Neuropsychiatric Score for Early Detection of Mild Cognitive Impairment of Elderly Populations in The Community

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Research Article

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Abstract

Background: The increase in the elderly population in a developing country like Indonesia will increase people with cognitive impairment. Mild Cognitive Impairment (MCI) is the most common cognitive impairment among the elderly. However, some health workers are not satisfied with the current tools for detecting MCI in the community.

Objective: This study intends to develop a novel, easy, and accurate method for early detection of MCI of the elderly population in the community in Indonesia.

Methods: This study analyzed the database of 110 elderly population in East Jakarta, Indonesia. We explored several brief neuropsychiatric battery and developed a neuropsychiatric score to detect MCI.

Results: The abnormal verbal semantic fluency test (p = 0.000), the existence of subjective memory complaints (p = 0.007), and low education level (p = 0.049) were found to be good predictors to detect MCI. The neuropsychiatric score, a combination of those variables, with a cut-off point of 2, has good accuracy to detect MCI (Sensitivity = 91.20%; Specificity = 78.9%).

Conclusion: The neuropsychiatric score is a novel, easy, and accurate method for early detection of MCI of the elderly population in the community in Indonesia.

Introduction

The proportion of the elderly population in developing countries like Indonesia continues to grow. The number of older people in Indonesia in 2017 was 23.66 million. The number of elderly in the year 2025 is estimated at 33.69 million. The proportion of the elderly population in Indonesia in 2014 was 8.03% of the total population. The proportion of the elderly population continues to increase, estimated at 11.34% in 2020 [1].

A growing population of elderly people will increase the number of people with cognitive impairment. Mild Cognitive Impairment (MCI) is the most common cognitive impairment among the elderly in the community [1].

Mild cognitive impairment (MCI) is the stage between cognitive decline due to the normal aging process and dementia. The prevalence of MCI is around 21,3% for the elderly population [2].

The main steps to prevent MCI from getting worse are early detection and adequate management. Therefore, early detection of MCI in the elderly population is essential [3–5]. Early detection for elderly with MCI is related to primary health care teams' performance detecting elderly with MCI and referring them to referral hospital.

Health workers in Indonesia are not satisfied with the current early detection methods for MCI [6, 7]. Comprehensive neuropsychiatric assessment instruments are accurate but cannot be applied in the

community because they require a longer examination time. In contrast, the brief neuropsychiatric battery has insufficient accuracy [8–11]. Therefore we need a novel and easy yet accurate method for early detection of MCI in the elderly population.

This study intends to develop a neuropsychiatric score for early detection of MCI of the elderly population in the community in Indonesia. The neuropsychiatric score combines several brief neuropsychiatric batteries to detect MCI in the elderly. It is hoped that neuropsychiatric score can be a suitable method for early detection of MCI in the community.

Methods

Participants

This study using a cross-sectional research design. This study was conducted in East Jakarta, Indonesia. This research analyzed the database of 110 elderly population, age 60 years or older. We explored several brief neuropsychiatric battery and developed a neuropsychiatric score to to detect MCI in the elderly in the community. Measurement of predictor variables and diagnostic of MCI was carried out simultaneously by different examiners, blindly.

The sample size of this study was calculated based on sensitivity = 95%, specificity = 90%, α = 0.05, and deviation = 9% [12]. The eligibility criteria included: elderly (60 years old and over), availability during the testing phases, and can write and read. Exclusion criteria included: the history of stroke/TIA, intracranial tumors, and severe head injury, Parkinson's disease, recurrent seizure, past consumption of drugs affecting brain function, and presence of serious medical conditions.

Statistical analysis

Chi-square statistical test was used to compare the demographic, clinical factors, and results of several brief cognitive assessments between the elderly with MCI and the normal elderly. Any variables with $p < 0.25$ were then entered into multivariate analysis.

