Impairment in Working Memory in Younger and Older Adults of Intellectual Disability

Intellectually PwDs are having Impaired Working Memories

Abstract

[Draw your reader in with an engaging abstract. It is typically a short summary of the document. When you're ready to add your content, just click here and start typing.]

Dr Shivajee Kumar & Dr Ashutosh Kumar

Shivajee100@gmail.com

Title of the article:

Impairment in Working Memory in Younger and Older Adults of Intellectual Disability

Name of the authors:

Dr. Ashutosh Kumar Santosh*
&
Dr. Shivajee Kumar

Institutional Affiliation:

Assistant Professor Clinical Psychology
Composite Regional Center for Persons with Disabilities (CRC),
Patna – 800001 (Bihar)

&

State Commissioner for PwDs (Bihar)
Ex-Consultant and Assistant Professor (Disability)

Telephone/ Mobile No:

9135886763, 7903065037

9431015499, 9873822161

E-mail address:

ashu875@yahoo.com

shivajee100@gmail.com

*corresponding author.

Impairment in Working Memory in Younger and Older Adults of Intellectual Disability

Abstract:

Background: Memory plays a very significant role in human lives. Psychological research on memory has a reach tradition. By 1960's the advancement of computer led to cognition revolution in psychology and a new concept emerged as "Working Memory". Specific parts of the brain, that is, frontal and parietal lobe and prefrontal cortex (PFC) are crucial for working memory function. Limitation in working memory appears to play a crucial role in learning endeavor and behavioral problems in children with intellectual disability. Hence the present study intended to know the effects of different age group of adults having mild level of intellectual disability upon working memory.

Methods: Purposive sampling was used to select 30 subjects of both the sexes aged 15 to 60 years. The working memory performance of a group of 15 to 40 years old with mild intellectual disability (I.Q. 50 to 69) were compared with a group of 41 to 60 years old with mild intellectual disability. PGI Memory Scale by Pershad & Wing was used in this study as a data collection tools.

Results: Results were analyzed with the help of Mann-Whitney U-test.

Conclusion: Result revealed that older adults (41 to 60 years of age with Mild ID) showed poor working memory as compared to younger adults of mild level of ID. Results also showed deficit in all three components of working memory (phonological memory, visuo-spatial memory and central executive loaded memory) increases as the age of the persons with intellectual disability will increases.

Key words: Working memory, intellectual disability, impairment, adults.

Impairment in Working Memory in Younger and Older Adults of Intellectual Disability

Introduction:

Memory adds richness in context to human lives. Without memory we would not recognized anyone or anything as familiar. Life has no meaning without it. Memory is used for numerous purposes like making conversation, writing, make a sense what we read or recognize a person etc. Psychological research on memory has a rich tradition. By 1960's the advancement of computer led to cognitive revolution in psychology and new concept emerged as "working memory". The term "working memory" was first coined by Miller Galanter & Prilram. Atkinson & Shiffrin (1968) also used the term to describe "short term store". Cowan (1995, 2005) considered working memory not as a separate system, but as a part of long-term memory. Working memory is organized in two embedded levels. The first level consists of long-term memory representations that are activated. There is no limit to activation representation in long – term memory the second level is focus of attention.

Baddeley (1998, 2000, 2001, 2003) a British Psychologist, first proposed the concept of "working memory" as a system that temporarily holds information as persons perform cognitive tasks. Working memory is a kind of "work bench" on which information is manipulated and assembled to help us comprehend languages, making decision, planning and problem solving. Nyberg & Cabeza (2000) viewed that working memory is not a passive storehouse but it store information until it moves to long-term memory, rather it is an active memory system.

Previously, the original three-stage model viewed short –term memory as a temporary holding station along the route from sensory to long-term memory. Information that remained in short-term memory for long time transferred to more permanent storage. Researchers conducted by Baddeley & Hitch (1974) observed the fact that working memory has following four components:

(a) Phonological Loop
(b) Visuospatial Sketch Pad
(c) Episodic Buffer
(d) Central Executives.

