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Voluntary cognitive screening: characteristics of participants in an Asian setting

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Background: Mild cognitive impairment (MCI) and dementia are reaching epidemic proportions in Asia. Lack of awareness and late presentation are major obstacles to early diagnosis and timely intervention. Cognitive screening may be an effective method for early detection of dementia in Asia. The purpose of this work was to study the characteristics of subjects volunteering for cognitive screening in an Asian setting and to determine the prevalence of MCI.

Methods: Retrospective and cross-sectional data from community subjects attending a screening program from 2008 to 2013 were analyzed. Information on demographics, vascular risk factors, subjective symptoms, and cognitive measures were analyzed over the 6-year period.

Results: Over the 6 years from 2008 to 2013, 1,243 community subjects voluntarily turned up for cognitive screening (91.2% were Chinese, 5.23% were Indian, 1.37% were Malay, and 2.25% were Eurasian). The mean age of the participants was 61.3 years and the mean number of years of education was 11.0 years. A total of 71.1% of participants were living in public housing, 59.8% had at least one cardiovascular risk factor, and 56.2% reported subjective cognitive symptoms. Over a period of 6 years, no significant change in demographic or clinical variables was noted. High cholesterol and hypertension were consistently the top two risk factors found in the population screened. In total, 17.2% of the total cohort had MCI. Across the 6 years, the proportion with MCI and depression was relatively constant.

Conclusion: A significant proportion of participants attending voluntary cognitive screening have MCI. Low level of education and presence of vascular risk factors are general predisposing characteristics for MCI, and there are more specific factors pertaining to sex and employment status.

Keywords: early detection, screening, cognitive impairment, dementia, vascular risk factors

Introduction

An estimated 35.6 million people live with dementia worldwide, with a forecast of doubling every 20 years.[1,2] In Singapore, the overall age-standardized and race-standardized prevalence was 1.26% based on a study published in 2008.[3] This lower prevalence compared with other countries in the region may be related to low awareness of dementia in the community and lack of community-based data. It is also likely that only patients with significant dementia were included in the 2008 study by Sahadevan et al and those in the mild stages of dementia were not represented.[3]

Cognitive impairment and dementia has far-reaching social and economic implications. In 2010, the global societal cost of dementia was US$ 604 billion.[1] Further, dementia is the main reason for institutionalization in the elderly[4] and is responsible for driving many families below the poverty line.[1,4] Thus, informal care is indispensable.[5] Support for these caregivers come largely from having an early diagnosis and a stable community infrastructure.

By bringing the diagnostic phase one step earlier and screening community dwellers for mild cognitive impairment (MCI), there are significant benefits. MCI is a high-risk

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state for dementia, with annual progression rates to dementia ranging from 12% to 15%.[6,7] Introduction of lifestyle changes such as mentally-stimulating activities and reduction of risk factors may prevent progression.[8,9] Additionally, alerting patients early when they have most of their mental capacities intact allows for autonomy in future planning, allaying fears of uncertainty with regards to medical treatments[10] and personal affairs.[11] Therefore, MCI screening is useful in maximizing ability.

Cognitive screening also forms part of the public health agenda of dementia awareness and education. The Value of Knowing study[12] found dementia to be one of the most feared diseases second only to cancer. Lack of awareness decreases resilience of the family unit, increases financial and legal vulnerability, and impedes construction of a firm social infrastructure. On the other hand, improved understanding helps eliminate stigmatization, prevents social isolation, and circumvents delays to seeking aid. By promoting public education on the warning signs of dementia and modifiable cardiovascular risk factors, it is hoped that the general public can take active measures to reduce their susceptibility to dementia.

International organizations have placed much emphasis on such efforts. The Kyoto Declaration by Alzheimer's Disease International[13] released minimum recommendations for dementia care, including monitoring community health. To supplement these guidelines, the World Health Organization launched the Mental Health Gap Action Programme,[14] with dementia as a priority non-communicable condition. In Singapore, the Health Promotion Board's strategic dementia plan[15] raised national awareness via various modalities, such as mass media and community engagement. Hence, the way forward is identification of reliable and locally relevant estimates of the country's need in order to develop effective national dementia policies.

There has been much research describing risk factors for cognitive impairment, although most have conflicting results. This ambiguity could be attributed to the different unique population groups studied, emphasizing the importance of local data for policy development. Of the more common risk factors examined, education level has consistently been found to be protective.[16,17] Cardiovascular risk factors such as high serum total cholesterol,[16] hypertension,[17] stroke,[18] and diabetes[19] have been found to be associated. These parameters are useful in describing the cohort susceptible to cognitive impairment so that steps can be taken to identify and monitor them, and if possible, improve modifiable risk factors.

