

## Review Article

## Assessment of memory deficits in psychiatric disorders: A systematic literature review

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## ABSTRACT

Memory deficits are observed across psychiatric disorders ranging from the prodrome of psychosis to common mental disorders such as anxiety, depression, and dissociative disorders. Memory deficits among patients recovering from psychiatric disorders could be directly related to the primary illness or secondary to the adverse effect of a treatment such as Electroconvulsive Therapy (ECT). The trouble in the meaningful integration of working-memory and episodic memory is the most commonly affected domain that requires routine assessments. An update on the recent trends of methods of assessment of memory deficits is the first step towards understanding and correcting these deficits to target optimum recovery. A systematic literature search was conducted from October 2018 to October 2022 to review the recent methods of assessment of memory deficits in psychiatric disorders. The definition of 'Memory deficit' was operationalized as 'selective processes of memory, commonly required for activities of daily living, and affected among psychiatric disorders resulting in subjective distress and dysfunction'. We included 110 studies, most of them being conducted in western countries on patients with schizophrenia. Other disorders included dementia and mild cognitive impairment. Brief Assessment of Cognition in Schizophrenia, Cambridge Automated Neuropsychological Test Battery, California Verbal Learning Test, Trail Making Test Part A and B, Rey Auditory Verbal Learning Test, Wechsler Memory Scale, Wechsler Adults Intelligence Scale-IV were the most common neuropsychological assessments used. Mini-Mental State Examination and Montreal Cognitive Assessment were the most common bedside assessment tools used while Squire Subjective Memory Questionnaire was commonly used to measure ECT-related memory deficits. The review highlights the recent developments in the field of assessment of memory deficits in psychiatric disorders. Findings recommend and emphasize routine assessment of memory deficits among psychiatric disorders in developing countries especially severe mental illnesses. It remains interesting to see the role of standardized assessments in diagnostic systems given more than a decade of research on memory deficits in psychiatric disorders.

**Keywords:** Memory deficits, Cognitive, Recent memory, Working memory, Assessment, psychiatry, Neuropsychological assessment

## INTRODUCTION

Memory is defined as the faculty of the brain essential for encoding, storing, and retrieving information.<sup>[1]</sup> Memory is an integral part of healthy living and most psychiatric disorders including depression, anxiety, psychotic illnesses, and prodromal syndromes are known to have variable levels of impairments in memory.<sup>[2]</sup> The forgetfulness brought about by the functional or organic nature of an illness has great implications for recovery from an illness and has widely been appreciated in the literature. Most commonly appreciated deficits in memory are found in episodic, autobiographical, and working memory (WM) domains among psychiatric disorders. Furthermore, immediate and recent recall is probably the most commonly performed bedside test during

an examination of a psychiatry case, which also forms an integral part of the mental status examination. The WM is relevant in psychiatry because it forms a connection to the integration of emotional aspects with cognitive tasks besides forming a channel to long-term memory.<sup>[3]</sup> In addition, it also facilitates the task-completion supplemented by other executive functions of the brain. Under stressful conditions, a dynamic change happens in the memory throughout life. This part of memory refers to the ability to hold the stimuli "online" for a short time then either use it directly after a short delay or process or manipulate it mentally to solve cognitive and behavioral tasks.<sup>[4]</sup> The WM involves active rehearsing, processing, and manipulation of information that depends on the function of the prefrontal cortex. It is well recognized

