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Prevalence of very mild and mild dementia in community-dwelling older Chinese people in Hong Kong

Linda C. W. Lam,[1] Cindy W. C. Tam,[1] Victor W. C. Lui,[1] W. C. Chan,[2] Sandra S. M. Chan,[1] Sunny Wong,[1] Ada Wong,[3] M. K. Tham,[3] K. S. Ho,[3] W. M. Chan[3] and Helen F. K. Chiu[1]

[1] *Department of Psychiatry, The Chinese University of Hong Kong, New Territories, Hong Kong SAR, The People's Republic of China*
[2] *Castle Peak Hospital, Tuen Mum, Hong Kong SAR, The People's Republic of China*
[3] *Elderly Health Service, Department of Health, Hong Kong SAR, The People's Republic of China*

ABSTRACT

Introduction: In this report, the results of a household survey were used to examine the prevalence of very mild and mild dementia in Chinese older persons in Hong Kong.

Methods: The study adopted a two-phase design. At Phase 1, 6100 subjects were screened using the Cantonese version of the Mini-mental State Examination (MMSE) and a short memory inventory. At Phase 2, 2073 subjects were screened positive and 737 were evaluated by psychiatrists. Clinical Dementia Rating (CDR) and cognitive assessment were used for diagnosis of dementia. Very mild dementia (VMD) was defined as a global CDR of 0.5, with memory and non-memory subscale scores of 0.5 or more. Mild dementia was classified for subjects with a CDR of 1.

Results: The overall prevalence of VMD and mild dementia for persons aged 70 years or above was 8.5% (95%CI: 7.4–9.6) and 8.9% (95%CI: 7.8–10.0) respectively. Among subjects with clinical dementia, 84.6% had mild (CDR1) dementia. Logistic regression analyses revealed that older age, lower educational level and significant cerebrovascular risk factors were risk factors for dementia, while regular physical exercise was a protective factor for dementia.

Conclusions: A sizable proportion of community-living subjects suffered from milder forms of dementia. They represent a high risk for early intervention to reduce potential physical and psychiatric morbidity.

Key words: prevalence, mild dementia, Chinese, community

Correspondence should be addressed to: Dr. Linda C. W. Lam, Department of Psychiatry, The Chinese University of Hong Kong, Shatin, NT, Hong Kong SAR, The People's Republic of China. Phone: +852 26076026; Fax: +852 26671255. Email: cwlam@cuhk.edu.hk. Received 9 May 2007; revision requested 12 Jun 2007; revised version received 28 Jun 2007; accepted 29 Jun 2007. First published online 25 September 2007.

Introduction

Increasing life expectancy has been associated with an exponential increase in the number of older persons with dementia. Large-scale epidemiological surveys on the prevalence of dementia have focused on patients with well-established disease. Studies of milder forms of cognitive impairments in old age are mostly from developed countries (Fisk *et al.*, 2003). On the other hand, it is expected that the greatest increase in the dementia population will come from developing countries in the next few decades (Ferri *et al.*, 2005; Wimo *et al.*, 2006). A recent review of prevalence studies conducted in China estimated that 1.26% of people over 60 years old had Alzheimer's disease (AD) (Liu *et al.*, 2003). Sociodemographic and lifestyle factors may modulate prevalence of the disease (Zhang *et al.*, 2006). Regular exercise has been associated with reduced risks of cognitive deterioration (Teri *et al.*, 2003; Larson, *et al.*, 2006). Attention to cognitive stimulating exercise and cerebrovascular risk factors (CVRFs) are also lifestyle factors that may influence cognitive function at old age. As these factors are potentially modifiable, their significance as public health promotion strategies in reducing the incidence of dementia should be carefully investigated (Qiu *et al.*, 2007).

Consensus studies have provided invaluable information on the prevalence of dementia across different ethnic groups (Prince *et al.*, 2003; Ferri *et al.*, 2005). There are, however, great variations in the reported prevalence of Mild Cognitive Impairment (MCI) (Panza *et al.*, 2005). The differences in case definition, methodology, genetic makeup, lifestyles and health factors are all contributing factors. In the present study, we aimed to evaluate the prevalence of milder forms of dementia and sociodemographic risk factors in community-dwelling older Chinese people in Hong Kong. In the selection of available assessment tools for milder forms of dementia in the Chinese community, the Clinical Dementia Rating (CDR) was chosen because the assessment is based on clinical information obtained from the subject and informants (Hughes *et al.*, 1982; Morris *et al.*, 2001). CDR is a semi-structured interview comprising five global ratings (0 normal cognition; 0.5 questionable dementia (QD); 1 mild dementia; 2 moderate dementia; 3 severe dementia). There are six subscales in different domains to form a global clinical impression. Subjects with CDR of 0.5 are likely to include those with MCI or very mild dementia (VMD). As the clinical entity of MCI has not been well characterized in community-dwelling subjects in the region, the current report only focused on subjects with VMD and mild dementia (CDR 1). It has been suggested that VMD is likely to represent a stage of very mild AD. For the present study, VMD was defined as a global CDR of 0.5, with memory and three or more non-memory domains rated as 0.5 (Storandt *et al.*, 2002; Cacchione et al., 2003).

