

# The diagnostic accuracy of the Thai dementia screening scale for primary care in the community

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## Abstract

**Objective:** To validate the Thai dementia screening scale (DSS) in the community setting in Thailand. **Methods:** A 3-step approach was used. First, a door-to-door survey was carried out by 36 community health volunteers (CHVs). People aged 55 years and older were screened with the Thai dementia screening scale developed previously. Second, potential cognitive impairment cases were interviewed by trained personnel using the DSS and picture recognition, verbal fluency test and the Rowland Universal Dementia Assessment Scale (RUDAS). Then suspected cases were examined by a neurologist and also sent for neuropsychological assessment by a psychologist. **Results:** There were 2,222 individuals screened by CHVs. Of these, 845 were identified as potential cognitive impairment cases. Then 585 potential cases as well as 67 cases who were normal at screening were interviewed by personnel (total 652 cases), which led to 93 suspected cases. Of these, 65 suspected cases and another 92 negative RUDAS cases were examined. There were 17 individuals with dementia, 16 with mild cognitive impairment and 70 who were possible dementia cases. At the cut-off score of 3, the DSS for CHV had a sensitivity of 100%. Combination of DSS, picture recognition and verbal fluency test for paramedical personnel had acceptable accuracy (>80%). The point prevalence of dementia in this sample was 1.5%.

**Conclusion:** The DSS by CHVs has been validated in the community setting in this study. The questionnaires can be used to screen for dementia after a half-day training program.

**Keywords:** Community; dementia; screening

## INTRODUCTION

Epidemiological studies of dementia in Thailand have shown a wide range of prevalence rates due to the use of different methods and instruments. Nearly all studies were one-stage designs which yield prevalence rates between 1.8%-16% in the age group 45 years and above.<sup>1-6</sup> Among these, only 2 studies were confirmed by neurological examination which yielded an average prevalence rate of 1.8%.<sup>3,6</sup> The other surveys were one-stage designs, with the Mini Mental State Examination (MMSE) being the most popular questionnaire. Other instruments i.e., the Chula Mental Test<sup>4</sup>, clock drawing test (CDT)<sup>7,8</sup> and Informant Questionnaire on Cognitive decline in the Elderly (IQCODE)<sup>9</sup> were administered at the community level. However, these instruments were administered by trained paramedical personnel. Recently, the Mini Cognitive Assessment Instrument (Mini-Cog) has been reported to have the highest sensitivity for screening of dementia but the studies were

performed in western countries.<sup>10</sup> However, clock drawing skills require five or more years of education.<sup>11,12</sup> Thus, the CDT and Mini-Cog are of limited use in Thailand because most of the elderly in rural areas have less than 4 years of education.<sup>1</sup>

Thailand has been an aging society since 2008.<sup>13,14</sup> The Ministry of Public Health has set key indicators since 2014 for each regional health area to evaluate geriatric syndromes (such as dementia) in the elderly using the Abbreviated Mental Test (AMT) and MMSE.<sup>15</sup> But MMSE has been under copyright since 2001<sup>16</sup>, and AMT has not been validated in the community. This highlights the need for a dementia screening tool that is comparable to, or better than, the MMSE in addition to being convenient for users.

This project was funded by the National Research Council of Thailand, to develop a dementia screening test for lay persons and paramedical personnel to screen the elderly in the community at the primary care level; and

to develop a neuropsychological battery test for clinical psychologists to use as a reference test in psychiatric hospitals or other secondary level institutions. This study aimed to validate the dementia screening scale (DSS) in the primary care setting in Thailand.

## METHODS

The 3-stage cross-sectional study was carried out from June 2017 to March 2018. Sample size was estimated using the prevalence of cognitive impairment at 12.3% ( $p=0.123$ ), <20% error ( $d=0.024$ ) and cluster sampling with design effect ( $d_{eff} = 3$ ), on the n4Studies application<sup>17</sup> (output  $N = 2159$ ) and 10% was added in case of non-compliance, with the total number being 2,398 cases. The target population was people aged 55 years and above who have been living in the selected area for at least 6 months prior to data collection. This study was approved by the ethical committee of Srithanya hospital (1<sup>st</sup> February 2016, Q9/2559).