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that long-term memory is retained while short-term memory is vulnerable to organic brain damage.<sup>[5]</sup> Certain memories may not be verbal, and they are often procedural which could be implicit (limbic) and explicit (hippocampus).<sup>[6]</sup> Again autobiographical memory summates the subjective details of personal experience, which are subsumed under episodic memory. Semantic memory is more concerned about recollecting facts of the matter such as the capital of the city.<sup>[7]</sup> Therefore, impairment in episodic or WM could cause trouble in the meaningful integration of our existence. Psychiatric disorders are state phenomena; therefore, the impairment in memory could be transient and modulated by dysfunctional neural connectivity. Meaningful recovery is largely dependent on the assessment and management of memory impairment.<sup>[8,9]</sup> The assessment of memory deficits could be carried out through bedside testing, structured scales or detailed neuropsychological assessments. It is known that different psychiatric disorders could have impairments in specific domains of memory.<sup>[9]</sup> Various methods of assessment of memory deficits have been widely used across the world, and it would be useful to look at the current trend and development in the field of neuropsychiatry in terms of assessment across the world. It would also be interesting to understand the cross-cultural use of similar tests across different disorders, along with the use of standardized tools such as Mini-mental state examination (MMSE). Through this review, we aimed to look at the current trends in memory assessments, tools used, and domains studied in psychiatric disorders across the world in the past 5 years.

## METHODS

We operationalized the memory deficits in psychiatric disorders as “selective processes of memory that are most commonly affected during the illness or treatment of an illness with development of subjective distress and dysfunction in daily activities.” The operational definition included the assessment of verbal memory, visual memory, WM, episodic memory, autobiographical memory, short-term memory, declarative memory, logical memory, facial recognition, and visuospatial memory. The definition of memory deficits was limited to the above domains, and we excluded the assessments of other executive domains and complex cognitive processes such as cognitive flexibility, set-shifting, response inhibition, and processing speed.

### Search strategy and terms

A systematic literature search of the following databases was conducted on November 1, 2022, by two independent authors (RS and AK) on PubMed and Google scholar. In addition, the reference lists of the pertinent literature were screened for relevant literature. Literature was searched using

the search terms: Memory AND psychiatric illness, memory deficit AND psychiatry AND assessment, memory deficit AND psychiatric disorders, memory impairment AND schizophrenia AND assessment, memory impairment AND depression AND assessment, memory impairment AND dementia AND assessment, memory AND depression AND assessment, memory AND anxiety AND assessment, and memory AND bipolar disorder AND assessment. AK and RS screened the articles using the inclusion/exclusion criteria with assistance from DB.

### Eligibility criteria for studies

We included all the observational and interventional studies (including cross-sectional, case-control, and cohort), and published protocols of such studies in the past 5 years that mentioned the methods of assessment of memory deficits in any psychiatric disorders published in the English language from October 2017 to October 2022. We included mild cognitive impairment (MCI) and dementia as psychiatric disorders in this review due to extensive evidence of behavioral disturbances found in them.

### TYPE OF PARTICIPANTS

We included studies with subjects of either gender or any age. We excluded animal studies and studies on healthy subjects, healthy geriatric populations, various cancers, Parkinson's, multiple sclerosis, stroke, road traffic accidents, human immunodeficiency virus, chronic obstructive pulmonary disease, COVID, diabetes mellitus, systemic lupus erythematosus, cancer-survivors, domestic violence, and subjects with cochlear implants or any other medical conditions.

### TYPE OF OUTCOME MEASURES

#### Primary outcome

Types of assessment methods used for identifying memory deficits in psychiatric disorders and most commonly studied psychiatric disorders.

#### Secondary outcome

Most commonly tested domains of memory.

#### Selection process

RS and AK carried out the preliminary search. Author AK and RS read the abstracts and extracted the relevant articles for full text in Microsoft Excel. Any duplicate citations were removed by DB. Color coding was used for any discrepancies with the resolution by the involvement of DB.

## Data collection process

Studies reporting the assessment methods of any type were further read for mention of details by two independent reviewers DB and RS. RS extracted the data into a table in Microsoft Word and then did another full-text screening of all the articles. RS and AK extracted the raw data from each article and put it into another table for further analysis.

## Data items

Studies were read in detail and data extracted included author, year of publication, type of study, country of research, assessment method used, psychiatric disorder studied, and domains of memory assessed.

## RESULTS

### Result of the study selection

A total of 1699 studies were identified from the databases. After the removal of 108 duplicate studies, 1591 studies were reviewed. The 1444 studies were excluded because assessment methods of interest were not there, animal studies or not relevant to the review objective or were not in English. After the full-text screening, 147 studies were, further, screened for eligibility and 110 were included in the review as shown in Figure 1.