Multivariate analysis was performed to estimate the independent association between predictor variables and the diagnosis of MCI. Multivariate analysis using a logistic regression model. The statistical test is considered significant if the two-sided p-value < 0.05.

Several potential predictor variables of MCI are used to develop a neuropsychiatric score for detecting MCI in the elderly.

Neuropsychiatric score

Receiver Operating Characteristic (ROC) procedure was performed to determine the Area Under Curve and the optimal cut-point value to assess the probability of MCI. This stage produces the probability value of MCI in the elderly in the community. A test of sensitivity, specificity, and probability was done to analyze the neuropsychiatric score's validity [13].

Mild Cognitive Impairment (MCI)

The diagnosis criteria of MCI include concern regarding a change in cognition but non-demented, impairment cognitive on the objective cognitive task, and preserved baseline activities of daily living or minimal impairment [14]. Assessment of cognitive status was done using Consortium to Establish a Registry for Alzheimer's Disease Neuropsychological Battery [15]. Evaluation of the Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) was done using ADL of Katz and IADL of Lawton and Brody.

The Brief Neuropsychiatric Battery

Clock drawing test.

Subjects were instructed to draw a wall clock in the shape of a large circle, write numbers on the clock face, and draw the clock's hands at 11:10 am. The things that are assessed are: (1) the twelve numbers are placed correctly, (2) the minute hand is drawn longer than the hour hand, and (3) the shorthand is precisely pointing to the number 11. The examination result is normal if at least two scoring items are correct [16].

Verbal semantic fluency test.

Subjects were asked to name ten items from each of the four categories (color, animal, fruit, city). The examination result is normal if the total score is 20 or more [17].

Alphabetical 'WAHYU' test.

Subjects were asked to spell the word 'WAHYU', sorted forward and backward. The examination results are categorized as normal if the subject can sort the letters forward and backward correctly [18].

Subjective memory complaints.

The research subjects were asked a question: "Have you ever had complaints from family members who live together at home that you often repeat questions, or repeat the same story or statement, over and over again)?" The examination result is categorized as normal if the answer is "No".

Results

Most of the research subjects were women (70%). Among the 110 study subjects, there were 34 elderly with MCI (30.9%). Baseline characteristics and results of a brief neuropsychiatric assessment are shown in Table 1.

Table 1
Baseline characteristics and brief neuropsychiatric assessment result of the normal elderly and the elderly with MCI

Variables		MCI (-) n (%)	MCI (+) n (%)	p
Gender	Men	20 (60.6%)	13 (39.4%)	0.207
	Women	56 (72.7%)	21 (27.3%)	
Age (years)	60–65	58 (69.9%)	25 (30.1%)	0.754
	> 65	18 (66.7%)	9 (33.3%)	
Education (years)	≥ 12	59 (72.8%)	22 (27.2%)	0.155
	< 12	17 (58.6%)	12 (41.4%)	
Hypertension	No	40 (78.4%)	11 (21.6%)	0.049
	Yes	36 (61.0%)	23 (39.0%)	
Diabetes Mellitus	No	65 (71.4%)	26 (28.6%)	0.246
	Yes	11 (57.9%)	8 (42.1%)	
Clock drawing test	Normal	63 (73.3%)	23 (26.7%)	0.074
	Abnormal	13 (54.2%)	11 (45.8%)	
Verbal semantic fluency test	Normal	75 (89.3%)	9 (10.7%)	0.000
	Abnormal	1 (3.8%)	25 (96.2%)	
Alphabetical 'WAHYU' test	Normal	71 (70.3%)	30 (29.7%)	0.359
	Abnormal	5 (55.6%)	4 (44.4%)	
Subjective memory complaints	Normal	61 (84.7%)	11 (15.3%)	0.000
	Abnormal	15 (39.5%)	23 (60.5%)	

Multivariate analysis showed that abnormal verbal semantic fluency test (p = 0.000; OR = 36.696 (95% CI 23.388–42.182)), the existence of subjective memory complaints (p = 0.007; OR = 13.083 (95% CI 2.017–84.877)), and low education level (p = 0.049; OR = 6.839 (95% CI 1.697–67.142)) were found to be good predictors to detect MCI in the elderly (Table 2). These variables then combined to make the neuropsychiatric score for early detection of MCI of the elderly population. Scoring is obtained through statistical calculations using the value of B and SE. The resulting neuropsychiatric score is shown in Table 3 and Table 4.

