RESEARCH ARTICLE

The effect of Aging on Memory in South Indians

Suzanne Maria D'cruz[1], Navin Rajaratnam[2], Mallem Pravin Kumar[3]

[1] Department of Physiology, Sri Muthukumaran Medical College Hospital and Research Institute, Chennai, India

[2] Department of Physiology, Meenakshi Medical College Hospital and Research Institute, Kanchipuram, India

[3] Department of Physiology, Karpagam Faculty of Medical Sciences and Research, Coimbatore, India

Correspondence to:
Suzanne Maria D'cruz
(susandr@ymail.com)

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ABSTRACT

Background: Aging affects many functions including cognition. Changes in Memory, which is a cognitive function, occur in healthy aging.

Aims & Objective: To determine the effect of aging on memory in normal non-demented subjects in South India using the Wechsler Memory Scale (WMS) and a test of Delayed Recall.

Materials and Methods: The Wechsler Memory Scale and a test of Delayed Recall were administered to 50 controls aged 20-50 years (Group I), 50 subjects aged 60-75 years (Group II) and 50 subjects aged above 75 years (Group III).

Results: There was a significant difference in the Wechsler Memory Scale raw scores of the controls (Group I) vs. subjects aged 60-75 years (Group II),with a p- value of 0.001; as well as between controls (Group I) vs. subjects aged above 75 years (Group III),with a p- value of 0.000. Comparison of the subset scores between controls and subjects (Group II + Group III) revealed a significant decline (p = 0.000) in all subsets except Orientation and Digit Span.

Conclusion: Our study revealed that there were memory changes with aging with many aspects of memory declining with age and others showing no significant difference.

KEY WORDS: Aging; Cognition; Memory; Wechsler Memory Scale

INTRODUCTION

Cognitive function changes with aging. The term 'Mild cognitive impairment' has been used for cognitive defects that exceed age-related cognitive decline but do not satisfy the criteria for dementia.[1] Different terms like "age-associated memory impairment , age-consistent memory impairment, late life forgetfulness, mild cognitive impairment, amnestic"[2] and "aging associated cognitive decline"[3] have also been proposed.

Although there are changes in cognitive function with normal aging, not all cognitive functions are affected equally with aging and there are differences in the degree and pattern of decline. Memory, which is one of the cognitive functions, is divided by Physiologists into explicit or declarative memory which includes episodic memory (for events) and semantic memory (for facts) and implicit or non-declarative memory which includes procedural memory (skills), priming, non-associative and associative learning.[4] Explicit memory and many forms of implicit memory involve short-term memory (which lasts for seconds to hours, one form of which is working memory) and long-term memory (which lasts for years).[4] Working memory is defined as the "ability to temporarily maintain and manipulate information over time".[5] Baddeley divides long-term memory into episodic memory, semantic memory and procedural memory.[6] The terms immediate, recent and remote memory are also sometimes used for working memory, short-term memory and long-term memory respectively.[7] Clinically, memory is assessed using two subtypes – auditory/verbal and visual memory.

Salthouse found that changes in memory begin in early adulthood.[4] Declarative and episodic memory show a greater decline with age.[9] Semantic and procedural memory have been found to be comparatively better preserved in old age[10], Peterson et al. who studied memory in 161 cognitively normal individuals aged 62 to 100 years showed that learning declined uniformly with aging[11]. The cognitive impairment in learning, memory and problem solving could be due to the progressive decrease in speed of processing information that occurs with aging.[12] Kirasic et al. found that there was a significant decrease in information processing speed, working memory and declarative learning with aging and postulated that working memory would have been the most important mediator.[13] While working memory, visuo-spatial and verbal processing speeds and learning were found to decrease with aging, visuo-spatial cognition has been found to be more sensitive to the effects of aging.[14]

In an 11 year follow up study of four successive age cohorts, decrements in both verbal and spatial memory were found.[15] Johnson et al. found that healthy older adults showed a decrease in delayed recall, although they had good immediate recall.[16] Compton et al. found that age predicted performance in the Wechsler Memory Scale subset of Logical Memory (that tests immediate and verbal recall), but also suggested that intellectually active individuals need not necessarily show a cognitive decline with aging.[17] Starkstein and Kremer studied different aspects of cerebral aging and conclude that the cognitive functions of language, visuospatial and executive function change with aging and even declarative memory involving free, cued and source recall and prospective memory decline with aging.[18] The effect of aging on implicit, short-term and recognition memory was relatively milder.[18]

A twenty- two year prospective study on 1076 participants of the Framingham study showed that lower scores on measures of episodic memory, semantic memory, new learning, recall and abstract reasoning were risk factors for development of probable Alzheimer's disease (pAD).[19] However, in a study involving 500 subjects of the Longitudinal Study on Adult development and aging, it was found that aging - associated cognitive decline did not predict dementia.[2]

It was therefore decided to do a preliminary study on the effect of aging on memory, in normal

non-demented subjects attending the outpatient department of a General Hospital in South India using the Wechsler Memory Scale (WMS)[20], along with a simple short test of delayed verbal recall. The Wechsler Memory Scale was preferred for this study, on the basis of its simplicity, brevity and clarity; keeping in mind the general literacy level and socio-economic status of the participants.