### Study-site

The majority of the studies ( $n = 30$ ) were from Europe (particularly from Spain and Sweden) followed by 26 from the USA. There were 17 studies from the Asian continent

(mostly from China and South Korea) and six studies each from India and Canada. Two studies were each from Mexico, Israel, and Australia, and ten studies were multicentric.

### Type of studies

Most studies were cross-sectional and observational, and some were retrospective chart reviews. Few were prospective two-staged interventional studies. Very few were interventional randomized controlled trials for studying the effectiveness of interventions for improving memory deficits or interventions that lead to memory deficits.

### Studies included under review

We included 55 studies on psychiatric disorders with predominant memory impairment such as schizophrenia, bipolar disorder, substance use disorder, and depression, as detailed in [Supplementary Table 1],<sup>[10-64]</sup> whereas minor impairment in memory (17 papers) included suicide attempters, anxiety disorders, fibromyalgia, eating disorders, obsessive compulsive disorder, post-traumatic stress disorder (PTSD), dissociative disorder, attention deficit hyperactivity disorder, Autism spectrum disorder, and borderline personality disorder as shown in Supplementary Table 2.<sup>[65-81]</sup>

### Studies focusing on neuropsychiatric disorders in the review

We found 29 studies<sup>[38,82-109]</sup> on neuropsychiatric disorders with major memory impairments such as dementia, MCI, and vascular events while nine studies on memory deficits related

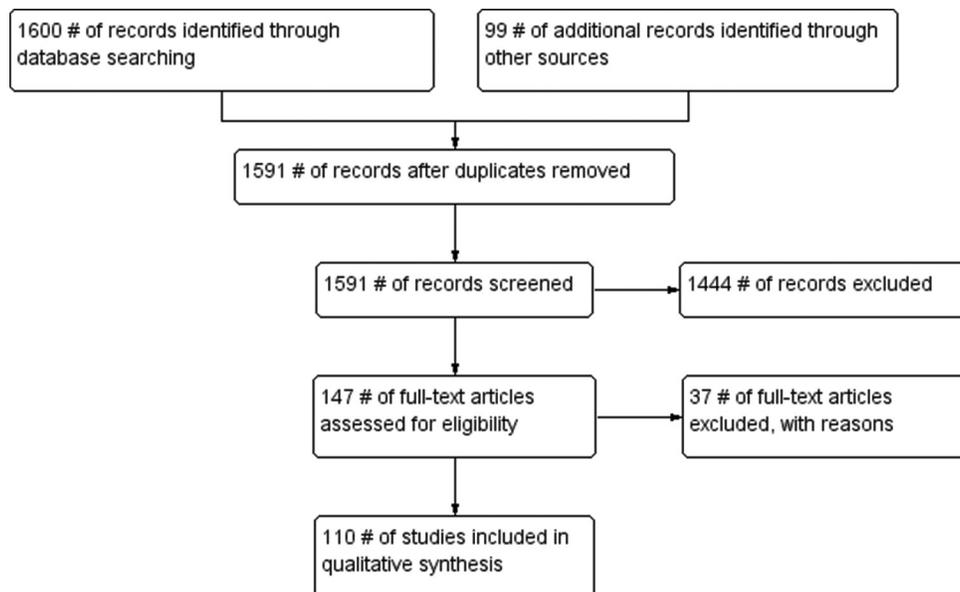


Figure 1: PRISMA flow diagram.

to electroconvulsive therapy (ECT).<sup>[72,110-117]</sup> These details are shown in Supplementary Tables 3 and 4, respectively.

