



Detection of Malingering in the Memory of Patients with Dementia: A Pilot Study on Coin-in-the-Hand Test in a Northern Taiwan Memory Clinic

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Background: The aim of this study is to investigate the validity of the coin-in-the-hand (CIH) test with other neuropsychological tests for the detection of malingering in the memory. **Materials and Methods:** A simulated scenario design was developed to investigate the validity of the CIH test, entitled the Test of Memory Malingering (TOMM), associated with the Clinical Dementia Rating, the cognitive abilities screening instrument, the Mini-Mental Status Examination, and the WHO Quality of Life-BREF. The performances of the patients with dementia ($n = 25$) were compared with one group of normal controls ($n = 9$), and another group instructed to simulate malingering dementia ($n = 19$). **Results:** The CIH test demonstrated good validity and displayed a better sensitivity and a positive likelihood ratio than the TOMM, while patients with dementia could provide, on average, more than nine correct answers, in comparison to only more than six correct answers in the simulated malingering group. The optimal cutoff score of the CIH test is ≤ 8 . **Conclusions:** This pilot study showed that the CIH test is a quick and practical test for detecting malingering in the memory.

Key words: Malingering, Coin-in-the-Hand test, memory, dementia

INTRODUCTION

Malingering is defined as the falsification or profound exaggeration of physical or mental illness to gain external benefits such as avoiding work or responsibility, seeking drugs, avoiding prosecutions and/or trials, seeking attention, avoiding military service, obtaining school leaves, or a paid leave from a job.^{1,2} Feigning illness to receive disability compensation is common in the United States Social Security Disability Benefits, occurring in 45.8%–59.7% of adult cases.^{3,4} A study in Taiwan also estimated that 20.77%–50.85% of applicants for labor insurance disability payment faked their memory deficits.⁵ Mittenberg *et al.* estimated that 29% of

personal injury cases, 30% of disability cases, 19% of criminal cases, and 8% of medical cases probably involve malingering and symptom exaggeration.⁶ In 2011, the estimated cost of malingering in medicolegal cases totaled US\$20.02 billion.⁴

Dementia is an increasing health problem worldwide, with 35.6 million people currently diagnosed with dementia, and 7.7 million new cases reported every year.⁷ Between 2011 and 2012, 130,000 people or 4.97% of those aged 65 years and over in Taiwan had dementia,⁸ which is a heavy burden for these patients and their caregivers, community, or society.^{9–11} The malingering of dementia or other neurocognitive disorders would potentially exhaust the resources from

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the social welfare system and could cause inappropriate allocations of these resources for those who really need them, as aforementioned.^{4,5} The neuropsychological tools for detecting malingering have become increasingly important in recent years with the growing needs in forensic evaluations for cognitive and other mental problems.¹²⁻¹⁶ Furthermore, previous studies in Taiwan on the topic of forensic psychiatric evaluations have rarely investigated malingering,^{11,17-30} with only a few exceptions.^{5,31-33} Therefore, it is crucial to develop a practical tool for clinicians in the evaluations of malingering in memory and/or other problems.

The coin-in-the-hand (CIH) test was developed by Professor Narinder Kapur to detect malingering in cognitive assessment.³⁴ Several studies have confirmed that the CIH could detect faking memory impairments³⁵⁻³⁷ or even dementia,³⁸ and there are no reliable tools in Chinese for detecting such faking memory impairments. After obtaining an agreement from Professor Kapur, a Chinese translation was completed for this study. The primary purpose of the current research was to validate the Chinese version CIH test in Taiwan by providing data for the samples of cognitively intact normal controls, patients with dementia, and simulated malingering, by defining the cutoff and specificity for feigning memory problems in this population. The secondary outcome was to extend the clinical utility of this assessment by the normative and investigation data of our study such as neuropsychological tests, quality of life (QOL), and the malingering memory test. We hypothesize that there would be a difference in the groups of patients with dementia, normal volunteers, and volunteers who simulated memory problems.

MATERIALS AND METHODS

Informed consents

All participants, patients with dementia, malingering simulators, and the healthy control groups provided their written informed consents to participate in the study, and the next of kin or legally authorized representative consented on behalf of the participants with dementia.