Methods

Study sample

The study was conducted from October 2005 to July 2006. The Phase 1 screening was conducted via the Thematic Household Survey (THS)

commissioned by the Census and Statistics Department (C&SD) of the Hong Kong SAR Government. In the THS, households were randomly selected in accordance with a scientifically designed sampling scheme by C&SD. Approximately 15,000 households were successfully enumerated in the THS conducted from October 2005 to December 2005. The THS covered the land-based non-institutional population across Hong Kong, which, at the time of enumeration, numbered about 6.9 million of whom 15.3% were aged 60 and over. In every successfully enumerated household, a trained interviewer identified the target respondents (i.e. those aged 60 and over) and invited them to participate in the Phase 1 screening.

Study design and procedure

This was a two-phase study to estimate the prevalence of dementia across the spectrum of severity, including very mild, mild, moderate and severe dementia. In Phase 1, participants were screened by trained lay interviewers. Those who scored below the cutoff (described below) were invited to participate in Phase 2. Phase 2 assessment was conducted either at the regional social centers or at the participants' homes. All subjects were interviewed by an experienced psychiatrist and research assistant (RA) for diagnosis of dementia and its severity. The study has been approved by the ethics committees of the Chinese University of Hong Kong and the Department of Health. Written informed consent was obtained for each subject in each phase independently. For moderate to severely demented subjects who were unable to give consent, the first degree relatives were contacted for consent.

Phase 1 population survey

The screening tools in Phase 1 comprised the Cantonese version of the Mini-mental State Examination (CMMSE)(Chiu *et al.*, 1998), and the Abbreviated Memory Inventory for the Chinese (AMIC). AMIC is a brief memory questionnaire which looks for subjective memory problems. Its validity has been evaluated among a group of local Chinese elders with mild cognitive impairment (MCI) and mild dementia (Lam *et al.*, 2005). Three groups of subjects were invited for Phase 2 assessment. The first group of subjects had screened positive for dementia: their CMMSE scores were below the local cutoff for dementia (18 and below for illiterate persons; 20 and below for those with one to two years of education; 22 and below for participants with more than two years of education).

The second group comprised subjects with possible very mild dementia (VMD). The CMMSE scores of this group were above the local cutoff for dementia. They also had significant memory complaints as evaluated by AMIC. To determine the educational level adjusted cutoff scores of MMSE and AMIC, an algorithm was derived from an independent sample of 396 community Chinese elders as follows: (1) to screen for VMD, all subjects with CMMSE scores ≤ 23 were considered positive; (2) for subjects with ≤ 2 years of education, the screen-positive criteria were an AMIC score ≥ 3 if CMMSE scores were between 24 and 26; (3) for subjects with 2–6 years of education, the screen-positive criteria were either CMMSE 24, or AMIC ≥ 3 and a CMMSE score between 25 and 27; and (4) for subjects with > 6 years of education, the

screen-positive criteria were either MMSE of 25 or 26, or AMIC ≥ 3 and CMMSE scores between 27 and 28. With the cutoff estimated above using an independent sample, the sensitivity to identify subjects with VMD and clinical dementia (CDR 1 to 3) was 97%. The specificity to identify the cognitively intact subjects (CDR 0) was 72%. The third group consisted of 5% of randomly recruited screen negative subjects. They were assessed for evaluation of the specificity of the screening tools. All lay interviewers of Phase 1 underwent training for CMMSE and AMIC before commencement of the project. The intraclass correlation coefficient (ICC) of the AMIC and CMMSE scores was 0.88 and 0.72 respectively.

Phase 2 clinical evaluation

Phase 2 assessments were conducted either in regional social centers for older persons, or at the participants' homes. In this phase, a psychiatrist from the research team interviewed the subjects for diagnosis of dementia.

Diagnostic criteria for severity of dementia and subtypes

At Phase 2, a trained psychiatrist conducted CDR and diagnostic assessment for dementia. Clinical dementia was defined according to clinical criteria given in the DSM-IV (American Psychiatric Association, 1994). Due to limitations in resources, diagnoses of dementia subtypes were based on clinical criteria without the concomitant investigation using neuroimaging. The diagnosis of AD followed the criteria of the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criteria for possible AD (McKhann *et al.*, 1984). The diagnosis of possible vascular dementia (VaD) was based on the National Institute of Neurological Disorders and Stroke-Association Internationale pour la Recherche et l'Enseignement en Neurosciences (NINDA-AIREN) criteria (Román *et al.*, 1993). Diagnosis of Parkinson's disease related dementia (PDD) and dementia with Lewy bodies (DLB) was based on the consensus guidelines of the report of the consortium on DLB international workshop (McKeith *et al.*, 1996).