### *Study area and population*

The Bangken sub-district located in the Maung district of Nonthaburi province consists of 9 villages (moo). Two villages (moo1 and 2) are modernized and composed of two department stores, condominium/room for rent and private villages. In moo 4, some areas are crowded (slum area) and one could only commute by foot or bicycle in small alleys. In moo 5-7, some are garden areas where commuting was more difficult. These impacted the survey because staff could not visit target persons without help from CHVs and community leaders.

In the beginning, 5 villages (moo 3 – moo 7) attached to Bangken Health Promoting Hospital (HPH) were selected that is moo 3 to moo 7, but target persons were less than 1,500 cases, therefore, some other villages from Khaisaeng were included. Eligible cases were Thai native speakers, aged 55 years and above. Blindness, brain surgery, vegetative stage, as well as known cases of mental illness such as schizophrenia and major depression, were excluded from the study. Informed consent was obtained through the head of each village and from each volunteer and caretaker prior to the survey. All were informed that the questionnaire was to identify people with cognitive impairment in the elderly population.

From the registered name list of the Health Data Center (HDC), there were 11,336 people aged 60 years and above. The demographic of

the population distributed by age and gender is shown in Table 1.

31 CHVs affiliated to Bangken HPH passed the interview by the researcher (SK) and participated in a half-day workshop held on 14 June 2017 in order to practice how to conduct the screening questionnaire properly before data collection. Another 5 CHVs affiliated to Khaisaeng HPH were trained on 29 November 2017.

Paramedical personnel (6 nurses and 3 public health technical officers) were trained to use the RUDAS and other questionnaires by the psychologist (SK). The psychologist team consisting of 6 clinical psychologists received clinical licenses by the Department of Mental Health. They were trained by the lead psychologist (SK) on how to administer the standard battery and other tests developed by researchers.

### *Instruments*

#### *For community health volunteers*

The Thai dementia screening scale contained 3 questions i.e., 1) 3 word learning: mountain, leaf and airplane, 2) What day is today? 3) Fruit fluency in 1 minute and three word recall. These questions had a cut-off point  $\leq 3$  which the sensitivity and specificity were 89% and 81.1% respectively.<sup>18</sup>

#### *For paramedical personnel*

The Thai Geriatric depression scale (TGDS)<sup>19</sup> was used to screen and exclude depression using a cut-off score of  $<5$ . Permission to use the Thai version of the Rowland Universal Dementia Assessment Scale (RUDAS) was received from Limpawattana P<sup>20,21</sup> and Storey J.<sup>22</sup> RUDAS was used as the standard screening questionnaire by our personnel and the cut-off score was  $\leq 19$  giving a sensitivity and specificity of 95% and 100% respectively.<sup>18</sup> Fruit fluency in 1 minute (maximum = 8) was substituted with animal fluency in the total score of RUDAS (RUDAS\_n-fruit) based on our previous study in which formal education level did not significantly impact fruit fluency.<sup>18</sup> However, animal and fruit fluency in 1 minute (verbal fluency or VFT) were both recorded. In addition, paramedical personnel used the DSS but the three words tested were changed to “book, street and star” in order to prevent rehearsal bias and to check the agreement between results obtained by CHV and paramedical personnel. Visual memory was tested using picture recognition consisting of 6 pictures (circle located in the middle of the square, spade, square with 2

**Table 1: Population registered name (N= 11336) and sample by age range and gender**

Age	Male (n, %)							Female (n, %)						
	HDC	CVH	staff	Dr				HDC	CVH	Staff	Dr			
				all	F2	F3	F4				all	F2	F3	F4
55-59	n/a	48						n/a	104	5				
60-64	1399	178 (12.7)	31 (17.4)	5	1	1	1	1837	353 (19.2)	67 (19.0)	7	1	0	0
65-69	1082	135 (12.5)	46 (34.1)	7	3	0	2	1486	376 (25.3)	85 (22.6)	12	2	1	0
70-74	748	139 (18.6)	36 (25.9)	7	4	1	0	1070	261 (24.4)	82 (31.4)	20	9	1	3
75-79	642	114 (17.8)	54 (47.4)	13	7	0	2	902	226 (25.1)	89 (39.4)	26	13	4	0
80-84	464	67 (14.4)	44 (65.7)	16	7	0	2	602	126 (20.9)	58 (46.0)	23	13	3	1
85-89	230	28	15	4	2	3	1	377	42	25	9	5	1	2
90-94	101	10	5	2	0	1	0	152	12	9	5	2	0	3
95-99	39	0	1	1	1	0	0	55	3	0				
>=100	75			0	0			75						
	445	38 (8.5)	21 (55.3)		3	4	1	659	57 (8.6)	34 (59.6)		7	1	5
Sum	4780	719	232	55	25	6	8	6556	1503	420	102	45	10	9
average		(15.0)	(32.3)		3.5	0.8	1.1		(22.9)	(27.9)		10.7	2.4	2.1
Total		2222	652	F2= 70 (3.2)					F3+F4 = 33 (1.5)					