This is one of the first studies to examine an Asian population who voluntarily take up cognitive screening. This naturalistic approach indirectly informs about the cohort with high awareness. Risk factors for MCI can be evaluated, both in general and for specific groups, and mismatch in characteristics between those screened to be cognitively intact and those with MCI can then be identified. These data can be used to inform awareness-raising campaigns that can be tailored specifically for the more susceptible group in order to maximize effectiveness and target screening.

Materials and methods

This is a retrospective study of urban, multi-ethnic, community-dwelling participants who voluntarily attended cognitive screening organized by the National Neuroscience Institute in Singapore from 2008 to 2013.

Screening program

The screening was organized annually and was conducted over a course of 1 day, with different cohorts enrolled into the database registry each year. The screening event was open to all Singapore residents over the age of 50 years with no prior diagnosis of a cognitive disorder. The event was publicized through local mainstream media, including radio programs and print media (eg, flyers, newspaper advertisements), in the main languages, including English, Mandarin, Malay, and Tamil. Participants were required to telephone in advance to make appointments for the cognitive screening. Registration could be made by the participant or their next-of-kin. At the time of the screening event, participants provided informed consent to be entered into the study.

Screening assessments were conducted by trained staff. Raters underwent training sessions prior to the event and were instructed to follow standardized protocols and instruction manuals for each cognitive test to ensure standardized administration. Each participant went through a three-step process:

1. Questionnaire for demographic and clinical data, including type and duration of any cognitive symptoms, use of medications, and comorbidities. They were specifically required to indicate the presence of diabetes mellitus, hypertension, high cholesterol, stroke, heart disease, and history of smoking. For demographic features, a high level of occupation referred to a job position demanding complex skills, planning, judgment, and higher qualification (eg, professional or managerial posts), whereas a low level one referred to a job position demanding simple skills, manual work, and lesser qualifications.

This includes unemployment, having an unskilled (eg, cleaner) or semi-skilled job (eg, taxi driver). High socioeconomic status required three or more of the following: high level of education, employed, high level of occupation, or private residence.

2. Cognitive screening battery: locally validated 30-point Mini-Mental State Examination (MMSE), 30-point Montreal Cognitive Assessment (MoCA), Frontal Assessment Battery (FAB), 15-point Geriatric Depression Scale (GDS), and 8-point Even Briefer Assessment Scale for Depression.[20–23] All four questionnaires were forward and back-translated into Mandarin, Tamil, and Malay to cater for the multi-ethnic population in Singapore.
3. One-to-one structured interview on cognitive symptoms using the Memory Assessment Questionnaire, a brief index of memory complaint,[24] and the Instrumental Activities of Daily Living,[25] also culturally validated in Singapore.[26]

Diagnostic process

At the end of the three-step process, a clinical diagnosis of MCI, dementia, or no cognitive impairment was made. MCI was diagnosed based on the Petersen criteria,[27] whereby: the participants and/or informant reported objective cognitive decline for at least the previous 6 months; scores on global cognition were 1.5 standard deviations below the locally validated norms for age and education;[28] functional abilities of participant were intact; and the participant had no dementia. Dementia was diagnosed based on the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition-Text Revised* (*DSM IV-TR*) criteria.[29] Depression was diagnosed in participants with a Geriatric Depression Scale score >4 or Even Briefer Assessment Scale for Depression score >2.[23]

Statistical analysis

Analyses were carried out using Stata version 10.2 software (Statacorp, College Station, TX, USA). For descriptive analyses, Mann–Whitney *U*-tests for continuous variables and chi-square tests for categorical variables were used to compare means for the demographic, clinical, and cognitive variables. Fisher's exact test was used for nominal variables if the cell count reached ≤ 5. Mann–Whitney *U*-tests were utilized as the data were non-parametric based on Shapiro–Wilk tests (all $P<0.05$). Sociodemographic, risk factor, and cognitive characteristics were described as a cohort, separately by year and by presence of cognitive impairment. A series of omnibus Kruskal–Wallis tests was used for comparison of variables across the years. Comparison between younger (≤ 60 years) and older (≥ 61 years) subjects was performed using a median split. Multivariate logistic regression analyses adjusting for age, education, ethnicity, sex, and employment were carried out. The level of statistical significance was set to $P \leq 0.05$.