The severity of dementia was determined by global CDR algorithms of 1 to 3 indicating mild to severe dementia (Hughes *et al.*, 1982). For subjects rated with a global CDR of 0.5, they were classified as having very mild dementia (VMD) if the memory and three or more non-memory subscales were rated as 0.5 or above (Storandt *et al.*, 2002). Subjects with memory-only and/or less than three non-memory domains rated as 0.5 were grouped as having MCI. For the purpose of this study, subjects with MCI would be excluded for estimation of prevalence of VMD and associated risk factors. In situations where one psychiatrist has difficulty in deciding the severity of cognitive impairment, the clinical history would be reviewed by two senior old age psychiatrists of the research team with over ten years of clinical experience. Consensus opinion was used to determine the severity and subtypes of dementia using standard criteria.

Cognitive assessment

Apart from clinical interview, a cognitive battery was conducted by an independent research assistant. For those with Phase 2 assessments conducted at social centers, a more extensive cognitive battery was performed. The cognitive assessment included the Chinese version of the ADAS-Cog (Chu *et al.*, 2000) and MMSE, digit span, Chinese trail making and category verbal fluency tests (CVFT) (Lam *et al.*, 2006). For subjects with Phase 2 assessments at home, a simplified cognitive battery consisting of list learning, delayed recall, CVFT, similarities and differences were conducted due to limitations in the physical environment.

Clinical assessment

Demographic factors and physical health status were obtained and recorded through a checklist. The physical factors of interests included significant CVRFs and practice of regular physical exercise. CVRFs were calculated from a physical illness score checklist. The score included a summation of history for each of the following medical disorders: significant hypertension and diabetes (as defined by a need for regular specialist attention and patient report of complications), presence of hyperlipidemia, heart disease including arrhythymia, and cerebrovascular accident. Physical exercise practiced for more than 6 months was categorized according to the nature of activity: stretching (SE), aerobic (AE) and mind-body (MB) exercise. A history of self-reported depression necessitating medical treatment was analyzed as a separate risk factor. For all consenting participants, blood tests for fasting glucose and cholesterol were performed. Subjects with clinical diagnosis of dementia were referred to the geriatric, memory or psychogeriatric clinics for comprehensive evaluation.

Data analysis

The prevalence of VMD and clinical dementia was determined using standard methods with a two-phase design. The prevalence rates were computed using clinical diagnosis of subjects assessed at Phase 2 and adjusted proportionally to all screen-positive subjects, and then the full cohort of Phase 1 participants (Dunn *et al.*, 1999). Figure 1 shows the flow chart of recruitment and assessment status. At Phase 1, 6891 subjects were invited for assessment. Of these, 6100 (88.5%) subjects completed assessment; 791 (11.5%) were either unwilling to participate or uncooperative during the assessments. Their responses were considered by the field workers as unreliable. The demographic information of the 11% uncooperative subjects was compared to the 6100 Phase 1 participants. There was no gender difference between the two groups ($\chi^2 = 2.4$, $p = 0.12$). Uncooperative subjects were older than Phase 1 participants by an average of 2.8 years (72.9 versus 70.1, $p < 0.001$). A total of 2073 subjects (33.9%) failed Phase 1 screening and were considered as screen-positive, while 737 (35.6%) agreed to Phase 2 assessment. An additional group of 194 subjects from the screen-negative group were assessed at Phase 2 as controls. Comparisons between the screen-positive subjects who refused and completed Phase 2 assessment revealed no significant differences in MMSE scores, age, educational