### Domains of memory were included for the review

Registration and recall are the predominant domains highlighted in the review. The details assessed in various studies included fluency, planning and perseveration, inattention, sustained attention and vigilance, declarative memory, immediate and delayed verbal memory performance, memory for complex shapes, WM, visual delayed recall, rapid visual information processing, verbal memory, attention and concentration, recent memory, language, visual-constructional ability, orientation, calculation, semantic fluency, logical memory, verbal learning, verbal IQ, auditory tone matching, phonological awareness (non-word) reading fluency, verbal memory, working semantic fluency, letter fluency, verbal fluency language, calculation, WM, attention, and short-term memory. Commonly used tests were reported at various studies<sup>[110-64]</sup> and are shown in Supplementary Table 1.

### Highlights of the common tests used in psychiatry in the past 5 years

We reviewed the commonly used neuropsychological tests for memory assessments<sup>[65-81]</sup> that are being summarized in Table 1, whereas bedside clinical scales included MMSE, Delta MSE, Baylor profound MSE, Montreal cognitive assessment (MoCA), and cognitive failure questionnaire. These tests simulate the situations of daily-life activities targeting specific events and would require a recall of specific details in the encoding context. It appears necessary to identify flaws during the various stages of information encoding, consolidation, and retrieval.

Whereas the subjective reporting of memory difficulties in many patients could be assessed using the Squire subjective memory questionnaire (SSMQ), Memory Assessment Clinic Questionnaire (MAC-Q), memory items from the Comprehensive Psychiatric Rating Scale (CPRS), and subjective memory complaint (SMC) scale. These tests are important as the disparity between subjective and objective memory is common in psychiatric disorders.

In recent years, automated tests have been used widely for research, also known as computerized battery, which includes a variety of assessments of neurocognitive functions and processes such as psychomotor and motor speed, reasoning, and planning abilities, memory and attention, and frontal, temporal, and hippocampal dysfunctions are available. They predominantly include Cambridge Automated Neuropsychological Test Battery, THINC-integrated tool, and Pennsylvania computerized neurocognitive tests, which are being widely employed for research across

the disciplines of medicine, psychiatry, rehabilitation, and neurology. Uniformity across the subjects, optimum duration (40–45 min), language independence, standardized nature, and gender neutrality are the core features of these tests. Number of studies in the past five years, assessing the memory deficits in psychiatric disorders are shown in Supplementary Figure 1.

## DISCUSSION

The findings of this review reinforce the growing number of studies on the assessment of memory deficits in dementia and MCI followed by schizophrenia. The development in the field of neuropsychology using automated tests for dementia is rapidly growing and has also been replicated in primary psychiatric disorders such as schizophrenia in the past five years. A significant number of studies were reported from the West as compared to the East (more from Europe and USA followed by Japan and Korea). Both, treated as well as untreated, patients with schizophrenia frequently experience difficulties in cognitive domains that contribute toward overall dysfunction<sup>[118,119]</sup> and brief assessment of cognition in schizophrenia, Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS), trail making test part A and B (TMT-A and TMT-B), and Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) are the most commonly used assessment methods in the past 5 years. They can capture the most commonly established memory deficits such as WM and verbal and visual memory deficits in an active phase of illness as well as during remission. Most of the studies reported in this review are from the developed world and recognize the impact of assessing memory deficits on functioning, quality of life, treatment adherence, and a prolonged period of recovery.<sup>[54]</sup> The highlights of the specific type of memory deficits in psychiatric disorders are shown in Table 2.

Studies on common mental disorders such as mood disorders, anxiety disorders, and PTSD have reported deficits in WM and episodic memory using tests such as TMT-A and TMT-B, Stroop test, Stroop color test, and Stroop color-word test, Wechsler's memory scale, spatial WM (SWM) test, California verbal learning test, Rey Auditory Verbal Learning Test and Continuous Performance Test. Mechanism of stress-induced reversibility of amnesia in dissociative disorders, pseudo dementia in depressive disorders, and flashbulb memory of PTSD requires uniform assessment methods as highlighted in this review.<sup>[120]</sup> The neurobiological explanation is beyond the scope of this review. Patients undergoing ECT also report memory impairment in areas of short-term and autobiographical memory and MMSE, B4ECT-ReCoDe, delta-MMSE (d-MMSE), Squire SMC, autobiographical memory inventory, and CPRS are commonly used assessment methods in this regard. SMCs, WM impairment, and short-

