

Prevalence of mild and major neurocognitive disorders in community and residential care homes in Hong Kong: considerations for multidimensional risk factor evaluation and intervention in primary care

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ABSTRACT

Introduction: Given the rapid population ageing, the cognitive healthcare needs of older adults warrant attention. This study reports on the findings of the Hong Kong Mental Morbidity Survey for Older People (HKMMSOP), which evaluated the prevalence of neurocognitive disorders (NCD) and associated health factors that may inform primary care risk assessment and intervention.

Methods: The HKMMSOP recruited 4871 participants aged 60 years or above through random sampling in Hong Kong during 2019 and 2023, including 4368 community-dwelling and 503 residential care home residents. Participants were assessed for cognitive function and mental status and completed health and lifestyle questionnaires. The prevalence of NCD and associated factors were evaluated with reference to the 2022 Hong Kong population.

Results: The age- and gender-adjusted prevalences of mild and major NCD were 21.8% and 9.7%, respectively, among adults aged 60 years or above in Hong Kong. Approximately 70% of residents in long-term care (LTC) institutions had major NCD. Chronic diseases, sarcopenia risk, sensory impairments, and specific lifestyle habits were associated with cognitive function in logistic regression analyses adjusted for demographic confounders ($P < 0.05$). Specialised medical services, including psychiatric care, were used by approximately 40% of community participants with major NCD.

Conclusion: A range of NCD is prevalent in both community and LTC settings, with the highest rates observed among the oldest-old. To improve functional independence, community primary

healthcare should prioritise early cardiovascular disease management, physical health maintenance, correction of sensory impairments, and promotion of intellectual and social engagement. For effective healthcare planning for frail older adults living in LTC institutions, the complex needs of nursing home residents with NCD should be addressed.

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Introduction

Ageing, characterised by a progressive loss of physiological integrity leading to impaired function and increased vulnerability to death, is a major health concern for global populations.¹ The older population (threshold defined by the World Health Organization as aged ≥ 60 years) in Hong Kong, one of the most rapidly ageing communities worldwide, is expected to increase from 2.28 million (30.5% of the total population) in 2023 to 3.31 million (40.4%) in 2046, with the steepest growth occurring in advanced old age.² Major neurocognitive disorders (NCD) [also referred to as dementia] are the most common neurodegenerative disorders associated with ageing and exert a substantial impact on healthcare systems. A global projection estimated that the number of people living with dementia would increase almost threefold, from 57.4 million cases in 2019 to 152.8 million in 2050.³ In the most recent epidemiological study of dementia in Hong Kong conducted in 2008, over 8.9% of community-dwelling older adults had mild dementia, and 8.5% had mild cognitive impairment (MCI), a synonym for mild NCD.⁴ Given that these estimates are over a decade old, demographic changes (eg, higher educational attainment and evolving health conditions among older adults) warrant re-evaluation of prevalences and associated factors.⁵

Factors affecting cognitive decline are best understood through a life-course perspective. While genetic and early-life predisposing factors are not readily modifiable, mid- and late-life health and lifestyle factors are increasingly recognised as modulators of cognitive impairment. A 2024 *Lancet review*⁶ suggested that 14 potentially modifiable lifestyle and health factors, including cardiovascular risk, hearing and vision loss, air pollution, and mental health and lifestyle factors (eg, smoking, alcohol consumption, physical inactivity, social

香港社區及安老院舍輕度認知障礙與認知障礙症的患病率：基層醫療中多維風險因素評估與介入的考量

林翠華、陳偉智、李廷俊、霍兆樺、林翠嬋、馮慧東、馬淑玲、鄭柏榮、鄭相德、黎浩然、葉漢基、黃仰山

引言：隨着人口急速老化，長者的認知健康需求值得關注。《香港長者精神健康調查》評估了認知障礙的患病率及相關健康因素，本研究報告相關結果，以助基層醫療風險評估與介入策略。

方法：《香港長者精神健康調查》於2019至2023年間，透過隨機抽樣方式在全港招募4871名年滿60歲的參與者，當中4368位居於社區，503位居於安老院舍。參與者接受認知功能與精神狀況評估，並填寫健康與生活習慣問卷。研究根據2022年香港人口資料評估認知障礙的患病率及相關因素。

結果：在全港60歲或以上人士中，經年齡與性別調整後，輕度認知障礙與認知障礙症的患病率分別為21.8%與9.7%。在安老院舍長者中，約七成患有認知障礙症。慢性疾病、肌少症風險、感官障礙，以及某些生活習慣與認知功能呈顯著相關（經人口因素調整後的P值為 <0.05 ）。在社區中，約有四成認知障礙症長者使用專科醫療服務，包括精神科支援。

結論：不同程度的認知障礙在社區及長期護理環境中均十分普遍，尤以高齡長者最為常見。為提升長者的自理能力，社區基層醫療應優先處理心血管疾、維持身體健康、改善感官障礙，以及鼓勵參與智力及社交活動。針對居於長期護理設施的體弱長者，醫療規劃亦需應對其複雜的健康需要。

isolation, and depression), accounted for 45% of the population-attributable risk of dementia. Growing research interest has also focused on other potential risk factors, such as sleep, diet, dental disease, and frailty, which are also important determinants of cognitive health.⁶

Investigating secular trends in dementia is essential to understand the full spectrum of the

New knowledge added by this study

- The study revealed that 9.7% of older adults had major neurocognitive disorders (NCD), and nearly one in five older adults had mild NCD in Hong Kong. The high prevalence of mild NCD warrants attention, particularly from the perspective of early management to reduce progression from functionally independent mild NCD to dependent states of major NCD.
- The lifestyle evaluation from the study highlighted that regular participation in physical and intellectual activities, being socially active, and maintaining good sleep quality were associated with better cognitive function.
- Specialised medical services utilisation among community-dwelling participants with major NCD was relatively low ($<40\%$). Promoting awareness of early assessment may help reduce the risk of secondary complications and improve long-term health outcomes associated with NCD.

