Evaluation of Available Cognitive Tools Used to Measure Mild Cognitive Decline: A Scoping Review

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Abstract: Cognitive decline is a broad syndrome ranging from non-pathological/age-associated cognitive decline to pathological dementia. Mild cognitive impairment (MCI) is defined as the stage of cognition that falls between normal ageing and dementia. Studies have found that early lifestyle interventions for MCI may delay its pathological progression. Hence, this review aims to determine the most efficient cognitive tools to discriminate mild cognitive decline in its early stages. After a systematic search of five online databases, a total of 52 different cognitive tools were identified. The performance of each tool was assessed by its psychometric properties, administration time and delivery method. The Montreal Cognitive Assessment (MoCA, \( n = 15 \)), the Mini-Mental State Examination (MMSE, \( n = 14 \)) and the Clock Drawing Test (CDT, \( n = 4 \)) were most frequently cited in the literature. The preferable tools with all-round performance are the Six-item Cognitive Impairment Test (6CIT), MoCA (with the cut-offs of \( \leq 24/22/19/15.5 \)), MMSE (with the cut-off of \( \leq 26 \)) and the Hong Kong Brief Cognitive Test (HKBC). In addition, SAGE is recommended for a self-completed survey setting whilst a 4-point CDT is quick and easy to be added into other cognitive assessments. However, most tools were affected by age and education levels. Furthermore, optimal cut-off points need to be cautiously chosen while screening for MCI among different populations.

Keywords: dementia; mild cognitive decline; cognitive decline; mild cognitive impairment; neuropsychological tests; neuropsychological battery; cognitive screening tool; cognition; older adults

1. Introduction

Dementia is currently recognised as a global health priority, and is one of the major causes of disability amongst older adults [1,2]. Globally, there are 50 million people diagnosed with dementia, with a disease burden of AUD 1.4 trillion annually [1,2]. As the population continues to age, the worldwide prevalence of dementia is predicted to triple to 152 million people within the next three decades [3]. This will result in further costs for governments, communities, families and individuals. In addition, the medical, psychological and emotional impact on those with dementia and to caregivers/families is significant and detrimentally affects their quality of life [1].

Cognitive decline is a broad syndrome ranging from non-pathological/age-associated cognitive decline to pathological mild cognitive impairment, and further progression to dementia [4]. Mild cognitive impairment (MCI) is a term used to identify the stage of cognition that falls between normal ageing and dementia, defined as slight but measurable cognitive decline without the loss of functional ability [5–7]. Therefore, cognitive decline is recognised to occur through a mild and subtle manner onto a more comprehensive presentation; and its changes form a continuum [4]. Different from dementia, people with MCI can perform daily living activities independently with minimal aids or assistance [5].
Its onset is evident since middle age (age 45 to 49), but the failure to detect subtle cognitive changes has resulted in the delay of care among 27–81% of affected patients [8–10]. Detection can be unpredictable because each individual experiences different rates of decline [4]. In addition, research indicates that MCI is associated with heightened risk of progression to dementia as compared to individuals with more normal cognition [11].

Due to the poor prognosis implications, early detection of subtle cognitive changes is beneficial for practitioners to identify possible treatable causes or provide appropriate interventions. Currently, the clinical diagnosis of MCI is mainly determined by a physician’s best judgement [12,13]. Clinical characterisation methods including the Clinical Dementia Rating (CDR) scale, Petersen’s Criteria and the National Institute on Ageing-Alzheimer’s Association (NIA-AA) Criteria are frequently used in combination with laboratory and neurological tests to diagnose MCI [7]. These tests need to be administered by trained physicians and require extensive amounts of time. Hence, various brief cognitive tools have been introduced to detect cognitive decline as first-line screening methods [14]. A structured screening tool is required to be brief, easy to administer, have good psychometric properties, generalisable in elderly populations, and preferably able to be self-administered or conducted by non-health care professionals [14]. Many studies had evaluated and validated the dementia screening tests; however, there is limited research on MCI screening tools specifically. The most recent systematic review suggested that the Montreal Cognitive Assessment (MoCA) is the preferred tool for screening MCI in the primary care setting [14]. However, only a limited number of studies (14 articles) were included in this review [14]. There is also a lack of knowledge regarding the generalisability and usability of the tools in other settings and/or populations [14].

Disease-modifying therapy (DMT) for cognitive decline is currently a prioritised global research area to manage the rise in prevalence of cognitive decline and associated costs to society [15]. It is clear from clinical trials that there is a lack of pharmacological agents which are able to treat the underlying cause(s) or slow down the rate of cognitive decline [5]. Primarily, these pharmacological agents can only manage the symptoms by temporarily ameliorating memory and cognitive problems [5]. Hence, the emphasis of research has shifted to utilising lifestyle modifications as prevention or early treatment approaches. Several studies have shown a relationship between the development of cognitive decline and lifestyle-related risk factors [16]. Therefore, World Health Organisation guidelines recommend stakeholders to target modifiable lifestyle factors including improved nutrition and diet to diminish the risk [3,16]. This is supported by a recent systematic review which demonstrated that the modification of diet quality is a promising, yet long-term (more than 6 months) preventive measure to limit the progression of cognitive decline [17]. Even so, the lack of knowledge regarding the type and properties of cognitive tools remains one of the biggest barriers in research because the large range of tools used in studies makes comparison between studies difficult [17]. It is recommended that improved knowledge in the properties of cognitive assessment would help to elucidate the effectiveness of diet and nutrition in cognitive decline [17].

Therefore, the demand for easily administered, sensitive, specific and reliable cognitive tools to identify the early stages of subtle cognitive decline is high for several reasons. Firstly, identifying these tools can assist future researchers with selecting appropriate tools for the study design, and strengthen the ability to assess the effectiveness of interventions (both lifestyle and pharmacological) on the progression of cognitive impairment [18]. Secondly, health care practitioners can select these tools to assess an individual’s cognition and detect abnormal cognitive changes earlier, thus resulting in earlier intervention and improved patient outcomes [18].

In this study, we aimed to catalogue and assess the tools used to evaluate mild cognitive impairment and decline among healthy elderly populations. To achieve this, we considered multiple factors of the cognitive tools, including their psychometric performance and generalisability in different settings and/or populations. A scoping review
instead of systematic review was chosen in order to include all the relevant information available and tools cited in the literature and to identify any gaps for future studies.

2. Materials and Methods

2.1. Protocol and Registration

This protocol was developed using the methodological framework for scoping reviews proposed by Arksey and O’Malley (2005) [19] and further refined by using the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist [20]. The protocol for this review was registered with the Open Science Framework: https://osf.io/tb3gc/ (accessed in 1 June 2020).

2.2. Eligibility Criteria

To be included in this review, papers need to be focused on the evaluation of screening and/or diagnostic performance of cognitive tools used to measure mild cognitive decline. Peer-reviewed journal papers were included if they were: in English language, assessed general healthy adult humans (>45 years, without any diagnosed health conditions or diseases) and evaluated the psychometric performance (i.e., specificity, sensitivity, validity, reliability) of cognitive tools. All quantitative study designs were eligible for inclusion. However, reviews and grey literature were excluded. Papers were excluded if they did not meet the above specified criteria or they focused on interventions rather than performance of cognitive tools. Tools that are not easily administered or are invasive (such as imaging tools or biomarkers) were also excluded. Moreover, papers published before 2015 were excluded to provide an up-to-date review on current literature. All papers had to be easily available to the research team at the time of the study, as time was limited due to the nature of the embedded honours program of the principal researcher.

2.3. Information Sources and Search

Comprehensive literature searches for potentially relevant articles up until April 2020 were conducted in the following online databases: CINAHL (Ebsco), MEDLINE (Ovid), EMBASE (Ovid), PsycINFO (Ovid) and Cochrane. The search strategies were developed with the assistance of an experienced research librarian. The search strategy contained population, intervention and outcome terms. Searches were limited to adults aged 45 years and above as this is the age range in which mild cognitive decline presents [9]. The articles with publication dates before 2015 were excluded to provide an up-to-date review. The final search strategy for MEDLINE can be found in Supplementary Table S1. Similar search strategies were used while conducting searches in other identified databases. The final search results were exported into the EndNote X9 [21] referencing software. After removing the duplicates, the results were uploaded onto the online systematic review management system Covidence [22] for article screening purpose.

2.4. Selection of Sources of Evidence

After removing duplicates from EndNote X9 [21] and Covidence [22], 32,681 publications were available for screening (Figure 1). Prior to screening, 3 reviewers (CTC, KS and AM) conducted screening trials and discussions on two occasions to increase consistency among reviewers. During the screening trials, CTC, KS and AM double screened 10 articles independently before discussions. After the mutual agreement of screening trial results, abstracts and titles of potentially relevant articles were single screened by CTC, KS or AM in Covidence [22]. Full-text screening and discussions as above were conducted again prior to data extraction. Relevant full-text articles (n = 444) were single screened by CTC, KS or AM against the inclusion criteria, with the reason for exclusion recorded. All included full-text papers (n = 49) underwent data extraction.
2.5. Data Charting Process and Data Items

CTC designed a standardised data-charting form (a customised spreadsheet) under supervision to chart data from eligible studies and to determine the appropriate variables to extract. The included variables in the spreadsheet were study characteristics (author, year, country of origin), characteristics of tools (name of the tool, the version of tool, range of the scores/points, cut-off point to detect mild cognitive decline, administration method and the duration of administration), study design, study population (age, %female, education level), settings, the psychometric performance of tools (including sensitivity, specificity, reliability and validity in detecting mild cognitive decline), factors that may affect the performance of the cognitive tool and the comparison standard(s) in the validation studies.

CTC charted the data in the data charting form under supervision. LMW checked the extracted data. AM hand-search the information if there was missing data in the spreadsheet. KS double-checked 10% of the extracted data. Reviewers iteratively updated the data-charting form before synthesising the results.

2.6. Synthesis of Results

By using the standardised data-charting form, all results were summarised and synthesised after discussions with all reviewers. By using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flowchart, reviewers documented the screening methods and recorded the quantity of included and excluded studies in
this review (Figure 1). Additionally, by using the coding system, reviewers counted the frequency that each tool cited in included papers to catalogue which tool had the most frequent research done on its performance.

