech Language Pathology, AWH Special College, Calicut, Kerala, India

Abstract
It is a well known fact that cognitive linguistic abilities as a whole are affected in Alzheimer's disease. However, a general misconception is that memory is the primary mental faculty that is affected even from the initial stages of the disease. The present study aims at examining the qualms of this notion by comparing eight cognitive linguistic abilities including mental status, memory, attention and discrimination, language, problem solving, perception, visuospatial skills and executive functions, in the early stages of Alzheimer's disease. Functional cognitive linguistic test in Malayalam (FCLT-M) was administered on fifty patients diagnosed with Alzheimer's disease post six months of the initial diagnosis. Results revealed that language was the most affected element with attention and memory subsequent to it. Henceforth, it can be concluded that an individual's language would reflect subtle nuances for commencement of Alzheimer's disease, even in the initial stages as it requires interactions between various cognitive linguistic aspects, thereby making it an effective diagnostic tracker in these cases.

Keywords: Alzheimer's disease, visuospatial, linguistic, FCLT-M

Introduction
Alzheimer's disease is considered as most prominent cause of dementia. It is characterized by the progressive loss of mental functions such as attention, memory, language, problem, solving, visuospatial function etc. The deterioration takes place in gradual stages. It is still unclear as to which cognitive linguistic ability is compromised in the early stages of Alzheimer's disease in most of the cases the patients are reported only after relative progression of the condition. By that point, the evident decline would be in memory and other cognitive aspects.

Forbes-McKay and Venneri (2006) [1]. Used picture description task to detect linguistic deficits in Alzheimer's disease. They reported that Alzheimer's disease patients even in early stages had semantic processing deficits as well as mild linguistic impairments. Taler and Philips (2008) substantiated this finding by adding that these language declines can be used as diagnostic markers in case of Alzheimer's disease and mild cognitive impairments. On the other hand, authors like Chertkow, Gauthier, and Serge (2007) [3]. Reports working memory and control of attention preceded the other cognitive linguistic declines in the initial stages of Alzheimer's disease. Other cognitive domains in early stages of the disease are yet not widely explored.

Even though it is a known fact that cognitive linguistic abilities as a whole are deteriorated in Alzheimer's disease, it is presumed that memory is the most affected faculty even in the initial stages of the disease. This study attempts to explore the areas of cognition and language for curbing such preconceived notions and identifying the foremost affected area.

Aim
To compare and analyze cognitive linguistic processes in patients with early stages of Alzheimer's disease using functional cognitive linguistic test in Malayalam (FCLT-M).

Method
Participants
- The participants comprised of fifty individuals with Alzheimer's disease (60-80yrs) diagnosed by neurologist on the basis of clinical, neurological and radiological investigations.
- All of these participants satisfied the diagnostic criteria of DSM V prescribed for mild neuro cognitive disorder (NCD) with Alzheimer's disease.

Procedure
The testing was done during post morbid period of six months to one year after the diagnosis. Testing was done using functional cognitive linguistic test in Malayalam (FCLT-M). Details of test material with scoring are given in table 1.

Table 1: Details of functional cognitive linguistic test in Malayalam (FCLT-M) including domain, test item and scoring

Domain	Test Item	Max Score
Mental status		
	General questions	10
Memory		
Episodic memory	1. Recent memory questions	5

Working memory	2. Digit forward 3. Digit backward	5 5
Semantic memory	1. Responsive naming	5
	2. Co-ordinate naming	4
	3. Super-ordinate naming	5
Attention & discrimination		
a. Visual subsets	1. Letter cancellation	10
	2. Word cancellation	10
	3. Contingent letter cancellation	10
b. Auditory subsets	1. Letter pair discrimination	5
	2. Word pair discrimination	5
	3. Counting of sounds	10
Language		
a. Comprehension	1. Following commands	17
	2. Comparative question test	5
	3. Reading comprehension test	5
b. Expression	1. Concept definition	6
	2. Confrontation naming	10
	3. Generative naming	10
Problem solving		
	1. Sentence formulation	5
	2. Compare and contrast	10
Perception		
	1. Object perception	6
	2. Color perception	6
	3. Shape perception	3
	4. Motion perception	2
Visuospatial skills		
	1. Generative drawing	6
	2. Figure copying test	9
Executive function		
	1. Goal orientation task	8
	2. Ascending digit task	3

Domain 1: Mental status

General questions are used in this domain. 10 questions are included.