Implications for clinical practice or policy

- Primary care platforms focused on early detection and management of chronic diseases should adopt a multidimensional approach—particularly addressing cardiovascular health, stroke prevention, sensorimotor function, physical activity, sleep hygiene, and leisure engagement—to achieve long-term cognitive benefits.
- Over 70% of residents in long-term care had major NCD. To improve quality of life and the caregiving environment, service provision and planning should be integrated to address the combined physical, cognitive, and mental health needs of these residents.

condition in general populations and to identify risk factors across populations and life stages.⁷ Recent estimates from various populations have reported lower-than-expected prevalence rates, possibly due to improvements in education, environmental enrichment, and healthcare, with resulting reductions in cerebrovascular risk.^{6,8} In the local context, an updated prevalence study facilitates systematic evaluation of the evolving occurrence and modulating factors of cognitive decline from physical health to psychosocial perspectives.⁶ Such evaluation is essential for developing context-, culture-, and practice-tailored preventive strategies targeting the identified risk factors, as well as for optimising treatment and management.^{6,7} Particularly with advancing age and rising rates of physical and mental co-morbidities among older adults in Hong Kong, the burden of care and service demands related to cognitive impairment require more comprehensive assessment and practical guidance.

This study aimed to estimate the current prevalence of mild and major NCD in Hong Kong and to identify their multidimensional associated factors, based on the Hong Kong Mental Morbidity Survey for Older People (HKMMSOP). We also discuss how these findings may inform healthcare interventions for early risk modification, reduction of cognitive decline, and optimisation of care.

Methods

Study design and setting

The HKMMSOP was a commissioned study funded by the Advisory Committee on Mental Health through the Health and Medical Research Fund. Conducted from January 2019 to January 2023, it was designed as a territory-wide, population-based, cross-sectional survey to examine the prevalence and modulating factors of NCD among older adults in Hong Kong. The study settings of HKMMSOP included both community households and long-term care (LTC) institutions. For clinical assessments, HKMMSOP adopted a two-phase design. Phase 1 interviews comprised cognitive assessments for mild and major NCD, evaluation of neuropsychiatric syndromes and functioning, as well as physical health and psychosocial measurements. Phase 2 involved clinician interviews for diagnostic assessment and subtyping of NCD.

Study size calculation

Sample size was determined based on previous prevalence studies of dementia (2008)⁴ and common mental disorders (2010-2013)⁹ in Hong Kong. For an estimated NCD prevalence of approximately 2% among adults aged 60 to 74 years, 3012 participants were required to achieve a recommended precision of 0.005. For an estimated prevalence of

approximately 5% among those aged 75 years or above, 1168 participants were required to achieve a recommended precision of 0.0125. The HKMMSOP ultimately recruited and completed assessments for 3560 participants aged 60 to 74 years and 1311 participants aged 75 years or above.

Sampling and subject recruitment

To recruit a representative sample of the older adult population in Hong Kong, we adopted a multi-stage random sampling method commonly used in household surveys. A random list of addresses (sampling frame) was generated by the Census and Statistics Department of the Hong Kong SAR Government, then stratified by geographical location and residential type (private versus public housing). For each address, an invitation letter introducing the survey and a consent form for assessment were enclosed. A telephone hotline, designated website, and email contact were provided for enquiries and to document refusals. Up to three invitation letters were sent within 6 months to improve recruitment success and reduce response bias; participants who responded to the third contact had higher rates of active employment compared with the rest of the sample ($P < 0.05$).

When households responded and included residents aged 60 years or above, we invited them for interviews; there could be one or more eligible residents per household. If individuals agreed to participate but were unable to provide complete information (eg, due to profound sensory deficits), data were obtained from their first-degree relatives and categorised as proxy. Households with no eligible participants (ie, all residents aged under 60 years) were invited to notify the research team of their ineligibility through convenient contact channels (email, text messages, or direct phone calls). From January 2019 to January 2023, a total of 39772 invitation letters were sent to randomly generated addresses. Of these, 3352 households with 4369 eligible community-dwelling participants consented to and completed the survey. Eligibility and demographic characteristics were unknown for the remaining 36420 households. The flow of participant sampling, recruitment, and assessment is depicted in the Figure.

To obtain representative statistics for people residing in LTC institutions, we adopted a two-stage cluster sampling method. Superintendents of 600 residential care homes for the elderly (ie, LTC institutions), randomly selected from the master list of registered old age homes in Hong Kong, were first approached for participation. When residential care homes agreed to assist with recruitment, eligible residents were randomly selected. Following institutional consent and consent from participants and/or their family members, assessments were

completed for 503 residents from 51 registered old age homes across Hong Kong. The prison population was not included in this survey.

Data collection and measurements

Phase 1 study

Phase 1 assessments were conducted by trained research assistants during visits to participants' residential addresses or at the department's research centre. Due to social distancing and infection control policies during the COVID-19 pandemic, phone assessments were offered as an alternative and were utilised by 28.7% of community participants. Proxy-based assessments were conducted for participants with profound physical or mental deficits (2.7% of community participants and 34.2% of LTC participants).

Socio-demographic information was collected, including age, gender, birthplace, housing type, education level, marital status, household composition, current employment status, family income, receipt of government financial subsidies, and religious affiliation.