Regarding the psychometric properties, validity was charted as the Sensitivity (Sn), Specificity (Sp), Area Under the Curve (AUC), Positive Predictive Value (PPV) and Negative Predictive Value (NPV). Sn is the ability of a tool to correctly classify an individual as having ‘mild cognitive decline’, whereas Sp is the ability of a tool to correctly classify an individual as ‘without mild cognitive decline’ [23]. AUC is an overall measurement of validity performance of a screening/diagnostic test [13]. PPV is the percentage of patients with a positive test who actually have ‘mild cognitive decline’; whereas NPV is the percentage of patients with a negative test who actually do not have ‘mild cognitive decline’ [23]. All the above properties were charted as percentages, with the closeness to 100% being higher respective validity. Reliability of a tool was identified based on its performance on all reliability tests used in the included studies. Interpretation of the above properties is presented in Table 1. By referencing with other validity studies, reviewers interpreted the psychometric properties based on the criteria developed by researchers’ consensus [13,24]. To be classed as good, the cognitive tool has to achieve the below criteria: good to excellent validity, good reliability, short administration time of ≤15 min whilst being able to be self-administered or conducted by non-health care professionals [14]. Hence, reviewers assessed the performance of cognitive tools using the above appraisal format.

Table 1. Validity criteria for cognitive tools.

| Criteria * | Interpretation | Range (%) |
|------------|----------------|-----------|
| Sn and Sp  | Excellent      | 91–100    |
|            | Good           | 76–90     |
|            | Fair           | 50–75     |
|            | Poor           | <50       |
| AUC        | Excellent      | 91–100    |
|            | Good           | 81–90     |
|            | Fair           | 71–80     |
|            | Poor           | <70       |
| PPV and NPV| Excellent      | 91–100    |
|            | Good           | 76–90     |
|            | Fair           | 50–75     |
|            | Poor           | <50       |

* The criteria for Sn, Sp, PPV and NPV were decided based on researchers’ consensus. The criterion for AUC was adapted from Safari S et al. [13].

Lastly, a narrative synthesis of results was developed to assess and evaluate the characteristics and psychometric properties of each of the identified cognitive tools based on the data charting form and the criteria (Table 1).

3. Results

3.1. Study Selection

In total, 46,015 articles published in the five-year period (2015 to April 2020) were retrieved. After removing duplicate articles, 32,681 articles were screened in Covidence [22], with another 395 articles excluded due to inappropriate outcomes (n = 137), inappropriate study purpose (n = 104), inappropriate population (n = 84), papers which were unable to be retrieved (n = 25), not tools of interest (n = 23), inappropriate study design (n = 17) and duplicated articles (n = 5). After evaluating the full text, 49 articles met inclusion criteria and were included in this review.

3.2. Study Characteristics

Key characteristics of the 49 included articles can be found in Table 2. Considerable variations were found between studies for country, participant’s characteristics, studied cognitive tools and their comparison standard(s). The majority of studies were conducted
in Asian countries \( (n = 17) \) [25–41], followed by European countries \( (n = 13) \) [42–54] and the United States \( (n = 7) \) [55–61]. The remaining studies came from Brazil \( (n = 3) \) [62–64], Australia \( (n = 2) \) [65,66], Greece \( (n = 2) \) [67,68], Argentina \( (n = 1) \) [69], unclear origin \( (n = 2) \) [70,71], Cuba \( (n = 1) \) [72] and Turkey \( (n = 1) \) [73]. In terms of study design, most included articles were cross-sectional \( (n = 33) \) [25–29,31,32,34,35,37–47,49,53,54,63,65–73] and cohort studies \( (n = 14) \) [30,33,36,48,50–52,55–58,61,62,64]. The characteristics for participants in each study were similar, with the age ranging from 50 to 95 years and the proportion of females ranging from 33 to 87%. Participants with low, average and high levels of education were included. To evaluate the psychometric performance of tools, studies used various validated comparison standards including the Clinical Dementia Rating (CDR) [26,32,56,65], the Mini-Mental State Examination (MMSE) [25,42,45,46,49], Petersen’s criteria [29,36,53,57,64,71,73], National Institute on Ageing-Alzheimer’s Association (NIA-AA) criteria [40,44,47,50,70], brief cognitive tests [59,67], clinical consensus by health professionals [61], Magnetic Resonance Imaging (MRI) scans, Diagnostic and Statistical Manual of Mental Disorders criteria (DSM) [27], other methods [51,60,63,68,72], or a combination of the above standards [28,30,31,33–35,37–39,41,43,48,52,55,56,62,66,69,72] to classify participants as ‘mild cognitive decline’ or ‘without mild cognitive decline’.

3.3. Cognitive Tools for Mild Cognitive Decline

A total of 52 different cognitive tools used to detect cognitive decline were catalogued and assessed in this review (Table 3). The Montreal Cognitive Assessment (MoCA) \( (n = 15) \) [26–29,31,32,34,36,44,49,56,61,63,65,73] and MMSE \( (n = 14) \) [26–29,32,34,36,40,50,53,57,66,72,73] followed by the Clock Drawing Test (CDT) \( (n = 4) \) [47,50,51,54] were most frequently cited in the literature. The other 49 tools were only studied in a limited number of articles (1 to 2 studies each). All of the tools were studied in clinical context and were applied in primary care and/or community settings. Most of the tools need to be administered by health care professionals \( (n = 14) \) [28,32,35,36,38,46,47,49,54,58,59,62–65,67,72,73] or trained personnel \( (n = 12) \) [26,31,33,39–41,44,53,65,68,70,72]. The remaining tools can be conducted by untrained examiners \( (n = 6) \) [27,29,42,45,51] or self-administered \( (n = 6) \) [30,43,53,58,60,62]. Among the self-administered tools, the Hong Kong–Vigilance and Memory Test (HK-VMT) [30] and the Self-Administered GeroCognitive Examination (SAGE) [60] can be administered via electronic devices.

3.4. Psychometric Performance of Included Cognitive Tools

Table 4 collates the available version(s), cut-off point(s), and psychometric performance (validity and reliability), factors which affect the performance and the administration time of the cognitive tools. Table 5 summarises all the data for the performance of the cognitive tools compared with the pre-identified criteria on the tools overall performance. Based on the researchers’ appraisal, there are several cognitive tools that achieved the status of good cognitive tool, including the Six-item Cognitive Impairment Test (6CIT), MoCA (with the cut-offs of \( \leq 24/22/19/15.5 \)), MMSE (with the cut-off of \( \leq 26 \)) and the Hong Kong Brief Cognitive Test (HKBC).
| No. | Authors, Year, Country | Study Design | Participants Characteristics | Cognitive Tool | Comparison Standard |
|-----|-------------------------|--------------|------------------------------|----------------|---------------------|
| 1   | Apostolo JLA et al., 2018, Portugal [42] | Cross-sectional | Age (Mean ± SD or Range): 67.7 ± 9.7 | % Female: 70.4 | 6CIT MMSE |
| 2   | Avila-Villanueva M et al., 2016, Spain [43] | Cross-sectional | Age (Mean ± SD or Range): 74.07 ± 3.8 | % Female: 63 | EMQ CDR, NIA-AA criteria |
| 3   | Baerresen KM et al., 2015, US [55] | Cohort | Age (Mean ± SD or Range): 60.84 ± 10.76 | % Female: 60 | BSRT, RCFT, TMT Rigorous diagnostic methods: MRI scan, clinical consensus of neurology, geriatric psychiatry, neuropsychology and radiology staff |
| 4   | Bartos A et al., 2018, Czech Republic [44] | Cross-sectional | Age (Mean ± SD or Range): 70 ± 8 | % Female: 59 | MoCA NIA-AA criteria |
| 5   | Bouman Z et al., 2015, Netherlands [45] | Cross-sectional | Age (Mean ± SD or Range): 76.6 ± 5.9 | % Female: ~66 | BCSE MMSE |
| 6   | Broche-Perez Y et al., 2018, Cuba [72] | Cross-sectional | Age (Mean ± SD or Range): 73.28 ± 7.16 | % Female: ~67 | ACE, MMSE Petersen’s criteria, CDR |
| 7   | Charemboom T, 2019, Thailand [25] | Cross-sectional | Age (Mean ± SD or Range): 64.9 ± 6.5 | % Female: 76.7 | ACE Thai version of MMSE |
| 8   | Chen K-L et al., 2016, China [26] | Cross-sectional | Age (Mean ± SD or Range): 68.2 ± 9.1 | % Female: ~66 | MMSE, MoCA CDR |
| 9   | Chipi E et al., 2017, Italy [46] | Cross-sectional | Age (Mean ± SD or Range): 70.9 ± 5.1 | % Female: 61.2 | CFI MMSE |
| 10  | Chiu HF et al., 2017, Hong Kong [27] | Cross-sectional | Age (Mean ± SD or Range): 75.4 ± 6.6 | % Female: 56.6 | HKBC, MoCA, MMSE DSM-5 |
| 11  | Chiu P et al., 2019, Taiwan [33] | Cross-sectional | Age (Mean ± SD or Range): 67.8 ± 10.7 | % Female: 47.2 | MMSE, NMD-12, MoCA, IADL, AD8, CASI, NPI NIA-AA criteria, CDR |
| 12  | Chu L et al., 2015, Hong Kong [29] | Cross-sectional | Age (Mean ± SD or Range): 72.2 ± 6.1 | % Female: 87 | MMSE Petersen’s criteria |
| 13  | Clarinette R et al., 2016, Australia [65] | Cross-sectional | Age (Mean ± SD or Range): 50-95 | % Female: 52 | Qmci, MoCA CDR |
| 14  | Damin A et al., 2015, Brazil [62] | Cohort | Age (Mean ± SD or Range): 68.27 ± 7.34 | % Female: N/A | CCQ MMSE, CAMCog, CDR and the brief cognitive screening battery |
| 15  | Duro D et al., 2018, Portugal [47] | Cross-sectional | Age (Mean ± SD or Range): 69.47 ± 8.89 | % Female: 63.5 | CDT NIA-AA criteria |
| 16  | Freedman M et al., 2018 [70] | Cross-sectional | Age (Mean ± SD or Range): 75.3 ± 7.9 | % Female: ~67 | TorCA NIA-AA criteria |
| 17  | Fung AW-T et al., 2018, Hong Kong [30] | Cohort | Age (Mean ± SD or Range): 68.8 ± 6.3 | % Female: 58.4 | HK-VMT Combined clinical and cognitive criteria suitable for local older population, CDR |
| 18  | Georgakis MK et al., 2017, Greece [67] | Cross-sectional | Age (Mean ± SD or Range): 74.3 ± 6.6 | % Female: 51.6 | TICS 5-objects test |
| 19  | Heyanka D et al., 2015 [71] | Cross-sectional | Age (Mean ± SD or Range): 71.5 ± 7.5 | % Female: ~43 | RBANS Petersen’s criteria |
| 20  | Huang L et al., 2018, China [31] | Cross-sectional | Age (Mean ± SD or Range): 65.71 ± 8.10 | % Female: ~56 | RCFT, MoCA, VOSP, BNT, STT, JLO, ST Petersen’s criteria, CDR |
| 21  | Iatraki E et al., 2017, Greece [68] | Cross-sectional | Age (Mean ± SD or Range): 71.0 ± 6.9 | % Female: 64.6 | TYM, GPCog Unclear |
| 22  | Julayanont P et al., 2015, Thailand [52] | Cross-sectional | Age (Mean ± SD or Range): 66.6 ± 6.7 | % Female: 84 | MoCA, MMSE CDR global |
| 23  | Khandiah N et al., 2015, Singapore [33] | Cohort | Age (Mean ± SD or Range): 67.8 ± 8.86 | % Female: 46.1 | VCAT Petersen’s criteria, CDR, NIA-AA criteria |
Table 2. Cont.