Results

Over the 6 years from 2008 to 2013, 1,243 community participants (67.0% female, 33% male) voluntarily turned up for cognitive screening. In total, 91.2% were Chinese, 5.2% were Indian, 1.3% were Malay, and 2.2% were Eurasian. The mean age of the participants was 61.3±8.08 years. The mean number of years of education was 11.0±3.85, with 87% having secondary education or higher. In total, 71.1% of participants were living in public housing, 39.2% were employed, and 55.7% had or were holding high level jobs (Table 1). In terms of risk factor profile, 59.8% had at least one cardiovascular risk factor; 12.4% had diabetes mellitus, 35.7% had hypertension, 39.7% had high cholesterol, 6.6% had heart disease, 1.2% had stroke, and 4.2% were smokers; 56.2% reported subjective cognitive symptoms. The mean scores for MMSE, MoCA, and FAB were 28.0±2.31, 25.9±2.99, and 16.4±1.48, respectively.

When demographic characteristics were compared over 6 years of cognitive screening, participants were consistently predominantly female and Chinese, which reflects the demographic composition of the country. Most had secondary education or higher, and were currently unemployed (Table 2). Except for the years 2008 and 2013, there had been more participants of high than low socioeconomic status. This finding was similarly reflected in the type of housing, as most lived in public housing. The only year in which more participants held a low level occupation was 2008. For risk factor profile, the majority had at least one cardiovascular risk factor, and this was seen for all years. High cholesterol and hypertension were consistently the top two risk factors found in the population screened, and stroke was the lowest. Although the percentage reporting subjective cognitive symptoms fluctuated across the years, MMSE, MoCA, and FAB scores were relatively constant and the proportion diagnosed to have MCI was similarly consistent. Only a minority were depressed.

From Table 3, 17.2% of the cohort had MCI. Comparison between no cognitive impairment and MCI populations reveal participants with MCI to be older, of ethnic minority, and to have fewer years of education, even after adjusting for covariates of age, years of education, ethnicity, socioeconomic status, and occupation. History of prior stroke (1.2% versus 1.4%, $P=0.01842$) was found to be higher among

Table 1 Demographic, risk factor, and cognitive profiles of all subjects

	Whole cohort (n=1,243)
Demographic profile	
Age, years (mean ± SD)	61.3±8.08
Sex, n (%)	
Male	410 (33.0)
Female	833 (67.0)
Ethnicity, n (%)	
Chinese	1,133 (91.2)
Malay	17 (1.4)
Indian	65 (5.2)
Eurasian	28 (2.2)
Years of education, years (mean ± SD)	11.0±3.85
Level of education, n (%)	
No formal education	38 (3.06)
Primary	125 (10.0)
Secondary	534 (43.0)
Tertiary	546 (44.0)
Housing type, n (%)	
Public	416 (71.1)
Private	169 (28.9)
Employment, n (%)	
Employed	487 (39.2)
Unemployed	756 (60.8)
Level of occupation, n (%)	
High	597 (55.7)
Low	475 (44.3)
Risk factor profile	
Diabetes mellitus, n (%)	154 (12.4)
Hypertension, n (%)	444 (35.7)
High cholesterol, n (%)	494 (39.7)
Heart disease, n (%)	83 (6.7)
Stroke, n (%)	15 (1.2)
Smoking, n (%)	46 (4.3)
Cognitive profile	
Subjective cognitive symptoms, n (%)	699 (56.2)
MMSE (n=968), mean ± SD	28.0±2.31
MoCA (n=1,072), mean ± SD	25.9±2.99
FAB (n=704), mean ± SD	16.4±1.48

Abbreviations: FAB, Frontal Assessment Battery; MoCA, Montreal Cognitive Assessment; MMSE, Mini-Mental State Examination; SD, standard deviation.

subjects with MCI. The incidence of depression was not found to be different.

Table 4 describes the population stratified based on age. Participants aged ≥61 years had higher rates of MCI, lower education, and a higher burden of vascular risk factors. A comparison based on sex demonstrated subjective memory difficulty to be correlated with cognitive impairment in both females (adjusted odds ratio [OR] 2.60; confidence interval [CI] 1.49–4.53; *P*=0.001) and males (adjusted OR 7.90; CI 3.17–19.69; *P*=0.00001), and specifically for females, education (adjusted OR 0.27; CI 0.10–0.76; *P*=0.013) and high cholesterol (adjusted OR 0.51; CI 0.28–0.93; *P*=0.03) were implicated. When analyses were performed based on employment status, age was significantly associated with MCI among employed subjects (adjusted OR 1.08; CI 0.04–0.12; *P*=0.00001) while education was significantly associated with MCI among the unemployed (adjusted OR 0.09; CI −4.53–0.31; *P*=0.00001).