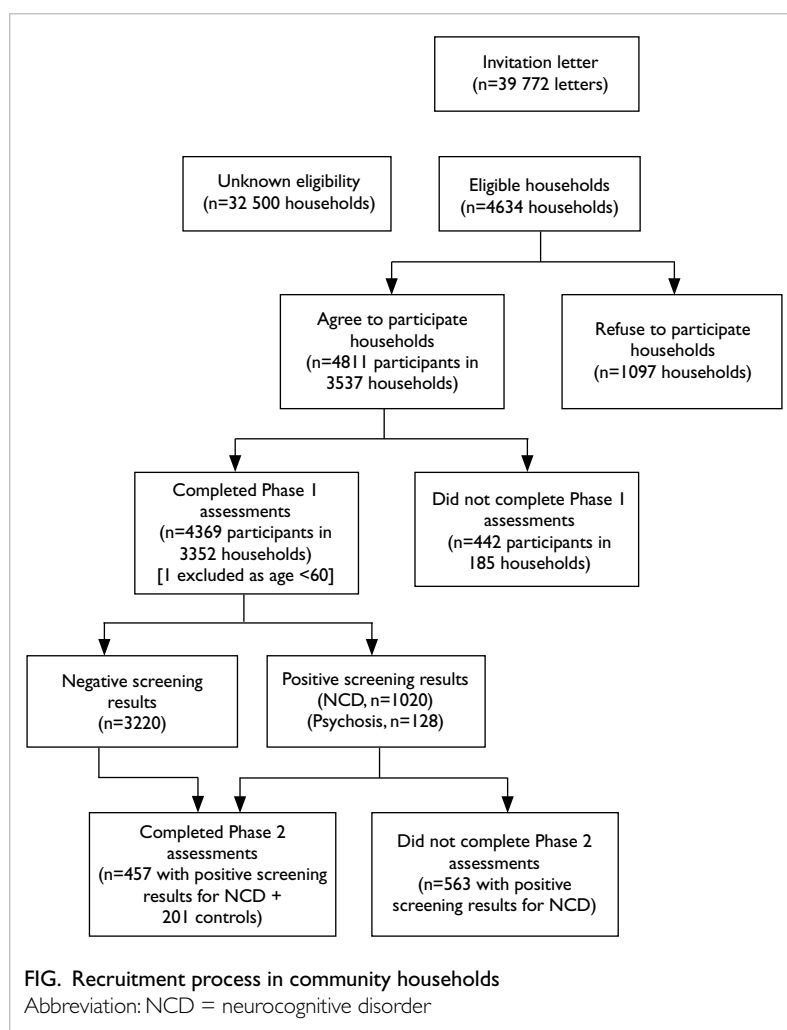
Cognitive function was assessed using two locally validated tools: the Chinese Abbreviated MCI test¹⁰ and the Hong Kong version of Montreal Cognitive Assessment (HK-MoCA).^{11,12} For participants with moderate to severe major NCD in both domiciliary and institutional settings, an abridged version of the cognitive and mental state assessment was used based on the HK-MoCA 5-minute protocol. All interviewers were trained to administer the Clinical Dementia Rating (CDR) to each participant, and satisfactory concordance was achieved between interviewer-rated and clinician-rated results (Spearman's correlation: 0.668; $P < 0.001$).¹³ Neuropsychiatric symptoms were screened in all participants using the Neuropsychiatric Inventory Questionnaire.¹⁴

Physical health was assessed using questionnaires on chronic disease burden (Cumulative Illness Rating Scale [CIRS]),¹⁵ along with health screening measures including blood pressure, body mass index, oral health, grip strength, hearing and vision, postural balance, and sarcopenia (SARC-F: Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls).¹⁶ Activities of daily living were evaluated using the Chinese version of the Disability Assessment for Dementia.¹⁷

Lifestyle factors were assessed using questionnaires covering smoking and alcohol consumption, physical and non-physical leisure activities, sleep quality (Pittsburgh Sleep Quality Index), use of drugs and vitamins, dietary intake of fruits and vegetables, loneliness, and quality of life.¹⁸⁻²¹

Phase 2 study

Among the 1020 participants whose scores crossed



the threshold for mild or major NCD, clinician interviews were conducted for NCD subtyping, including assessment of cerebrovascular risk and neuroimaging. Of these, 457 participants (response rate: 44.8%) completed face-to-face structured assessments at the department's research centre, where blood sampling facilities were available (Fig). For consenting participants, fasting lipid profiles, glycated haemoglobin, and apolipoprotein E4 genotypes were analysed. Diagnoses and subtypes of NCD were established according to the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition)²² through clinician assessment supplemented by laboratory results and structural magnetic resonance imaging of the brain.

Additionally, 201 participants with negative NCD screening results (CDR=0) were interviewed by research team psychiatrists to evaluate the sensitivity and specificity of Phase 1 assessments. The sensitivity of the Phase 1 screening tools for detecting mild or major NCD was 96.7%, while the specificity for correctly identifying participants

without NCD was 81%. The positive predictive value was 90% and the negative predictive value was 93%.

Supplementary study for long-term care institutions

Due to strict COVID-19 visitor policies in place during the fieldwork period (2022-2023), videoconference assessments were conducted with participants in some LTC facilities (62.6%). Individual health assessments were not performed because of infection control policies in effect during data collection in 2022.