| No. | Authors, Year, Country | Study Design | Participants Characteristics | Cognitive Tool | Comparison Standard |
|-----|------------------------|--------------|------------------------------|----------------|---------------------|
|     |                        |              | Age (Mean ± SD or Range) | % Female | Education Years (Mean ± SD or Range) |                      |                      |
| 24  | Phua A et al., 2017, Singapore [34] | Cross-sectional | 66.8 ± 5.5 | 62 | 9.3 ± 4.9 | MoCA, MMSE |                      |
| 25  | Krishnan K et al., 2016, US [56] | Cohort | 58-77 | 64 | 15.2 ± 2.7 | MoCA | DSM-IV, CDR global |
| 26  | Lee S et al., 2016, Australia [66] | Cross-sectional | Median 73 | 53 | Median 14 |                      | CVLT, The Envelope Task, PRMQ, Single-item Memory Scale, MMSE |
| 27  | Lemos R et al., 2016, Portugal [48] | Cohort | 70.22 ± 7.65 | 52.5 | 7.7 ± 5.01 | FCSRT | History, clinical examination, CDR, and a comprehensive neuropsychological battery based on published criteria |
| 28  | Low A et al., 2019, Singapore [35] | Cross-sectional | 61.47 ± 7.19 | 70 | 12.36 ± 3.76 | VCAT | HVLT-R, Logical Memory, Wechsler Memory Scale Third Edition, Verbal Paired Associates, Wechsler Memory Scale Fourth Edition, RCF, CDR, ADECS, NINCDS-ADRD A criteria, MMSE |
| 29  | Malek-Ahmadi M et al., 2015, US [57] | Longitudinal Cohort | 81.70 ± 7.25 | ~48 | 14.74 ± 2.54 | MMSE, AQ, FAQ | MMSE, CDR |
| 30  | Mansbach W et al., 2016, US [58] | Cohort | 82.33 ± 9.15 | 64 | 84% at least 12 years education | BCAT, AD8 | Petersen’s criteria |
| 31  | Mellor D et al., 2016, China [36] | Cohort | 72.54 ± 8.40 | 57.9 | 9.12 ± 4.36 | MoCA, MMSE | Petersen’s criteria |
| 32  | Mitchell J et al., 2015, US [59] | Case-control | 75.9 ± 8.5 | 50.9 | 15.2 ± 2.9 | FAQ, DSRS, CWLT, BADLS | WMS-III Logical Memory test or the CERAD Word List |
| 33  | Ni J et al., 2015, China [37] | Cross-sectional | 62.57 ± 8.61 | ~59 | 12.04 ± 3.34 | DSR | History and physical exams, MMSE, story recall (immediate and 30 min delayed), CDR, ADL, MoCA-K, MMSE-K, neuropsychological battery (Rey Auditory Verbal Learning Test and Delayed Visual Reproduction and Logical Memory, two subtests of the Wechsler Memory Scale) |
| 34  | Park J et al., 2018, South Korea [38] | Cross-sectional | 74.93 ± 6.96 | 56.3 | 5.83 ± 4.52 | mSTS-MCI | Petersen’s criteria |
| 35  | Pinto T et al., 2019, Brazil [63] | Cross-sectional | 73.9 ± 6.2 | 76.4 | 10.9 ± 4.4 | MoCA | Statistically compared |
| 36  | Pirrotta F et al., 2014, Italy [49] | Cross-sectional | 70.5 ± 11.5 | 58.2 | 8.1 ± 4.6 | MoCA | Petersen’s criteria |
| 37  | Radanovc M et al., 2017, Brazil [64] | Cohort | ~68.7 ± 5.85 | ~79 | ~10.35 ± 2.45 | CAMCog | Petersen’s criteria |
| 38  | Rakusa M et al., 2018, Slovenia [30] | Cohort | Median 74 | N/A | 65% Secondary school, 23% University, 12% Primary School | MMSE, CDT | NIA-AA criteria |
| 39  | Ricci M et al., 2016, Italy [51] | Cohort | 73.3 ± 6.9 | N/A | 7.2 ± 4.2 | CDT | NINCDS-ADRD A criteria |
| 40  | Roman F et al., 2016, Argentina [69] | Cross-sectional | 67.5 ± 8.3 | N/A | 11.5 ± 4.1 | MBT | Spanish Version of MMSE, CDT, Signoreet Verbal Memory Battery, TMT, VE, Spanish Version of BNT, and the Digit Span forward and backward |
| 41  | Scharre D et al., 2017, US [60] | Investigational | 75.2 ± 7.3 | 67 | 15.1 ± 2.7 | SAGE | Unclear |
| 42  | Serna A et al., 2015, Spain [52] | Cohort | 78.10 ± 5.04 | 59.3 | 64.2% illiteracy/read and write, 35.8% primary/secondary or higher | Semantic Fluency/VF, Logical Memory | International Work Group criteria, MMSE |
| 43  | Townley R et al., 2019, US [61] | Cohort | ~72.4 ± 8.95 | 47-51 | ~15.05 ± 2.65 | STMS, MoCA | Clinical consensus |
Table 2. Cont.

| No. | Authors, Year, Country | Study Design | Participants Characteristics | Cognitive Tool | Comparison Standard |
|-----|------------------------|--------------|------------------------------|----------------|---------------------|
| 44  | Van de Zande E et al., 2017, Netherlands [53] | Cross-sectional | Age (Mean ± SD or Range) 73.05 ± 8.62 % Female -52 Education Years (Mean ± SD or Range) 10.34 ± 3.66 | MMSE, TYM | Petersen’s criteria |
| 45  | Vyhnálek M et al., 2016, Czech Republic [54] | Cross-sectional | Age (Mean ± SD or Range) 71.20 ± 6.77 % Female -64 Education Years (Mean ± SD or Range) 15.30 ± 2.95 | CDT | CDR |
| 46  | Feng X et al., 2017, China [59] | Cross-sectional | Age (Mean ± SD or Range) 65.99 ± 10.45 % Female 62.95 Education Years (Mean ± SD or Range) 2.88% 0 years, 16.1% 1-6 years, 51.08% 7-12 years, 38.85% ≥12 years | DMS48 | Chinese Version of MMSE, MoCA, CDR, NIA-AA criteria |
| 47  | Xu F et al., 2019, China [40] | Cross-sectional | Age (Mean ± SD or Range) 82.87 ± 3.134 % Female 33.4 Education Years (Mean ± SD or Range) 0-21 (Median 5) | MMSE, GPCog | NIA-AA criteria |
| 48  | Zainal N et al., 2016, Singapore [61] | Cross-sectional | Age (Mean ± SD or Range) 75.4 ± 6.9 % Female 65 Education Years (Mean ± SD or Range) 11.70 ± 3.13 | MMSE, Qmci | Petersen’s criteria |

6 CIT: Six-item Cognitive Impairment Test; MMSE: Mini-Mental State Examination; EMQ: Everyday Memory Questionnaire; CDR: Clinical Dementia Rating; NIA-AA: National Institute on Aging-Alzheimer’s Association; BSRT: Buschke Simple Reaction Time; RCFT: Rey-Osterrieth Complex Figure Test; TMT: Trail Making Test; MRI: Magnetic Resonance Imaging; MoCA: Montreal Cognitive Assessment; BCSE: Brief Cognitive Status Exam; ACE: Addenbrooke’s Cognitive Examination. Abbreviations list for Table 2: CFI: Cognitive Function Instrument; HKBC: Hong Kong Brief Cognitive Test; HK-VMT: Hong Kong—Vigilance and Memory Test; TICS: Telephone Interview for Cognitive Status; RBANS: Repeable Battery for the Assessment of Neuropsychological Status; VOSP: Visual Object and Space Perception; BNT: Boston Naming Test; ST: Similarity Test; TYM: Test Your Memory; GPCog: General Practitioner assessment of Cognition; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, 4th Edition; NMD-12: Normal-MCI-Dementia 12 Questionnaire; IADL: Instrumental Activities of Daily Living; AD8: Dementia Screening Interview; CSE: Cognitive Abilities Screening Instrument; NSCL: Neuropsychological Inventory; Qmci: Quick Mild Cognitive Impairment; CCGQ: Cognitive Change Questionnaire; CAMCog: Cambridge Cognitive Examination; TorCA: Toronto Cognitive Assessment; HK-VMT: Hong Kong—Vigilance and Memory Test; TICS: Telephone Interview for Cognitive Status; RBANS: Repeable Battery for the Assessment of Neuropsychological Status; VOSP: Visual Object and Space Perception; BNT: Boston Naming Test; ST: Similarity Test; TYM: Test Your Memory; GPCog: General Practitioner assessment of Cognition; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, 4th Edition; CVLT: California Verbal Learning Test; PRMQ: Prospective and Retrospective Memory Questionnaire; HULS: Hopkins Verbal Learning Test—Revised; ADFACS: Alzheimer’s Disease Functional Assessment and Change Scale; NINCDS-ADRDA: National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer’s Disease and Related Disorders Association; FCSRT: Free and Cued Selective Reminding Test; VCAT: Visual Cognitive Assessment Test; AQ: Alzheimer’s Questionnaire; FAQ: Functional Activities Questionnaire; BCAT: Brief Cognitive Assessment Tool; BLAT: Blind Learning Aptitude Test; DRS: Delayed Story Recall; WMS-III: Wechsler Memory Scale-3rd Edition; CERAD: Consortium to Establish a Registry for Alzheimer’s Disease; ADL: Activities of Daily Living; mSTS-MCI: Mobile Screening Test System for screening Mild Cognitive Impairment; MoCA-K: Korean version of MoCA; MMSE-K: Korean version of MMSE; CDT: Clock Drawing Test; MBT: Memory Binding Test; VF: Verbal Fluency; SAGE: Self-Administered Gerocognitive Examination; STMS: Short Test of Mental Status; DMS48: Delayed Matching-to-Sample Task 48; ADAS-Cog: Alzheimer’s Disease Assessment Scale-Cognitive subscale.
Table 3. Included Tools and Its Study Characteristics.