Subjects and clinical assessments

A total of 53 participants were taken from a volunteer community sample ($n = 28$) and patients with dementia ($n = 25$). We recruited patients with dementia at the outpatient memory clinic in a medical center for 1 year. Our inclusion criteria were those aged 65 or older, and a diagnosis of dementia based on the Diagnostic and Statistical Manual of Mental Disorders, Version IV, Text Revision.¹ One senior board-certified psychiatrist with a subspecialty in geriatric psychiatry confirmed and assessed the diagnosis according to the integration of multiple sources

of information including patient and collateral history, medical history, laboratory results, neuroimaging findings, psychiatric examination findings, and neuropsychological test results. Potential participants were excluded if they had indicative motivation to feign (i.e., litigation and applying compensation). Moreover, individuals, that presented psychotic symptoms (i.e., such as delirium or behavioral and psychological symptoms of dementia) or with severe physical condition, were not eligible for inclusion because they may not have an incentive for better performance. There were 28 volunteers screened to rule out head injury, neurocognitive, or psychiatric disorders. They were further allocated to the malingering simulators ($n = 19$) and healthy control groups ($n = 9$). The malingering simulators were asked to feign that they suffered from dementia-related problems such as memory impairment and difficulty with personal care tasks.

They were told that the associated neuropsychological tests were about to take place and an inferior performance would contribute to a greater amount of compensation. In contrast, patients with dementia and the healthy control group were asked to perform honestly on the measurements.

The demographics of all the participants in the study had been collected. Assessments for neuropsychology and QOL were administered first including the Clinical Dementia Rating Scale (CDR), Cognitive Abilities Screening Instrument (CASI), Mini-Mental Status Examination (MMSE), and the WHO Quality of Life-BREF (WHOQOL-BREF). These were followed by the administration of Trials 1 and 2 of the Test of Memory Malingering (TOMM). Finally, they underwent the CIH test. All these data were collected during the face-to-face interviews by the experienced psychologist in the outpatient clinic.

Cognitive Abilities Screening Instrument

The CASI has a score ranging from 0 to 100 and offers quantitative assessment on attention, concentration, orientation, short-term memory, long-term memory, language abilities, visual construction, list-generating fluency, abstraction, and judgment. It has been commonly used in clinical practice to evaluate the cognitive function and the progression of dementia. The performance on the cognitive assessment was shown to be significantly associated with the educational level, and cutoff scores of the CASI in the diagnosis of dementia in the Chinese version are suggested to be: 49/50 for noneducated; 67/68 for educational years <6; and 79/80 for educational years more than six.³⁹ The CASI has its cross-culture usefulness in the screening and follow-up of dementia.

Clinical Dementia Rating Scale

The CDR is obtained through a semi-structured interview of the patients and informants, and the cognitive functioning

is rated in six domains of functioning as follows: memory, orientation, judgment and problem solving, community affairs, home, and hobbies, and personal care. Each of the six domain areas rated on a scale of 0 through 0.5, 1, 2, and 3 which means healthy, questionable, or very mild impairment, mild impairment, moderate impairment, and severe impairment, respectively. This scale is used to characterize each domain of cognitive and functional performance applicable to Alzheimer's disease^{40,41} and related dementia.^{42,43}

Mini-Mental Status Examination

The MMSE is a screening tool that can be used to systematically and thoroughly assess a mental status. It is composed of an 11-questionnaire measure (maximum score 30) that tests five areas of cognitive function as follows: orientation, registration, attention and calculation, recall, and language.⁴⁴ According to the previous report, normal cognition results were defined as a score of >24 in literate elders and >13 in illiterate elders.⁴⁵ The MMSE has been proved to be an effective way to estimate the severity of cognitive function,^{46,47} to follow the course of cognitive changes,⁴⁸ and to document an individual's response to treatment.⁴⁹

Test of Memory Malinger

The TOMM, a 50-item, forced-choice, visual recognition test, is the most widely used and researched tests of malingering.⁵⁰ This instrument is composing of two learning trials and a delayed retention trial, and the validation studies indicate that this instrument is considered to be a reliable tool in neuropsychological and forensic testing scenarios.^{51,52} During the test, participants are shown 50 pictures for 3 s, each with a one-second interval. Thereafter, they are given 50 recognition panels, with each panel containing the target picture and an irrelevant picture. Following the presentation of the stimuli, the participant is required to indicate the picture viewed earlier. Feedback about the accuracy of the participant's answer is offered. After two learning trials are given, a retention trial is administered 10 min later. Tombaugh *et al.* reported a criterion score below 45 on Trial 2 or the retention trial can readily distinguish individuals that deliberately faked their memory from those with neurocognitive dysfunction.⁵³ The TOMM has been verified as a valuable test, whether the participants were native English speakers or not,⁵⁴ and this test has been used in one previous study for the Chinese speakers.⁵