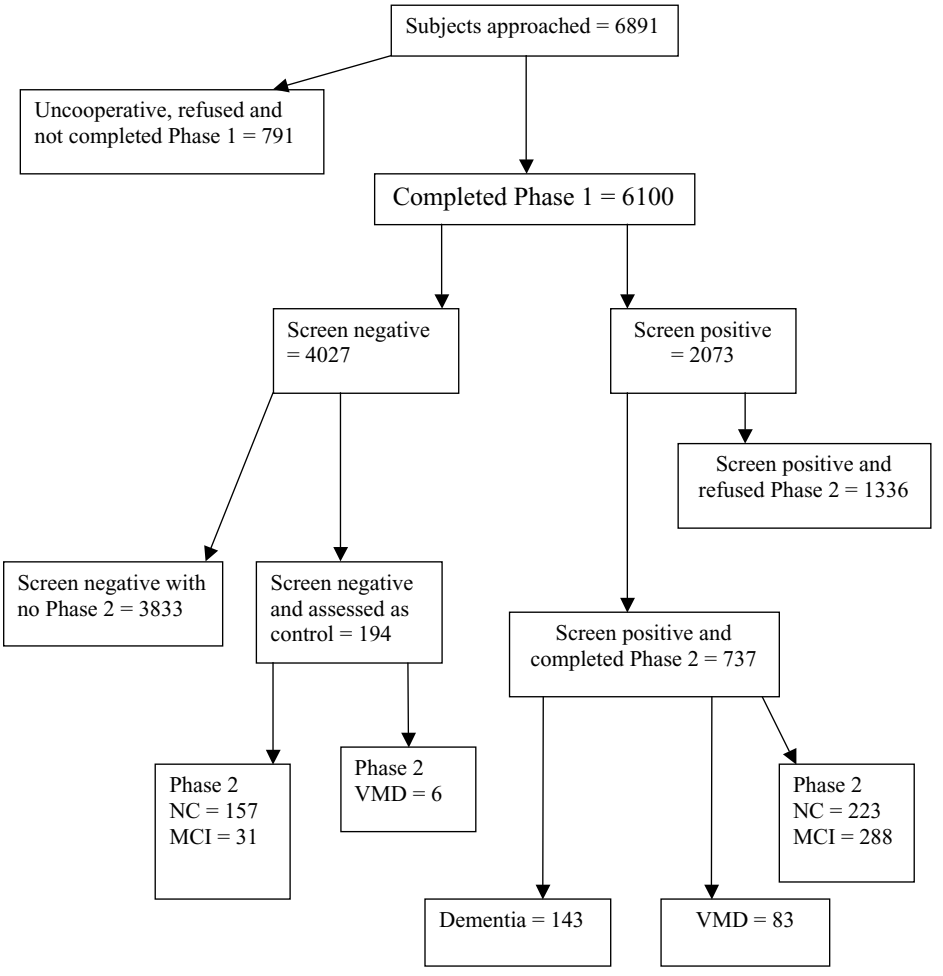

Figure 1. Flow chart of study.
NC = normal cognition (clinical dementia rating = 0); MCI = mild cognitive impairment; VMD = very mild dementia.

attainment, monthly family income and number of CVRFs (p = not significant). Subjects assessed at Phase 2 had higher AMIC scores than those who refused (1.3 versus 0.96, $t = 4.37$, $p < 0.001$). The mean AMIC scores of both groups were below the cutoff considered clinically significant (AMIC = 3)(Lam *et al.*, 2005). Overall, a higher proportion of men were assessed than those who refused Phase 2 assessment ($\chi^2 = 4.48$, $p = 0.03$) (Table 1). The weighing of Phase 2 diagnosis was adjusted according to the proportion of screen-positive responders versus non-responders and stratified with gender and age groups (before and after 70 years of age) (Figure 1). Age and sex specific prevalence of dementia of different severity were determined and proportionally adjusted from the Phase 2 participants to the whole sample. The 95% confidence intervals were estimated using standardized ratios adjusted according to the proportion of corresponding

Table 1. Demographic characteristics of Phase 1 full cohort and screen-positive subjects

	PHASE 1 SUBJECTS (N = 6,100)	SCREEN POSITIVE AND COMPLETED PHASE 2 (N = 737)	SCREEN POSITIVE AND REFUSED PHASE 2 (N = 1,336)	P-VALUE #
Age	70.7(7.5)	73.6(7.9)	73.0(7.9)	n.s.
Sex	3018:3082	313:424	504:832	n.s.
M:F (< 70)	1515:1372	116:123	201:262	n.s.
M:F (≥ 70)	1503:1710	197: 301	303: 570	n.s.
Educational attainment				n.s
Illiterate	1409(23.1%)	267(36.2%)	465(34.8%)	
2 years or less	800(13..1%)	91(12.4%)	212(15.9%)	
2 to 6 years	1797(29.5%)	179(24.3%)	274(20.5%)	
> 6 years	2094(34.3%)	200(27.1%)	385(28.8%)	
MMSE	25.6(4.2)	21.4(4.7)	21.4(4.2)	n.s.
AMIC total score	0.6(1.1)	1.3(1.7)	0.96(1.4)	< 0.001†
Exercise type				n.s.
NE	1486(24.4%)	209(28.4%)	341(26.5%)	
SE	3251(53.3%)	396(54.0%)	784(58.7%)	
AE	735(12.0%)	63(8.5%)	116(8.7%)	
MB	628(10.3%)	69(9.4%)	95(7.1%)	

Notes: #Comparison of screen positive subjects who completed versus those who refused Phase 2 assessments; †Mann-Whitney U tests; figures in brackets represent standard deviations unless otherwise specified; n.s. = non-significant.
Exercise type: NE = no exercise, SE = stretching exercise, AE = aerobic exercise, MB = mind-body exercise.

gender and age groups. Subtypes of dementia were reported according to the clinical assessment using the criteria specified above.