HDC= health data center, CHV= community health volunteer, Dr= neurologist F2-4 = FAST2-4:possible/MCI/dementia

dots above the diagonal line, circle located in the upper corner of the square, club and square with each dot separated by the diagonal).<sup>23</sup> Recording time of RUDAS (excluding the VFT) was between 4 - 10 minutes.

*For psychologists*

Standard tests were the Digit Symbol-Incidental Learning (DS-IL) test<sup>24</sup> and the Stroop Color and Word Test(SCWT).<sup>25</sup> The tests developed by researchers were 12-word list learning<sup>23</sup> and 6 pictures selected from the naming test from clinical data which was not included in this study. RUDAS was also administered by psychologists in order to be the reference test at this stage. Fruit fluency in 1 minute was tested after the animal fluency item of RUDAS, in order to calculate the accuracy of verbal fluency test at the community level. Total assessment time was between 32-56 minutes.

*Data collection*

A three-stage design was used to identify people with dementia. First, door-to-door surveys using

the screening questionnaire was carried out on people aged 55 years and older from July 2017 to February 2018.

Second, anyone who scored 3 or below was considered a potential case and 5% of negative cases were randomly selected for further interview by paramedical personnel within 2 weeks. Then, suspected cases from the second step, plus an additional 20% of negative cases selected by the researcher (SC) were invited for further psychological testing and neurological examination within 4 weeks. Nearly all cases were assessed at their homes, with only 15 cases assessed at the community center in the village.

Dementia was defined by the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (Text Revision) (DSM-IV-TR) and the severity was classified by the Functional Assessment Staging of Alzheimer’s Disease (FAST). Clinical Dementia Rating scale<sup>26</sup> was also applied to assess judgement, problem solving and community affair. Neurological examination was done by a neurologist (OS), who was blinded to RUDAS, psychological tests. Luria test (fist-edge-palm) was assessed for those suspected to

have MCI and considered “failed” after 3 trials using each hand.

Blood tests such as thyroid function, syphilis screening test and radiography (CT brain scan) were performed according to the clinical practice guideline for dementia.<sup>27</sup> Unfortunately, some of the elderly and their relatives refused further investigations giving reasons like they have already attended other hospitals (such as university hospitals or provincial hospitals.)

*Statistical analysis*

Demographic and descriptive data were analyzed. The sensitivity and specificity of the screening questionnaire and standard tests were analyzed by MedCalc.

The DSS has two parts, the “Screen” for the question of “What day is today” and 3 words recall”; and an adjusted fruit fluency in 1 minute. If the total fruit count was  $\geq 12$ , the adjusted fruit score was 1, and if the total fruit count was  $< 12$ , the adjusted fruit score was 0.<sup>18</sup> The Screen\_v and Screen\_n stand for the Screen plus adjusted fruit score done by CHVs and paramedical personnel respectively.

The “Screen” plus 5-picture recognition (except picture 2) was named “Primary: Pri\_”. The combination of “Pri\_” plus a total fruit fluency in 1 minute was termed Pri\_fruit whereas the combination of “Pri\_” plus total fruit and animal fluency in 1 minute was designated Pri\_vocab. The Pri\_fruit, and Pri\_vocab had clinical accuracies of 95% and 96% respectively.<sup>18</sup>

The optimal cut-off point for each scale/questionnaire by receiving operating characteristic curve (ROC) was calculated. The area under curve (AUC) for each test was compared to RUDAS done by psychologists. The point prevalence of dementia was also calculated. Pearson’s correlation among Screen\_v, Screen\_n and also RUDAS by paramedical personnel (RUDASn) and psychologists (RUDASp) were analyzed.