(a)Phonological or articulatory loop briefly holds information for a short period of time in a phonological or speech based form. In other words, this loop contains on acoustic code that decays in a few seconds and rehearsal helps the person to repeat the words in the phonological loop.

(b) Visuospatial sketch pad: it stores visual and spatial information including visual imagery (Logie, 1995). Like Phonological loop, its capacity is also limited. If the person tries to put many items in visuospatial sketch pad, the person can't represent them accurately and retrieve them successfully. However, the phonological loop and visuospatial sketch pad both function independently (Reed, 2001). As for the person while silently repeating the word "sunset" also hold the mental image of "sunset".

(c) Episodic Buffer: It provides a temporary storage space where information from long-term memory and from the phonological or visuospatial sub-systems can be integrated, manipulated and also made available for conscious awareness (Baddeley, 2002).

(d) Central executive is the key component of working memory that directs the overall action. It plays an important role in attention, planning and organizing. The central executive acts much like a supervisor who monitors information deserves attention to be ignored. It further selects that which strategies to use to process information and solve problems. It further monitor the progress an interim steps are completed (DeStefano LeFevre, 2004). But central executives has limited capacity as compared to phonological loop and visuo-spatial sketch pad.

Thus, working memory is the executive and attentional aspect of short-term memory involved in integration, processing, disposal and retrieval of information. Working memory tasks also include the active monitoring or manipulation of information of behaviors. It is a theoretical construct found in cognitive psychology and neuroscience as well. Theories exist both regarding the theoretical structure of working memory and the role of specific parts of the brain involved in working memory. Recent research findings indicate that the frontal cortex, parietal cortex, anterior cingulated and parts of the basal ganglia are crucial for working memory function.

In recent years, the most rapidly expanding research frontier within psychology is the area of cognitive neuroscience. The brain gets the primary attention of cognitive neuroscientists because the brain is the center of information processing. They divide the brain into three major parts such as hindbrain, midbrain and forebrain. Out of these, the forebrain is the area of primary interest for cognitive neuroscientists. It comprises mostly of the brain and consists mainly of the

cerebral cortex. The cerebral cortex is the primary neural substrate that controls higher cognitive functions. Such as remembering, planning, deciding, thinking, communicating etc.

Anterior portions of frontal lobe (commonly known as prefrontal cortex) are important in higher aspects of motor control such as planning and executive complex behaviours. In terms of cognitive Processes, the parietal lobe houses areas are important in regulating the processes of attention and working memory.

Intellectual disability (ID) is one of the major disabilities under the Rights of the Persons with Disability Act (RPWD Act) 2016. It is a condition of arrested or incomplete development of mind. RPWD act defined intellectual disability in the terms of significant limitations in intellectual functioning and adaptive behavior and manifested during the developmental age i.e. before the age of 18 years of life. Intellectual functioning includes reasoning, learning, problem-solving skills, cognitions, etc. on which ID children are lacking. If we assess their intelligence on any standardized test of intelligence, they can't perform well and often there score is less than 70. Their adaptive behavior is also having significant limitations in the areas of conceptual, social and practical skills.

Intellectual disability is formerly known as mental retardation, that term is now not in use due to the social stigma attached with the name. ID is divided into the four categories on the basis of their I.Q. range. Profound ID (I.Q. in the range of less than 20), severe ID (20-34 I.Q. level), moderate ID (35-49 I.Q. level) and finally mild ID (50 to less than 70 I.Q. levels). ID can be caused by many genetic factors, environmental and psycho-social factors.

The birth of an intellectually disabled child induces complex feelings in the parents and other family members. Every parent wants a normal child. But when they came to know that their child is not normal and suffering from ID, their reaction towards the child and towards each other may change. They may start blaming each other which leads to frustration and conflict in

their relationship. Their interpersonal relationship may become strained and ultimately they may ignore their academics.

Few parents those who accept the conditions of their child, may through negative emotions towards their child that ultimately affect their self-esteem, confidence levels and other positive variable which are responsible for good academic performance. Such negative attitudes of the parents towards the learning situations may produces frustration, anxiety, stress, depression, and so on and diminished their time management skills.