Scoring: A scoring of one point was given for each correct response.

Domain 2: Memory

The main processes tested in this domain are:

a) Episodic Memory**:** Tested by evaluating the performance in general knowledge, questions related to self, place and time.

Scoring: A score of one had been given for each correct response.

b) Working Memory: the digit forward and digit backward repetition test are used to evaluate this sub test. A minimum of seven digits are included in this list. (suggested by Carter *et al*. 1980)

Scoring: one point was given if all digits are repeated in correct order.

c) Semantic Memory: the following task were used in this category

- Responsive Naming: the participant had to name the target word on which the description has been provided.
- Co-ordinate Naming: the participant had to name at least 4 items in a noun class provided.
- Super-ordinate Naming: the participant had to say which category the test items provided belongs.

Scoring: each item score one point for the correct answer

Domain 3: Attention and Discrimination

The two main modes considered in this domain include visual and auditory

I. Visual Subsets

a) The cancellation of letter: the cancellation of all pointed letters is the task. This is a task that require sustained attention

b) The cancellation of words: it is also a sustained attention task. Procedure is same as above.

c) Contingent cancellation: this evaluates the selective cancellation. A pre requisite contingency before the cancellation is necessary.

Scoring: time taken to complete each task was noted down. The performance is based on the accuracy of the response.

II. Auditory Subsets

a) Letter pair discrimination/word pair discrimination**:** this set is a discrimination predominant task. The participants' discrimination ability for pair of letters or words read out

by the clinician is assessed. It can be either same or different.

b) Auditory sound count: the sustained auditory attention was evaluated whereby the participant has to count mentally how many times a particular letter is repeated in the list.

Scoring: A scoring of one point was given for each correct response.

Domain 4: Language

The two main modes considered in this domain are comprehension and expression.

I. Comprehension

The following tasks are included in this category.

a. Following Commands

The auditory comprehension of one step, two step, and three step commands was evaluated where by participant had to follow the commands.

b. Comparative Question Test

This subtest was assessing simple reasoning and auditory comprehension in question format. Participants were questioned about relations between two entities.

c. Reading Comprehension Test

This subtest evaluates reading comprehension at the world level.

Scoring: Each item score one point for the correct response.

II. Expression

The Following tasks are included in this category

a) Concept definition: This task evaluates knowledge of word meaning. Here participants were asked to define the stimulus words.
b) Confrontation naming: This task evaluates participant's naming ability. Here the participant had to name the picture stimulus.
c) Generative naming: This task evaluates the ability to name items in category. Here the participant had to name five items in a category.

Scoring: For each item score one point for the correct answer except concept definition. In concept definition points awarded based on the content i,e awarded 3 to a definition that contain at least three ideas.

Domain 5: Problem Solving

This domain tests the reasoning ability that aid in problem solving. The following tests were considered.

a) Sentence formulation: here the word order is scrambled and patient response is to unscramble the sentence and create grammatically correct sentence.
b) Compare and contrast: here the participant task was to identify similarity and difference between the pair of objects named.

Scoring: each item score one point for correct response.

Domain 6: Perception

Four tasks were included in this category

- Object perception: This task evaluates participant's perception of objects. Here participant had to name the objects as shown by the examiner.
- Color perception: This task evaluates participant's ability to perceive color. The participants had to say the colored number within 3 sec.
- Shape perception**:** This task evaluates participant's ability to perceive movements. The participants had to say the direction of the movement on a spherical moving sphere.
- Motion perception: This task evaluates the participant's ability to perceive movements. The participants had to say the direction of the movement on a spherical moving sphere.