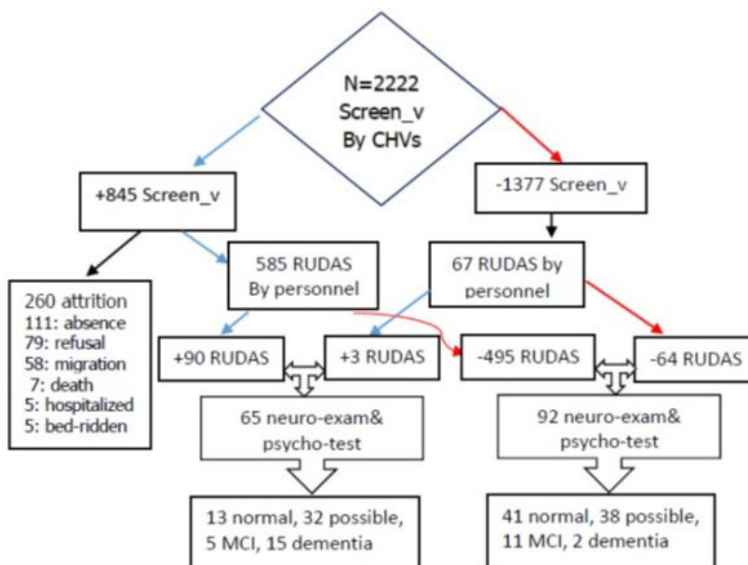
**RESULTS**

CHVs were able to identify 2,222 persons (92.7% of calculated population) from 11,336 registered names from the HDC. The number of positive cases was 845. Of these, 585 cases were invited for further interviews by medical personnel. Among 260 positive cases, 111 were absent, 79 refused interview, 58 had migrated, 7 had died, 5 were admitted to the hospital and 5 were bed-ridden.

From the total of 2,222 cases screened by CHVs, 1,503 were females (67.6%) and aged between 57-99 years. The average age was  $76.5 \pm 7.7$  years. There were 152 cases aged between 57-59 years who had negative screen results.

*Door-to-door survey*

Positive cases (845 persons) who had a score of 3 or below on the Screen\_v went for further interviews, in addition to 5% of people randomly selected from 1,377 negative cases (70 persons). The total number was 915 but only 585 positive and 67 negative persons had volunteered for the



Flow chart: 3-stage designed survey

Figure 1. Flow chart of the study

next step. (652 persons). Figure 1 shows the flow chart of the study.

*Potential cases*

Among 585 positive persons, the Screen<sub>n</sub> was positive in 65.1% (204 cases). Pearson's correlation between Screen<sub>n</sub> and Screen<sub>v</sub> was 0.23 (p<0.01). 90 people who had RUDAS<sub>n</sub>-fruit score ≤19 were considered potential cases. In contrast, the negative group (total 67 persons) yielded 3 potential cases. Therefore, from the 652 people who came for further interview, RUDAS<sub>n</sub>-fruit yielded 14.3% ((93/652) \* 100) potential cases. Another 559 people (495 positive group + 64 negative group) turned out not to be potential cases. 50% of people who had RUDAS<sub>n</sub>-fruit score of 20-23 (106 out of 212 cases) and another 10% of the remaining participants (37 out of 368 cases) were selected for further psychological testing and neurological examination. Of those selected, 63 persons with

RUDAS<sub>n</sub>-fruit score of 20-23 and 29 persons from the remaining group participated further. In summary, 157 persons consisted of 65 potential cases (from 93 RUDAS positive cases) and 92 negative cases (from 559 RUDAS negative cases).

*Suspected cases*

According to DSM-IV-TR and FAST, there were 16 MCI (FAST3), 17 dementia (FAST4 and above), 70 possible (FAST2) and 54 normal (FAST1) cases from the 157 people who went for further psychological and neurological testing. Among 17 cases of dementia, 7 were known cases of stroke and possible vascular dementia. The others were possible Alzheimer disease and had stroke risks such as diabetes mellitus, hypertension, and dyslipidemia. Demographic and clinical data of all cases are shown in Table 2.