The aim of this study was therefore to determine the effect of aging on memory in normal non-demented subjects in South India using the Wechsler Memory Scale (WMS)[20] and a test of delayed recall.

MATERIALS AND METHODS

This cross-sectional study was done in the Institute of Physiology and Experimental Medicine, Madras Medical College, Chennai and the Department of Geriatric Medicine of Government General Hospital in Chennai, in South India.

Sample Size: 50 controls aged 20-50 years (Group I), 50 subjects aged 60-75 years (Group II) and 50 subjects aged above 75 years (Group III) were selected using the following inclusion and exclusion criteria, after obtaining their consent.

Inclusion Criteria: Only individuals with a minimum 6th standard education were included.

Exclusion Criteria: Individuals with history or clinical evidence of dementia or any neurological, psychiatric or medical diseases that would affect cognitive function like, stroke, transient ischaemic attacks, depression, Parkinsonism, epilepsy, head injury, brain tumors or brain surgery and individuals with un-corrected visual or auditory defects were excluded from the study.

After screening of the subjects and controls (consisting of history and clinical examination), the Wechsler Memory Scale (WMS)[20], which is a commonly used neuropsychological test was administered to assess memory. The Wechsler Memory Scale has seven subsets: "Personal and Current Information, Orientation, Mental Control, Logical Memory, Digit span, Visual Reproduction and Associate Learning"[20], with scores of 6, 5, 9, 23, 15, 14 and 21 respectively and a total maximum raw score of 93. Although typically raw scores are converted to correct scores and a Memory Quotient is calculated, we compared the raw scores of the groups. In addition, we also tested delayed verbal recall by asking the participants to recall the matter from the Logical memory subset after 30 minutes and scores were expressed as a percentage of the scores obtained on immediate recall.

Statistical Analysis: SPSS software was used for statistical analysis. Means and standard deviations were determined for each group. Comparison of the scores all three groups was done using ANOVA and Bonferroni post-hoc test while comparison of the scores of controls (Group I) and subjects (Group I + Group II) was done using the unpaired student 't' test. A p-value of < 0.05 was taken as representing significance.

RESULTS

There was a significant difference in the Wechsler Memory Scale[20] raw scores of the controls (Group I) vs. subjects aged 60-75 years (Group II) as well as between controls vs subjects aged above 75 years (Group III) [Table 1]. Analysis of the Wechsler Memory Scale raw scores of the controls (Group I) vs. subjects (Group II + Group III) also showed that there was a significant difference; with the controls obtaining a higher score [Table 2].

It was also found that there were significant differences ($p = 0.00$) between the means and standard deviation of the Delayed Recall scores of the controls (Group I: 95.66 ± 6.45) vs subjects aged 60-75 years (Group II: 64.80 ± 10.27) as well as between controls vs subjects aged above 75 years (Group III: 52.78 ± 9.61). Analysis of the Delayed Recall scores of the controls (Group I: 95.66 ± 6.45) vs subjects (Group II + Group III:

58.79 ± 11.59) also showed that there was a significant difference (p = 0.00), with the controls performing better.

Further analysis of each of the Wechsler Memory Scale subset scores of the controls (Group I) vs. subjects (Group II + Group III) was done. It revealed that there were no significant differences in the Orientation and Digit Span subset scores, while there were significant differences in the other subset scores with the controls performing better (Table 3).

Table-1: Comparison of the Wechsler Memory Scale Scores of the Three Groups

Group I (20-50 years)	Group II (60-75 years)	Group II (>75 years)	Statistical Analysis	
			Category	p value
63.26 ± 9.32	55.80 ± 9.59	52.16 ± 10.65	I vs II	0.001*
			I vs III	0.000*
			II vs III	0.202

Results are expressed as mean and standard deviation of the Wechsler Memory Scale[20] raw scores (Maximum score = 93) for the three groups; * p < 0.05 = significant

Table-2: Comparison of the Wechsler Memory Scale Scores of Controls (Group I) and Subjects (Group II+ Group III)