Domain 7: Visuo spatial skills

The following tasks are included.

a) Generative drawing: This task evaluates visuo spatial and generative tasks. Participants had to draw different things as said by the examiner.
b) Figure copying test: it is a visuo spatial oriented test. Participants had to copy figure.

Scoring: these all are timed test. Points are given according to the complexity of pictures.

Domain 8: Executive Function

The following tasks are included,

a) Goal orientation: it evaluates participants planning, decision making ability. Participant had to say in detail how he is going to achieve a goal in different situations.
b) Ascending digit task: this task evaluates participant's ability to order the sequence of numbers. The participant had to reorder the sequence of numbers in ascending order.

Scoring: one point for each correct answer except in goal orientation task which is scored based on the content of the responses.

Procedure

Each participant was seated comfortably on a chair in a quiet room. Only one participant was tested at a time. Prior to the testing a brief introduction about the test was given in Malayalam by the examiner.

The instruction given to the participant by the examiner is as follows.

"This is a simple test and it may take 20-30 minute to complete the test. It has 8 small tasks. I will give instructions in each subtest and you have to follow them. If you feel that you have not understood whatever I tell you, please stop me and ask to repeat." Scoring the was done simultaneously along with the test.

Result

The test utilized for the current study comprises of eight cognitive linguistic functions including Mental status, Memory, Attention & discrimination, Language, Problem solving, Perception, Visuospatial skills, and Executive functions.

Factor analysis was conducted to investigate the correlation among the eight selected cognitive-linguistic elements. EFA (Exploratory factor analysis) and its basic version PCA (principle component analysis) were used for this purpose. The results showed that the data from eight elements of the study can be extricated into one component. This finding can be supported using figure 1, which implies that only single component has Eigenvalue greater than one as well as table 2, which reveals that all the elements have p value less than.01 (p=.000). Total variance extracted using principle component analysis reveals a value of 76.854 (table.3) which suggests that all the variables must be included for the analysis. The component matrix reveals that all the elements have value closer to one which indicates that all of them are highly correlated. All of these results affirm that the selected elements are highly correlated. Table 4 represents the rate of relationship of total score towards each one of the variable