Because the focus of the present study was to determine clinical characteristics of milder dementia in the community, the evaluation of potential risk factors was compared between cognitively intact subjects and those with VMD and mild dementia (CDR 1) independently. Information obtained from Phase 2 participants was used to compute the associations. Factors significantly associated with VMD and mild dementia compared with cognitively intact subjects was analyzed using Logistic Regression Analysis. Data analyses were performed using the SPSS for Windows version 14.0. Statistical significance was set at $p < 0.05$ with Bonferroni corrections adjusted for multiple comparisons.

Results

Age and sex-specific prevalence of dementia at different levels of severity

The age and sex-specific weighted prevalence of VMD and clinical dementia is depicted in Table 2. The overall prevalence of VMD and mild dementia for

Table 2. Weighted prevalence of very mild and clinical dementia in different age groups

AGE GROUPS	VERY MILD DEMENTIA (%)	95% CI	MILD DEMENTIA (CDR 1) (%)	95% CI
60–64	2.0	1.3–2.7	0.8	0.3–1.27
Women	0.9	0.2–1.6	0.5	0–1.0
Men	3.0	1.8–4.2	1.1	0.4–1.8
65–69	3.4	2.6–4.3	2.1	1.4–2.8
Women	2.0	1.0–3.0	2.8	2.4–4.0
Men	4.8	3.4–6.4	1.4	0.6–2.2
70–74	5.9	4.6–7.2	4.7	3.6–5.8
Women	9.0	6.5–11.6	7.4	3.4–11.4
Men	2.8	1.6–4.1	2.1	1.1–3.1
75–79	8.1	6.3–9.9	8.4	6.6–10.2
Women	8.7	6.1–11.3	11.0	6.5–17.5
Men	7.7	5.2–10.2	5.8	3.7–7.9
80–84	9.2	6.7–11.7	14.2	11.1–17.3
Women	12.5	8.6–16.4	19.9	14.2–25.6
Men	4.9	2.1–7.7	6.5	3.2–9.7
85 or above	19.7	14.8–24.6	19.1	14.3–23.9
Women	14.5	9.4–19.6	19.9	11.3–28.5
Men	30.4	19.8–41.0	17.6	9.6–25.6
Age ≥ 60	5.8	4.4–5.6	5.4	4.8–6.1
Women	6.3	5.3–7.3	7.6	6.3–8.9
Men	5.1	4.2–6.0	3.1	2.4–3.8
Age ≥ 70	8.5	7.4–9.6	8.9	7.8–10.0
Women	10.2	8.6–11.8	12.3	10.2–14.4
Men	6.6	5.1–8.1	5.0	3.7–6.3

CI: confidence intervals.

persons 70 years or above was 8.5% (95% CI: 7.4–9.6) and 8.9% (95% CI: 7.8–10.0) respectively. The prevalence of VMD increased with age, but the rate of increase was less than the corresponding increase in clinical dementia. Women had a higher prevalence of dementia until advanced age over 85 years (Table 2). The characteristics of subjects with normal cognition (CDR 0), VMD and mild dementia as assessed at Phase 2 were reported in Table 3. The sensitivity and specificity of the Phase 1 screening tool was weighted according to the proportion of diagnostic groups, and adjusted with the proportion of responders and non-respondents of screen-positive subjects. If an overall screen-positive (combining dementia and VMD cutoff) cutoff value was adopted, the sensitivity for detecting VMD and clinical dementia was 65.5% and 100% respectively. The specificity for screening negative subjects as free from VMD and clinical dementia was 72.9%.

Table 3. Demographic and cognitive characteristics of Phase 2 subject groups

	NORMAL COGNITION CDR 0	VERY MILD DEMENTIA	MILD DEMENTIA CDR 1
Age*	69.7 (6.4)	77.1 (7.3)	78.3 (7.2)
Sex (women:men)†	198:187 (51%:49%)	57:32 (64%:36%)	82:39 (68%:32%)
Educational level*	6.5 (4.7)	2.5 (3.9)	1.3 (2.6)
MMSE*	27.3 (1.9)	23.3 (2.7)	18.5 (3.4)
Significant CVRFs*	0.6 (1.1)	1.1 (1.4)	1.0 (1.4)
Exercise habit†			
NE (%)	98 (26%)	37 (42%)	55 (47%)
SE (%)	153 (40%)	42 (48%)	50 (43%)
AE (%)	69 (18%)	5 (6%)	4 (4%)
MB(%)	60 (16%)	4 (5%)	7 (6%)

*Kruskal Wallis test, $p < 0.005$; †Pearson chi squares, $p < 0.005$; NE = no exercise, SE = stretching exercise, AE = aerobic exercise, MB = mind body exercise; Significant CVRFs, summation of history for each of the following medical disorders: significant hypertension and diabetes (as defined by a need for regular specialist attention and patient report of complications), presence of hyperlipidaemia, heart disease including arrhythymia and cerebrovascular accident.