Table 2
Multivariate logistic regression analysis

Dependent Variables	p	OR	95% CI	
			Lower	Upper
Gender	0.997	97.900	0.127	130.234
Verbal semantic fluency test	0.000 *)	36.696	23.388	42.182
Clock drawing test	0.949	0.943	0.154	5.760
Subjective memory complaints	0.007 *)	13.083	2.017	84.877
Education	0.049 *)	6.839	1.697	67.142
Hypertension	0.973	0.968	0.147	6.388
Diabetes Mellitus	0.799	0.702	0.046	10.653
*) statistically significant				

Table 3
Scoring system

Variabel	B	S.E.	B/SE	(B/SE) / 1.652	Scoring
Verbal semantic fluency test	5.726	1.313	4.361	2.639	**3**
Subjective memory complaints	2.571	0.954	2.695	1.631	**2**
Education	1.923	1.165	1.652	1	**1**

Table 4
The Neuropsychiatric Score for early detection of MCI

No	Variable	Score
1.	**Verbal semantic fluency test**	0
	Normal	3
	Abnormal	
2.	**Subjective memory complaints**	0
	No	2
	Yes	
3.	**Education**	0
	≥ 12	1
	< 12	

Receiver Operating Characteristic (ROC) procedure produced an AUC value of 0.934 (95% CI 0.882–0.986) (Fig. 1). This AUC value is included in the quality of excellent discrimination. By utilizing the sensitivity and specificity value of the AUC curve, we determine the cut-off point. The neuropsychiatric score with a cut-off point of 2 has sensitivity = 91.20%, specificity = 78.9%, likelihood ratio (+) = 4.32, and probability = 81.2%.

Discussion

There were 30.9% elderly with MCI in this study. This prevalence is higher than in previous studies with similar population characteristics. Xu S et al. and Petersen et al. stated that the prevalence of MCI in the elderly 60 years and over ranges from 8.4–25.2%. This difference is probably caused by the low educational background of the research subjects in this study [2, 4].

This study showed that low levels of education were significantly associated with the incidence of MCI. This is consistent with research by Petersen et al. and Xu S et al., which states that the prevalence of MCI will be higher in populations with lower levels of education [2, 4].

This study also showed that the presence of subjective memory complaints was statistically significant with MCI. These results are in line with research by Petersen et al. and Mitchell AJ, which showed that subjective memory complaints were associated with disruption of new long-term memory formation in MCI. [4, 22]. This variable makes sense for inclusion in a brief screening program for MCI, especially when combined with other examinations [19–21].

Research by Radanovic M et al., Mueller KD et al., and Mirandez RM et al. proven that the elderly with MCI had lower verbal fluency test results, primarily semantic fluency. This is consistent with this study's results that showed that an abnormal verbal semantic fluency test was statistically significantly associated with MCI [22–24]. Verbal fluency is a cognitive function that involves executive functioning and language skills in retrieving information from memory stored in the brain. Therefore, to assess executive functioning and language skills, verbal fluency tests can be used. Language skills reflect the left temporal lobe function. Executive function reflects the function of the frontal lobe and left prefrontal, dorsolateral cortex [25, 26].

The elderly with MCI have a risk of developing dementia of about 10–12% per year, whereas the rate of development of dementia in the average elderly population is about 1–2% per year [27, 28]. Elderly with MCI can be prevented from developing dementia if MCI can be detected early and received adequate therapy. Several studies have shown that the percentage conversion of MCI to normal cognitive function in the elderly can range from 25–40% [29, 30]. Therefore, we need a novel and easy yet accurate method for early detection of MCI in the elderly population. It is hoped that neuropsychiatric score can be a suitable method for early detection of MCI in the community. This method is early detection before the further examination to establish a diagnosis of MCI.

