

MODIFIED INFORMANT QUESTIONNAIRE ON COGNITIVE DECLINE IN THE ELDERLY (IQCODE) AS A SCREENING TEST FOR DEMENTIA FOR THAI ELDERLY

Sukhontha Siri¹, Kamolnetr Okanurak¹, Sirintorn Chansirikanjana², Dwip Kitiyaporn³
and Anthony F Jorm⁴

¹Department of Social and Environmental Medicine, Faculty of Tropical Medicine, Mahidol University; ²Department of Medicine, Faculty of Medicine at Ramathibodi Hospital, Mahidol University, Bangkok; ³The Bumrungrad International Clinical Research Center, Bumrungrad International Hospital, Bangkok Thailand; ⁴Department of Psychiatry, University of Melbourne, Australia

Abstract. A potential test for early detection of dementia in the elderly is the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), which is based on information from the informant for the elderly about the changes of the elderly in everyday cognitive functioning associated with dementia. The present study aimed to modify and assess the reliability and validity of the modified IQCODE consisting of 32 items. The study consisted of two methods of assessing dementia: DSM-IV diagnosis carried out by clinicians, and informants responding to the IQCODE. The subjects were 200 pairs of elderly subjects and their informants who visited the Geriatric Clinic, Ramathibodi Hospital. The optimal cutoff score on the modified IQCODE was 3.42, with 90% sensitivity and 95% specificity. The positive predictive values, negative predictive values, and accuracy were 0.94, 0.90, and 0.92, respectively. The IQCODE items had high internal consistency. The IQCODE associated with the elderly person's age, but not with their gender and educational level; nor were they associated with the demographic characteristics of the informant. Therefore, the IQCODE could be used as an alternative screening test for dementia in Thailand with acceptable sensitivity and specificity. This tool may be useful for dementia screening in the community and the geriatric clinic for early detection of disease.

INTRODUCTION

Health problems that are usually found in the elderly, more than other age groups, include diabetes, hypertension, arthritis, and cerebrovascular disease. Dementia is another health problem that is commonly found among elderly persons. Dementia creates a high burden for patients, their families, and society. Dementia can cause patients to experience cognitive and functional decline, increased dependency, and can complicate other health conditions (Brodsky *et al*, 1998; Dunkin and Anderson-Hanley, 1998). For the family, it may lead to financial and emo-

tional stresses. The cost of caring for a demented patient increases significantly with the severity of the disease (Peterson and Gass, 2001).

It was estimated that there were 18 million people in the world who suffer from dementia in 2000, and this number would rise to 34 million by the year 2025 (Breteler *et al*, 1992). It was estimated that by the year 2003, 11.4 % of the elderly population in 24 provinces of Thailand would be demented (Anonymous, 2002). The health status of the dementia patient could be improved if he/she could be treated in the early stages of the disease (Khachatorian *et al*, 1994). However, those who are in the early stages usually do not realize their cognitive decline until they reach moderate or severe stages of the disease, which are more difficult to treat (Valcour *et al*, 2000). Therefore, the early detection of this disease is necessary.

Dementia can be detected by several meth-

Correspondence: Dr Kamolnetr Okanurak, Department of Social and Environmental Medicine, Faculty of Tropical Medicine, Mahidol University, 420/6 Ratchawithi Road, Bangkok 10400, Thailand.
Tel: +66 (0) 2354-9100; Fax: +66 (0) 2354-9166
E-mail: tmkok@mahidol.ac.th

ods, for example, medical history interviewing, physical examinations, laboratory examinations, special instruments (eg, imaging tests), and neurological tests (eg, International Classification of Disease-10 (ICD-10). Medical history interviewing, physical examinations, and neurological tests are not complicated, but the validity is not as high as laboratory examinations and special instruments. Laboratory examinations and special instruments have high effectiveness for dementia diagnosis, but they are expensive and are only available in well-equipped hospitals.