Subtypes of dementia

Diagnoses of dementia subtypes were based on clinical criteria as evaluated by psychiatrists. As subjects with VMD had not yet satisfied diagnostic DSM-IV criteria for clinical dementia, the analyses of dementia subtypes were based on subjects with clinical dementia (CDR 1 to 3). For subjects satisfying a current clinical diagnosis of dementia, 84.6% suffered from mild (CDR 1), 9.8% suffered from moderate (CDR 2) and 5.6% suffered from severe (CDR 3) dementia. With regards to dementia subtypes, 73.5% satisfied criteria for possible AD (17.0% with prominent CVRFs); 22.4% satisfied criteria for possible VaD and 3.9% had dementia with Parkinsonian features (DLB and Parkinson's disease related dementia).

Factors associated with VMD and mild dementia

Demographic and lifestyle factors were compared among normal, VMD and mildly demented (CDR 1) subjects respectively. VMD and CDR 1 subjects were significantly older and had lower educational levels (t-tests, $p < 0.001$). A higher proportion of women were found among subjects with dementia (χ^2, $p < 0.05$). The difference in sex ratio was more significant in mildly demented ($\chi^2 = 9.95$, $p = 0.002$) than VMD group ($\chi^2 = 4.63$, $p = 0.03$). A history of depression was not associated with both VMD and mild dementia (χ^2, $p > 0.05$). Subjects with VMD and mild dementia both had a higher score for significant CVRFs (Mann-Whitney U tests, $p < 0.05$). There were also significant differences in the practice of regular physical exercise between cognitively intact and impaired

Table 4. Logistic regression analyses of demographic and physical health factors in differentiating subjects with normal cognition from very mild and mild dementia

	VERY MILD DEMENTIA	MILD DEMENTIA (CDR 1)
Age*†		
OR	1.13	1.16
95% CI	1.09–1.18	1.11–1.21
Sex		
OR	1.33	1.29
95% CI	0.75–2.35	0.72–2.33
Education*†		
OR	0.85	0.72
95% CI	0.79–0.91	0.65–0.80
Significant CVRFs		
OR	1.21	1.20
95% CI	0.97–1. 51	0.97–1.47
Exercise (SE)*		
OR	0.59	0.55
95% CI	0.33–1.09	0.30–1.0
Exercise (AE)*		
OR	0.34	0.23
95% CI	0.12–1.02	0.07–0.81
Exercise (MB)*†		
OR	0.23	0.34
95% CI	0.07–0.76	0.12–0.97

OR, odds ratio; CI, confidence interval; *significant risk factor differentiating subjects with CDR 0 from mild dementia; †significant risk factor differentiating subjects with CDR 0 from those with very mild dementia $p < 0.05$; exercise (with reference to no exercise), SE = stretching exercise, AE = aerobic exercise, MB = mind body exercise.

subjects. A higher proportion of NC subjects performed physical exercise, compared with VMD ($\chi^2 = 9.20$, $p = 0.002$) and CDR 1 groups ($\chi^2 = 19.48$, $p < 0.001$). Logistic regression analyses were carried out to identify significant factors associated with VMD and CDR 1 groups. For both groups, older age and lower educational level were significant risk factors while the practice of regular MB exercises was a protective factor. The protective effects of SE and AE were significant in the CDR 1 group only (Table 4).

Discussion

The present study aimed to identify the prevalence of early-stage dementia in Chinese older persons. Over 10% of community-dwelling subjects over the age of 70 years suffered from very mild and mild dementia. We have adopted

the concept of VMD for early detection of high risk populations. For subjects with VMD, comprehensive clinical evaluation revealed impairment in overall cognition, although the severity had not yet reached the current diagnostic threshold for dementia. With advances in the detection of early neuropathology, it may be necessary to consider a shift in the diagnostic paradigm so that milder forms of dementia can be detected earlier to obtain the maximal benefits of intervention. Further prospective studies on elderly people with VMD would help to clarify the reliability and stability of this conceptual framework.

A higher educational level was associated with a lower risk of developing dementia, even in the VMD group. As a significant proportion of the Chinese older cohort had low levels of literacy, this may have contributed to a higher prevalence of dementia. As predicted, advancing age is associated with a higher prevalence of dementia. There was a higher proportion of demented subjects with CVRFs, which are identified as risk factors for both AD and VaD. Significant CVRFs could be identified in a sizable proportion of AD subjects. Although the association between CVRFs and dementia is not a novel finding, our results reiterate the need for attention to early treatment of cardiovascular diseases as a long-term goal for reducing the risk of developing dementia. Among different forms of exercise, it is interesting that MB exercise was associated with significant protective effects in VMD. In the Chinese community, the practice of MB exercise was popular and highly regarded, and a significant proportion of subjects carry on with this exercise into advanced age. The benefits of practicing traditional Chinese MB exercise have been studied previously (Thomas *et al.*, 2005; Sattin *et al.*, 2005). Our findings suggest a unique opportunity for early intervention. Chinese-style MB exercises are culturally acceptable, physically endurable, relatively safe and economical. Future clinical trials should be conducted to provide evidenced-based results on the effectiveness of MB exercises in slowing down cognitive deterioration and maintaining independent functioning.