Statistical analysis

Sample representativeness

In the two-phase prevalence study design, selection bias could potentially arise if heterogeneity in characteristics (eg, age, education level, family structure, physical and mental morbidity) existed between responders and non-responders. During the study invitation and Phase 1 assessment, demographic and clinical information for non-responders and non-completers was unavailable. Therefore, we compared Phase 2 completers (n=457) and non-completers (n=563) among participants with positive NCD screening results in Phase 1. Non-completers were more likely to be older (>75 years: 49.9% vs 36.1%; $P<0.001$), have a higher burden of chronic conditions (CIRS score: 4.8 ± 3.0 vs 4.4 ± 2.4 ; $P=0.007$), show greater levels of cognitive impairment (CDR ≥ 1 : 20.5% vs 12.2%; $P<0.001$), exhibit more impaired daily functioning (score of the Chinese version of the Disability Assessment for Dementia: 90.6 ± 20.5 vs 96.0 ± 9.6 ; $P<0.001$), and have a prior diagnosis of dementia before joining the study (5.9% vs 1.6%; $P=0.001$). The potential impact of participant imbalance in Phase 2 on study findings is addressed in the Discussion section. No imputation was performed for missing data.

Prevalences of mild and major neurocognitive disorders

Prevalence estimates of NCD were stratified by age-group, gender and recruitment setting. Weighted prevalence was calculated using sampling weights that reflected the proportion of participants in each stratum, with reference to the population distribution by age and gender, as well as community and LTC statistics (year-end population, 2022).^{23,24} Diagnoses included mild NCD and major NCD. For each disorder, prevalence was expressed as the rate per 100 persons, with corresponding 95% confidence interval (95% CI). Sampling errors were estimated using a bootstrap strategy implemented in Stata software (StataCorp, College Station [TX], US). One thousand samples were randomly drawn from the original dataset through sampling with replacement.

The standard error of weighted prevalence was calculated as the square root of the sample variance across these resamples.

Factors associated with neurocognitive disorders

The psychosocial, physical health, and lifestyle correlates of NCD were evaluated. Crude and adjusted associations (odds ratios) between the prevalence of NCD and three categories of associated factors were examined: (1) demographic characteristics, including age, gender, years of education, marital status (married, co-habiting, widowed, divorced, separated or single), monthly household income (<HK\$6000, HK\$6000-14 999, HK\$15 000-29 999, \geq HK\$30 000), and housing type (owned or rented); (2) physical health status, including history of hypertension, postural balance test (pass or fail), corrected vision (normal or abnormal), corrected hearing (normal or abnormal), oral health problems (yes or no), sarcopenia (SARC-F score), and chronic disease burden (CIRS score); and (3) lifestyle habits, including smoking and alcohol consumption (never, former, current), fruit intake (\geq two portions/day or not), vegetable intake (\geq three portions/day or not),^{18,25} sleep quality (score of the Pittsburgh Sleep Quality Index²¹), regular participation (once or more per week) in aerobic, resistance, and intellectual activities,²⁰ and social loneliness.¹⁹ Multivariable logistic regression analyses were conducted to identify independent associations between physical health and lifestyle factors and NCD, adjusting for confounders previously linked to NCD, including age, gender, years of education, marital status, and socio-economic status.^{5,6,8} All analyses were performed using SPSS (Windows version 22.0; IBM Corp, Armonk [NY], US), and differences were considered statistically significant at $P<0.05$.

Results

Participant characteristics

Basic characteristics of participants living in the community and in LTC settings are presented in Table 1. The mean age was 69.6 ± 7.5 years (range, 60-105). Just over half of the respondents (53.6%) were born in Hong Kong. A large proportion had attained a secondary school education or above (66.1%) and were married or co-habiting (67.5%). Most older adults were economically inactive (retired, homemaker, or never worked) [78.1%].

Of the 503 participants residing in LTC facilities, 274 (54.5%) were women and the mean age was 80.3 ± 11.0 years (range, 60-106). More than half (54.6%) were born in Chinese Mainland; 30.4% had attained secondary education or above; and 50.4% were widowed, divorced or separated. Compared with the LTC sample, the community sample included a higher proportion of women (56.3% vs

TABLE I. Socio-economic and health characteristics of participants in the Hong Kong Mental Morbidity Survey for Older People (n=4871)*

	Community-dwelling participants (n=4368)		LTC participants (n=503)	
	Before weighting	After weighting†	Before weighting	After weighting‡
Gender				
Male	1908 (43.7%)	2068 (47.3%)	229 (45.5%)	221 (43.9%)
Female	2460 (56.3%)	2300 (52.7%)	274 (54.5%)	282 (56.1%)
Age-group, y				
60-64	1295 (29.6%)	1281 (29.3%)	34 (6.8%)	55 (10.9%)
65-69	1169 (26.8%)	1089 (24.9%)	54 (10.7%)	58 (11.5%)
70-74	932 (21.3%)	814 (18.6%)	76 (15.1%)	59 (11.7%)
75-79	472 (10.8%)	467 (10.7%)	58 (11.5%)	51 (10.1%)
80-84	284 (6.5%)	303 (6.9%)	79 (15.7%)	60 (11.9%)
≥85	216 (4.9%)	414 (9.5%)	202 (40.2%)	220 (43.7%)
Birthplace				
Hong Kong	2339 (53.6%)	2254 (51.7%)	168 (39.9%)	175 (41.6%)
Chinese Mainland	1779 (40.8%)	1858 (42.6%)	230 (54.6%)	224 (53.2%)
Other countries	243 (5.6%)	248 (5.7%)	23 (5.5%)	22 (5.2%)
Housing type				
Owned	2975 (68.5%)	2961 (68.2%)	N/A§	N/A§
Rented	1367 (31.5%)	1381 (31.8%)		
Education				
Primary or below	1482 (34.0%)	1539 (35.3%)	315 (69.5%)	317 (69.8%)
Secondary	2161 (49.6%)	2101 (48.1%)	117 (25.8%)	119 (26.2%)
Post-secondary	718 (16.5%)	725 (16.6%)	21 (4.6%)	18 (4.0%)
Marital status				
Married/co-habiting	2942 (67.5%)	2914 (66.8%)	134 (29.8%)	128 (28.5%)
Widowed/divorced/separated	1203 (27.5%)	1251 (28.7%)	227 (50.4%)	229 (51.0%)
Never married	216 (5.0%)	196 (4.5%)	89 (19.8%)	92 (20.5%)
Employment status				
Not working	3408 (78.1%)	3417 (78.3%)	N/A§	N/A§
Working	957 (21.9%)	947 (21.7%)		
Monthly household income, HK\$				
<6000	1193 (27.6%)	1216 (28.1%)	323 (69.6%)	323 (69.5%)
6000-14 999	1260 (29.1%)	1244 (28.8%)	137 (29.5%)	137 (29.5%)
15 000-29 999	923 (21.3%)	912 (21.1%)	3 (0.6%)	4 (0.9%)
≥30 000	948 (21.9%)	950 (22.0%)	1 (0.2%)	1 (0.2%)
Smoking				
Never	3663 (84.0%)	3614 (82.9%)	403 (80.1%)	403 (80.1%)
Former	469 (10.8%)	505 (11.6%)	80 (15.9%)	79 (15.7%)
Current	230 (5.3%)	243 (5.6%)	20 (4.0%)	21 (4.2%)