| No. | Cognitive Tool | Article No. | Authors, Year, Country | Settings | Administration Method |
|-----|----------------|-------------|-------------------------|----------|-----------------------|
| 1   | 6CIT           | 1           | Apostolo JLA et al., 2018, Portugal [42] | Community, Primary health care units | By untrained examiner (post-graduate student) |
| 2   | EMQ            | 1           | Avila-Villanueva M et al., 2016, Spain [43] | Community | Self-administered |
| 3   | BSRT           | 2           | Baerresen KM et al., 2015, US [55] | Community | NR |
| 4   | RCFT           | 2           | Baerresen KM et al., 2015, US [55] | Community | NR |
|     |                | 2           | Huang L et al., 2018, China [31] | Memory Clinic | By trained examiner |
| 5   | TMT            | 4           | Baerresen KM et al., 2015, US [55] | Community | NR |
| 6   | MoCA           | 8           | Bartos A et al., 2018, Czech Republic [44] | Community | By trained examiner |
|     |                | 10          | Chen K-L et al., 2016, China [26] | Hospital | By trained examiner |
|     |                | 12          | Chiu HF et al., 2017, Hong Kong [27] | Community | By untrained examiner (research assistant) |
|     |                | 13          | Chu L et al., 2015, Hong Kong [29] | Memory Clinic, Community | By examiner |
|     |                | 6           | Clarnette R et al., 2016, Australia [65] | Geriatrics Clinic | By trained professionals (geriatrician) |
|     |                | 22          | Julayanont P et al., 2015, Thailand [32] | Community Hospital | By trained professionals (nurse with expertise in cognitive assessment) |
|     |                | 24          | Phua A et al., 2017, Singapore [34] | Memory Clinic | NR |
|     |                | 25          | Krishnan K et al., 2016, US [56] | Community, Clinical Care | NR |
|     |                | 31          | Mellor D et al., 2016, China [36] | Community | By trained professionals (psychologist or attending level psychiatrist) |
|     |                | 35          | Pinto T et al., 2019, Brazil [63] | Health Care Centres | By trained professionals (neurologist researcher) |
|     |                | 36          | Pirrotta F et al., 2014, Italy [49] | Clinical, Research | By trained professionals (psychologist) |
|     |                | 43          | Townley R et al., 2019 US [61] | Community | NR |
|     |                | 48          | Yavuz B et al., 2017, Turkey [73] | Geriatrics Clinic | By trained professionals (psychologist) |
|     |                | 11          | Chiu P et al., 2019, Taiwan [28] | Health Care Centres | By professionals (neuropsychologist) |
|     |                | 20          | Huang L et al., 2018, China [31] | Memory Clinic | By trained examiner |
| 7   | BCSE           | 5           | Bouman Z et al., 2015 Netherlands [45] | Memory Clinic | By untrained examiner |
| 8   | ACE            | 6           | Broche-Perez Y et al., 2018, Cuba [72] | Primary Care Community Centre: nursing homes (permanent residences for the elderly) and day care centres | By trained professionals (neurologist and geriatrician) |
|     |                | 7           | Chareromboon T, 2019, Thailand [25] | Memory Clinic | By examiner |
| 9   | MMSE           | 6           | Broche-Perez Y et al., 2018, Cuba [72] | Primary Care Community Centre: nursing homes (permanent residences for the elderly) and day care centres | By professionals (neurologist and geriatrician) |
|     |                | 8           | Chen K-L et al., 2016, China [26] | Hospital | By trained examiner |
|     |                | 10          | Chiu HF et al., 2017, Hong Kong [27] | Community | By untrained examiner (research assistant) |
|     |                | 12          | Chu L et al., 2015, Hong Kong [29] | Memory Clinic, Community | By examiner |
| No. | Cognitive Tool | Article No. | Authors, Year, Country | Settings | Administration Method |
|-----|----------------|-------------|------------------------|----------|-----------------------|
| 22  | Julayanont P et al., 2015, Thailand [32] | Community Hospital | By trained professionals (nurse with expertise in cognitive assessment) |
| 24  | Phua A et al., 2017, Singapore [34] | Memory Clinic | NR | Unclear |
| 26  | Lee S et al., 2016, Australia [66] | Community, Memory Clinic | By trained professionals (psychologist or psychiatrist) | NR |
| 31  | Mellor D et al., 2016, China [36] | Community | By trained examiner |
| 38  | Rakusa M et al., 2018, Slovenia [50] | Community | By trained examiner |
| 44  | Van de Zande E et al., 2017, Netherlands [53] | Memory Clinic | By trained examiner |
| 47  | Xu F et al., 2019, China [40] | Community | By trained examiner |
| 48  | Yavuz B et al., 2017 Turkey [73] | Geriatrics Clinic | By professionals (neuropsychologist) | NR |
| 11  | Chiu P et al., 2019, Taiwan [28] | Health Care Centres | By professionals (neuropsychologist) |
| 29  | Malek-Ahmadi M et al., 2015, US [57] | Community | By professionals (neuropsychologist) |
| 10  | CFI | 9 | Chipi E et al., 2017, Italy [46] | Memory Clinic | By professionals (neuropsychologist) |
| 11  | RBANS | 19 | Heyanka D et al., 2015 [71] | Medical Centre | By untrained examiner (research assistant) |
| 12  | HKBC | 10 | Chiu HF et al., 2017, Hong Kong [27] | Community | By professionals (neuropsychologist) |
| 13  | NMD-12 | 11 | Chiu P et al., 2019, Taiwan [28] | Health Care Centres | By trained examiner |
| 14  | Qmci | 13 | Clarinette R et al., 2016, Australia [65] | Geriatrics Clinic | By professionals (physician) or self-administered |
| 15  | CCQ | 14 | Damin A et al., 2015 Brazil [62] | Clinical | By professionals (neuropsychologist) |
| 16  | CDT | 15 | Duro D et al., 2018, Portugal [47] | Tertiary Centre | By professionals (neuropsychologist) |
| 38  | Rakusa M et al., 2018, Slovenia [50] | Community | By untrained examiner |
| 39  | Ricci M et al., 2016, Italy [51] | Memory Clinic, Community | By professionals (neuropsychologist, neurologist, resident) |
| No. | Cognitive Tool | Article No. | Authors, Year, Country | Settings | Administration Method |
|-----|----------------|-------------|------------------------|----------|-----------------------|
| 17  | HK-VMT        | 17          | Fung AW-T et al., 2018, Hong Kong [30] | Community | Self-administered (touch-screen laptop) |
| 18  | TorCA         | 16          | Freedman M et al., 2018 [70] | Suitable for use in any medical setting | By trained examiner or professionals (health care professionals) |
| 19  | TICS          | 18          | Georgakis MK et al., 2017, Greece [67] | Community, Health Centre | By professionals (health care professionals) |
| 20  | VOSP          | 20          | Huang L et al., 2018, China [31] | Memory Clinic | By trained examiner |
| 21  | TYM           | 21          | Iatraki E et al., 2017, Greece [68] | Rural Primary Care | By trained examiner |
| 22  | GPCog         | 21          | Iatraki E et al., 2017, Greece [68] | Memory Clinic, Primary Clinical Setting | Self-administered (under supervision) |
| 23  | CVLT          | 26          | Lee S et al., 2016, Australia [66] | Community, Memory Clinic | NR |
| 24  | The Envelope Task | 26       | Lee S et al., 2016, Australia [66] | Community, Memory Clinic | NR |
| 25  | PRMQ          | 26          | Lee S et al., 2016, Australia [66] | Community, Memory Clinic | NR |
| 26  | Single-item Memory Scale  | 26       | Lee S et al., 2016, Australia [66] | Community, Memory Clinic | NR |
| 27  | FCSRT         | 27          | Lemos R et al., 2016, Portugal [48] | Community, Hospital | NR |
| 28  | AQ            | 29          | Malek-Ahmadi M et al., 2015, US [57] | Designed for ease of use in primary care setting | NR |
| 29  | FAQ           | 29          | Malek-Ahmadi M et al., 2015, US [57] | Community | NR |
| 30  | BCAT          | 30          | Mansbach W et al., 2016, US [58] | Long-Term Care | By professionals |
| 31  | AD8           | 11          | Chiu P et al., 2019, Taiwan [28] | Health Care Centres | By professionals (neuropsychologist) |
| 32  | DSRS          | 32          | Mitchell J et al., 2015, US [59] | Community | Self-administered |
| 33  | CMLT          | 32          | Mitchell J et al., 2015, US [59] | Community | By professionals (clinician) |
| 32+ | CWLT-5 + DSRS | 32          | Mitchell J et al., 2015, US [59] | Community | By professionals (clinician) |
| 34  | BADLS         | 32          | Mitchell J et al., 2015, US [59] | Community | By professionals (clinician) |
| 35  | DSR           | 33          | Ni J et al., 2015, China [37] | Memory Clinic | NR |
| 36  | mSTS-MCI      | 34          | Park J et al., 2018, South Korea [38] | Clinical settings, Primary care, Geriatrics | By professionals (occupational therapist), using mobile application |
| 37  | CAMCog        | 37          | Radanovic M et al., 2017, Brazil [64] | Clinical | By professionals (physician) |
| 38  | MBT           | 40          | Roman F et al., 2016, Argentina [69] | Clinical | NR |
| 39  | SAGE          | 41          | Scharre D et al., 2017, US [60] | Community, Clinic, Research | Self-administered (paper-based or on tablet) |
### Table 3. Continued.

| No. | Cognitive Tool | Article No. | Authors, Year, Country | Settings | Administration Method |
|-----|----------------|-------------|------------------------|----------|-----------------------|
| 40  | Semantic  Fleuncy/VF | 42          | Serna A et al., 2015, Spain [52] | Community | NR                    |
| 41  | Logical Memory | 42          | Serna A et al., 2015, Spain [52] | Community | NR                    |
| 42  | STMS           | 43          | Townley R et al., 2019 US [61] | Community, Primary Care | NR        |
| 43  | DMS48          | 46          | Feng X et al., 2017, China [39] | Memory Clinic | By trained examiner |
| 44  | ADAS-Cog       | 49          | Zainal N et al., 2016, Singapore [41] | Clinical Trials, Clinic | By trained examiner |
| 45  | IADL           | 11          | Chiu P et al., 2019, Taiwan [28] | Health Care Centres | By professionals (neuropsychologist) |
| 46  | CASI           | 11          | Chiu P et al., 2019, Taiwan [28] | Health Care Centres | By professionals (neuropsychologist) |
| 47  | NPI            | 11          | Chiu P et al., 2019, Taiwan [28] | Health Care Centres | By professionals (neuropsychologist) |
| 48  | BNT            | 20          | Huang L et al., 2018, China [31] | Memory Clinic | By trained examiner |
| 49  | STT            | 20          | Huang L et al., 2018, China [31] | Memory Clinic | By trained examiner |
| 50  | JLO            | 20          | Huang L et al., 2018, China [31] | Memory Clinic | By trained examiner |
| 51  | ST             | 20          | Huang L et al., 2018, China [31] | Memory Clinic | By trained examiner |
| 52  | VCAT           | 23          | Khandiah N et al., 2015, Singapore [33] | Community, Clinical | By trained examiner |
|     |                | 28          | Low A et al., 2019, Singapore [35] | Community, Memory Clinic | By professionals (psychologist) |

Note: ‘Article No.’ extracted from Table 2. Abbreviation list for Table 3: NR: not reported.