Although there are significant roles of both parents in raising a child with ID, mothers are more responsible for the caring, rearing, and education of children with ID than fathers, especially in countries like India. Hence, it can be said that mothers are the main caregivers for children with ID. Compared with mothers of children with normal development, mothers of children with ID have lower family support, a higher caregiver burden, and a lower sense of coherence. As nurturing an ID child is lifelong and time-consuming, the mothers reported that they were emotionally and physically exhausted and felt socially isolated. Parents often have needs of support during these times that are not addressed by professionals because of the exclusive focus on the child during the evaluation.

In India, Psychosocial factors like self-esteem, confidence levels, good moral support, enthusiastic and optimistic reinforcing environment etc. which are responsible for better academic performance is often neglected. That leads to poor academic performance. Therefore, this study aims to identify the prominent psycho-social factors that adversely affect the academic performance of children with ID having mild level of severity in intellectual functioning. In addition, this study also investigates the influence of various socio-demographic variables and

their clinical correlation with academic performance among the children with mildly intellectual disabilities.

A large number of persons have suffered brain damage due to accidents, strokes; alcohol abuse etc. and evidences from these may be used to understand how the intact brain works. The credit goes to cognitive neuropsychologists whose research in the area helps us to understand the working of the cognitive system by studying brain damaged patients and the kinds of impairment associated with brain damage. Several brain disorders like epilepsy, brain injuries etc. have major influences on thought and behavior of the individual.

To identify the conditions that might cause brain malfunction is an important task. This task is further complicated by the fact that damage to a particular area of the brain can have diverse effects. It has been found that several symptoms are often seen in patients who have disorders related with malfunction of the frontal lobe of the brain. Due to cognitive impairment the person shows several symptoms like disturbances in perception, memory, imagination, thought processing, problem solving skills and judgments. It is against this background that the present study intends to know the impact of brain injury upon working memory of such patients.

Objectives of the study:

The present study attempts to focus on the impact of mild level of intellectual disability having the different age group upon working memory. It further seeks to know the impact of age upon working memory as well.

Hypothesis:

(i) There will be significant differences between working memory of older and younger adults with mild level of intellectual disability.

(ii) There will be significant deficit in all three components of working memory (phonological memory, visuo-spatial memory and central executive loaded memory) increases as the age of the persons with intellectual disability will increases.

Material and Methods:

Sample: Out of 30 brain injured patients, 15 adults (Male = 8, Female = 7) belongs to in the age range of 15 to 40 years and 15 adults (Male = 10, Female = 5) in the age range of 41 to 60 years of age. Samples were purposively selected from Samarpan Special School, Patna, Child Concern Special School, Patna and Creation Foundation (Institute of Mental Health and Behavioral

Studies), Patna from the duration of February, 2015 to May, 2015. Their age ranged from 15 to 60 years and they were divided into two age groups (a) 15 to 40 years and (b) 41 to 60 years.

Design: In this study between group design was used. Following tests and tools were used in this study:

(a) PGI Memory Scale by Pershad & Wig.

(a) PGI Memory Scale:

This test is developed by Pershad & Wig (2009) in India. This scale is very popular and has replaced the Boston Memory Scale and Wechsler Memory Scale. This scale is very useful for neuropsychological assessment of organic brain dysfunction (Pershad, Verma et. al, 1984). This test is a good measure for evaluating cognitive functions and organic brain dysfunction.

This test consists of ten sub-tests like (1) remote memory (2) recent memory (3) mental balance (4) attention – concentration (5) delayed recall (6) immediate recall (7) retention for similar pairs (8) retention for dissimilar pairs (9) visual retention and (10) recognition. The test retest reliability of this test ranged between 0.70 to 0.84 for organic psychotic groups and 0.48 to 0.84 for neurotic and normal group. Split – half reliability was between 0.91 and 0.83 respectively for above groups. This test is validated against Boston Memory Scale and has a correlation of 0.71 and 0.85 with Wechsler Memory Scale. Percentile norms were also developed for this test.