Abbreviations: CIRS = Cumulative Illness Rating Scale; HK\$ = Hong Kong dollars; LTC = long-term care; N/A = not applicable;

PSQI = Pittsburgh Sleep Quality Index; SARC-F = Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls

* Data are shown as No. (%). No imputation was performed for missing data

† The weighting factors used for community-dwelling participants by gender and age were: 1.16 (male 60-64 years), 1.01 (male 65-69 years), 0.96 (male 70-74 years), 1.02 (male 75-79 years), 1.18 (male 80-74 years), 1.63 (male ≥85 years), 0.87 (female 60-64 years), 0.87 (female 65-69 years), 0.80 (female 70-74 years), 0.97 (female 75-79 years), 0.98 (female 80-74 years), and 2.18 (female ≥85 years)

‡ The weighting factors used for residential care home participants by gender and age were: 1.64 (male 60-64 years), 1.20 (male 65-69 years), 0.81 (male 70-74 years), 0.97 (male 75-79 years), 0.74 (male 80-74 years), 0.90 (male ≥85 years), 1.58 (female 60-64 years), 0.95 (female 65-69 years), 0.73 (female 70-74 years), 0.80 (female 75-79 years), 0.76 (female 80-74 years), and 1.19 (female ≥85 years)

§ Not applicable for LTC participants due to the study setting (housing type) and limitations of physical assessments under COVID-19 infection control policies (vision, hearing, diet, balance test, sleep quality)

TABLE I. (cont'd)

	Community-dwelling participants (n=4368)		LTC participants (n=503)	
	Before weighting	After weighting [†]	Before weighting	After weighting [‡]
Alcohol consumption				
Never	3891 (89.2%)	3868 (88.7%)	461 (91.7%)	462 (91.8%)
Former	156 (3.6%)	167 (3.8%)	33 (6.6%)	31 (6.2%)
Current	316 (7.2%)	328 (7.5%)	9 (1.8%)	10 (2.0%)
Corrected vision				
Normal	2868 (91.4%)	2827 (90.3%)	N/A [§]	N/A [§]
Abnormal	271 (8.6%)	302 (9.7%)		
Corrected hearing				
Normal	2944 (93.8%)	2902 (92.8%)	N/A [§]	N/A [§]
Abnormal	194 (6.2%)	226 (7.2%)		
Fruit intake, portions per day				
<2	2311 (73.9%)	2313 (74.2%)	N/A [§]	N/A [§]
≥2	817 (26.1%)	804 (25.8%)		
Vegetable intake, portions per day				
<3	2637 (84.1%)	2649 (84.8%)	N/A [§]	N/A [§]
≥3	498 (15.9%)	475 (15.2%)		
Oral health problem				
No	1964 (45.7%)	1934 (45.0%)	202 (40.2%)	202 (40.1%)
Yes	1927 (44.8%)	1877 (43.7%)	106 (21.1%)	104 (20.6%)
Not applicable (no teeth)	410 (9.5%)	485 (11.3%)	195 (38.8%)	198 (39.3%)
Balance test				
Pass	2736 (87.2%)	2651 (84.8%)	N/A [§]	N/A [§]
Fail	403 (12.8%)	477 (15.2%)		
Sarcopenia score (SARC-F)				
0	2517 (57.9%)	2489 (57.3%)	48 (9.5%)	48 (9.5%)
1	840 (19.3%)	812 (18.7%)	33 (6.6%)	33 (6.6%)
≥2	990 (22.8%)	1042 (24.0%)	422 (83.9%)	422 (83.9%)
No. of co-morbidities (CIRS)				
0-1	745 (17.1%)	725 (16.7%)	34 (6.8%)	35 (7.0%)
2-3	1524 (35.0%)	1493 (34.3%)	128 (25.4%)	131 (26.0%)
4-5	1190 (27.4%)	1192 (27.4%)	171 (34.0%)	170 (33.8%)
≥6	890 (20.5%)	937 (21.6%)	170 (33.8%)	167 (33.2%)
Hypertension				
No	2263 (52.1%)	2224 (51.2%)	146 (29.0%)	148 (29.4%)
Yes	2084 (47.9%)	2120 (48.8%)	357 (71.0%)	356 (70.6%)
Diabetes mellitus				
No	3499 (80.5%)	3478 (80.1%)	325 (64.6%)	328 (65.2%)
Yes	846 (19.5%)	865 (19.9%)	178 (35.4%)	175 (34.8%)
History of stroke				
No	4128 (95.0%)	4116 (94.8%)	418 (83.1%)	417 (82.9%)
Yes	218 (5.0%)	227 (5.2%)	85 (16.9%)	85 (17.1%)
Sleep quality				
Good (PSQI ≤5)	2356 (54.9%)	2363 (55.2%)	N/A [§]	N/A [§]
Poor (PSQI >5)	1937 (45.1%)	1917 (44.8%)		