WHO Quality of Life-BREF

The WHOQOL-BREF is a shorter version of the original instrument that can measure the following broad domains: physical health, psychological health, social relationships, and environment. This 26-item questionnaire has been found to be

an effective cross-cultural assessment of the QOL with good to excellent psychometric properties of reliability and validity. In addition to the four domains, the WHOQOL-BREF includes two stand-alone questions to assess the rated QOL and satisfaction with health.⁵⁵ The WHOQOL-BREF Taiwan version contains the same four domains as the standard WHOQOL-BREF. The scale administration and scoring procedures are the same as for the WHOQOL and are more convenient for usage in large research studies or clinical trials.⁵⁶

Coin-in-the-Hand test

In this task, the participants were asked to remember carefully in which hand a new Taiwan ten-dollar coin (diameter = 2.5 cm, cupronickel, 7.5 g) was held and make sure it could be visualized for approximately 2 s before closing. The participants were then requested to close their eyes and count backward from 10 to 1. When the participant had finished counting, they were requested to open their eyes and tap the hand that contained the coin. After each of the 10 trials, feedback was given to the participants as to whether their responses were "right" or "wrong." The test was repeated for 10 trials, and the order of hands was randomized equally as suggested by the previous report as follows: right, left, left, right, right, left, right, left, right, left.³⁶ Patients with a neurological disorder may have no difference in performance as the control groups.³⁶ In contrast, the suspected malingerers usually and deliberately achieved, at best, at the chance level.^{35,36}

Approvals

All procedures performed in the studies involving human participants were in accordance with the Ethical Standards of the Institutional and/or National Research Committee and with the 1964 Helsinki declaration and its later amendments or comparable Ethical Standards (TSGH IRB 2-102-05-035).

Statistical analyses

The demographic data are presented as frequencies, percentages, means, and standard deviations (SD). Comparisons of differences in the assessments were performed using the one-way ANOVA followed by the *post hoc* Scheffé test and the Fisher's Exact Test for multiple groups. The overall diagnostic accuracy of the CIH and the TOMM were calculated through the receiver operating characteristics (ROC) analysis, which provides information relevant to the full range of scores that should be considered when deciding about a cutoff point for the discriminating malingering. All statistical tests were two-tailed, and the values of $P < 0.05$ were considered statistically significant. Data were analyzed with the IBM SPSS statistics version 22 (IBM SPSS statistics, Armonk, NY: IBM Corp).

RESULTS

Sample characteristics

The demographic characteristics of the three groups are summarized in Table 1. When compared with the malingering simulators, the patients with dementia were mostly male (64.0% vs. 31.6%), significantly greater in age (80.2 ± 7.3 vs. 33.7 ± 6.1), received fewer years of education (8.6 ± 6.4 vs. 16.1 ± 1.8), and were more satisfied with their QOL (85.4 ± 11.4 vs. 76.3 ± 11.4). Regarding the types of dementia, 56% were diagnosed with Alzheimer's dementia, 32% as vascular dementia, 8% as mixed type, and 4% as other types.

Coin-in-the-Hand and Test of Memory Malingering for the subjects

Table 2 shows the mean scores for the CIH and each part of the TOMM index by the groups. As can be seen, the group of malingering simulators criteria produced significantly lower scores on the CIH and all the TOMM indices ($P < 0.01$).

Next, a ROC curve was generated to differentiate the malingering simulators and dementia [Figure 1]. In the normal, healthy control group, two of the individuals in this group showed normal, age-related forgetfulness, with the CDR as 0.5. The senior board-certified psychiatrist (NST) with the subspecialty in geriatric psychiatry has confirmed that these two individuals were healthy individuals without cognitive disorders. Thus, the CDR was 0.1 ± 0.2 in this study.