Discussion

In this study, we report on a voluntary cognitive screening Asian population across 6 years. Our findings demonstrate that females and those with higher education, higher socioeconomic status, and pre-existing vascular risk factors are more likely to attend for cognitive screening voluntarily. A significant proportion (17.2%) of community-dwelling subjects who attended screening was found to have MCI. Participants with MCI were older, female, and had fewer years of education.

When compared with other screened groups, the characteristics of this population attending for cognitive screening in Asia closely resemble those of their western counterparts. Previous studies conducted in the USA have looked at screened populations as well. Lawrence et al targeted a more elderly population.[30] Aside from the older age, our results are consistent with their predominance of females and more educated subjects. Another voluntary study using data from the free Memory Screening Outreach Program[31] also has a similar demographic profile, and found depression to be present in only a minority (17.0%). The cohort with a higher probability of cognitive impairment in that program was older and had fewer years of education, which correlates well with our MCI population.

The majority of participants reported subjective cognitive symptoms but were not depressed, and this might be their primary reason for attending voluntary screening. Further, of those who reported such symptoms, a significant proportion turned out to have MCI. This finding suggests that people who volunteer for cognitive screening have genuine cognitive deficits which they are aware of. It may be that this group of highly educated people are more sensitive to changes in their cognitive function, perhaps due to intellectually demanding jobs or hobbies. Notably, while many of them reported subjective cognitive symptoms, they did not present to their doctors. This reluctance to seek professional help may be attributed to social stigma related to cognitive impairment, lack of access to specialized services such as memory clinics, or unwillingness to pay for a seemingly trivial issue. Screening may therefore potentially be helpful in removing these barriers,[32] in tandem with education to emphasize differences between normal aging and pathological cognitive impairment.