TABLE 2. Distribution of Clinical Dementia Rating by age-group, gender, and setting (unweighted) [n=4871]*

Setting and age, y	Male				Female†			
	CDR=0	CDR=0.5	CDR=1	CDR≥2	CDR=0	CDR=0.5	CDR=1	CDR≥2
Community-dwelling (n=4368)								
60-64	469 (88.7%)	58 (11.0%)	2 (0.4%)	0	673 (87.9%)	86 (11.2%)	5 (0.7%)	2 (0.3%)
65-69	419 (80.0%)	100 (19.1%)	2 (0.4%)	3 (0.6%)	517 (80.2%)	116 (18.0%)	10 (1.6%)	2 (0.3%)
70-74	308 (75.3%)	89 (21.8%)	11 (2.7%)	1 (0.2%)	373 (71.3%)	131 (25.0%)	13 (2.5%)	6 (1.1%)
75-79	126 (57.3%)	80 (36.4%)	11 (5.0%)	3 (1.4%)	133 (52.8%)	100 (39.7%)	16 (6.3%)	3 (1.2%)
80-84	64 (51.2%)	44 (35.2%)	9 (7.2%)	8 (6.4%)	60 (37.7%)	60 (37.7%)	25 (15.7%)	14 (8.8%)
≥85	37 (36.6%)	30 (29.7%)	13 (12.9%)	21 (20.8%)	20 (17.4%)	36 (31.3%)	21 (18.3%)	38 (33.0%)
Subtotal	1423 (74.6%)	401 (21.0%)	48 (2.5%)	36 (1.9%)	1776 (72.2%)	529 (21.5%)	90 (3.7%)	65 (2.6%)
Trend‡	T value=0.322, P<0.001				T value=0.392, P<0.001			
Residential care homes (n=503)								
60-64	2 (10.5%)	12 (63.2%)	3 (15.8%)	2 (10.5%)	2 (13.3%)	7 (46.7%)	1 (6.7%)	5 (33.3%)
65-69	3 (10.3%)	8 (27.6%)	10 (34.5%)	8 (27.6%)	3 (12.0%)	7 (28.0%)	6 (24.0%)	9 (36.0%)
70-74	4 (9.3%)	17 (39.5%)	12 (27.9%)	10 (23.3%)	2 (6.1%)	10 (30.3%)	13 (39.4%)	8 (24.2%)
75-79	4 (13.8%)	8 (27.6%)	7 (24.1%)	10 (34.5%)	4 (13.8%)	3 (10.3%)	10 (34.5%)	12 (41.4%)
80-84	4 (10.8%)	5 (13.5%)	12 (32.4%)	16 (43.2%)	2 (4.8%)	7 (16.7%)	11 (26.2%)	22 (52.4%)
≥85	1 (1.4%)	12 (16.7%)	23 (31.9%)	36 (50.0%)	5 (3.8%)	20 (15.4%)	24 (18.5%)	81 (62.3%)
Subtotal	18 (7.9%)	62 (27.1%)	67 (29.3%)	82 (35.8%)	18 (6.6%)	54 (19.7%)	65 (23.7%)	137 (50.0%)
Trend‡	T value=0.317, P<0.001				T value=0.272, P<0.001			

Abbreviation: CDR = Clinical Dementia Rating

* Data are shown as No. (% by age-group)

† No significant gender difference was observed within each age-group, except for those aged ≥85 years in the community-dwelling sample (P=0.037) based on independent samples Kolmogorov-Smirnov tests

‡ Trend analyses between age-group and CDR were significant in both genders and across settings based on Spearman's correlation coefficients

54.5%) and younger-old adults (aged <75 years: 77.7% vs 32.6%), whereas the LTC sample included more men (45.5% vs 43.7%) and adults aged ≥75 years (67.4% vs 22.2%). After sample weighting by age and gender, both samples were comparable with the overall older population in Hong Kong (Table 1).

Cognitive function and neuropsychiatric symptoms

The distribution of CDR before sample weighting is presented by 5-year age intervals and gender in both community and LTC settings (Table 2). Older age was associated with a higher prevalence and greater severity of NCD, as measured by CDR (P<0.001). Montreal Cognitive Assessment scores stratified by gender and grouped into 5-year age intervals are also presented for community-dwelling participants (Table 3). Older age was associated with lower HK-MoCA scores (P<0.001), while men had higher HK-MoCA scores within 5-year age-groups >70 years (P<0.05).

The proportion of neuropsychiatric symptoms increased with worsening cognitive impairment.

TABLE 3. Montreal Cognitive Assessment total scores by age and gender among community-dwelling participants (unweighted)*

Age-group, y	Male (n=1894)	Female† (n=2420)	Total (n=4314)
60-64	26.4 ± 3.1	26.3 ± 3.1	26.3 ± 3.2
65-69	25.4 ± 3.6	25.2 ± 3.8	25.3 ± 3.7
70-74	24.5 ± 3.8	23.8 ± 4.3	24.1 ± 4.1
75-79	23.1 ± 4.5	21.8 ± 5.0	22.4 ± 4.8
80-84	21.8 ± 5.1	18.9 ± 6.4	20.2 ± 6.0
≥85	18.4 ± 7.0	14.9 ± 7.3	16.7 ± 7.3
Subtotal	24.6 ± 4.4	24.1 ± 5.0	24.3 ± 4.8

* Data are shown as mean ± standard deviation

† Gender differences were statistically significant for all age-groups (P<0.05), except for those aged 60-64 and 65-69 years based on independent samples t tests

Among community-dwelling participants, the prevalence of psychotic symptoms rose from 2.1% in those with normal cognition to 6.3% in those with mild NCD, and 21.3% in those with major NCD

($P<0.001$). Similarly, the prevalence of depression and anxiety also increased with higher CDR scores ($P<0.001$). Sleep disturbances were common across all cognitive groups, affecting 32.2% of participants with normal cognition, 43.5% with mild NCD, and 40.2% with major NCD.