**Table 1:** Description of commonly used tests in psychiatric disorders with memory impairments.

Heading 1	Heading 2
TMT-A and TMT-B	This is one of the most popular neuropsychological tests and is included in most test batteries. The TMT provides information on visual search and working memory along with scanning, speed of processing, mental flexibility, and executive functions. This test can be administered within the age range of 8–79 years, 11 months and it takes 5–15 min to administer.
WMS	This is a neuropsychological test designed to measure different memory functions in a person. Anyone aged 16–90 years is eligible to take this test. The current version is the fourth edition (WMS-IV) which was published in 2009 and was designed to be used with the WAIS-IV. A person's performance is reported as five index scores: Auditory memory, visual memory, visual working memory, immediate memory, and delayed memory. WMS requires 45–60 min for administration.
RAVLT	The RAVLT is a neuropsychological tool used to assess cognitive functions such as attention, verbal learning, and short-term memory.
CVLT	This is a comprehensive, detailed assessment of verbal learning, and memory deficits in older adolescents and adults. Anyone aged 16–89 years is eligible to take this test. This test takes 30 min for the administration.
RBANS	This test was developed for the dual purposes of identifying and characterizing abnormal cognitive decline in older adults and as a neuropsychological screening battery for younger patients. The entire battery takes <30 min to administer and yields scaled scores for five cognitive domains.
BACS	This is a newly developed instrument that assesses the aspects of cognition found to be most impaired and most strongly correlated with outcomes in patients with schizophrenia. The BACS requires <35 min to complete in patients with schizophrenia.
AMI	This is a semi-structured interview designed to assess memory for autobiographical information, impairment of which is often indicative of retrograde amnesia (inability to recall previously learned information or past events) and potentially associated with a variety of neurological and psychiatric disorders.
HVLT-R	This test was used to assess acquisition and delayed recall. A new test for verbal learning and memory, the test consists of three trials of free-recall of a 12-item. The performance of patients with Alzheimer's disease and chronic amnesia is described. The test is likely to be useful in patients too impaired for more comprehensive memory assessments and where repeated testing is necessary.
MoCA	This is a test used by healthcare providers to evaluate people with memory loss or other symptoms of cognitive decline. It can help identify those at risk for developing Alzheimer's disease and other forms of dementia. It is also used as a screening tool for conditions such as Parkinson's disease, brain tumors, substance abuse, and head trauma. The MoCA contains 30 questions and takes around 10–12 min to complete. It is a useful screening test, but it needs to be considered alongside the results of other tests to confirm a diagnosis.
ROCF test	This test is a commonly used neuropsychological assessment tool. It is widely used to assess the visuoconstructional ability and visual memory of neuropsychiatric disorders, including copying and recall tests. By drawing the complex figure, the functional decline of a patient in multiple cognitive dimensions can be assessed, including attention and concentration, fine-motor coordination, visuospatial perception, non-verbal memory, planning and organization, and spatial orientation.
MCCB	This recently developed tool measures cognition in individuals diagnosed with schizophrenia and related disorders. The test can be administered to an individual with the age range: of 20–59 years and it takes time 60–90 min for the administration. Consists of ten individually administered tests that measure cognitive performance in seven domains: speed of processing, attention/vigilance, working memory, verbal learning, visual learning, reasoning, problem-solving, and social cognition.