The mean scores and area under curve (AUC) of RUDAS and other questionnaires are listed in Tables 3 and 4 respectively. The cut-off score of

**Table 2: Demographic and clinical data classified by neurological exam**

Factors	CHVs (N=2065)	FAST (n= 157 persons)				Total N=2222
		normal (n=54)	possibleF2 (n=70)	MCI(F3) (n=16)	dement(F≥4) (n=17)	
age(SD)	69.2(7.8)	73.5(8.0)	78.1(6.6)	77.8(6.6)	78.9(9.3)	76.5(7.7)
age range	57-99	60-94	62-94	62-88	63-91	
sex male	664(32.2)	16(29.6)	25(35.7)	6(37.5)	8(47.1)	719(32.4)
female	1401(67.8)	38(70.4)	45(64.3)	10(62.5)	9(52.9)	1503(67.6)
education						
No	110(5.3)	4(7.4)	9(12.9)	2(12.5)	1(5.9)	129(5.8)
Primary	1158(56.1)	31(57.4)	50(71.4)	9(56.2)	14(82.3)	1262(56.8)
Second	496(24.0)	9(16.7)	6(8.6)	4(25)	1(5.9)	516(23.2)
vocation	93(4.5)	2(3.7)	2(2.9)	0	1(5.9)	98(4.4)
bachelor	208(10.1)	8(14.8)	3(4.3)	1(6.25)	0	220(9.9)
marital						
single	288(13.9)	6(11.1)	12(17.1)	1(6.25)	2(11.8)	309(13.9)
married	1157(56.0)	29(53.7)	29(41.4)	7(43.75)	7(41.2)	1229(55.3)
separate	620(30.0)	19(35.2)	29(41.4)	8(50)	8(47.1)	684(30.9)
disease						
1.diabetes	235(11.4)	4(7.4)	6(8.6)	1(6.2)	0	246(11.1)
2.HT	393(19.0)	6(11.1)	5(7.1)	1(6.2)	4(23.5)	409(18.4)
3. CHD	23(1.1)	1(1.8)	1(1.4)	0	0	25(1.1)
4. DLD	101(4.9)	1(1.8)	0	0	0	102(4.6)
5. others	379(18.4)	11(20.4)	15(21.4)	3(18.7)	2(11.8)	410(18.5)
6. 1-5 mixed	451(21.8)	26(48.2)	34(48.6)	9(56.2)	11(64.7)	531(23.9)
7. no	365(17.7)	5(9.3)	7(10)	3(18.7)	1(5.9)	381(17.1)
dementia						
no	1998(96.8)	52(96.3)	68(97.1)	13(81.2)	11(64.7)	2142(96.4)
suspect	19(0.9)	2(3.7)	2(2.9)	2(12.5)	6(35.3)	31(1.4)
yes	42(2.0)	0	0	1(6.2)	0	43(1.9)