Table 3 depicts that the CIH, TOMM Trial 1, and the TOMM Trial 2 indices provided a good to excellent discriminative ability, while the patients with dementia could provide an average of more than nine correct answers, in comparison to only more than six correct answers in the simulated malingering group. Furthermore, the CIH achieved the highest area under the curve value (area under the ROC curve [AUC] = 0.79, 95% CI = 0.63–0.94), followed by the TOMM Trial 1 (AUC = 0.692, 95% CI = 0.51–0.88), and the TOMM Trial 2 (AUC = 0.688,

Table 1: Sample characteristics in the groups of this study

Variable	Normal (N) ($n=9$)	Dementia (D) ($n=25$)	Malingering simulator (Ms) ($n=19$)	P^a	Scheffe Post hoc
Age (years), mean $\pm$ SD	76.2 $\pm$ 9.2	80.2 $\pm$ 7.3	33.7 $\pm$ 6.1	<0.001	N > Ms, D > Ms
Educational (years), mean $\pm$ SD	11.2 $\pm$ 3.7	8.6 $\pm$ 6.4	16.1 $\pm$ 1.8	<0.001	Ms > D
Sex, n (%)					
Male	2 (22.2)	16 (64.0)	6 (31.6)	0.035 ^a	
Female	7 (77.8)	9 (36.0)	13 (68.4)		
Marital status					
Unmarried	1 (11.1)	0	10 (52.6)	<0.001 ^a	
Married	7 (77.8)	15 (60.0)	9 (47.4)		
Widowed	1 (11.1)	10 (40.0)	0		
Financial support from					
Participants	5 (55.6)	14 (56.0)	10 (52.6)	0.008 ^a	
Parents	0	0	2 (10.5)		
Spouses	3 (33.3)	2 (8.0)	5 (26.3)		
Offspring	1 (11.1)	9 (36)	0		
Siblings	0	0	2 (10.5)		
Employment					
No	9 (100)	25 (100)	2 (10.5)	<0.001 ^a	
Yes	0	0	17 (89.5)		
WHOQOL-BREF	77.8 $\pm$ 10.0	85.4 $\pm$ 11.4	76.3 $\pm$ 11.4	0.029	D > Ms
Dementia subtype					
Alzheimer		14 (56)			
Vascular		8 (32)			
Mixed		2 (8)			
Other		1 (4)			

^aFisher's exact test. WHOQOL-BREF=WHO Quality of Life-BREF; SD=Standard deviation

Table 2: The comparisons of the results of cognitive tests in all the groups

Variable	Normal (N) (<i>n</i> =9)	Dementia (D) (<i>n</i> =25)	Malingering simulator (Ms) (<i>n</i> =19)	<i>P</i> ^a	Scheffe <i>Post hoc</i>
CIH	10.0±0.0	9.1±2.0	6.0±3.4	<0.001	N > Ms, D > Ms
CASI	92.5±5.8	57.2±21.2	78.6±20.3	<0.001	N > D, Ms > D
MMSE	28.9±1.5	17.7±6.6	23.5±6.7	<0.001	N > D, Ms > D
CDR	0.1±0.2	1.5±0.6	0.0±0.0	<0.001	D > N, D > Ms
TOMM Trail 1	46.9±6.1	38.2±8.0	28.2±15.5	<0.001	N > Ms, D > Ms
TOMM Trail 2	49.4±1.3	41.1±8.9	27.6±18.4	<0.001	N > Ms, D > Ms
TOMM Retention Trail	47.8±5.6	41.6±8.6	31.1±18.5	0.004	N > Ms, D > Ms

^aFisher's exact test. CASI=Cognitive Abilities Screening Instrument scale; CDR=Cognitive abilities screening instrument; CIH=Coin-in-the-hand test; MMSE=Mini-mental status examination; TOMM=Test of memory malingering

Table 3: The comparisons of the results of coin-in-the-hand test and test of memory malingering in all the groups

Tests	AUROC (95% CI)	SE	Optimal cutoff	Sensitivity	Specificity	PLR	<i>P</i>
CIH	0.786 (0.63-0.94)	0.08	≤8.00	0.67 (0.41-0.87)	0.88 (0.69-0.97)	5.56	<0.01
TOMM Trail 1	0.692 (0.51-0.88)	0.09	≤27.00	0.61 (0.36-0.83)	0.88 (0.69-0.97)	5.09	0.03
TOMM Trail 2	0.688 (0.50-0.87)	0.10	≤21.00	0.50 (0.41-0.87)	1.00 (0.86-1.00)	NA	0.04
TOMM Retention Trail	0.610 (0.41-0.81)	0.10	≤29.00	0.50 (0.26-0.74)	0.88 (0.69-0.97)	4.17	0.22