Prevalence of neurocognitive disorders

The unweighted prevalence of mild and major NCD is presented in online supplementary Table. As shown in Table 4, the weighted prevalence of mild NCD was 21.8% among community-dwelling older adults, 24.3% among those living in LTC facilities,

and 21.8% overall in Hong Kong. For major NCD, prevalence was 7.4% in the community, significantly higher at 68.8% in LTC settings, and 9.7% overall.

Among Phase 2 community-dwelling participants with mild or major NCD, 22.0% met the DSM-5 criteria for Alzheimer's disease, 23.7% had mixed vascular NCD and AD, and 43.5% had vascular NCD. Neurocognitive disorders due to Lewy body disease and frontotemporal lobar degeneration accounted for 1.2% and 0.5% of cases, respectively. The apolipoprotein E4 genotype was identified in 17% of cognitively normal participants, 19% of those with mild NCD, and 22% of those with major NCD.

TABLE 4. Weighted prevalence of neurocognitive disorders in the Hong Kong older population (n=4871)*

Setting and age-group, y	Mild NCD†		Major NCD†		Major NCD (mild)†		Major NCD (moderate)†		Major NCD (severe)†	
	Prevalence	95% CI, %	Prevalence	95% CI, %	Prevalence	95% CI, %	Prevalence	95% CI, %	Prevalence	95% CI, %
Community-dwelling (n=4368)‡										
60-64	142 (11.1%)	9.6-12.8	8 (0.6%)	0.3-1.3	7 (0.5%)	0.2-1.1	0	0.0-0.0	2 (0.2%)	0.0-0.6
65-69	202 (18.5%)	16.4-20.8	15 (1.4%)	0.9-2.2	11 (1.0%)	0.6-1.7	3 (0.3%)	0.1-0.8	2 (0.2%)	0.0-0.7
70-74	191 (23.5%)	20.8-26.3	27 (3.3%)	2.3-4.7	21 (2.6%)	1.7-3.8	6 (0.7%)	0.3-1.5	0	0.0-0.0
75-79	178 (38.1%)	33.8-42.6	33 (7.1%)	5.0-9.7	27 (5.8%)	4.0-8.1	4 (0.9%)	0.3-2.4	2 (0.4%)	0.1-1.6
80-84	111 (36.6%)	31.0-42.4	58 (19.1%)	15.1-24.1	35 (11.6%)	8.4-15.8	16 (5.3%)	3.1-8.5	7 (2.3%)	1.2-5.1
≥85	127 (30.7%)	24.9-37.1	184 (44.4%)	38.0-50.8	67 (16.2%)	11.7-21.7	68 (16.4%)	12.1-22.2	48 (11.6%)	7.8-17
Total	951 (21.8%)	20.5-23.1	325 (7.4%)	6.6-8.4	168 (3.8%)	3.2-4.5	97 (2.2%)	1.7-2.9	61 (1.4%)	1.0-2.0
Residential care homes (n=503)§										
60-64	31 (56.4%)	38.9-71.8	18 (32.7%)	18.5-50.0	7 (12.7%)	4.3-28.5	8 (14.5%)	6.2-30.8	3 (5.5%)	1.4-21.0
65-69	16 (27.6%)	17.4-41.2	36 (62.1%)	47.6-73.3	18 (31.0%)	19.2-44.1	14 (24.1%)	14.1-38.0	4 (6.9%)	2.6-17.1
70-74	21 (35.6%)	25.7-47.3	33 (55.9%)	44.7-67.2	19 (32.2%)	22.8-44.2	9 (15.3%)	9.1-26.1	5 (8.5%)	3.6-16.3
75-79	10 (19.6%)	11.3-32.3	34 (66.7%)	53.1-77.5	15 (29.4%)	18.8-41.3	11 (21.6%)	12.8-34.9	8 (15.7%)	8.1-28.3
80-84	9 (15.0%)	8.8-25.0	46 (76.7%)	66.6-85.3	17 (28.3%)	19.7-40.6	17 (28.3%)	20.1-40.3	11 (18.3%)	11.8-29.1
≥85	35 (15.9%)	11.4-21.3	179 (81.4%)	75.2-85.9	49 (22.3%)	17.1-28.9	78 (35.5%)	29.0-42.5	51 (23.2%)	17.9-29.6
Total	122 (24.3%)	20.4-28.5	346 (68.8%)	64.1-72.8	125 (25.0%)	21.2-28.8	137 (27.3%)	23.6-31.7	82 (16.4%)	13.4-19.9
Overall (n=4871)¶										
60-64	164 (11.8%)	10.2-13.5	15 (1.1%)	0.7-1.8	10 (0.7%)	0.4-1.3	3 (0.2%)	0.1-0.5	3 (0.2%)	0.1-0.6
65-69	222 (18.7%)	16.5-21.0	30 (2.5%)	1.8-3.4	18 (1.5%)	1.0-2.3	8 (0.7%)	0.4-1.2	4 (0.3%)	0.1-0.8
70-74	212 (23.7%)	21.1-26.6	41 (4.6%)	3.5-5.9	29 (3.2%)	2.4-4.5	10 (1.1%)	0.6-1.8	2 (0.2%)	0.1-0.4
75-79	195 (37.5%)	33.3-41.8	47 (9.0%)	6.9-11.8	34 (6.5%)	4.7-8.9	8 (1.5%)	0.9-2.9	5 (1.0%)	0.5-1.9
80-84	122 (35.2%)	30.0-40.8	79 (22.8%)	18.8-27.3	44 (12.7%)	9.6-16.6	23 (6.6%)	4.5-9.7	12 (3.5%)	2.1-5.8
≥85	149 (28.4%)	23.4-34.1	261 (49.8%)	43.9-55.9	90 (17.1%)	13.2-21.9	102 (19.4%)	15.3-24.2	70 (13.3%)	10.0-17.8
Total	1064 (21.8%)	20.7-23.1	473 (9.7%)	8.9-10.7	225 (4.6%)	4.0-5.3	154 (3.2%)	2.6-3.8	96 (2.0%)	1.6-2.5