### Table 4. Psychometric Properties of Cognitive Tools to Detect Mild Cognitive Decline.

| No. | Cognitive Tool | Version of Tools | Author, Year, Country | Range of Total Score | Cut-Off Point * | Sn/Sp (%) | Validity AUC (%) | PPV/NPV (%) | Reliability | Affecting Factors | Duration (mins) |
|-----|----------------|------------------|-----------------------|----------------------|-----------------|-----------|------------------|-------------|-------------|-------------------|-----------------|
| 1   | 6CIT           | Portuguese Version | Apostolo JLA et al., 2018, Portugal [42] | 8–11 | ≤10 (all literacy level) | 82.78/84.84 | 91 | 84.3/83.3 | High test-retest reliability, Strong internal consistency | Literacy Level | 2 to 3 |
|     |                | Portuguese Version | Apostolo JLA et al., 2018, Portugal [42] | 4–15 | ≤12 (education 0–2 years) | 93.44/68.09 | 94 | 88.4/80 | High test-retest reliability, Strong internal consistency | Literacy Level | 2 to 3 |
|     |                | Portuguese Version | Apostolo JLA et al., 2018, Portugal [42] | 9–12.03 | ≤10 (education 3–6 years) | 88/86.23 | 95 | 82.2/90.8 | High test-retest reliability, Strong internal consistency | Literacy Level | 2 to 3 |
| 2   | EMQ            |                  | Avila-Villanueva M et al., 2016, Spain [43] | NR | NR | NR | NR | NR | NR | NR | NR |
| 3   | BSRT           |                  | Baerreresen KM et al., 2015, US [55] | NR | NR | Predicted conversion to MCI and the conversion to AD | NR | NR | NR | NR |
| No. | Cognitive Tool | Version of Tools | Author, Year, Country | Range of Total Score | Cut-Off Point * | Sn/Sp (%) | Validity | Reliability | Affecting Factors | Duration (mins) |
|-----|----------------|------------------|-----------------------|---------------------|---------------|-----------|----------|-------------|-----------------|----------------|
| 4   | RCFT - Baerresen KM et al., 2015, US [55] | | | 0–36 | NR | Predicted conversion from normal aging to MCI | NR | NR |
| 5   | TMT Test B (TMT-B) - Baerresen KM et al., 2015, US [55] | | | 0–36 | ≤32 | 46.9/76.9 | 81.6 | NR | NR | NR | NR |
| 6   | MoCA Chinese Version (MoCA-CZ) - Bartos A et al., 2018, Czech Republic [44] | | | 0–30 | ≤25 | 94/62 | 89 | NR | NR | NR | 12 ± 3 |
|     | Czech Version (MoCA-CZ) - Chen K-L et al., 2016, China [26] | | | 0–30 | ≤24 | 87/72 | 89 | NR | NR | NR | 12 ± 3 |
|     | Chinese Version (MoCA-BC) - Chen K-L et al., 2016, China [26] | | | 0–30 | ≤19 (education ≤6 years) | 87.9/81 | 89.6 | NR | NR | NR | NR |
|     | Chinese Version (MoCA-BC) - Chu HF et al., 2017, Hong Kong [27] | | | 0–30 | ≤22 (education 7–12 years) | 92.9/91.2 | 94.9 | NR | NR | NR | NR |
|     | Cantonese Version - Chiu HF et al., 2017, Hong Kong [27] | | | 0–30 | ≤24 (education >12 years) | 89.9/81.5 | 91.6 | NR | NR | NR | NR |
| 6   | MoCA Cantonese Chinese Version (MoCA-BR) - Chu I et al., 2015, Hong Kong [28] | | | 0–30 | ≤22/23 | 78/73 | 95 | NR | High test–retest reliability, High internal consistency, High inter-rater reliability | Education (sex and age not associated) | ≤10 |
|     | Basic Version (MoCA-B) - Clarinette R et al., 2016, Australia [63] | | | 0–30 | ≤23 | 87/80 | 84/92 | 95/58 | NR | NR | 15 to 21 |
|     | Basic Version (MoCA-B) - Julayanont P et al., 2015, Thailand [32] | | | 0–30 | ≤24 | 86/86 | NR | 85/82 | Good internal consistency | NR | NR |
|     | Brazilian Version (MoCA-BR) - Phua A et al., 2017, Singapore [34] | | | 0–30 | ≤26 | 63/77 | NR | 70/65 | NR | NR |
|     | - Krishnan K et al., 2016, US [56] | | | 0–30 | ≤26 | 51/96 | NR | NR | Good test–retest reliability | NR | 10 |
| 6   | MoCA Brazilian Version (MoCA-BR) - Mellor D et al., 2016, China [36] | | | 0–30 | ≤22.5 | 87/73 | 89 | 54.5/93.6 | NR | Good internal consistency, Good test–retest reliability, Excellent inter-examiner reliability, High intra-rater reliability | Age, Gender, Education | NR |
|     | - Pinto T et al., 2019, Brazil [63] | | | 0–30 | NR | NR | NR | NR | NR | 13.1 ± 2.7 |
|     | Italian version - Pirrotta F et al., 2014, Italy [49] | | | 0–30 | ≤15.5 | 83/97 | 96 | NR | High test–retest agreement, Excellent inter-rater reliability | NR | 10 |
|     | - Townley R et al., 2019 US [61] | | | 0–30 | ≤26 | 89/47 | Incident MCI: 70, a-MCI: 90, na- MCI: 84 | NR | NR | NR | NR |
Table 4. Cont.