BACS: Brief assessment of cognition in schizophrenia, TMT: Trail making test, MATRICS: Measurement and treatment research to improve cognition in schizophrenia, HVLT-R: Hopkins verbal learning test-revised, CVLT: California verbal learning test, WMS: Wechsler memory scale, RAVLT: Rey auditory verbal learning test, MoCA: Montreal cognitive assessment, WAIS-IV: Wechsler adults intelligence scale-IV, MCCB: MATRICS consensus cognitive battery, ROCF: Rey–Osterrieth complex figure, AMI: Autobiographical memory interview, RBANS: Repeatable battery for the assessment of neuropsychological status

term problems are frequently reported problems in patients with MCI and dementia. In these patients, MMSE, MoCA, tests related to SMCs, Consortium to Establish a Registry for Alzheimer's Disease, neuropsychological comprehensive batteries, Wechsler's memory scale, etc., are used for assessment of these problems. This information gives a fair idea to establish stable deficits (depression, schizophrenia,

PTSD, and personality), progressive deficits (MCI, dementia, and ECT-induced) or track the improvement by choosing the set of tests for particular disorders.

Because most of the studies are cross-sectional, the consistency of measurement being tested and tests applied should be replicated among longitudinal and interventional studies.

**Table 2:** Commonly used assessments for affected domain of memory in various psychiatric disorders, MCI and post-ECT assessments.

S. No.	Disorder/clinical condition	Commonly affected domain	Assessments
1.	Schizophrenia	Working memory, processing speed, verbal learning memory, and visual learning memory	BACS, MATRICS battery, TMT-A and TMT-B, RBANS, HVLIT, and CVLT
2.	Mood disorder	Episodic memory – (particularly poor memory for positive events), working memory.	TMT-A and TMT-B, Stroop test, SCT, SCWT, WMS spatial working memory test, CVLT, RAVLT, continuous performance test, and BVMT
3.	Anxiety disorders	Working memory, registration, and recall, declarative memory particularly in PTSD	SCWT, CFQ, Digit span test, TMT, and WMS
4.	Alcohol dependence	Autobiographical memory and working memory	CANTAB, MoCA, working memory – WAIS-IV, Digit Span test, MMSE, etc.
5.	MCI	SMCs, working memory, and short-term memory	MMSE, MoCA, Tests related to SMCs, CERAD, WMS, etc.
6.	ECT-related memory problems	Short-term memory and autobiographical memory	MMSE, B4ECT-ReCoDe, delta-MMSE, Squire SMC, AMC, and m-CPRS

BACS: Brief assessment of cognition in schizophrenia, BVMT: Brief visuospatial memory test, CANTAB: Cambridge neuropsychological test automated battery, CERAD-NP: Consortium to establish a register for Alzheimer's disease-neuropsychological test battery, CVLT: California verbal learning test, CPRS: Comprehensive psychopathology rating scale, ECT: Electroconvulsive therapy, HVLIT: Hopkins verbal learning test, MATRICS: Measurement and treatment research to improve cognition in schizophrenia, MCI: Mild cognitive impairment, MMSE: Mini-mental state examination, MoCA: Montreal cognitive assessment, TMT-A and TMT-B: Trail making test part A and B, RAVLT: Rey auditory verbal learning test, RBANS: Repeatable battery for the assessment of neuropsychological status, WMS: Wechsler memory scale, WAIS-IV: Wechsler adults intelligence scale-IV, SCT: Stroop color test, SCWT: Stroop color-word test, CFQ: Cognitive failures questionnaire, PTSD: Post-traumatic stress disorder, SMC: Subjective memory complaint

The widely used MMSE provides tentative estimates about a delayed recall given the lesser time between registration and recall while Addenbrooke's cognitive assessment is one such test to complement the MMSE in resource-prone countries. Most of the selected studies have used a battery of tests for assessments of more than one cognitive function including processing speed, response inhibition, set shifting, and cognitive flexibility; however, this review focused only on the memory deficits in psychiatric disorders, the discussion of other executive functions is beyond the scope of this review.