Due to these limitations of diagnosis, dementia screening is used as an alternative method for detecting dementia in the general population because it is not complex, saves costs, and it can identify dementia in the general population (Peterson and Gass, 2001; Harris *et al*, 2001). The dementia screening is the presumptive identification of unrecognized disease or defect by application of test examinations which can be applied to sort out apparently well persons. A dementia-screening test is not intended to replace diagnosis. A person who has positive findings must be referred to a clinician for confirmatory diagnosis.

There are many screening instruments for dementia, such as: the Mini-Mental State Examination (MMSE), Clock Drawing Test (CDT), Blessed Orientation Memory (BOMC), and Memory Impairment Screen (MIS). The Mini-Mental Stage Examination (MMSE) is widely used for dementia screening, but it has been found to be affected by the socio-demographic characteristics of subject, especially education (Folstein *et al*, 1975; Uhlmann and Larson, 1991; Cummings, 1993). Some dementia screening tests involve an informant reporting about the elder's daily cognitive functioning, such as: the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), Functional Activities Questionnaire (FAQ), Activities of Daily Living (ADL), and Instrument Activities of Daily Living (IADL). Several studies have shown that these informant-based instruments have had high validity for dementia screening.

The IQCODE, widely used for dementia screening, measures an informant's perception of an elderly person's cognitive decline (Jorm and

Scott, 1991; Jorm, 2004). The IQCODE had been assessed in several countries, including China, Spain, France, and Italy (Fuh *et al*, 1995; Del-Ser *et al*, 1997; Law and Wolfson, 1995; Isella *et al*, 2002). According to this literature, the IQCODE was found to be better than the MMSE as a screening instrument for dementia in a population that has a variation of educational backgrounds. The IQCODE was developed in Australia where the cultural and socio-demographic backgrounds of people differ from Thailand. It was found that the translated questionnaire developed in one country was not appropriate to collect data in another country (Manochiopming, 1984). The questions need to be modified according to the social and cultural contexts of the people who would be studied.

This study, therefore, was intended to modify and then to assess the reliability and validity of the IQCODE so that it would be appropriate to screen dementia among the Thai elderly population.

MATERIALS AND METHODS

This research was a cross-sectional study, the data was collected one time. The data collection was carried out between May and October 2005 at the Geriatric Clinic, Faculty of Medicine at Ramathibodi Hospital, Mahidol University, Bangkok.

Subjects

The study subjects consisted of two groups. The first group included 200 elderly persons who were aged at least 60 years old, and who visited the Geriatric Clinic, Ramathibodi Hospital. They must have an informant, who could communicate in Thai and were willing to participate in the study. They were then separated into two sub-groups: 100 normal and 100 demential elderly persons. The patients were diagnosed as mild and moderate dementia following DSM-V code (American Psychiatric Association, 1994). The normal persons did not have any history of neurological or psychiatric illness.

Another subject group included 200 caregivers of the elderly subjects who served as informants. An informant was the person, aged

at least 25 years old, who lived with or had continuous contact with the elderly subjects during the previous ten years, and who could give information about the cognitive changes of the elderly persons and who was willing to participate. These informants could be a family member, relative or employee who met the inclusion criteria mentioned above.

Instrument

The instrument used in this study was the modified IQCODE. The original 26-item version of IQCODE was translated into Thai and certified by a professional translator. It was then modified to account for the Thai social and cultural contexts. In addition, another six items were added to the modified IQCODE: three items that assessed cognitive functions, and three that assessed daily life activities. The modified IQCODE was pre-tested and corrected before data collection.

Information about the demographic characteristics of elderly person and his/her informant were also collected.

Procedure

The elderly persons and their informants who met inclusion criteria were invited to participate in the study after informed consent. The informants were interviewed by either the researcher or an assistant who were blinded from the elderly person's diagnostic status. The modified IQCODE was used to assess the cognitive changes of the elderly person by asking his/her informant. The informant rated the elder's changes in memory, intelligence, and activities of daily life during the previous ten years on a five-point scale: 1 = "much improved in the previous ten years," and 5 = "much worse in the previous ten years." The modified IQCODE score was calculated by averaging the responses to all items. The range of total score was 1-5.

Analysis

The data were edited and then analyzed by using SPSS (Statistical Package for Social Science, v11.5). Descriptive statistics, such as frequency, percentage, mean, and standard deviation were used to describe the characteristics of the volunteers.