Compared with an earlier prevalence study conducted in Hong Kong some 10 years ago (Chiu *et al.*, 1998), the prevalence rates of dementia are higher in the present study. The apparent differences in findings may be related to several factors. First, the life expectancy of Hong Kong Chinese has increased. For men, life expectancy has increased from 76 to about 79 years; for women from 81.5 to 84 years of age. As the prevalence of dementia in the old-olds was the highest, the death censorship effects may operate in increasing the prevalence rate. Secondly, the present older cohort is likely to be at higher risk of developing dementia owing to lack of education opportunities during the Second World War. On the other hand, they have also benefited from the prosperity of Hong Kong in their middle years and corresponding increases in life expectancy. The combination of these life factors may relate to an increased risk of developing dementia during late life. Finally, the objective of the present study was to detect milder forms of dementia in the community. The investigating team adopted the recent emphasis on a subtle but definite change of cognitive and functional decline in the diagnosis of mild dementia. It is possible that adjustment of diagnostic sensitivity to fit the study objective may influence identification of dementia.

The merits of this study lie in the random recruitment of all households in Hong Kong, making it likely that the results are representative of the Hong Kong Chinese community. Second, this is one of the first community surveys specifically designed for detection of mild dementia in non-Caucasian populations. CDR was used as a standard instrument for evaluating the severity of cognitive impairment. This permits the detection of mild dementia without heavy reliance on comprehensive neuropsychological testing (Lim *et al.*, 2007). Although direct comparisons with the results of community surveys using Mayo clinic criteria for MCI (Petersen, 2004) are limited, the present methodology attempted to overcome the problems of resource limitations and cultural differences in cognitive test performance characteristics. Nevertheless, there are also limitations to be acknowledged. The response rate of the Phase 1 screen-positive subjects was not high. Subjects who refused Phase 1 and 2 assessments may be biased against older subjects with a higher risk of cognitive impairment. As most subjects were active and ambulatory, they were either not prepared for cognitive evaluation or not aware of the significance of cognitive impairment. The high prevalence of mild dementia identified in this study, coupled with a low response rate, highlighted the need for public education about memory impairment in old age. As only non-institutional households were approached in this study, the estimation of prevalence on more disturbed subjects with moderate and severe dementia may be biased. Secondly, a crude instrument using subjective memory complaints and MMSE scores was used as the screening tool for Phase 1. Owing to the logistical difficulties of conducting large-scale home visits by lay interviewers, the present method may have been over-inclusive and many false-positive subjects were anticipated. The use of CDR by trained psychiatrists, combined with cognitive assessments, was designed to enhance diagnostic sensitivity at Phase 2. Thirdly, dementia subtypes were determined using clinical criteria only. The absence of neuroimaging and elaborate physical investigation precluded more specific diagnosis of dementia subtypes.

The present study, despite limitations, provides information on the prevalence of milder forms of dementia in the Chinese community. As this group represents older persons at high risk of more severe dementia, health service planning should be more proactive in offering them appropriate care to reduce the secondary and tertiary impairments.

Conflicts of interest

None.

Description of authors' roles

L. C. Lam was involved in planning and organizing the study, collecting and analyzing the data, and preparing the manuscript. C. W. Tam, W. C. Chan, V. W. Lui, S. S. M. Chan and S. Wong were involved in planning the study,

data collection and preparation of the manuscript. A. Wong, M. K. Tham, K. S. Hom W. C. Chan and H. F. Chiu were involved in planning and organizing the study and preparation of the manuscript.

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References

American Psychiatric Association (1994). *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV*, 4th edn. Washington, DC: American Psychiatric Association.

Cacchione, P. Z., Powlishta, K. K., Grant, E. A., Buckles, V. D. and Morris, J. C. (2003). Accuracy of collateral source reports in very mild to mild dementia of the Alzheimer type. *Journal of the American Geriatrics Society*, 51, 819–823.

Chiu, H. F. *et al.* (1998). Prevalence of dementia in Chinese elderly in Hong Kong. *Neurology*, 50, 1002–1009.

Chu, L. W., Chiu, K. C., Hui, S. L., Yu, G. K., Tsui, W. J. and Lee, P. W. (2000). The reliability and validity of the Alzheimer's Disease Assessment Scale Cognitive Subscale (ADAS-Cog) among the elderly Chinese in Hong Kong. *Annual of the Academy of Medicine, Singapore*, 29, 474–485.