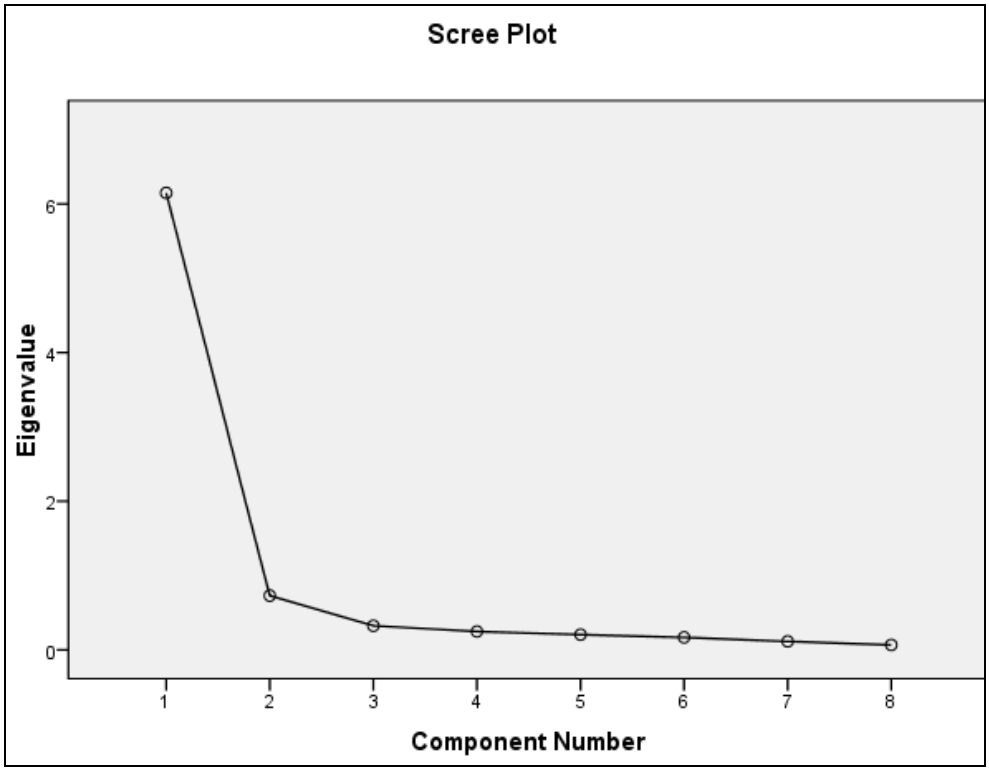

Fig 1: Eigenvalue curve for the elements mental status, attention and discrimination, memory, language, visuospatial functions, problem solving, perception and executive functions

Table 2: Correlation Matrix for the elements mental status, attention and discrimination, memory, language, visuospatial functions, problem solving, perception and executive functions

		Mental status	Memory	attention	Language	Problem solving	Perception	Visuo spatial skill	Executive function
Correlation	mentalstatus	1.000	.775	.588	.806	.802	.662	.553	.645
	memory	.775	1.00	.645	.849	.767	.742	.537	.674
	attention	.588	.645	1.000	.767	.754	.777	.797	.753
	Language	.806	.849	.767	1.000	.812	.830	.676	.759
	Problemsolving	.802	.767	.754	.812	1.000	.803	.684	.751
	perception	.662	.742	.777	.830	.803	1.000	.756	.726
	Visuospatialskill	.553	.537	.797	.676	.684	.756	1.000	.871
	Exeutivefunction	.645	.674	.753	.759	.751	.726	.871	1.000
Sig. (1-tailed)	mentalstatus		.000	.000	.000	.000	.000	.000	.000
	memory	.000		.000	.000	.000	.000	.000	.000
	attention	.000	.000		.000	.000	.000	.000	.000
	Language	.000	.000	.000		.000	.000	.000	.000
	Problemsolving	.000	.000	.000	.000		.000	.000	.000
	perception	.000	.000	.000	.000	.000		.000	.000
	Visuospatialskill	.000	.000	.000	.000	.000	.000		.000
	Exeutivefunction	.000	.000	.000	.000	.000	.000	.000	

Table 3: Total Variance Explanation for the elements mental status, attention and discrimination, memory, language, visuospatial functions, problem solving, perception and executive functions

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative%
Mentalstatus	6.148	76.854	76.854	6.148	76.854	76.854
Memory	.729	9.117	85.970			
Attention	.324	4.051	90.021			
Language	.247	3.088	93.110			
Problemsolving	.205	2.559	95.669			
Perception	.167	2.087	97.756			
Visuospatialskill	.113	1.415	99.171			
Exeutivefunction	.066	.829	100.000			

Table 4: Component matrix for the cognitive linguistic elements

Component	
	1
Mental status	.831
Memory	.855
Attention	.868
Language	.928
Problemsolving	.910
Perception	.900
visuospatialskill	.837
exeutivefunction	.881

Multiple regressions with standardized values and correlation analysis were carried out for determining the most impacted cognitive-linguistic ability. Since each variables are of different magnitudes standardized model is more applicable. For that, before doing the multiple regression and partial correlation analysis, each of the variables were standardize and tested for its normality.

Regression analysis revealed that the most significantly affected variable is language (beta=.349) followed by attention (beta=.254) and memory (beta=.149). Visuospatial skills are relatively more affected (beta=.099) than perception (beta=.076), problem solving (beta=.070), executive functions (beta=. 069) and mental status (beta=.054). The results are compartmentalized using table 5.