CIH=Coin-in-the-hand test; TOMM=Test of memory malingering; PLR=Positive likelihood ratio; NA=Not available; SE=Standard error; CI=Confidence interval; AUROC=Area under the receiver operating characteristic

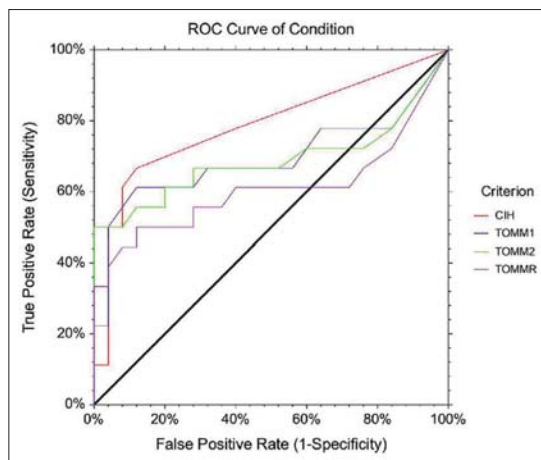


Figure 1: The receiver operating characteristics curve for comparison between coin-in-the-Hand test and Test of Memory Malingering

95% CI = 0.50–0.87). Optimal cutoff values were 8, 27, and 21, respectively. However, the area under the curve value of the TOMM Retention Trial did not reach a statistically significant level ($P = 0.22$).

Comparison of WHO Quality of Life-BREF, Cognitive Abilities Screening Instrument, Clinical Dementia Rating Scale, and Mini-Mental Status Examination in three groups

On comparison of the quality of life, WHOQOL-BREF

were significantly lower in malingering simulators than dementia patients (76.3 ± 11.4 vs. 85.4 ± 11.4); however, no significant differences were found for comparison with normal controls. We found that the CDR of the patients with dementia was 1.5 ± 0.6 (ranged from 1 to 3), which was significantly greater than the other groups (healthy control = 0.1 ± 0.2 , ranged from 0 to 0.5; and malingering simulators = 0 ± 0 , respectively). At the time of testing, the CASI and MMSE showed no significant difference between the groups of healthy control and malingering simulators. In contrast, we found that the groups of dementia patients had the lowest CASI score (57.2 ± 21.2 , $P < 0.001$) and the MMSE (17.7 ± 6.6 , $P < 0.001$) among these group [Table 2].

DISCUSSION

Coin-in-the-Hand in distinguishing patients with dementia and malingering simulators

This study was undertaken to examine the efficacy of Trial 1, Trial 2, the Retention Trial, and the CIH test in the heterogeneous groups. We found that the patients with dementia performed better than the malingering simulators. Our results further indicated that the CIH test is superior to the TOMM indices in its ability to discriminate between the groups of patients providing credible and noncredible performances on the psychological assessment. When compared to our dementia participants (MMSE = 17.7), only two of them (8%)

made more than two errors.

While there is no apparent evidence of neurological or other organic deficit, a neuropsychological test can provide the only potentially objective evidence of deficits. For forensic purposes, it is difficult to make a judgment due to the deliberate intention of exaggerating somatic or psychological problems by malingering. Although the patients with dementia were compromised in more neurocognitive domains, the simulators still had the poorest performance in the CIH test. However, further research with a larger sample size is warranted when using this test for forensic purposes.

Comparison of this study to previous literature

Kelly *et al.* when using a group of 40 head injury patients with memory impairment, showed similar mean scores of normal patient's groups and controls (10 vs. 9.75).³⁷ In a previous study by Hanley *et al.*, the authors reported that the performance of patients with amnesia was comparable to the healthy participants (9.65 vs. 9.95).³⁶ Our results found a lower MMSE score in the dementia patients; however, they relatively persevered on the performance of the CIT test. The previous report also indicated that age, education, and neurocognitive domains did not significantly correlate the errors of the CIH test among the mild dementia patients (MMSE = 21.47).³⁸ On the other hand, the cutoff score of ≤ 8 resulted in a sensitivity rate of 67% and a specificity rate of 88% (positive likelihood ratio 5.56) in distinguishing malingering simulators and dementia patients. Only six malingering simulators scored within the dementia range in this study. Kelly *et al.* demonstrated that the cutoff score of ≤ 8 yielded a sensitivity rate of 92.5% and a specificity rate of 87.5% for differentiating between those with head-injured and the malingering participants.³⁷