The analysis of the modified IQCODE was

separated following the roles of a screening test in public health work (Galen and Gambino, 1974):

1. Sensitivity and specificity: to determine the proficiency of a test in correctly classifying diseased persons and non-diseased persons.
2. Predictive value of positive: to measure its ability in detecting pre-symptomatic cases and estimate the number of diseased persons in a screened population.
3. Finding the best optimal cutoff point for screening instrument.

In order to cover all three functions of a screening test, the study used Receptor Operative Characteristics (ROC) analysis, following the standard rules for diagnostic tests. The ROC curve is a graphical plot of true positive probability (sensitivity) against false positive probability (1-specificity). The accuracy of the modified IQCODE is measured by the area under the ROC curve. An area of 0.90-1.00 represents an excellent screening test. Furthermore, the modified IQCODE should indicate an optimal cut-off point for classification of normal and ill persons that has high sensitivity and specificity.

The internal consistency of the modified IQCODE was estimated by the Cronbach's alpha coefficient. A regression analysis was used to assess the effects of the elderly and informant demographic characteristics on the IQCODE score (Bernard, 2000).

RESULTS

Demographic characteristics of elderly subjects

There were 200 elderly subjects: 100 normal and 100 demential persons (Table 1). The average age of the total elderly group was 72.88 years. Most of them were female (72.5%) and had at least primary school education (88.5%). In the normal group, the average age was 71.23 years, most of them were female (79%), six persons were uneducated, and 48 persons had a high school education or higher. For the demential group, the average age was 74.52 years old, most of them were female (66%), 15 persons were uneducated, and 34 persons had at least a high school education.

There were significant differences in age and

Table 1
Demographic characteristics of elderly subjects.

	Total (n=200)	Normal (n = 100)	Demential (n = 100)	p-value
Age (yr) mean \pm SD (range)	72.88 \pm 7.00 (60-89)	71.23 \pm 6.38 (60-86)	74.52 \pm 7.22 (60-89)	0.001
Sex				
Male	55 (27.5%)	21 (21%)	34 (%)	0.04
Female	145 (72.5%)	79 (79%)	66 (%)	
Education				
Uneducated	21 (11.5%)	6 (6%)	15 (15%)	0.28
Primary school	74 (37.0%)	34 (34%)	40 (40%)	
Secondary school	23 (11.5%)	12 (12%)	11 (11%)	
High school	24 (12.0%)	14 (14%)	10 (10%)	
Diploma or higher	58 (29.0%)	34 (34%)	24 (24%)	

Table 2
Demographic characteristics of the informants.

	Total (n=200)	Informant of normal (n = 100)	Informant of demential (n = 100)	p-value
Age (yr) mean \pm SD (range)	48.66 \pm 13.07 (25-78)	48.28 \pm 14.53 (25-78)	49.04 \pm 11.49 (25-77)	0.68
Sex				
Male	49 (24.5%)	32 (32%)	17 (17%)	0.14
Female	151 (75.5%)	68 (68%)	83 (83%)	
Education				
Uneducated	3 (1.5%)	1 (1%)	2 (2%)	0.18
Primary school	17 (8.5%)	8 (8%)	9 (9%)	
Secondary school	12 (6.0%)	8 (8%)	4 (4%)	
High school	14 (7.0%)	6 (6%)	8 (8%)	
Diploma or over	154 (77.0%)	77 (77%)	77 (77%)	
Relationship with the elderly				
Spouse	39 (19.5%)	21 (21%)	18 (18%)	0.33
Child	109 (54.5%)	48 (48%)	61 (61%)	
Other relatives	38 (19.0%)	24 (24%)	14 (14%)	
Friend	4 (2.0%)	3 (3%)	1 (1%)	
Employee	10 (5.0%)	4 (4%)	6 (6%)	
Frequency of meeting with the elderly				
Live with elderly	121 (60.5%)	58 (58%)	63 (63%)	0.66
Everyday	27 (13.5%)	16 (16%)	11 (11%)	
Every week	31 (15.5%)	16 (16%)	15 (15%)	
Every two weeks	9 (4.5%)	3 (3%)	6 (6%)	
Every month	12 (6.0%)	7 (7%)	5 (5%)	

gender between the normal and demential groups ($p < 0.05$). There was no significant difference in the level of education between these two groups ($p > 0.05$).