| No. | Cognitive Tool | Version of Tools | Author, Year, Country | Range of Total Score | Cut-Off Point * | Sn/Sp (%) | Validity AUC (%) | PPV/NPV (%) | Reliability | Affecting Factors | Duration (mins) |
|-----|----------------|------------------|------------------------|----------------------|----------------|-----------|-----------------|-------------|-------------|-----------------|----------------|
| 6   | MoCA           | -                | Yavuz B et al., 2017, Turkey [73] | 0–30                 | <26             | 59/72     | 69              | 72/71       | NR          | NR              | 10             |
|     |                | -                | Chiu P et al., 2019, Taiwan [28] | 0–30                 | 19/20           | 68/65     | 67              | NR          | NR          | Age, Education | NR             |
|     |                | -                | Huang L et al., 2018, China [31] | 0–30                 | ≤24             | 81.5/65.1 | 81.8            | NR          | NR          | NR              | NR             |
| 7   | BCSE           | Dutch Version    | Bouman Z et al., 2015 Netherlands [45] | 0–58                 | ≤46             | 81/80     | NR              | 61/92       | Excellent inter-rater reliability, High internal consistency | Age | 5 to 15 |
|     | Dutch Version  | Bouman Z et al., 2015 Netherlands [45] | 0–58                 | ≤27             | 84/76 | NR              | 57/92       | Excellent inter-rater reliability, High internal consistency | Age | 5 to 15 |
| 8   | ACE            | Cuban Revised Version (ACE-R) | Broche-Perez Y et al., 2018, Cuba [72] | 0–100                 | ≤84             | 89/72     | 93              | NR          | Good internal consistency reliability | Age, Years of Schooling | A few mins more than MMSE |
|     | Mexican Mini   | Thai Mini Version | Charemboon T, 2019, Thailand [25] | 0–100                 | 21/22           | 95/85     | 90              | 80.9/96.2   | High internal consistency | NR | 8 to 13 |
| 9   | MMSE           | -                | Broche-Perez Y et al., 2018, Cuba [72] | 1–30                 | 25/26           | 56/83     | 63              | NR          | NR          | NR              | NR             |
|     | -              | Chen K-L et al., 2016, China [26] | 1–30                 | ≤26             | 86.2/60.3 | 79.7          | NR          | NR          | NR              | NR             |
|     | -              | Chen K-L et al., 2016, China [26] | 1–30                 | ≤27             | 78.6/52.2 | 73.6          | NR          | NR          | NR              | NR             |
|     | -              | Chen K-L et al., 2016, China [26] | 1–30                 | ≤28             | 76.4/53.4 | 72.1          | NR          | NR          | NR              | NR             |
|     | Cantonese      | Cantonese Version | Chiu HF et al., 2017, Hong Kong [27] | 1–30                 | 25/26           | 83/84     | 90.4            | 93/98       | NR          | NR              | NR             |
| 9   | MMSE           | Chinese Version  | Chu L et al., 2015, Hong Kong [29] | 1–30                 | 27/28           | 67/83     | 78              | NR          | NR          | Education | NR             |
|     | Thai Version   |                    | Julayanont P et al., 2015, Thailand [32] | 1–30                 | NR             | 33/88     | 70.2            | NR          | NR          | NR              | NR             |
|     | -              | Phua A et al., 2017, Singapore [34] | 1–30                 | NR             | 70/59     | 64/66           | NR          | NR          | NR              | NR             |
|     | -              | Lee S et al., 2016, Australia [66] | 1–30                 | <29             | 75.7/68.9 | 77              | NR          | NR          | Emotional status indices (anxiety and depression) | Age, Gender, Educational Level | NR |
|     | -              | Mellow D et al., 2016, China [36] | 1–30                 | ≤25.5           | 68/83     | 85              | 60.5/87.4   | NR          | Age          | NR             |
| 9   | MMSE           | -                | Rakusa M et al., 2018, Slovenia [50] | 1–30                 | 25/26           | 20/93     | 63              | NR          | NR          | NR              | NR             |
|     | -              | Van de Zande E et al., 2017, Netherlands [53] | 1–30                 | ≤23             | 57/98     | 68.5            | 96/69.5     | NR          | Education | 5 to 10         |
| No. | Cognitive Tool | Version of Tools | Author, Year, Country | Range of Total Score | Cut-Off Point * | Sn/Sp (%) | Validity | Reliability | Affecting Factors | Duration (mins) |
|-----|----------------|------------------|------------------------|----------------------|----------------|-----------|----------|-------------|------------------|-----------------|
|     | 1              | Xu F et al., 2019, China [40] | 1–30                  | 27 ≤ and ≤ 29        | 59/58.2       | NR        | NR       | NR          | NR               | 5 to 10         |
|     | 2              | Standardised Mini Version (SMMSE) | Yavuz B et al., 2017 Turkey [73] | 1–30 | ≤23 | 36/94 | 71 | 87/56 | NR | NR | NR |
|     |                 | Chiu P et al., 2019, Taiwan [52] | 1–30                   | 26/27                | 64/70          | 66        | NR       | NR          | Age, Education    | NR              |
|     |                 | Malek-Ahmadi M et al., 2015, US [57] | 1–30                   | NR                    | Small sensitivity to change (helpful in detecting change over time) | 56% Reliability | NR | NR | NR |
|     | 3              | CFI Italian Version | Chipi E et al., 2017, Italy [46] | 0–14 | NR | Accurate | Reliable | NR | NR | NR |
|     | 4              | Heyanka D et al., 2015 [71] | 0–100                  | NR                    | 52–93/35–93 (based on different subtests) | NR | 16–91/72–94 (based on different subtests) | NR | NR | NR |
|     | 5              | Chiu P et al., 2019, Taiwan [28] | 0–30                   | 21/22                 | 90/86          | 95.5      | 94/99    | NR          | Good test–retest reliability, Excellent inter-rater reliability, Satisfactory internal consistency | NR | 7 |
|     | 6              | Clarnette R et al., 2016, Australia [65] | 0–100 | <60 | 93/80 | 91–97 | 95/73 | NR | 4.2 |
|     | 7              | Yavuz B et al., 2017 Turkey [73] | 0–100 | <62 | 67/81 | 80 | 80/68 | Strong inter-rater reliability, Strong test–retest reliability | NR | 3 to 5 |
|     | 8              | Damia A et al., 2015 Brazil [62] | 0–18 (Babins System) | 0–10 (Rouleau System) | <15 | 60/62 | 63.8 | 61/61 | High inter-rater reliability | NR | NR |
|     | 9              | Duro D et al., 2018, Portugal [47] | 0–4 | ≥2 | 78/93.9 | High Accuracy | 94.1/77.5 | NR | NR | NR |
|     | 10             | Ricci M et al., 2016, Italy [51] | 0–5                   | ≤1.30                 | 76/84          | Good Diagnostic Accuracy | Excellent inter-rater reliability | NR | Very short and easy | 16 |
|     | 11             | Vyhlalek M et al., 2016, Czech Republic [54] | 0–5                   | ≤275 | 80/79 | 79% Accuracy | Good test–retest reliability, Adequate internal consistency | NR | Median 34 |
|     | 12             | Freedman M et al., 2018 [70] | 0–205                  | 21/22                 | 86.1/75.3 | 79.3 | NR | Good test–retest reliability | Education | 15 |
| No. | Cognitive Tool | Version of Tools | Author, Year, Country | Range of Total Score | Cut-Off Point * | Sn/Sp (%) | Validity | Reliability | Affecting Factors | Duration (mins) |
|-----|----------------|------------------|-----------------------|----------------------|-----------------|------------|----------|-------------|------------------|----------------|}
| 16  | HK-VMT        | -                | Fung AW-T et al., 2018, Hong Kong [30] | 0–40 | <22 (education <6 years) | 71.1/87.3 | 79.3 | NR | Good test-retest reliability | Education | 15 |
| 17  | HK-VMT        | -                | Fung AW-T et al., 2018, Hong Kong [30] | 0–40 | <25 (education >6 years) | 71.4/76.5 | 79.3 | NR | Good test-retest reliability | Education | 15 |
| 18  | TICS          | -                | Georgakis MK et al., 2017, Greece [67] | 0–41 | 26/27 | 45.8/73.7 | 56.9 | 30.6/84.3 | Adequate internal consistency; Very high test-retest reliability | Age, Education | NR |
| 19  | TICS          | Abbreviated version of the Silhouettes subtest (Silhouettes-A) | Huang L et al., 2018, China [31] | 0–15 | ≤10 | 79.6/65.1 | 81.6 | NR | High internal consistency/inter-rater reliability; Excellent test-retest reliability | Gender, Education (Unaffected by age) | 3 to 5 |
| 20  | VOSP          | Greek Version    | Iatraki E et al., 2017, Greece [68] | 0–50 | 35/36 | 80/77 | NR | 47/93 | Good internal consistency | Age, Education | 5 to 10 |
| 21  | TYM           | Dutch Version    | Van de Zande E et al., 2017, Netherlands [53] | 0–50 | ≤38 | 74/91 | 79.5 | 87.9/79.2 | Good inter-rater reliability | Education | 10 to 15 |
| 22  | GPCog         | Greek Version of GPCog-Patient | Xu F et al., 2019, China [40] | 0–9 | 7/8 | 89/61 | 38/95 | Good internal consistency | Age, Education | <5 |
| 23  | CVLT          | Second Edition (CVLT-II) | Lee S et al., 2016, Australia [66] | 0–16 | <8 | 82.9/93.2 | NR | NR | Unaffected by education, gender and age | Emotional status indices (anxiety and depression) | 4 to 6 |
| 24  | The Envelope Task | -                | Lee S et al., 2016, Australia [66] | 0–4 | <3 | 64.3/91.9 | 83 | NR | NR | Emotional status indices (anxiety and depression) | NR |
| 25  | PRMQ          | -                | Lee S et al., 2016, Australia [66] | 0–80 | <46 | 50/75.7 | 66 | NR | NR | Emotional status indices (anxiety and depression) | NR |
| 26  | Single-item Memory Scale | -                | Lee S et al., 2016, Australia [66] | 0–5 | <3 | 55.7/89.2 | 76 | NR | NR | Emotional status indices (anxiety and depression) | NR |
| 27  | FCSRT         | Portuguese Version | Lemos R et al., 2016, Portugal [48] | ITR: 0–48 | ≤35 | 72/83 | 81.8 | 81/75 | Unaffected by literacy level | NR |
|     |               | Portuguese Version | Lemos R et al., 2016, Portugal [48] | DTR: 0–16 | ≤12 | 76/80 | 82.4 | 79/77 | Unaffected by literacy level | ~2 |

*Cut-Off Point* indicates the threshold score for classification.
| No. | Cognitive Tool | Version of Tools | Author, Year, Country | Range of Total Score | Cut-Off Point * | Sn/Sp (%) | Validity | Reliability | Affecting Factors | Duration (mins) |
|-----|----------------|------------------|-----------------------|----------------------|----------------|-----------|----------|-------------|------------------|-----------------|
| 28  | AQ             | -                | Malek-Ahmadi M et al., 2015, US [57] | 0–27                | NR             | Small sensitivity to change (helpful in detecting change over time) | 0.65 Reliability | NR | NR |
| 29  | FAQ            | -                | Malek-Ahmadi M et al., 2015, US [57] | 0–30                | NR             | Small sensitivity to change (helpful in detecting change over time) | 0.63 Reliability | NR | NR |
| 30  | BCAT Short Form (BCAT-SF) | Mansbach W et al., 2016, US [58] | 0–21                | ≤19                | 82/80          | 86/93 57 | Good internal consistency, Reliable | NR | 3 to 4 |
| 31  | AD8            | -                | Chiu P et al., 2019, Taiwan [28] | 0–8                 | 1/2            | 78/93     | NR | Unaffected by age, education |
|     |                | -                | Mansbach W et al., 2016, US [58] | 0–8                 | ≥1             | 78/30     | 78/29 Acceptable internal consistency Acceptable internal consistency | NR | NR |
|     |                | -                | Mansbach W et al., 2016, US [58] | 0–8                 | ≥2             | 68/63     | 83/34 Acceptable internal consistency | NR | NR |
| 31  | AD8            | -                | Mansbach W et al., 2016, US [58] | 0–8                 | ≥3             | 47/63     | 59/81 Acceptable internal consistency | NR | NR |
| 32  | DRSRS          | -                | Mitchell J et al., 2015, US [59] | 0–51                | NR             | 60/81     | 86/93 Acceptable internal consistency | NR | 5 |
| 33  | CWLT 3rd Trial | Mitchell J et al., 2015, US [59] | NR                  | NR                 | NR             | 62/96     | NR NR Acceptable internal consistency | NR | NR |
|     | CWLT-Trials 1–3 | Mitchell J et al., 2015, US [59] | NR                  | NR                 | NR             | 41/90     | NR NR Acceptable internal consistency | NR | NR |
|     | CWLT-Composite | Mitchell J et al., 2015, US [59] | NR                  | NR                 | NR             | 57/94     | NR NR Acceptable internal consistency | NR | NR |
| 32 and 33 | CWLT-5 + DRSRS | -                | Mitchell J et al., 2015, US [59] | NR                  | NR             | 66/95     | 76/98 Acceptable internal consistency | NR | NR |
| 34  | BADLS          | -                | Mitchell J et al., 2015, US [59] | NR                  | NR             | 36/86     | NR NR Acceptable internal consistency | NR | NR |
| 35  | DSR            | -                | Mitchell J et al., 2015, US [59] | NR                  | ≥15            | 100/95.9 99.8 Good diagnostic accuracy | NR | NR |
| 36  | mSTS-MCI Scores | Park J et al., 2018, South Korea [38] | 0–18                | 18/19             | 99/93 High Concurrent Validity | NR | 15 |
|     | mSTS-MCI Reaction Time | Park J et al., 2018, South Korea [38] | 0–10                | 13.22/13.32      | 100/97 High Concurrent Validity | NR | 15 |
|     | CAMCog Brief Version (CAMCog-Short) | Radanovic M et al., 2017, Brazil [64] | 0–63                | 51/52 (education >9 years) | 65.2/78.8 | 79.7 NR Acceptable internal consistency | NR | NR |
|     | CAMCog Brief Version (CAMCog-Short) | Radanovic M et al., 2017, Brazil [64] | 0–63                | 59/60 (education ≤8) | 70/75.5 | 77.3 NR Acceptable internal consistency | NR | NR |
| 38  | MBI Argentine Version | Roman F et al., 2016, Argentina [69] | 0–32                | NR                 | 69/88 88 93/55 NR Acceptable internal consistency | NR | 6 |
| 39  | SAGE           | -                | Scharre D et al., 2017, US [66] | 6–22                | <15            | 71/90     | 88/93 Acceptable internal consistency | NR | Median 17.5 |
Table 4. Cont.