The neuropsychiatric score is a simple, early detection method and easy to validate. A combination of verbal semantic fluency test, subjective memory complaints variables, and education level are used to develop a neuropsychiatric score for early detection of the MCI in the community.

The accuracy of the neuropsychiatric score for detecting elderly with MCI in the community was reasonably good. The neuropsychiatric score with a cut-off point of 2 has sensitivity = 91.20% and Specificity = 78.9%.

Conclusion

This study demonstrates that neuropsychiatric scores for early detection of the MCI in the elderly can be developed for use in the community setting. This method is the early detection before the subjects are referred for the further examination to establish a diagnosis of MCI. In the meantime, a large enough multi-center study is still needed so that this neuropsychiatric score can be feasible globally. However, this study's results indicate that the scoring system approach using this neuropsychiatric score can differentiate the elderly with MCI from normal elderly people in Indonesia.

Declarations

Acknowledgments

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Conflict of interest

All authors declare that they have no conflicts of interest in this work.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Ethical clearance

This study has received approval from the Ethics Committee for Research, Faculty of Medicine, University of Muhammadiyah Prof. Dr. HAMKA, Jakarta, Indonesia.

Informed concent

Informed consent was obtained from all individual participants included in the study.

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Figures

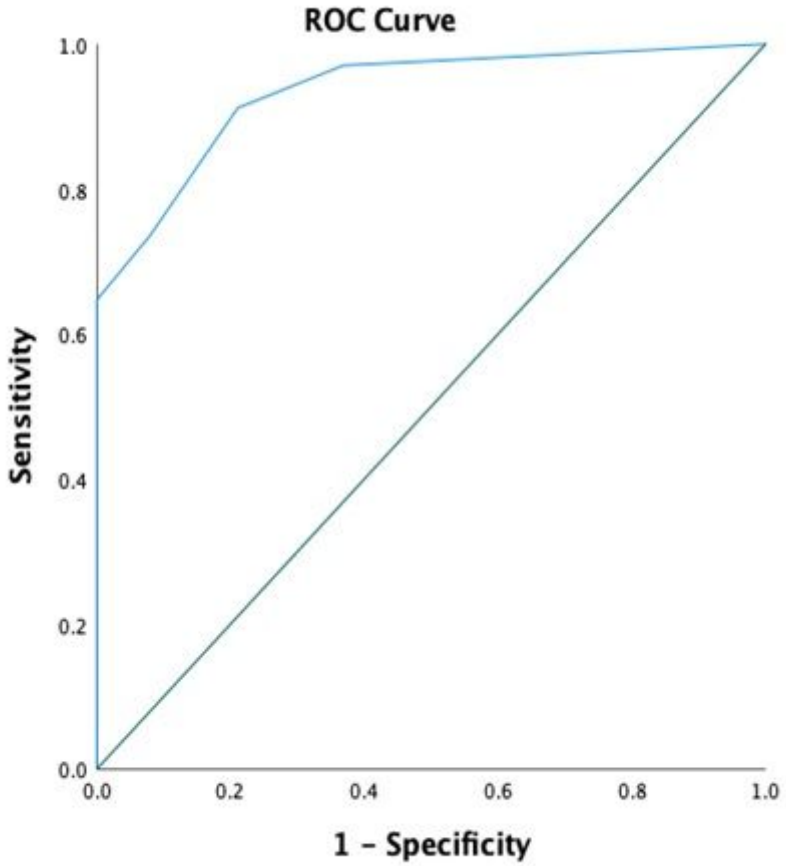

Figure 1

Area Under Curve (AUC) of the Neuropsychiatric Score for Early Detection of MCI.