Further, illiterate patients, patients with dementia, MCI,<sup>[121]</sup> and patients undergoing ECT frequently present with SMCs, and for them, it is important to use a subjective memory questionnaire periodically to quantify the memory deficits which have been validated as any other standard objective assessment tool.<sup>[122-124]</sup> The review findings emphasize the regular use of bedside objective measures such as MMSE, HMSE, MoCA, and d-MMSE in suspected subjects with psychiatric illnesses to track the trajectory toward recovery. At the same time, it is recommended to support with the most commonly used subset of neuropsychological tests. The B4ECT-ReCoDe is one such tool developed in India that informs us of differential memory deficits caused by unilateral ECT, ultra-brief pulse ECT, and bifrontal ECT.<sup>[124]</sup>

In the end, the review brings the latest developments in the past 5 years in terms of the assessment of memory deficits in psychiatric disorders. This review helps the clinician to

overcome the difficulties faced during the evaluation of memory deficits and revisit the knowledge to help themselves in medicolegal situations. One-stop availability of these methods of assessment makes it easy for researchers to acknowledge the current updates in the field of neuropsychology in psychiatric disorders including other mood disorders and psychotic disorders.<sup>[118]</sup> An upcoming self-administered or mobile device-based application to assess memory deficits could also provide good reliability and validity. A more detailed account of such validation should reach universal acceptance and prioritize future research. Although the memory deficits are subtle and transient, they play an important role in the maintenance of the pathological process, relapse, and become a barrier to functional recovery unless assessed on the given tools with adequate address for further recovery.<sup>[8]</sup> We emphasize the use of these tests routinely to complement the history and MSE findings while understanding their limitations.<sup>[125]</sup> In addition, protocols should be developed for recognizing the importance of functional neuroimaging to supplement the findings of the tests. For more than a decade of research on cognitive deficits in psychiatric disorders specifically schizophrenia, still no consensus/agreement helped to inform the diagnostic systems in psychiatry.<sup>[126]</sup>

### Translational implications

Understanding different domains of memory and their assessment is important for physicians, who often need to

assess WM in children, adults, and the elderly. Apart from organic causes of memory deficits, such as MCI and dementia, the slow deterioration of memory is evident in severe mental illnesses. Clinicians should be able to identify and recognize the signs of WM deficits in persons with mental health conditions, while psychiatrists should be aware of how to plan the assessments and treatment. While these approaches translate the clinical practice, we recognize the importance of developing neuroprotective pharmacotherapeutic agents that could help in improving cognition in psychiatry. To facilitate the understanding and ease the complexity, medical education is also required to emphasize the concepts of different types of memory, such as episodic, semantic, short-term, long-term, and autobiographical, and integrate them horizontally and vertically in the curriculum while residential courses in psychiatry are required to take up such assessments periodically to better translate their knowledge in practice. Although the specificity of memory deficits is not clear, clinical assessment could still find the patterns of deficits in certain phenotypes that can aid the diagnostic system in psychiatry.

#### Limitations of the study

The review is targeted to identify only memory deficits and not whole neurocognitive deficits encountered among psychiatric disorders because it is one of the most common subjective complaints reported by patients and these deficits are not commonly addressed. We also included the memory deficits encountered in dementia and MCI as these patients frequently encounter psychiatric services. The included selective memory deficits in the review could give us great insight into behavioral management and the tests used for them.

#### CONCLUSION

The review brings the latest developments in the past five years in terms of the assessment of memory deficits in psychiatric disorders. This review helps the clinician to overcome the difficulties faced during the evaluation of memory deficits and revisit the knowledge to help themselves in medicolegal situations. An upcoming self-administered or mobile device-based application to assess memory deficits could be a future alternative to provide reliable estimates. A more detailed account of such validation should reach universal acceptance and prioritize future research. In addition, protocols should be developed for recognizing the importance of functional neuroimaging to supplement the findings of the tests and they should be encouraged to become a part of the formal diagnostic and prognostic systems in psychiatry.

#### Authors' contributions

The contributions of each author should be described. RS: Conceptualization, investigation, writing-original draft, and

writing-review and editing. AK: Investigation, writing-original draft, and writing-review and editing. DB: Validation, writing-review and editing, and supervision. All authors read and approved the submitted version.

#### Ethical approval

The Institutional Review Board approval is not required.

#### Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

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#### Conflicts of interest

There are no conflicts of interest.

#### Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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