| No. | Cognitive Tool | Version of Tools | Author, Year, Country | Range of Total Score | Cut-Off Point * | Sn/Sp (%) | Validity | Reliability | Affecting Factors | Duration (mins) |
|-----|----------------|------------------|-----------------------|----------------------|-----------------|-----------|----------|-------------|------------------|-----------------|
|     |                |                  |                       |                      |                 |           | AUC (%)  | PPV/NPV (%) |                |                 |
| 40  | Digitally Translated (eSAGE) |                  | Scharre D et al., 2017, US [60] | 10–22 | ≤16 | 69/86 | 83 | NR | NR | Median 16 |
|     | Semantic Fluency/VF |                  | Serna A et al., 2015, Spain [52] | 0–17 | ≤10.5 | 53/67 | 72 | 52/75 | NR | 1 |
|     |                |                  | Serna A et al., 2015, Spain [52] | 0–17 | ≤11.5 | 62/67 | 72 | 52/75 | NR | 1 |
|     |                |                  | Serna A et al., 2015, Spain [52] | 0–17 | ≤12.5 | 70/56 | 72 | 48/76 | NR | 1 |
| 41  | Logical Memory | 20-min Delayed Recall (DR) | Serna A et al., 2015, Spain [52] | 0–6 | ≤2.5 | 43/85 | 71 | 63/72 | NR | 20 |
|     |                |                  | Serna A et al., 2015, Spain [52] | 0–6 | ≤3.5 | 57/71 | 71 | 54/74 | NR | 20 |
| 41  | Logical Memory | 20-min Delayed Recall (DR) | Townley R et al., 2019 US [61] | N/A | <35 | 72/74 | Incident MCI: 71, a-MCI: 85, na-MCI: 91 | NR | NR | NR | 20 |
| 42  | STMS |                  | Feng X et al., 2017, China [39] | 0–48 | 42/43 | 86.6/94.2 | 96.6 | NR | NR | Age (Unaffected by education) | Short time taking |
| 43  | DMS48 |                  | Zainal N et al., 2016, Singapore [41] | 0–70 | ≥4 | 73/69 | 78 | 90/40 | Excellent internal consistency | 30 to 45 |
|     |                |                  | Zainal N et al., 2016, Singapore [41] | 0–80 | ≥5 | 90/53 | 79 | 88/58 | Excellent internal consistency | 30 to 45 |
|     | ADAS-Cog 11-item |                  | Zainal N et al., 2016, Singapore [41] | 0–32 | ≥6 | 61/73 | 73 | 86/41 | Excellent internal consistency | 30 to 45 |
|     | ADAS-Cog 12-item |                  | Zainal N et al., 2016, Singapore [41] | 0–32 | ≥6 | 61/73 | 73 | 86/41 | Excellent internal consistency | 30 to 45 |
|     | ADAS-Cog Episodic Memory Composite Scale |                  | Chiu P et al., 2019, Taiwan [28] | NR | 7/8 | 98/27 | 63 | NR | NR | NR |
|     | IADL |                  | Chiu P et al., 2019, Taiwan [28] | NR | 82/83 | 68/68 | 72 | NR | NR | Age, Education | NR |
| 47  | NPI |                  | Chiu P et al., 2019, Taiwan [28] | NR | 3/4 | 63/62 | 63 | NR | NR | NR | NR |
| 48  | BNT |                  | Huang L et al., 2018, China [33] | NR | 24 | 70.6/55.2 | 67.3 | NR | NR | NR | NR |
| 49  | STT | Test B (STT-B) | Huang L et al., 2018, China [33] | NR | 169 | 50.7/80 | 68.3 | NR | NR | NR | NR |
| 50  | JLO |                  | Huang L et al., 2018, China [33] | NR | 27 | 59.7/53.2 | 62 | NR | NR | NR | NR |
| 51  | ST |                  | Huang L et al., 2018, China [33] | NR | 14 | 64/62.6 | 66.4 | NR | NR | NR | NR |
| 52  | VCAT |                  | Khandiah N et al., 2015, Singapore [33] | 0–30 | 18–22 | 85.6/81.1 | 93.3 | NR | Unaffected by language | 15.7 ± 7.3 |
|     |                |                  | Low A et al., 2019, Singapore [33] | 0–30 | 20–24 | 75.4/71.1 | Good construct validity | 74.4/72.3 | Good internal consistency | NR |
Table 5. Summary of the cognitive tools performance.

| Tool          | Cut-Off Point | Different Versions Included | Validity        | Good Reliability | Affecting Factors | Administration Time ≤15 mins | Can Be Self-Administered or Conducted by Non-Professional |
|---------------|---------------|-----------------------------|-----------------|------------------|--------------------|-----------------------------|--------------------------------------------------|
| 6 CIT         | ≤4/10/12      | ✓                           | Good/Excellent  | ✓                | Education          | ✓                           | ✓                                                 |
| EMQ           | Limited results |                             |                 |                  |                    |                             |                                                   |
| BSRT          | Limited results |                             |                 |                  |                    |                             |                                                   |
| RCFT          | ≤32           | ✓                           | Fair            | -                | -                  | x                           |                                                   |
| TMT           | Limited results |                             |                 |                  |                    |                             |                                                   |
| MoCA          | ≤26           | ✓                           | Fair/Good       | ✓                | Education (may be affected by gender and age) | ✓                           | ✓                                                 |
| BSRT          | Limited results |                             |                 |                  |                    |                             |                                                   |
| BSRT          | ≤26           | ✓                           | Fair/Good       | ✓                | Education          | ✓                           | x                                                 |
| MoCA          | ≤24, ≤22, ≤19, ≤15.5 | ✓                           | Fair/Good/Excellent Fair | ✓                | Education (may be affected by gender and age) | ✓                           | ✓                                                 |
| MMSE          | ≤26           | ✓                           | Fair/Good       | ✓                | Age, Education, Emotional status, Gender | ✓                           | ✓                                                 |
| ACE           | ≤84, ≤22      | ✓                           | Good/Excellent  | ✓                | Age, Education     | ✓                           | x                                                 |
| ACE           | ≤27, ≤46      | ✓                           | Fair/Good       | ✓                | Age               | ✓                           | x                                                 |
| BCSE          | ≤27, ≤46      | ✓                           | Fair/Good       | ✓                | Age               | ✓                           | x                                                 |
| BCSE          | ≤27, ≤46      | ✓                           | Fair/Good       | ✓                | Age               | ✓                           | x                                                 |
| NMD-12        | ≤2            | ✓                           | Excellent       | ✓                |                    | ✓                           | x                                                 |
| NMD-12        | ≤2            | ✓                           | Excellent       | ✓                |                    | ✓                           | x                                                 |
| Qmci          | <62/≤60       | ✓                           | Good/Excellent  | ✓                |                    | ✓                           | x                                                 |
| Qmci          | <62/≤60       | ✓                           | Good/Excellent  | ✓                |                    | ✓                           | x                                                 |
| CCQ           | >1, ≥2        | ✓                           | Good/Excellent  | ✓                |                    | ✓                           | x                                                 |
| CDT           | ≤15, ≤9, ≤3, ≤1.3 | ✓                           | Fair/Good       | ✓                | Age, Education     | ✓                           | x                                                 |
| CDT           | ≤15, ≤9, ≤3, ≤1.3 | ✓                           | Fair/Good       | ✓                | Age, Education     | ✓                           | x                                                 |
| TorCA         | ≤275          | ✓                           | Good            | -                | -                  | x                           | x                                                 |
| TorCA         | ≤275          | ✓                           | Good            | -                | -                  | x                           | x                                                 |
| HK-VMT        | <22, ≤25      | -                           | Fair            | ✓                | Education          | ✓                           | x                                                 |
| HK-VMT        | <22, ≤25      | -                           | Fair            | ✓                | Education          | ✓                           | x                                                 |
| TICS          | ≤27           | -                           | Poor/Fair       | ✓                | Age, Education     | ✓                           | x                                                 |
| TICS          | ≤27           | -                           | Poor/Fair       | ✓                | Age, Education     | ✓                           | x                                                 |
| VOSP          | ≤10           | -                           | Good            | ✓                | Gender, Education  | ✓                           | x                                                 |
| VOSP          | ≤10           | -                           | Good            | ✓                | Gender, Education  | ✓                           | x                                                 |
| TMS           | ≤38, ≤36      | ✓                           | Fair/Good       | ✓                | Age, Education     | ✓                           | x                                                 |
| TMS           | ≤38, ≤36      | ✓                           | Fair/Good       | ✓                | Age, Education     | ✓                           | x                                                 |
| GPCog         | ≥4, ≥8        | ✓                           | Fair/Good       | ✓                | Inconsistent results | ✓                           | x                                                 |
| GPCog         | ≥4, ≥8        | ✓                           | Fair/Good       | ✓                | Inconsistent results | ✓                           | x                                                 |
| CVLT           | <8            | ✓                           | Good/Excellent  | ✓                | Emotional Status   | -                           | -                                                 |
| CVLT           | <8            | ✓                           | Good/Excellent  | ✓                | Emotional Status   | -                           | -                                                 |
| The Envelope Task | <3          | -                           | Good            | -                | Emotional Status   | -                           | -                                                 |
| The Envelope Task | <3          | -                           | Good            | -                | Emotional Status   | -                           | -                                                 |
| PRMQ          | <46           | -                           | Poor/Fair       | ✓                | Emotional Status   | -                           | -                                                 |
| PRMQ          | <46           | -                           | Poor/Fair       | ✓                | Emotional Status   | -                           | -                                                 |
| Single-item Memory Scale | <3          | -                           | Fair/Good       | -                | Emotional Status   | -                           | -                                                 |
| Single-item Memory Scale | <3          | -                           | Fair/Good       | -                | Emotional Status   | -                           | -                                                 |
| FCSRT         | ≤35, ≤12      | ✓                           | Good            | -                | -                  | x                           | -                                                 |
| FCSRT         | ≤35, ≤12      | ✓                           | Good            | -                | -                  | x                           | -                                                 |
| AQ            | Limited results |                             |                 |                  |                    |                             |                                                   |
| AQ            | Limited results |                             |                 |                  |                    |                             |                                                   |
| Tool          | Cut-Off Point | Different Versions Included | Validity       | Good Reliability | Affecting Factors | Administration Time ≤15 mins | Can Be Self-Administered or Conducted by Non-Professional |
|--------------|---------------|-----------------------------|----------------|-----------------|-------------------|-------------------------------|---------------------------------------------------------|
| FAQ          | -             | -                           | Poor/Good      | -               | -                 | -                            | -                                                        |
| BCAT         | ≤19           | -                           | Good           | ✓               | ✓                 | ✓                            | x                                                        |
| AD8          | ≥1, ≥2, ≥3    | -                           | Poor/Fair      | ✓               | -                 | -                            | ✓                                                        |
| DRSR         | -             | ✓                           | Fair/Good      | ✓               | -                 | ✓                            | x                                                        |
| CWLT         | -             | ✓                           | Fair           | -               | -                 | -                            | x                                                        |
| CWLT + DSRS  | -             | -                           | Good/Excellent | -               | -                 | -                            | x                                                        |
| BADLS        | -             | -                           | Poor           | ✓               | ✓                 | -                            | x                                                        |
| DSR          | ≤15           | -                           | Excellent      | ✓               | ✓                 | -                            | x                                                        |
| mSTS-MCI     | ≤19, ≤13.32   | ✓                           | Excellent      | ✓               | ✓                 | x                            | x                                                        |
| CAMCog       | ≤52, ≤60     | ✓                           | Fair/Good      | -               | -                 | -                            | x                                                        |
| MBT          | -             | ✓                           | Good           | -               | -                 | ✓                            | -                                                        |
| SAGE         | <15, <16     | -                           | Good           | -               | -                 | -                            | x                                                        |
| Semantic Fluency/VF | ≤10.5, ≤11.5, ≤12.5 | - | Fair | - | - | ✓ | - |
| Logical Memory | ≤2.5, ≤3.5, ≤4.5 | ✓ | Poor/Fair | - | - | x | - |
| STMS         | ≤35           | -                           | Good           | -               | -                 | -                            | -                                                        |
| DMS48        | ≤43           | -                           | Good/Excellent | -               | Age               | -                            | x                                                        |
| ADAS-Cog     | ≥4, ≥5, ≥6   | ✓                           | Good/Excellent | ✓               | -                 | x                            | x                                                        |
| IADL         | ≤8            | -                           | Poor/Fair      | -               | -                 | -                            | x                                                        |
| CASI         | ≤83           | -                           | Fair           | -               | Age, Education    | -                            | x                                                        |
| NPI          | ≤4            | -                           | Fair           | -               | -                 | -                            | x                                                        |
| BNT          | ≤7            | -                           | Fair           | -               | -                 | ✓                            | -                                                        |
| STT          | ≤169          | -                           | Fair           | -               | -                 | ✓                            | -                                                        |
| JLO          | ≤27           | -                           | Fair           | -               | -                 | ✓                            | -                                                        |
| ST           | ≤14           | -                           | Fair           | -               | -                 | ✓                            | -                                                        |
| VCAT         | 18-22, 20-24  | -                           | Good/Excellent | ✓               | -                 | x                            | x                                                        |