Table 2 Demographic, risk factor, and cognitive profiles of subjects by year

	2008 (n=342)	2009 (n=119)	2010 (n=93)	2011 (n=171)	2012 (n=275)	2013 (n=243)	*P*-value
Demographic profile							
Age, years (mean ± SD)	59.2±9.02	60.9±7.22	58.8±5.63	62.7±6.44	61.7±8.27	63.9±7.66	<0.001
Sex, n (%)							0.0253 (with ties)
Male	132 (38.6)	33 (27.7)	35 (37.6)	52 (30.4)	94 (34.2)	64 (26.3)	
Female	210 (61.4)	86 (72.3)	58 (62.4)	119 (69.6)	181 (65.8)	179 (73.7)	
Ethnicity, n (%)							0.0204 (with ties)
Chinese	304 (88.9)	112 (94.2)	80 (86.0)	157 (91.8)	247 (89.8)	233 (95.9)	
Malay	0	0	2 (2.2)	1 (0.6)	11 (4.0)	3 (1.2)	
Indian	34 (9.9)	4 (3.4)	10 (10.8)	5 (2.9)	9 (3.3)	3 (1.2)	
Eurasian	4 (1.2)	3 (2.5)	1 (1.1)	8 (4.7)	8 (2.9)	4 (1.6)	
Years of education, years (mean ± SD)	10.0±3.74	10.9±3.40	11.6±3.21	11.9±3.56	11.6±4.49	11.0±3.57	<0.01
Level of education, n (%)							<0.01
No formal education	15 (4.4)	1 (0.8)	0	4 (2.3)	6 (2.2)	12 (4.9)	
Primary	67 (19.6)	13 (10.9)	7 (7.5)	8 (4.7)	21 (7.6)	9 (3.7)	
Secondary	143 (41.8)	57 (47.9)	37 (39.8)	62 (36.3)	101 (36.7)	134 (5.5)	
Tertiary	117 (34.2)	48 (40.3)	49 (52.7)	97 (56.7)	147 (53.5)	88 (36.2)	
SES, n (%)							<0.01
High	100 (29.2)	116 (97.5)	86 (92.5)	141 (82.5)	244 (88.7)	73 (30.0)	
Low	242 (70.8)	3 (2.5)	7 (7.5)	30 (7.5)	31 (11.3)	170 (70.0)	
Housing type (n=585), n (%)							
Public	254 (74.3)					162 (66.7)	
Private	88 (25.7)					81 (33.3)	
Employment, n (%)							0.0154
Employed	158 (46.2)	38 (31.9)	38 (40.9)	55 (32.2)	126 (45.8)	85 (35.0)	
Unemployed	184 (53.8)	81 (68.1)	55 (59.1)	116 (67.8)	149 (54.2)	158 (65.0)	
Level of occupation (n=1,072), n (%)							<0.01
High	36 (10.5)	100 (84.0)	77 (82.8)		209 (76.0)	175 (72.0)	
Low	306 (89.5)	19 (16.0)	16 (17.2)		66 (24.0)	68 (28.0)	
Risk factor profile							
Diabetes mellitus, n (%)	50 (14.6)	14 (11.8)	10 (10.8)	19 (11.1)	37 (13.5)	24 (9.9)	0.941
Hypertension, n (%)	118 (34.5)	43 (36.1)	26 (28.0)	65 (38.0)	98 (35.6)	94 (38.7)	0.739
High cholesterol, n (%)	132 (38.6)	55 (46.2)	29 (31.2)	74 (43.3)	107 (38.9)	97 (39.9)	0.497
Heart disease, n (%)	26 (7.6)	8 (6.7)	4 (4.3)	11 (6.4)	17 (6.2)	17 (7.0)	0.998
Stroke, n (%)	5 (1.5)	2 (1.7)	1 (1.1)	2 (1.2)	3 (1.1)	2 (0.8)	1
Smoking (n=1,072), n (%)	27 (7.9)	8 (6.7)	4 (4.3)		4 (1.5)	3 (1.2)	<0.01 (with ties)
Cognitive profile							
Subjective cognitive symptoms, n (%)	154 (45.0)	70 (58.8)	76 (81.7)	133 (77.8)	122 (44.4)	144 (59.3)	<0.01
MMSE (n=968), mean ± SD	27.6±2.84	28.7±2.04	28.6±0.247	28.2±2.88		27.9±2.30	<0.01
MoCA (n=1,072), mean ± SD	24.0±2.47	27.6±3.11	27.3±3.44		26.5±3.30	26.5±2.78	<0.01
FAB (n=704), mean ± SD	16.3±2.22	16.8±0.133				16.4±1.77	0.0749
Mild cognitive impairment, n (%)	129 (37.7)	9 (7.9)	11 (11.8)	14 (8.3)	27 (9.8)	24 (9.9)	<0.01
Depression (n=797), n (%)	65 (19.0)	21 (18.5)	10 (10.8)			47 (19.3)	0.637

Notes: MMSE and MoCA range 0–30; FAB range 0–18.

Abbreviations: FAB, Frontal Assessment Battery; MoCA, Montreal Cognitive Assessment; MMSE, Mini-Mental State Examination; SD, standard deviation; SES, socioeconomic status.

Those who were cognitively impaired were also more likely to have a low level of education. Cognitive protection conferred by a high level of education is well documented, and is attributed to having a higher cognitive reserve.[33,34] In addition, minority ethnic status as a predictor for MCI is consistent with findings from prior studies in the Western literature.[35] Notably, a protective effect of education was found to be more important in those who were unemployed, and this could be attributed to participation in more cognitively interactive hobbies after