Demographic characteristics of the informants

There were 200 informants (caregivers): 100 informants of normal persons and 100 informants of demential persons (Table 2). The aver-

age age of the total group of informants was 48.66 years. Most of them were female (75.5%), and they had at least a primary school education (98.5%). For the informants of the normal persons, the average age was 48.28 years. Most of them were woman (68%), and 77 informants had a diploma degree or higher and only one person was uneducated. The majority of informants were relatives of the elderly (93%), and 58 of them lived with the elderly person, while others saw or contacted the elderly several times a month.

For the informant of demential person group, the average age informant was 49.04 years. These informants included 83 women and 17 men. Only two persons were illiterate and 77 informants had at least diploma degree. The 61 informants were children of the demented persons, and 63 informants lived with the elderly persons.

There were no significant difference in age, gender, level of education, relationship with elderly and frequency of meeting with the elderly in these two groups ($p > 0.05$).

The modified IQCODE score

The range of modified IQCODE total score

Table 3
Average IQCODE scores of the elderly subjects.

	Mean	SD	Range
Normal person	3.16	0.18	2.38-4.22
Demential person	4.02	0.44	3.19-4.99
p-value (t-test)	0.00		

was 1-5 points. The individual who received a higher score would indicate a greater impairment. The study found that the average score of the modified IQCODE for the normal group was 3.16 points and that for the demential group was 4.02 points (Table 3). The mean difference of the modified IQCODE score was significant at the 95% confidence interval.

Receiver Operating Characteristic (ROC) analysis

The area of modified IQCODE under the ROC curve was 0.98 (Fig1). The optimal cutoff point on the modified IQCODE for screening dementia was 3.42, with 90% sensitivity and 95% specificity, respectively. With this optimal cutoff point, the modified IQCODE yielded 94% positive predictive value (PPV), 90% negative predictive value (NPV), and 92% accuracy, respectively (Table 4).

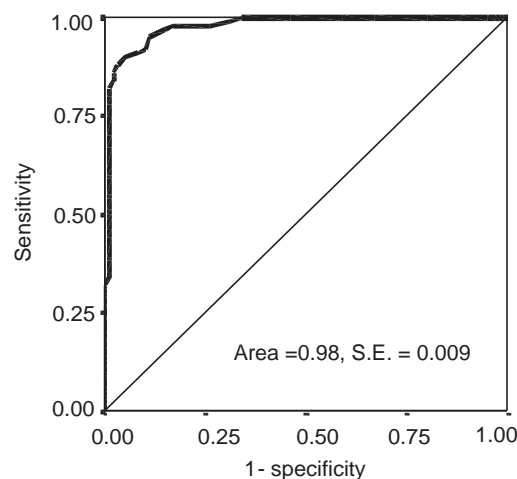


Fig 1-The receiver operating characteristic curve of the modified IQCODE.

Table 4
Dementia sensitivity and specificity of modified IQCODE scores.

Cutoff score	Sensitivity(%)	Specificity (%)	PPV(%)	NPV(%)
3.33	95	89	90	95
3.36	92	90	90	92
3.39	91	92	92	91
3.42	90	95	94	90
3.45	88	97	97	89
3.48	86	98	98	82
3.61	82	99	99	85

Table 5
The modified Informant Questionnaire on Cognitive decline in the Elderly (IQCODE).