One previous study has shown that malingerers might have different performances in different types of compensation, although types of diagnoses were more targeted.⁵⁷ In this study, we used the approach of dementia-related problems coaching, and another study has shown that the symptom-coached group performed more poorly on the TOMM relative to the test-coached group.⁵⁸ Therefore, we might judge that the simulators would perform as an inferior performance in this study.

Comparison between Coin-in-the-Hand and Test of Memory Malingering tests

It has been an advocated; some previous studies have concluded that the TOMM is a potentially useful measure of effort in the clinical neuropsychological evaluation for malingering. According to the previous references, this testing for modality has been demonstrated to be effective with the cognitively intact individuals and ages ranging from children to older adults.^{59,60} While on the face value this test appears to

be a reasonable measure for forensic usage, the poor sensitivity rate in our results alone prevents it from being a reliable and valid screening tool for an assessment of malingering from the true dementia patients (sensitivity = 0.61, 0.50, and 0.50 for the TOMM Trial 1, Trial 2, and the Retention Trial). In a previous study by Teichner *et al.*, the authors conducted that the TOMM in the heterogeneous groups trying to establish a psychometric validation, and the result indicated that the dementia patients (MMSE = 19) performed poorly on both Trial 2 and the Retention trial.⁶⁰ As the TOMM requires the participants to recognize visual stimuli, our finding did not support that application for individuals with dementia.⁶¹ Therefore, the poor performance on the TOMM indices may well be noted in the cognitive dysfunction associated with dementia, thus it might not be a useful measure to assess the malingering of cognitive disorders including dementia.

Rationale for the use of Coin-in-the-Hand in detecting malingering memory impairments

Hiscock (1989) hypothesized that the forced-choice procedure, as originally described by Pankratz (1979) as a methodology to assess the feigned presentation of a psychophysical complaint. The previous research has demonstrated that the brain-damaged and psychiatric inpatient groups could score a nearly perfect (96% and 98%, respectively), however, the faking group only scored 60% correct answers.⁶² The CIH test is one such 2-alternative, forced-choice test. A smaller number of errors can be used as a cutoff score for suspecting exaggeration or feigning of memory impairments, however, nearly a third of the faking group scored worse than coincidence, suggesting that the tests constructed criteria using the below-chance response pattern in malingering may not be appropriate. In point of fact, a previous research demonstrated that 73% of the patients with dementia had perfect scores on the CIT test with 11% of the patients that made more than two errors.³⁸

Limitations

This is the first study to evaluate all the TOMM indices and the CIH cutoffs for differentiating malingering in a sample of Taiwanese participants. However, this study still has some limitations. First, all the participants were recruited from only one memory clinic in a medical center hospital in Northern Taiwan, with the sample size being rather small, and in a cross-sectional design, and in such a memory clinic-based study, we have not recorded that the numbers of patients with psychotic symptoms in the clinic, before the test. Second, considering the limitations of the real-life clinical situations, it has been previously argued that the malingering simulators would continue to perform closely on the CIH test as one would

have with an impending litigation case, besides the ethical difficulties of being unable to recruit patients who are pursuing claims for compensation. Third, while we have recruited the malingering simulator volunteers, these volunteers were younger than the age of the enrollees in normal and dementia groups. However, we suppose that these volunteers might not matter much in this study since ages in the participants varied in the previous studies using the CIH test.³⁵⁻³⁸ Therefore, more qualitative further researches are recommended to assess the clinical usage of the CIH testing we investigated.

CONCLUSIONS

This pilot study showed that the CIH test is quick and practical for detecting any malingering in the memory since patients with dementia could provide, on average, more than nine correct answers, in comparison to only more than six correct answers in the simulated malingering group in this test, and the optimal cutoff score of the CIH test was ≤ 8 . Further study in a larger sample size population is needed in the validity of detecting the malingering memory impairment, using the CIH test, in dementia and other neurocognitive disorders.

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Conflicts of interest

There are no conflicts of interest.

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