Table 3 Normal cognition versus mild cognitive impairment

	NC (n=1,029)	MCI (n=214)	*P*-value	Adjusted OR (95% CI)	*P*-value
Demographic profile					
Age, years (mean ± SD)	61.00±7.57	62.8±10.0	0.0314	1.04 (1.02–1.06)	0.00002
Sex, n (%)			0.822	1.54 (1.08–2.19)	0.71017
Male	338 (32.8)	72 (33.6)			
Female	691 (67.2)	142 (66.4)			
Ethnicity, n (%)			0.0017		
Chinese	950 (92.3)	183 (85.5)		Reference point	
Malay	15 (1.5)	2 (0.9)		2.63 (0.89–7.79)	0.08006
Indian	39 (3.8)	26 (12.1)		2.07 (1.15–3.73)	0.0015
Eurasian	25 (2.4)	3 (1.4)		0.91 (0.30–2.72)	0.86533
Years of education, years (mean ± SD)	11.4±3.63	9.12±4.32	<0.01	1.04 (1.00–1.09)	0.03666
Level of education, n (%)			<0.01		
No formal education	21 (2.0)	17 (7.9)		0.91 (0.28–2.97)	0.87191
Primary	74 (7.2)	51 (23.8)		1.49 (0.51–4.36)	0.46456
Secondary	447 (43.4)	87 (40.7)		1.47 (0.50–4.31)	0.48670
Tertiary	487 (47.3)	59 (27.6)		Reference point	
Housing type, n (%)	(n=432)	(n=153)	0.408		
Public	300 (69.4)	116 (75.8)		1.01 (0.48–2.13)	0.98033
Private	132 (30.6)	37 (24.2)		Reference point	
SES, n (%)			<0.01		0.88626
Low	346 (33.6)	137 (64.0)		Reference point	
High	683 (66.4)	77 (36.0)		0.98 (0.69–1.38)	
Employment, n (%)			0.436		
Employed	610 (59.3)	133 (62.1)		Reference point	
Unemployed	419 (40.7)	81 (37.9)		1.09 (0.76–1.56)	0.64729
Level of occupation, n (%)	(n=872)	(n=200)	<0.01		
High	597 (68.5)	0		Reference point	
Low	275 (31.5)	200 (100)		1.31 (0.94–1.82)	0.10577
Risk factor profile					
Diabetes mellitus, n (%)	116 (11.3)	38 (17.8)	0.0088	1.16 (0.75–1.79)	0.51083
Hypertension, n (%)	357 (34.8)	87 (40.7)	0.0979	1.14 (0.83–1.57)	0.42791
High cholesterol, n (%)	400 (38.9)	94 (43.9)	0.170	0.97 (0.71–1.33)	0.865
Heart disease, n (%)	64 (6.2)	19 (8.9)	0.156	1.65 (0.97–2.81)	0.06483
Stroke, n (%)	12 (1.2)	3 (1.4)	0.774	3.57 (1.24–10.26)	0.01842
Smoking, n (%)	(n=872)	(n=200)	0.0131	1.14 (0.83–1.57)	0.42791
	31 (3.6)	15 (7.5)			
Cardiovascular risk factors, n (%)			0.0039		0.91931
0	426 (41.4)	73 (34.1)		Reference point	
1	334 (32.5)	65 (30.4)		1.02 (0.75–1.39)	
2	177 (17.2)	42 (19.6)			
3	79 (7.7)	29 (13.6)			
4	11 (1.1)	5 (2.3)			
5	1 (0.01)	0			
6	1 (0.01)	0			
Cognitive profile					
Depression, n (%)	(n=624)	(n=173)	0.267	1.11 (0.73–1.68)	0.62634
	107 (17.1)	36 (20.8)			
MMSE, mean ± SD	28.47 (2.12)	25.66 (3.45)	<0.001	1.44 (1.32–1.57)	0.00001
MoCA, mean ± SD	27.56 (2.91)	24.76 (4.76)	<0.001	1.20 (1.13–1.27)	0.00001
FAB, mean ± SD	16.72 (1.56)	15.48 (2.95)	<0.001	1.22 (1.10–1.36)	0.00014

Notes: In the multivariate logistic regression model, ORs were adjusted for covariates of years of education, ethnicity, socioeconomic status, and occupation.
Abbreviations: FAB, Frontal Assessment Battery; MoCA, Montreal Cognitive Assessment; MMSE, Mini-Mental State Examination; SD, standard deviation; SES, socioeconomic status; NC, normal cognition; MCI, mild cognitive impairment; OR, odds ratio; CI, confidence interval.

retirement. However, employment status was not found to be a sociodemographic variable predicting MCI, and this may have been related to the relatively high education in this cohort.

Additionally, most participants had at least one cardiovascular risk factor, possibly because this population with health comorbidities are more likely to have increased contact with health care professionals and so are more likely to attend