Item	Comparing the elder's change with the previous 10 years				
	1 Much improve	2 A bit improve	3 Not much change	4 A bit worse	5 Much worse
1. Recognizing the faces of family and friends					
2. Remembering the names of family and friends					
3. Remembering things about family and friends <i>eg</i> , occupations, birthdays, addresses					
4. Remembering things that have happened recently					
5. Recall conversations a few day later					
6. Forgetting what he/she want to say in the middle of a conversation					
7. Remembering his/her address and telephone number					
8. Remembering what day and month it is					
9. Remembering where things are usually kept					
10. Remembering where to find things which have been put in a different place from usual					
11. Remembering things that happened to him/her when he/she was young					
12. Remembering things he/she learned when he/she was young					
13. Knowing about important historical events of the past					
14. Adjusting to any change in his/her day-to-day					
15. Knowing how to work familiar machines around the house					
16. Learning to use a new gadget or machines around the house					
17. Learning the new things that in general					
18. Understanding the meaning of unusual words					
19. Understanding magazine or newspaper articles					
20. Following a story in a book or on TV					
21. Contacting with friends or for business purposes					
22. Making decisions on everyday matters					
23. Handing money for shopping					
24. Handing financial matters					
25. Handing other everyday arithmetic problems, <i>eg</i> knowing how much food to buy, knowing a period of time for doing activity					
26. Using his/her intelligence to understand what's going on and to reason things through					
^a 27. Able to sing or pray the used one					
^a 28. Selecting appropriate instrument					
^a 29. Keep speak repeating					
^a 30. Carrying out daily activities					
^a 31. Traveling to familiar place					
^a 32. Working ability					

^a Added items

Modified IQCODE items

The modified IQCODE item was analyzed. It was found that it had a Cronbach's alpha of 0.97, indicating a high level of internal consistency. The correlation between the modified IQCODE score and the demographic characteristics of volunteers was not associated with the elderly persons' gender, educational back-

ground, but was associated with their age ($r^2 = 0.05$, $p < 0.02$). In addition, the modified IQCODE was not associated with any demographic characteristics of the informant.

DISCUSSION

In the present study, the IQCODE version

was translated and modified for use in a Thai elderly population. Six items on cognitive decline that are usually found in Thai demential patients were added.

The study found that the modified IQCODE had very high internal consistency (Cronbach's alpha of 0.97), high validity (90% sensitivity and 95% specificity), and high predictive value (94% PPV and 90% NPV). It was found that its score was not associated with an elderly person's educational background, gender, or occupation, but was associated with the elderly person's age. In addition, it was found that the modified IQCODE score was not associated with any demographic characteristics of the informants who responded to the questionnaire. Similar results were also found in several other IQCODE studies.

Several IQCODE studies from different countries, such as France (Law and Wolfson, 1995), Spain (Del-Ser *et al*, 1997), and China (Fuh *et al*, 1995), found that the IQCODE had classification accuracy, high internal consistency, high validity, and independence from the confounding effects of the educational background of the elderly and demographic characteristics of the informant. The IQCODE score was found to be associated with the age of the elderly (Jorm and Scott, 1991; Fuh *et al*, 1995; Law and Wolfson, 1995; Del-Ser *et al*, 1997; Isella *et al*, 2002; Jorm, 2004). Regarding the finding that the subject's age was significantly correlated with the IQCODE score, this explained by the tendency that as the subjects get older, the informants were more likely to rate them as having cognitive deficits.

The modified IQCODE has several positive features. First, the 32 items in modified IQCODE were the daily activities of life that were easy for the informant to rate in terms of changes they could observe of their elderly charges. Second, the informant was a close observer, normally a relative, and one who lived or had contact with the elderly person for an extensive period. They were found to be sensitive to changes they could detect in early cognitive changes in the elderly. Third, the modified IQCODE was not intended to assess the actual level of mental performance of the elderly person, but it could assess any deterioration observed in the elderly intelligence

adaptive behavior over the previous ten years. Therefore, it focused on the change, a critical feature of dementia, especially in mild stages when actual performance could still be close to normal. This change was the most important clue to the early diagnosis of dementia. Fourth, it was simple to use and inexpensive. It could therefore be used in clinical and community settings (Ritchie and Fuhrer, 1992).

The limitations of the modified IQCODE may be lacking the appropriate informant and the informant's objectivity in his/her responding. With further research, the modified IQCODE could be applied in different settings to compare and adjust if needed. Then, the modified IQCODE would be more appropriate for the Thai context. It can be concluded that the modified IQCODE may be used as an alternative screening test for dementia in Thailand with acceptable sensitivity and specificity. It may be useful for dementia screening in the community and geriatric clinics for early detection of disease.