Table 5: Regression analysis for the components of mental status, memory, attention and discrimination, language, perception, visuospatial skills, problem solving and executive functios

b		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-3.245E-16	.001		.000	1.000	-.001	.001		
	score(mentalstatus)	.054	.001	.054	51.407	.000	.052	.057	.243	4.110
	score(memory)	.149	.001	.149	134.875	.000	.147	.151	.224	4.469
	score(attention)	.254	.001	.254	238.311	.000	.252	.257	.239	4.185
	score(Language)	.349	.001	.349	246.871	.000	.346	.351	.137	7.316
	score(Problemsolving)	.070	.001	.070	58.531	.000	.068	.073	.190	5.275
	score(perception)	.076	.001	.076	64.034	.000	.074	.079	.192	5.201
	score(visuospatialskill)	.099	.001	.099	73.024	.000	.096	.102	.149	6.732
	score(exeutivefunction)	.069	.001	.069	52.892	.000	.066	.071	.162	6.160

Note. B = unstandardized regression coefficient, std error = standard error, Beta = beta coefficient, t = coefficient divided by standard error, sig = P value, VIF = Variance inflation factors.

Further, Sub-element analysis of language, memory and attention revealed that comprehension is comparatively better than expression (table. 8) although not very significant. Semantic and episodic memory is found to be poorer (table.7) than working memory whereas auditory and visual attention is equally affected (table.6) although visual attention scores are slightly better.

Table 6: Sub -element analysis of attention

Visual attention	Auditory attention
0.9676	.9459

Table 7: Sub-element analysis of memory

Episodic memory	Working memory	Semantic memory
0.8539	.6846	.9502

Table 8: Sub-element analysis of Language

Comprehension	Expression
.94101	.98146

Discussion

Language may be relatively impaired in these patients in comparison to memory and attention as it requires simultaneous activation of multiple brain regions including Broca's area, pre-frontal cortex, superior and middle temporal cortex, pre-motor area, hippocampus and other subcortical structures. Participants in the present study had atrophy in the prefrontal regions and hippocampus. Hence, it can be presumed that these atrophies disrupt the interaction of

cognition and language thereby impacting the metalinguistic tasks. Language comprehension was observed to be comparatively better than expression although not very significant, which can again be attributed to the type of tasks undertaken in respective subsections. That is, language expression tasks (concept definition, confrontational naming and generative naming) required more input from other cognitive modalities as compared to comprehension tasks (following commands, comparative questions and reading comprehension).

Following language, the other subsequent domains which are further affected include attention and memory. The reason for this could be that the test material used in the present study used language as a medium for evaluating these domains. Hence, it can be ascertained once again that those tasks requiring the interaction between language and cognition would exercise added burden in Alzheimer's patients even in the initial stages.

The other domains (visuospatial functions, perception, executive tasks, and mental status) are relatively preserved as it requires either independent functioning of cognition or that of language. An interaction need not be present for the functioning of these domains.

Conclusions

The current study attempts to determine the primarily affected domain in the initial stages of Alzheimer's disease pertaining to cognitive linguistics. In contrary to the existing notion that memory is the first affected area, it was found out that language was affected prior to the involvement of memory and other cognitive abilities. This significant result proves that subtle degradations in language functions can be discerned in initial stages of Alzheimer's disease. Therefore it can be deduced that metalinguistic assessment will provide premonitions for detecting the onset of Alzheimer's disease.

References

1. Forbes-McKay KE, Venneri A. Detecting subtle spontaneous language decline in early Alzheimer's disease with a picture description task. Neurosciences. 2006; 26(4):243-54.
2. Taler V, Phillips NA. Language performance in Alzheimer's disease and mild cognitive impairment: a comparative review. Journal of Clinical Experimental Neuropsycholgy. 2008; 30(5):501-56.
3. Belleville S, Chertkow H, Gauthier S. Working memory and control of attention in persons with Alzheimer's disease and mild cognitive impairment. Neuropsychology. 2007; 21(4):458-469.A