Procedure:

Data were collected with the help voluntary consent of the patients. Sample consists of two groups (a) 15 to 40 years of mild intellectual disability and (b) 41 to 60 years of mild intellectual disability. Rapport and cordial relationship was especially established with the subjects. They were further convinced about the confidentiality of the data. Socio-demographic details of all subjects were taken on the Performa designed by the investigators. Then, they were asked to answer the questions of PGI Memory scale. Administration of the test is simple and similar to other memory scales and clinical evaluation of memory. It took about 20 to 30 minutes to complete it.

Result and Discussion:

Results were analyzed with the help of Mann – Whitney-U test, a non- parametric substitute of parametric t-test. It was hypothesized that there will be significant difference between working memory of older and younger adults with mild level of intellectual disability. The obtained result is shown in table – 1.

Table – 1: U- Value of younger and older adults having intellectual disability on working memory:

Group	N	U - Value	Significance
Younger adults (age range 15 to 40 years)	15	12.5	P<0.01*
Older adults (age range 41 to 60 years)	15		

*significant.

Table – 1 indicates that the obtained U-Value (12.5 P <0.01) of younger and older adults on the measures of working memory which is significant beyond 0.01 level of significance. Finding revealed that older adults showed poor working memory as compared to younger adults. Result obtained supported from recent researchers conducted on animal research (Fuster,1973) and on the basis of PET and MRI, it has been confirmed that areas of pre-frontal cortex (PFC) are involved in working memory functions.

There is still controversy regarding the functional distinction that dorsolateral areas are responsible for spatial working memory and ventrolateral areas for non- spatial memory. Former areas are mostly involved in pure maintenance of information and later areas are involved in tasks requiring some processing of the memorized materials.

In the second hypothesis, in which it was hypothesized that there will be significant deficit in all three components of working memory (phonological memory, visuo-spatial memory and central executive loaded memory) increases as the age of the persons with intellectual disability will increases. The obtained result is shown in table – 2.

Table – 2: U- Value of older/younger brain injured patients on working memory:

Group	N	U - Value	Significance
Younger adults (age range 15 to 40 years)	15	10.05	P<0.01*

Older adults (age range 41 to 60 years)	15		

*Significant.

Table – 2 indicates that the obtained U-Value (10.05 p <0.01) of older and younger adults on the measures of three components of working memory, namely phonological memory, visuo-spatial memory and central executive loaded memory was also significant beyond 0.01 level of significance. This finding revealed that the older adults showed poor working memory as compared to younger adults.

The obtained findings are supported by several experimental evidences (Hasher & Zacks, 1988, Salthouse, 1990, Wingfield at al. 1988). These research findings reveal that working memory is very sensitive with regard to aging. It is shown in decline in performance on working memory measures and older person shows deficit in reading span tests as compared to younger persons.

Brain imaging study has also observed that working memory functions are limited to the pre-frontal cortex. But several other researchers have shown that activation of working memory tasks also rather scattered over large part of the cortex. It has been further revealed that spatial task is more governed by right hemisphere areas and for verbal and object working memory by left hemisphere areas. Study has also shown that left posterior parietal cortex is related with mathematics and rehearsal is related with left frontal cortex (Broca's area for speech production).

There is an emerging consensus among neuroscientists that most working memory tasks recruit a network of pre-frontal cortex and parietal areas. A study by Mottaghy (2006) showed that during a working memory task the connectivity between these areas increases. Another study has shown that these areas are crucial for working memory and not simply activated accidentally during working memory tasks by temporarily blocking them through transcranial magnetic stimulation (TMS), thereby producing an impairment in tasks performance (Mottaghy,2006).

Thus working memory involves two processes with different neuro-anatomical locations in the frontal and parietal lobes. First, a selection operation that retrieves the most relevant items, and secondly, an updating operation that ultimately changes the focus of attention made upon it (Bledowskl et al 2009). These findings substantiated the present hypothesis. So it has been concluded that patients who had frontal lobe and parietal lobe damage have shown impaired

working memory while patients having cerebral cortex and other damages have shown less impaired working memory.

Further researches on large samples allowing for the possible role of gender differences are suggested.