ACKNOWLEDGEMENTS

This study was financially supported by the Thailand Research Fund (TRF). The authors would like to thank all of the staff at the Geriatric Clinic of Ramathibodi Hospital for their continuous assistance and support in collecting the data.

REFERENCES

- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Washington DC:APA, 1994.
- Anonymous. Prevalence of dementia in Thailand. MMSE-Thai 2002. Bangkok: Institute of Elderly, 2003. (In Thai).
- Bernard R. Fundamentals of biostatistics. 5th ed. Ch 11. Regression and correlation methods. Belmont CA: Duxbury Press, 2000: 425-509.
- Breteler MM, Claus JJ, Launer LJ, *et al*. Epidemiology of Alzheimer's disease. *Epidemiol Rev* 1992; 14: 59-82.
- Brodarty H, Clarke J, Gahguli M, *et al*. Screening for cognitive impairment in general practices toward a consensus. *Alzheimer Dis Assoc Disord* 1998; 12: 1-13.

- Cummings JL. Mini-mental state examination. *JAMA* 1993; 269: 242 0-1.
- Del-Ser T, Barquero Ms, Barquero M, *et al.* Application of the Spanish version of the informant questionnaire on cognitive decline in the elderly (IQCODE) in the clinical assessment of dementia. *Alzheimer Dis Assoc Disord* 1997;11: 3-8.
- Dunkin J, Anderson-Hanley C. Dementia caregiver burden: a review of the literature and guidelines for assessment and intervention. *Neurology* 1998; 51: S53-60.
- Fuh JL, Teng EL, Lin KN, *et al.* The informant questionnaire on cognitive decline in the Elderly (IQCODE) as a screening tool for dementia for a predominantly illiterate Chinese population. *Neurology* 1995; 45: 92-6.
- Folstein MF, Folstein SE, McHugh PR. Mini-mental state examination: a principle method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975; 12: 189-98.
- Galen RS, Gambino SR. *Beyond normality: the predictive value and efficiency of medical diagnosis.* New York: John Wiley and Sons, 1974.
- Harris RP, Helfand M, Wodf SH, *et al.* Current methods of the US preventive services task force: a review of the process. *Am J Prev Med* 2001; 20: 21-35.
- Isella V, Villa ML, Frattola L, Appolonio I. Screening cognitive decline in dementia: preliminary data on the Italian version of the IQCODE. *Neurol Sci* 2002; 23: S79-80.
- Jorm AF. The informant questionnaire on cognitive decline in the elderly (IQCODE): a review. *Int J Psychogeriatrics* 2004; 16: 1-14.
- Jorm AF, Scott R. Performance of the informant questionnaire on cognitive decline in the elderly (IQCODE) as a screening test for dementia. *Psychol Med* 1991; 21: 785-90.
- Khachatorian Z, Phelps C, Buckholtz N. The prospect of developing treatments for Alzheimer's disease. In: Terry R, Katzman R, Bick K. eds. *Alzheimer's disease.* New York: Raven Press, 1994: 445-54.
- Law S, Wolfson C. Validation of a French version of an informant-based questionnaire as a screening test for Alzheimer disease. *Br J Psychiatry* 1995; 167: 541-4.
- Manochiopming S. Assessment of communicative ability in Thai aphasic patients by using Thai version of PICA test. Bangkok: Mahidol University, 1984. Dissertation.
- Peterson CJ, Gass DA. Screening for cognitive impairment and dementia in elderly. *Can J Neurol Sci* 2001; 28: S42-51.
- Ritchie K, Fuhrer R. A comparative study of the performance of screening tests for senile dementia using receiver operating characteristic analysis. *J Clin Epidemiol* 1992; 45: 627-37.
- Uhlmann RF, Larson EB. Effect of education on the mini-mental state examination as a screening test for dementia. *J Am Geriatr Soc* 1991; 39: 876-80.
- Valcour V, Masaki K, Curb J. The detection of dementia in the primary care setting. *Arch Int Med* 2000; 160: 2964-8.