Extracted and evaluated from Tables 3 and 4. '✓' represents yes; 'x' represent no; '-' represent unavailable data. Multiple ratings recorded if there were different results from included articles.
These tools provided good to excellent validity and reliability in detecting people with mild cognitive decline within 15 min of administration time. In addition, they do not require health care professionals to administer. However, education levels, age, gender and emotional status can affect the performance of these cognitive tools. For instance, the performance of 11 tools were found to be associated with education [27–31,36,42,53,67,68,72] while the results of 10 tools were associated with age [28,36,39,41,45,50,67,68,72]. In addition, a briefer, revised or translated version which can better accommodate the settings of specific populations was also available for most of the tools [25–27,29,31,32,38,40–42,44–46,48,49,52,53,55,58–60,62–64,66,68,69,72,73].

4. Discussion
This scoping review collates a comprehensive list of brief cognitive tools used to measure mild cognitive decline in healthy elderly populations. To achieve effective screening outcomes, the brief cognitive tools are required to have good to excellent psychometric properties, short administration time and can be self-administered or administered by non-health care professionals [14,24].

Similar to recent systematic reviews, MoCA, MMSE and CDT are the most commonly used cognitive assessment tools in screening mild cognitive decline [14,74]. Based on our critical evaluation (Table 5), the ideal screening tools with versatile performance are 6CIT [42], MoCA (with the cut-offs of ≤24/22/19/15.5) [26–28,31,32,44,49,56], MMSE (with the cut-off of ≤26) [26–28,50,72] and HKBC [27]. The remaining 48 tools have suboptimal performance or insufficient information in any of these criteria: psychometric properties, administration time or administration methods. All of these tools are suitable to use in community or primary care settings.

Among these ideal screening tools, HKBC has the highest validity and reliability in identifying the earliest stages of subtle cognitive decline [27]. However, it was only validated in Hong Kong with a limited number of studies, and might not be generalisable among other populations.

MMSE is the most recognised brief cognitive tool which is frequently used in measuring cognitive impairment in clinical, research and community settings [75]. However, as supported by multiple systematic reviews and meta-analysis, MoCA can detect the subtle changes in cognitive capacity better than MMSE [14,75,76]. Studies proposed that there are several features in MoCA’s design that can potentially explain its superior sensitivity in MCI detection [77]. As compared to MMSE, MoCA’s assessment tasks includes more words, fewer learning trials, and a longer delay before the memory recall test [77]. MCI participants can be mildly impaired in their executive functions, complex visuospatial processing and the higher-level language abilities [77]. Thus, MoCA with more diverse and demanding tasks can better distinguish the changes in the above components than MMSE [77].

Even so, both MoCA and MMSE are recommended as the widely generalisable cognitive tools with all-round performance. They have been adapted and validated in different versions to minimise the effect of language and culture on their psychometric performance. Both tools can be administered by trained or untrained personnel in multiple health care settings such as hospital, primary care and the community. However, not all cut-off points provide high psychometric performances in screening mild cognitive decline. Different cut-off scores have also been published when the tests are modified to suit the local culture [74]. Hence, optimal cut-off points need to be carefully chosen while interpreting these results. Nonetheless, the presence of educational bias remains a concern while administering MoCA and MMSE and this was supported by a systematic review by Roshaslina Rosli et al. [74]. The impact of education may result in inappropriate referral due to the overestimation of the prevalence of mild cognitive decline [74]. To address this issue, MoCA-B is an modified version of MoCA which was designed to be less dependant on literacy levels [32]. Additional studies in this area may be beneficial for future use and development of the tools. Alternatively, Visual Cognitive Assessment Test (VCAT) is not affected by languages or cultural background, overcoming the common barriers for most
cognitive tools including MoCA and MMSE [33,35]. It is designed to be a visual-based cognitive tool to reduce the language demands [35]. Only the instructions, but not the test components require translation [35]. Based on our appraisal, the only criteria resulting in its exclusion from the ‘good cognitive tool’ category was the slightly lengthy administration time (15 to 20 min) for a brief cognitive tool [33].

To detect mild cognitive decline in surveys, self-completed tools such as the Dementia Screening Interview (AD8), SAGE, the Everyday Memory Questionnaire (EMQ), the Cognitive Change Questionnaire (CCQ), HK-VMT and Test Your Memory (TYM) can be suitable. Among these self-administered tools, SAGE has the best validity and reliability and is also validated to be conducted via electronic devices [60]. From our review, there are some very brief cognitive tools which required less than 5 min to deliver. 6CIT is a preferable very brief cognitive tool with versatile properties [42]. However, it was only validated against MMSE which is not a true gold standard in diagnosing MCI [42]. A 4-point CDT only requires less than 2 min to conduct [50]. Its only limitation is the fair to good validity while screening MCI. Thus, CDT may be beneficial to use in combination with other screening tools without adding a significant amount of administration time. In addition, a short-form Brief Cognitive Assessment Tool (BCAT) is also valid and reliable to be conducted by professional personnel within 3 to 4 min [58].

Interestingly, the level of psychometric performance can be different while screening different types of MCI. There are generally two subtypes of MCI, which are amnestic MCI (a-MCI) and non-amnestic MCI (na-MCI) [78,79]. Research has shown that there are structural differences in brain tissues among different MCI subtypes and these pathological changes affect different cognitive components [80]. Thus, people with a-MCI have impaired memory whereas na-MCI affects people’s thinking skills other than memory [78,79]. Hence, cognitive tests which assessed different domains may have different performance in identifying each MCI subtype. For instance, Short Test of Mental Status (STMS) has higher validity in discriminating na-MCI as compared to a-MCI which is potentially due to its assessment properties of having a larger domain in assessing memory rather than other cognitive skills [61,81]. Therefore, future studies are recommended to further validate the MCI screening tools’ performance in discriminating different subtypes of MCI. Additional studies were also required to further validate the cut-off points and psychometric performance of the included brief cognitive tools in this review.

The limited available studies and data among included articles remains the biggest limitation to our review. The exclusion of studies before 2015, grey literature and non-English studies may limit some of the information relevant to this review. To make this review more feasible within the honours program limitation, the optional critical appraisal of study quality was not conducted in this review. Despite these limitations, this is a thorough scoping review and has collated a large number of studies from the previous 5 years. Studies from various countries were included, which allowed us to catalogue the brief cognitive tools used in worldwide populations and across a variety of settings. Substantial work was undertaken to evaluate each of the tools used in measuring mild cognitive decline.

5. Conclusions

Based on our review, there were 52 different tools available to discriminate mild cognitive decline among healthy elderly populations. 6CIT [42], MoCA (with the cut-offs of \(\leq 24/22/19/15.5\)) [28,32,34,35,44,46,49,60], MMSE (with the cut-off of \(\leq 26\)) [26–28,50,72] and HKBC [27] are good at discriminating the subtle cognitive changes as a result of MCI. They have versatile performance in terms of their psychometric properties, administration time and delivery methods. In addition, MoCA and MMSE have been modified into various versions to be generalisable in multiple populations. To detect subtle cognitive changes in surveys, SAGE is recommended, and it can also be administered digitally. A 4-point CDT is quick and easy to be added into other cognitive screening tests while assessing
MCI. However, suitable cut-off points need to be further studied to validate performance as a mild cognitive decline screening test.

The lack of thorough evaluation of cognitive tools in identifying MCI appears to be a challenge among clinical and research settings. The aim of this review was to catalogue and assess the tools used to evaluate mild cognitive decline among healthy elderly populations, and to identify gaps in the literature which might guide future research in this area. This review advocates additional research being needed to recommend the best MCI cognitive screening tools among different populations and environments.

**Supplementary Materials:** The following are available online at https://www.mdpi.com/article/10.3390/nu13113974/s1, Table S1: the final search strategy for MEDLINE.

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