References:

1. Atkinson, R.C., & Shifrin, R.H. (1968). Human Memory: A Proposed System and its Control Procedures. In Spence, K.W., & Spence, J.T. (Ed). The psychology of learning and motivation. New York Academic Press, 2, 89-195.
2. Baddeley, A. (1998). Human Memory, Revised edition, Boston Aliyn & Bacon, 195-225.
3. Baddeley, A. (2000). Short-term and working memory. In Tulving, E., & Craik, F.,I.,M. editor, The Oxford handbook of memory, New York, Oxford University Press.
4. Baddeley, A. (2001). Is working memory still working? Paper presented at the meeting of the American Psychological Association. San Francisco.
5. Baddeley, A. (2002). Is working memory still working? European Psychologist, 7, 85-97.
6. Baddeley, A. (2003). Working memory and language: An overview. Journal of Communication Disorders, 36, 189-208.
7. Baddeley, A., & Hitch, G., J. (1974). Working memory. In Bower GH (eds.) The Psychology of learning and motivation, advances in research and theory, New York Academic Press.
8. Bledowski, C. Rah., & Rowe, M., B. (2009). What work in working memory? Separate Systems for selection and updating of critical information. The Journal of Neurosciences, 29 (43), 35-41.
9. Cowan, N. (1995). Attention and Memory: An integrated Framework, New York: Oxford University Press.
10. Cowan, N. (2001). The magical number 4 in short –term memory: A reconsideration of mental storage capacity. Behavioural and Brain Sciences, 87-185.
11. Cowan, N. (2005). Working memory capacity. New York, NY`: Psychology Press.
12. Destefano, D., & LeFevre, J. (2004). The role of working memory in mental arithmetic. Europeon Journal of cognitive psychology, 16, 353-386.

13. Fuster, J., M. (1973). Unit activity in prefrontal cortex during delayed response performance: Neuronal correlates of transient memory. Journal of Neurophysiology, 361, 61-78.
14. Hasher, L., & Zacks, R., T. (1988). Working memory: comprehension and aging – a review and new view. In Honey, G., H., & Fu Ch Kim, G., D. (Eds). Effects of vertical working memory load on corticocortical connectivity modeled by path-analysis of functional magnetic imaging data. Neuro Image, 17 (2), 573-582.
15. Logie, R., H. (1995). Visuospatial working memory. Hove, England: erilaum.
16. Mottaghy, F., M. (2006). Interfering with working memory in humans. Neurosciences, 139 (1), 85-90.
17. Nyberg, L., & Caleza, B. (2000). Brain Imaging of memory. In Tulving, E., & Clark, F.,I.,M. (eds.).
18. Pershad, D., & Wig, N., N. (2009). PGI Memory Scale. National Psychological Corporation, Agra.
19. Pershad, D., & Verma, S., K. (1984). A Handbook of PGI Battery of Brain Dysfunction.
20. Read, S., K. (2001). Structural Description and the limitations of visual-images. Memory and Cognition, 2, 329-336.
21. Salthouse, T., A. (1990). Working memory as a processing resources in cognitive aging. Developmental Review, 10, 101-124.
22. Smith, E., E., Marshuetiz, J., & Koeppe, R. A. (1998). Components of verbal working memory: evidence from neuroimaging. Proceedings of the National Academy of Sciences of the United States of America, 95 (3), 876-882.
23. Wingfield, A., Stine, E., A., L., Lahar, C., J., & Aberdeen, J., S. (1988). Does the capacity of working memory change with age? Experimental Aging Research,14, 103-107.

Acknowledgement:

The authors express their deepest gratitude towards the Secretary, Samarpan Special School, Patna; Secretary, Child Concern Special School, Patna; and towards the Secretary, Creation Foundation (Institute of Mental Health & Behavioral Studies), Patna to use the relevant data in

this research. The authors appreciate all those who participated in the study and helped to facilitate the research process.

Conflict of interest: The authors declared no conflict of interest.

How to cite this article: Santosh, A.K., & Kumar, S. (year). Impairment in Working Memory in Younger and Older Adults of Intellectual Disability (Name of journal), (vol. No.), (page No. from-to). (DIP No., if any), (DOI No., if any).

***