Table 4 Comparison of age groups based on median split

Total (n=1,243) Median 61.00	≤60 years (n=608)	≥61 years (n=635)	*P*-value	Multivariate OR (95% CI)	*P*-value
Demographic profile					
Age, years (mean ± SD)	54.83±3.85	67.52±5.89	0.00001	NA	NA
Sex, n (%)			0.00005	1.84 (1.43–2.37)	0.00001
Male	167 (27.47)	243 (38.27)			
Female	441 (72.53)	392 (61.73)			
Ethnicity, n (%)			0.09777		
Chinese	560 (92.11)	573 (90.24)		Reference point	
Malay	12 (1.97)	5 (0.79)		0.39 (0.13–1.14)	0.08418
Indian	25 (4.11)	40 (6.30)		1.52 (0.89–2.59)	0.12951
Eurasian	11 (1.81)	17 (2.67)		1.82 (0.81–4.08)	0.1499
Years of education, years (mean ± SD)	11.52±3.42	10.56±4.10	0.00189	1.09 (1.06–1.13)	0.00001
Level of education, n (%)			0.14232		
No formal education	21 (3.45)	17 (2.68)		Reference point	
Primary	58 (9.54)	67 (10.55)		1.53 (0.72–3.27)	0.2734
Secondary	279 (45.89)	255 (40.16)		1.13 (0.57–2.26)	0.72892
Tertiary	250 (41.12)	296 (46.61)		1.16 (0.57–2.33)	0.67777
Housing type, n (%)	(n=345)	(n=240)	0.38680		
Public	250 (72.46)	166 (69.17)		Reference point	
Private	95 (27.54)	74 (11.65)		1.06 (0.66–1.71)	0.80746
SES, n (%)			<0.00001		<0.00001
Low	286 (47.04)	197 (31.02)		Reference point	
High	322 (52.96)	438 (68.98)		2.21 (1.73–2.81)	
Employment, n (%)			<0.00001		<0.00001
Employed	351 (57.73)	136 (21.42)		Reference point	
Unemployed	257 (42.27)	499 (78.58)		5.41 (4.15–7.05)	
Level of occupation, n (%)			<0.00001		0.00736
High	359 (59.05)	287 (45.20)		Reference point	
Low	249 (40.95)	358 (54.80)		1.41 (1.10–1.80)	
Risk factor profile					
Diabetes mellitus, n (%)	52 (8.55)	102 (16.06)	0.00006	1.96 (1.35–2.85)	0.00045
Hypertension, n (%)	156 (25.66)	288 (45.35)	<0.00001	2.33 (1.82–3.00)	<0.00001
High cholesterol, n (%)	210 (34.54)	284 (44.72)	0.00024	1.52 (1.20–1.93)	0.00062
Heart disease, n (%)	29 (4.77)	54 (8.40)	0.00838	1.66 (1.01–2.72)	0.0457
Stroke, n (%)	6 (0.99)	9 (1.42)	0.48716	1.18 (0.40–3.51)	0.76294
Smoking, n (%)	25 (4.11)	21 (3.31)	0.45227	0.83 (0.43–1.59)	0.57118
Cardiovascular risk factors, n (%)			0.19019		
0	238 (39.14)	261 (41.10)		Reference point	
1	201 (33.06)	198 (31.18)		0.87 (0.66–1.15)	0.32757
2	101 (16.61)	118 (18.58)		1.11 (0.80–1.55)	0.54278
3	61 (10.03)	47 (7.40)		0.71 (0.46–1.09)	0.11745
4	5 (0.82)	11 (1.73)		2.36 (0.79–7.09)	0.12647
5	1 (0.16)	0 (0.00)		0	0.99958
6	1 (0.16)	0 (0.00)		0	0.99959
Cognitive profile					
MCI, n (%)	77 (12.66)	130 (20.47)	0.00022	1.72 (1.25–2.38)	0.00096
Depression, n (%)	(n=415)	(n=382)	0.85584	1.06 (0.77–1.45)	0.75044
	208 (49.88)	189 (49.48)			
MMSE, mean ± SD	28.42±1.90	27.58±3.12	<0.00001	1.12 (1.05–1.19)	0.00029
MoCA, mean ± SD	27.60±2.72	26.45±4.09	<0.00001	1.09 (1.04–1.15)	0.00092
FAB, mean ± SD	16.82±1.57	16.16±2.22	<0.00001	1.19 (1.08–1.31)	0.00046

Notes: In the multivariate logistic regression model, ORs were adjusted for covariates of years of education, ethnicity, socioeconomic status, and occupation.
Abbreviations: FAB, Frontal Assessment Battery; MoCA, Montreal Cognitive Assessment; MMSE, Mini-Mental State Examination; SD, standard deviation; SES, socioeconomic status; MCI, mild cognitive impairment; OR, odds ratio; CI, confidence interval.

health screening events. While the relationship between cardiovascular risk factors and cognitive impairment is complex, it has been found previously that the combined synergistic effects of multiple vascular risk factors may expedite the process of cognitive decline.[32] This study found a prior history of stroke to be more correlated with cognitive dysfunction, which is consistent with previous findings.[36,37] High cholesterol in particular has been found to be significant

among females, and has been examined previously.[16,38] A recent study has found higher apolipoprotein e4-related risk of developing Alzheimer's dementia in females, and this also partly accounts for the female preponderance with MCI.[39] Vascular risk factors have been implicated in the etiology of dementia,[40] hinting at a common neural basis and highlighting the importance of screening in this vulnerable cohort. However, longitudinal investigations are needed to elucidate causal relationships. In this population with comorbidities, visits to the doctor provide an ideal window of opportunity to screen for cognitive impairment and encourage a healthy lifestyle and management of medication. By managing all risk factors to address the multifactorial nature of cognitive decline, progression to dementia can be delayed.