Group I (20-50 years)	Group II + Group III (>60 years)	p value
63.26 ± 9.32	53.98 ± 10.25	0.000*

Results are expressed as mean and standard deviation of the Wechsler Memory Scale[20] raw scores; * p < 0.05 = significant

Table-3: Comparison of the Wechsler Memory Scale Subset Scores of Controls (Group I) and Subjects (Group II + Group III)

WMS Subsets	Group I (20-50 years)	Group II + Group III (>60 years)	p value
Personal and Current Information (Max. Score = 6)	5.18 ± 0.56	4.29 ± 1.42	0.000*
Orientation (Max. Score = 5)	4.94 ± 0.24	4.91 ± 0.35	0.587
Mental Control (Max. Score = 9)	7.76 ± 1.25	6.71 ± 1.77	0.000*
Logical Memory (Max Score = 23)	13.06 ± 3.06	9.86 ± 2.81	0.000*
Digit Span (Max. Score = 15)	9.90 ± 2.15	10.02 ± 2.16	0.748
Visual Reproduction (Max. Score = 14)	8.24 ± 2.63	6.07 ± 3.19	0.000*
Associate Learning (Max. Score = 21)	14.26 ± 3.12	12.13 ± 3.37	0.000*

Results are expressed as mean and standard deviation of the Wechsler Memory Scale[20] (WMS) subset scores, the maximum possible scores for each subset of the WMS being expressed in brackets. *p < 0.05 = significant.

DISCUSSION

Our finding that there was a significant difference in the WMS raw score of controls and subjects is to be expected as norms on the WMS for individuals aged above 70 years are lower than those of young adults[21], and age has been found to predict WMS subset scores[17]. On further analysis of subset scores, it was found that recent and remote memory (as measured by the Personal and Current Information subset), verbal recall and immediate memory (Logical Memory subset), visual memory (Visual Reproduction subset), verbal memory and learning (Associate Learning subset) and attention and executive function (Mental Control subset) declined with age.

In the Personal and Current Information subset, the individual is asked questions about personal and general knowledge. Fund of information reflects remote memory and includes current information also.[7] In the Logical memory subset of the WMS, the individual is asked to recall two paragraphs to test his immediate verbal recall. Our findings agree with the findings of Compton et al. who found that age predicted performance in this subset.[17] As subsequent versions of the WMS address delayed recall, we tested delayed recall after 30 minutes and found that there was a significant difference in scores of controls and subjects. Johnson et al. also found that healthy older adults showed a decrease in delayed recall.[16] Unlike our study, their study however showed that older adults had good immediate recall.[16] Individuals must draw figures that are shown to them in the Visual Reproduction subset. In the Associate Learning subset, the examiner presents lists of word pairs, the individual has to recall the second word when the examiner reads out the first. As this is repeated thrice, both verbal memory and learning are tested. Like our study, there was a decrease in verbal memory with aging in an 11 year longitudinal study of four successive age cohorts.[15] Others have also found that with aging, learning[11] and speed of processing information[13] decrease. In the Mental Control subset, individuals are asked to count backwards from 20 to 1, recite the

alphabet and add serial 3's, to test both attention and executive function. Our study showed a decline in this subset with aging.

Our study also showed that the scores in the Orientation and Digit Span subsets of the WMS did not vary significantly between controls and subjects. However, Orientation has been found to decline with aging, when the participants were tested using the Mini-Mental State Examination (MMSE)[22], probably because the MMSE addresses orientation more thoroughly. The Forward Digit Span subset of the WMS tests attention and working memory. In the Backward Digit Span, the individual not only uses working memory but also mentally manipulates the material and repeat the digits in reverse. In our study, the scores in the WMS subset of Digit Span did not vary significantly between controls and subjects and were instead found to be somewhat enhanced with aging, though not statistically significant. However, working memory has been found to decline with age by others.[13,14] Our study also showed that executive function declines with aging only when the test is timed (as in the mental control subset), and not if it is not timed (as in the digit span subset). A decrease in speed of processing information does occur with aging[12,13] and is stated to be the cause of differences in cognition with aging[23].

Limitations of the Study

The limitations of our study include the use of the WMS which is an older version; the cohort effect due to the cross-sectional nature of the study and the possibility of inclusion of individuals with occult dementia in spite of strict exclusion criteria.

CONCLUSION

This preliminary study done to evaluate the effect of aging on memory in normal non-demented subjects in South India using the Wechsler Memory Scale (WMS)[20] and a test of delayed recall, revealed that there were memory changes with aging with many aspects of memory declining with age and others showing no significant difference. It will be worthwhile doing further studies, ideally longitudinal, using the latest revised versions of instruments to assess the effect of aging on memory.

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