Dunn, G., Pickles, A., Tansella, M. and Vazquez-Barquero, J. L. (1999). Two-phase epidemiological surveys in psychiatric research. *British Journal of Psychiatry*, 174, 95–100.

Ferri, C. P., Prince, M. and Brayne, C. (2005). Global prevalence of dementia: a Delphi consensus study. *Lancet*, 366, 2112–2117.

Fisk, J. D., Merry, H. R. and Rockwood, K. (2003). Variations in case definition affect prevalence but not outcomes of mild cognitive impairment. *Neurology*, 11, 1179–1184.

Hong Kong Statistics (2006). *Population and Vital Events. Population by Age Group and Sex*. Hong Kong SAR: Statistics and Census Department. http://www.censtatd.gov.hk/hong_kong_statistics/statistical_tables

Hughes, C. P., Berg, L., Danziger, W. L., Coben, L. A. and Martin, R. L. (1982). A new clinical scale for the staging of dementia. *British Journal of Psychiatry*, 140, 556–572.

Lam, L. C., Lui, V. W., Tam, C.W. and Chiu, H. F. (2005). Subjective memory complaints in Chinese subjects with mild cognitive impairment and early Alzheimer's disease. *International Journal of Geriatric Psychiatry*, 20, 876–882.

Lam, L. C., Ho, P., Lui, V. W. and Tam, C. W. (2006). Reduced semantic fluency as an additional screening tool for subjects with questionable dementia. *Dementia and Related Geriatric Cognitive Disorders*, 22, 159–164.

Larson, E. B. *et al.* (2006). Exercise is associated with reduced risk for incident dementia among persons 65 years of age and older. *Annals of Internal Medicine*, 144, 73–81.

Lim, W. S., Chong, M. S. and Sahadevan, S. (2007). Utility of the clinical dementia rating in Asian populations. *Clinical Medicine and Research*, 5, 61–70.

Liu, L., Guo, X. E., Zhou, Y. Q. and Xia, J. L. (2003). Prevalence of dementia in China. *Dementia and Related Geriatric Cognitive Disorders*, 15, 226–230.

McKeith, I. G. *et al.* (2005). Diagnosis and management of dementia with Lewy bodies: third report of the DLB Consortium. *Neurology*, 65, 1863–1872.

McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D. and Stadlan, E. M. (1984). Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. *Neurology*, 34, 939–944.

Morris, J. C. *et al.* (2001). Mild cognitive impairment represents early-stage Alzheimer's disease. *Archives of Neurology*, 58, 397–405.

Panza, F. *et al.* (2005). Current epidemiology of mild cognitive impairment and other predementia syndromes. *American Journal of Geriatric Psychiatry*, 13, 633–644.

Petersen, R. C. (2004). Mild Cognitive Impairment as a diagnostic entity. *Journal of Internal Medicine*, 256, 183–194.

Prince, M. *et al.* (2003). Dementia diagnosis in developing countries: a cross-cultural validation study. *Lancet*, 361, 909–917.

Qiu, C., De Ronchi, D. and Fratiglioni, L. (2007). The epidemiology of the dementias: an update. *Current Opinion in Psychiatry*, 20, 380–385.

Román, G. C. *et al.* (1993). Vascular dementia: diagnostic criteria for research studies. Report of the NINDS-AIREN International Workshop. *Neurology*, 43, 250–260.

Sattin, R. W., Easley, K. A., Wolf, S. L., Chen, Y. and Kutner, M. H. (2005). Reduction in fear of falling through intense tai chi exercise training in older, transitionally frail adults. *Journal of the American Geriatrics Society*, 53, 1168–1178.

Storandt, M., Grant, E. A., Miller, P. and Morris, J. (2002). Rates of progression in mild cognitive impairment and early Alzheimer's disease. *Neurology*, 59, 1034–1041.

Teri, L. *et al* (2003). Exercise plus behavioral management in patients with Alzheimer's disease – a randomized controlled trial. *JAMA*, 290, 2015–2022.

Thomas, G. N. *et al.* (2005). Effects of tai chi and resistance training on cardiovascular risk factors in elderly Chinese subjects: a 12-month longitudinal, randomized, controlled intervention study. *Clinical Endocrinology*, 63, 663–669.

von Strauss, E., Viitanen, M., De Ronchi, D., Winblad, B. and Fratiglioni, L. (1999). Aging and the occurrence of dementia: findings from a population-based cohort with a large sample of nonagenarians. *Archives of Neurology*, 56, 587–592.

Wimo, A., Jonsson, L. and Winblad, B. (2006). An estimate of the worldwide prevalence and direct costs of dementia in 2003. *Dementia and Related Geriatric Cognitive Disorders*, 21, 175–181.

Zhang, Z. X. *et al.* (2006). Socio-demographic variation of dementia subtypes in China: methodology and results of a prevalence study in Beijing, Chengdu, Shanghai, and Xian. *Neuroepidemiology*, 27, 177–187.