HT= hypertension, CHD= cardiovascular heart disease, DLD= dyslipidemia

**Table 3: Mean scores of screening scales classified by FAST (N=157)**

Scale	mean (SD), 95%CI				
	FAST				
	normal n=54	Possible n=70	MCI n=16	dementia n=17	Average
Screen_v	2.2(1.0)	1.8(0.9)	2.1(1.3)	1.2(1.0)	1.9(1.0)
	1.9,2.4	1.6,2.0	1.4,2.8	0.6,1.7	1.7,2.1
Screen_n	2.7(1.3)	2.2(1.0)	1.9(1.1)	0.9(0.9)	2.3(1.3)
	2.1,3.4	2.0,2.5	1.3,2.5	0.5,1.4	2.0,2.4
Pri_fruit	17.5(4.4)	15.2(4.5)	14.2,5.2	9.7(2.6)	15.3(4.9)
	16.3,18.8	14.2(6.3)	11.4,16.9	8.4,11.0	14.5,16.1
Pri_vocab	30.3(9.5)	25.4(8.4)	23.5(8.8)	14.8(5.2)	25.7,(9.6)
	27.7,32.9	23.4,27.4	18.9,28.2	12.1,17.4	24.2,27.2
fruit_n	11.1(3.9)	9.2(3.9)	8.2(4.3)	4.9(2.0)	9.3(4.2)
	10.1,12.2	8.3,10.2	5.9,10.5	3.9,5.9	8.7,10.0
animal_n	14.2(4.9)	10.2(5.1)	9.3(4.2)	5.0(2.9)	10.9(7.9)
	11.3,17.2	9.0,11.4	7.0,11.5	3.6,6.5	9.7,12.2
fruit_p	11.9(4.2)	9.4(3.6)	8.3(3.7)	4.9(3.5)	9.7(4.4)
	10.8, 13.1	8.5,10.2	6.3,10.4	3.0,6.7	9.0,10.4
animal_p	13.9(6.7)	9.7(4.3)	8.9(5.0)	6.0(3.9)	10.7(5.8)
	12.1,15.7	8.7,10.7	6.1,11.7	3.9,8.1	9.8,11.6
RUDAS_n-fruit	22.7(4.0)	19.8(2.9)	19.2(4.2)	14.9(3.9)	20.2(4.2)
	21.7,23.8	19.1,20.5	17.0,21.5	12.9,17.0	19.6,20.9
RUDAS_n-animal	22.6(4.2)	19.7(3.4)	19.8(3.9)	14.8(4.5)	20.2(4.5)
	21.4,23.7	18.9,20.5	17.7,21.9	12.5,17.1	19.5,20.9
RUDAS_p-fruit	22.5(4.0)	20.3(4.2)	20.6(5.7)	13.2(5.6)	20.4(5.1)
	21.4,23.6	19.3,21.3	17.4,23.8	10.3,16.2	19.6,21.2
RUDAS_p-animal	22.4(4.2)	20.2(4.5)	20.3(6.1)	13.4(6.1)	20.3(5.3)
	21.3,23.5	19.1,21.2	16.9,23.6	10.1,16.6	19.4,21.1

v = community health volunteer, n = personnel, p = psychologist,  
 RUDAS\_p = RUDAS by psychologist, RUDAS\_p-fruit = fruit fluency in RUDAS done by psychologist  
 RUDAS\_n = RUDAS by personnel, RUDAS\_n-fruit = fruit fluency in RUDAS done by personnel

**Table 4: Means and 95% CI of area under ROC curve (AUC) of questionnaires**

Scale	AUC 95%CI						p-val
	FAST classification						
	possible F2	MCI, F3	Dementia, F4	Dementia+MCI	p-val	ALL	
RUDAS_p	0.64(0.55,0.73)	0.62(0.50,0.74)	0.89(0.79,0.95)	0.76(0.65,0.88)	Ref	0.68(.060,0.75)	Ref
RUDAS_p-fruit	0.64(0.55,0.73)	0.70(0.57,0.80)	0.91(0.81,0.96)	0.76(0.66,0.85)	0.64	0.75(0.67,0.81)	0.17
RUDAS_n	0.70(0.61,0.78)	0.65(0.53,0.76)	0.89(0.79,0.95)	0.78(0.67,0.86)	0.79	0.72(0.64,0.79)	0.37
RUDAS_n-fruit	0.71(0.62,0.81)	0.70(0.57,0.80)	0.92(0.82,0.97)	0.81(0.71,0.89)	0.40	0.74(0.67,0.81)	0.14
fruit	0.69(0.60,0.77)	0.75(0.63,0.84)	0.90(0.81,0.96)	0.83(0.73,0.90)	0.19	0.73(0.66,0.80)	0.22
animal	0.70(0.61,0.78)	0.72(0.60,0.82)	0.86(0.75,0.93)	0.79(0.69,0.87)	0.62	0.73(0.65,0.80)	0.18
Screen_v	0.59(0.49,0.67)	0.56(0.44,0.68)	0.73(0.61,0.83)	0.59(0.49,0.70)	0.01	0.59(0.51,0.67)	0.09
Screen_n	0.61(0.52,0.69)	0.67(0.54,0.78)	0.85(0.75,0.93)	0.76(0.66,0.85)	0.94	0.66(0.58,0.73)	0.67
Pri_fruit	0.66(0.57,0.74)	0.67(0.55,0.78)	0.92(0.84,0.97)	0.80(0.70,0.88)	0.47	0.70(0.62,0.77)	0.59
Pri_vocab	0.65(0.56,0.73)	0.68(0.55,0.78)	0.92(0.83,0.97)	0.82(0.72,0.89)	0.37	0.70(0.60,0.77)	0.66

v = community health volunteer, n = personnel, p = psychologist RUDAS\_p = RUDAS by psychologist, RUDAS\_p-fruit = fruit fluency in RUDAS done by psychologist, RUDAS-n = RUDAS by personnel, RUDAS\_n-fruit = fruit fluency in RUDAS done by personnel