MCI involves more substantial cognitive and memory decline than normal aging and represents a significant risk factor for development of dementia.[41] Although there is no disease-modifying drug available specifically for dementia as yet, there are numerous benefits of recognizing cognitive impairments early. The lack of pharmacological therapies elevates the importance of non-pharmacological management, which also serves to prevent overmedicalization of patients, many of whom are already at high risk of polypharmacy.[42] With more prompt detection, there is more time for these psychosocial measurements to be put in place, as opposed to late detection of moderate-to-severe dementia, when even hard-hitting pharmaceutical methods may only provide partial symptom control. Further, education is needed to optimize risk factors, including commencement and adherence with medications and lifestyle changes. Moreover, the importance of identifying MCI is set to increase with the eventual advent of trials involving newer preventative drugs, such as secretase inhibitors and immunotherapies.[43] These key learning points have to be conveyed to the public in order to remove barriers and increase uptake of screening.

The profile of the screened cognitively intact population differs from that of the MCI group. Hence, if nationwide screening is applied on a voluntary basis, the population served would be people who are financially secure and at low risk of being missed by the health system. More vulnerable groups may be missed due to a lack of awareness or access, and so more aggressive methods are needed, such as a house-to-house approach or targeted community screening. This mismatch highlights the gap in awareness of dementia, and education should be targeted specifically to the group that is at a higher risk.

The sociodemographic characteristics of those older participants (≥61 years) were male sex, few years of education, higher socioeconomic status, not gainfully employed, and lower-level occupation (Table 4). Higher proportions of older participants were found to have cardiovascular risk factors of diabetes mellitus, hypertension, high cholesterol, and heart disease. In terms of cognitive performance, there were higher proportions of persons with MCI in the older age groups, and their performance on the MMSE, MoCA, and FAB was noticeably poorer relative to that of their younger counterparts. Given that the Asian community-dwelling elderly 61 years and above constitute a high-risk group for developing MCI, public education efforts should actively target this older age group.

To our knowledge, this is the first study to describe the characteristics of an Asian population that takes up voluntary cognitive screening using a large cohort. We assessed both cognitive and clinical parameters using standardized and locally validated tools and protocols with trained staff, which would increase the sensitivity of detecting cognitive impairment. However, the limitations include large proportions of relatively highly educated (87.0%), Chinese (91.2%), and female (67.0%) participants. Our population may therefore have a different set of characteristics when compared with the rest of Singapore as a whole, and our findings may not necessarily be generalizable. Due to the opportunistic cross-sectional design of this study, cognitive tests and demographic factors collated over the years are not uniform. Given the retrospective nature of this study, its results should be interpreted with caution, and causal inferences cannot be drawn. Further, there were ceiling effects of the cognitive tests used, which masked differences in cognitive function between the MCI and non-MCI groups. Future work could include more challenging cognitive tasks, using a more comprehensive and robust battery of neuropsychological assessments to elucidate these differences.

The unique design of this study has allowed insight into the awareness of cognitive impairment in the population and identified risk factors in the Asian population for MCI. Results from this study may provide preliminary evidence that the presence of a low level of education and vascular risk factors are general predisposing characteristics for MCI, with specific factors pertaining to sex and employment status. It is clear that targeted free screening with addition of informant report is the way forward. Public education on early recognition of MCI and optimizing risk factors is also crucial in staving off the debilitating consequences of cognitive impairment.

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Author contributions

VH and NHZ had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis, as well as the preparation, review, or approval of the manuscript. AN, LL, ES, and NK were responsible for the design and execution of the cognitive screening exercise over the 6-year study period, including logistic arrangements, cognitive evaluation, and consultation; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. The sponsors were responsible for the design and execution of the cognitive screening exercise over the 6-year study period, including logistic arrangements, cognitive evaluation, and consultation. The sponsors were not responsible for the collection, management, analysis, or interpretation of the data, or the preparation, review, or approval of the manuscript, or decision to submit the manuscript for publication. All authors contributed toward data analysis, drafting and revising the paper and agree to be accountable for all aspects of the work.

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