**Table 5: Sensitivity, specificity, positive negative likelihood ratio (+LR,-LR) at optimal cut of score and Youden index**

Scale/severity	Score	Sensitivity	95% CI	Specificity	95% CI	LR+	LR-	Youden
RUDAS_p								
MCI	≤19	53.3	26.6 - 78.7	77.8	64.4 - 88.0	2.4	0.6	0.3
Dementia	≤17	81.2	54.4 - 96.0	87.0	75.1 - 94.6	6.3	0.2	0.7
Sum	≤19	67.7	48.6 - 83.3	77.8	64.4 - 88.0	3.0	0.4	0.4
RUDAS_n								
MCI	≤22	93.8	69.8 - 99.8	51.8	37.8 - 65.7	2.0	0.1	0.4
Dementia	≤20	100.0	80.5 - 100.0	70.4	56.4 - 82.0	3.4	0	0.7
Sum	≤19	88.2	63.6 - 98.5	75.9	62.4 - 86.5	3.7	0.2	
Sum	≤20	78.8	61.1 - 91.0	70.4	56.4 - 82.0	2.7	0	0.5
Pri_vocab								
MCI	≤24	68.8	41.3 - 89.0	74.1	60.3 - 85.0	2.6	0.4	0.4
Dementia	≤24	100.0	80.5 - 100.0	74.1	60.3 - 85.0	3.9	0.0	0.7
Sum	≤24	84.8	68.1 - 94.9	74.1	60.3 - 85.0	3.3	0.2	0.6
Pri_fruit								
MCI	≤14	62.5	35.4 - 84.8	75.9	62.4 - 86.5	2.6	0.5	0.4
Dementia	≤14	100.0	80.5 - 100.0	75.9	62.4 - 86.5	4.2	0	0.8
Sum	≤14	81.8	64.5 - 93.0	75.9	62.4 - 86.5	3.4	0.2	0.6
Screen_v								
Dementia	≤1	64.7	38.3 - 85.8	74.1	60.3 - 85.0	2.5	0.5	0.4
	≤2	88.2	63.6 - 98.5	37.0	24.3 - 51.3	1.4	0.3	
	≤3	100.0	80.5 - 100.0	7.4	2.1 - 17.9	1.1	0	
Dementia & MCI	≤1	48.48	30.8 - 66.5	74.07	60.3 - 85.0	1.87	0.7	0.2
	≤2	66.7	48.2 - 82.0	37.0	24.3 - 51.3	1.1	0.9	
	≤3	97.0	84.2 - 99.9	7.4	2.1 - 17.9	1.0	0.4	

v = community health volunteer, n = personnel, p = psychologist,

RUDAS\_p = RUDAS by psychologist, RUDAS\_p-fruit = fruit fluency in RUDAS done by psychologist

RUDAS\_n = RUDAS by personnel, RUDAS\_n-fruit = fruit fluency in RUDAS done by personnel

DSS, Pri\_ and RUDAS are in Table 5.

Pearson's correlation between RUDAS-fruit & RUDAS-animal done by psychologists compared to those done by paramedical personnel were 0.61 ( $p < 0.01$ ) and 0.57 ( $p < 0.01$ ) respectively.

### Point prevalence

The average prevalence of dementia (FAST3 and above) in this sample was 1.5% and tended to increase with age. The two genders showed similar rates of dementia except between ages 60-69 years. If possible cases (i.e. FAST2) were included, the average prevalence of dementia would be 4.7%. (Table 1). From CHVs (Table 1), there were 42 known cases of dementia and 19 suspected cases who were not examined. If these cases were included in MCI and dementia (FAST3 and above), the possible prevalence would be 4.2%.

## DISCUSSION

This study was the first three-stage approach in a

suburban area of Bangkok. The underestimation of prevalence rate was likely as indicated by other report where urbanized provinces were selected.<sup>2,28</sup> The sample size was adequate<sup>29</sup> and comparable to other studies.<sup>2,3</sup>

In the door-to-door screening step, a number of false positive cases would have been expected that might be explained by the skill and negative attitude towards the screening. We found some elderly people who were taught to recall words asked by CHVs and also trained on fruit fluency. The sensitivity was 100% but the accuracy was significantly different from RUDAS\_p. Therefore, the Screen\_v could be used in the community by CHVs with adequate training to ensure that they are aware of the importance of getting reliable results.

The average VFT was lower than that of clinical based<sup>18</sup> and other reports which can be explained by age and education.<sup>10,30</sup> Bootstrap (n=1000) technique was used to compare means of VFT among age groups and among different education levels. The results showed that age did

not lead to any significant differences, but level of education and animal fluency did. For fruit fluency, the mean score tended to have significant differences among education levels ( $p=0.05$ ). Thus for further field study, the adjusted fruit fluency score for uneducated, primary education and above primary education should be set at 8, 10, and 11 respectively in the Screen\_v and Screen\_n in order to increase their specificity. The average scores of VFT done by psychologists and paramedical personnel were similar. Thus, VFT could be the screening test done by trained personnel to reconfirm the findings from CHVs. However, re-testing within a short period of term might lead to drawbacks primarily from practice effects.

RUDAS\_n-fruit done by paramedical personnel yielded a similar suspected case rate comparing to that of the 4<sup>th</sup> National Health Examination Survey (NHES) in 2012 which used MMSE-Thai 2002 (average rate = 12.3%)<sup>2</sup>, but it was higher than that of the 5<sup>th</sup> NHES in 2014 (8.6%).<sup>1</sup> However, MMSE done by personnel in the NHES was not reconfirmed by a clinical psychologist or neurologist. The correlations between RUDAS done by psychologists and personnel were acceptable and based on the AUC in Table 3, the accuracy of RUDAS\_n (both fruit, animal) in the community did not significantly differ from those of RUDAS\_p. Thus, RUDAS can substitute for the MMSE when used by trained paramedical personnel to screen for dementia in the community.

Originally, animal fluency was used in RUDAS. We found that RUDAS with fruit fluency yielded a similar accuracy. There was no need to adjust for formal education level because 2/3 cases had primary level of education. By Bootstrap technique, the lowest 95% confident interval of RUDAS scores for normal people who were uneducated, had primary education or above primary level education were 19, 21 and 22 respectively. The mean scores of RUDAS did not differ among age groups. The recommended cut-off score for dementia ( $>FAST3$ ) was thus 19.

As Pri\_fruit and Pri\_vocab had acceptable accuracy (80% and 82% respectively), the Pri\_fruit and Pri\_vocab can be used as screening tests by trained personnel at HPH or general hospitals.

For the prevalence of dementia, apart from attrition (death, hospitalization and vegetative state), using DSM-V criteria<sup>31,32</sup>, if MCI in this study was classified as mild dementia, the prevalence rate would be similar to that of Wangtongkam *et al.* which was based on clinical

examination.<sup>3</sup> The point prevalence of dementia in Thailand, by neurological examination during 2 decades and based on DSM criteria, seemed to be stable.<sup>3,6</sup> Prince *et al.* reported that the prevalence of dementia in developing countries using DSM criteria was lower than their criteria, explained by social and occupational domains<sup>29</sup> and the simple way of life and culture in rural areas, leading to lack of awareness of early dementia. For age-specific prevalence, the prevalence tended to increase with age as in other reports.<sup>3,6,29</sup> If possible dementia cases were included, the prevalence ranged from 1.5 % (FAST3 and above) to 4.7% (FAST2 and above).

In conclusion, the DSS has been validated in the community in this study. This questionnaire was easy for health volunteers to administer to screen people for dementia in a community setting with just a half-day training program. Paramedical personnel can use the Pri\_fruit and Pri\_vocab to reconfirm the findings from CHVs in the HPH or general hospital setting.

The limitation of this study was that the point prevalence in this sample may not represent that of Bangken sub-district due to attrition. Age and level of education should be considered in further studies.

## DISCLOSURE

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Conflict of Interest: None

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