Abbreviations: 95% CI = 95% confidence interval; NCD = neurocognitive disorders

* Data are shown as No. (%), unless otherwise specified

† Mild NCD: CDR (Clinical Dementia Rating) = 0.5; Major NCD: CDR≥1; Major NCD (mild): CDR=1; Major NCD (moderate): CDR=2; Major NCD (severe): CDR=3

‡ Sample weighting was performed according to key characteristics of the Hong Kong community population in 2022 (gender and age)

§ Sample weighting was performed according to key characteristics of the institutional population in Hong Kong (excluding prisons) [gender and age]

¶ Sample weighting was performed according to key characteristics of the total Hong Kong population (gender, age, proportion of community and institutional population) [denominators by age-groups: 60-64 years: 1395, 65-69 years: 1190, 70-74 years: 895, 75-79 years: 520, 80-84 years: 347, ≥85 years: 524]

No significant differences in apolipoprotein E4 distribution were observed across cognitive function groups.

Physical health and lifestyle correlates of neurocognitive disorders

Mild neurocognitive disorders

In unadjusted analyses, older age, fewer years of education, being widowed, divorced or separated, living in rented housing, and lower household income were significantly associated with a higher prevalence of mild NCD. These factors were subsequently controlled for in the logistic regression analyses.

After controlling for the above demographic confounders, hypertension, diabetes mellitus, history of stroke, poor postural balance, higher SARC-F scores, visual or hearing impairment, and dental problems were associated with significantly higher adjusted ORs for mild NCD ($P < 0.05$). Physical exercise (mind-body and resistance), engagement in intellectual activities, and better subjective sleep quality were associated with lower adjusted ORs for mild NCD ($P < 0.05$). In contrast, individuals with mild NCD had significantly higher loneliness scores ($P < 0.05$) [Table 5].

Major neurocognitive disorders

Similar demographic risk factors, such as older age, female gender, fewer years of education, being widowed, divorced, separated or never married, living in rented housing, and lower household income level were associated with a higher prevalence of major NCD. These factors were controlled for in the logistic regression analyses (Table 5).

After controlling for demographic confounders, hypertension, diabetes mellitus, history of stroke, poor postural balance, abnormal vision or hearing, edentulism, high SARC-F scores (≥ 2), and multiple co-morbidities (≥ 4 chronic diseases) were associated with higher adjusted ORs for major NCD ($P < 0.05$) [Table 5].

Less loneliness, participation in mind-body physical exercise, engagement in intellectual activities, and consumption of three portions of vegetables or more per day were associated with a lower likelihood of major NCD after adjustment for demographic confounders ($P < 0.05$). Poor sleep quality was associated with a higher risk of major NCD in unadjusted analyses (Table 5).

Family history

A family history of dementia was reported by 27% of cognitively normal participants, 25% of those with mild NCD, and 23% of those with major NCD. Pearson Chi squared test showed no significant differences across groups.

Service use

Self-reported service utilisation among community-dwelling participants with NCD was assessed in 488 individuals who completed the Phase 2 assessment. Participants with mild and major NCD reported higher use of inpatient, accident and emergency, and outpatient services compared with those with normal cognition. Notably, participants with major NCD reported significantly more psychiatric (15.7%) and neurological (23.0%) consultations in the preceding 3 months than those with normal cognition (2.5% and 2.7%, respectively) and those with mild NCD (6.3% and 4.2%, respectively) [$P < 0.001$].

Discussion

Main findings

Prevalence of neurocognitive disorders in Hong Kong compared with other Asian economies

As population ageing accelerates, the Asia-Pacific region is projected to experience more than a threefold increase in the number of people living with dementia over the next three decades, rising from 23 million in 2015 to 71 million by 2050.²⁶ This territory-wide, population-based study provides up-to-date prevalence estimates of NCD among adults aged ≥ 60 years in Hong Kong in 2022. The prevalence of mild NCD was 21.8% (21.8% in the community; 24.3% in LTC settings), while the prevalence of major NCD was 9.7% (7.4% in the community; 68.8% in LTC settings).²⁶

A nationwide population-based study conducted in Chinese Mainland in 2020 reported overall age- and gender-adjusted prevalences of 15.5% (95% CI=15.2-15.9) for MCI and 6.0% (95% CI=5.8-6.3) for dementia.⁵ The relatively higher prevalence observed in Hong Kong may be related to differences in population demographics and healthcare systems. First, the present study included older adults residing in residential care homes in both recruitment and prevalence estimates. The higher proportion of older adults living in LTC facilities in Hong Kong (3.7% of the older population)²⁴ compared with Chinese Mainland ($< 1\%$),²⁷ combined with the high prevalence of major NCD among LTC residents (68.8%), contributed to an increased overall prevalence of major NCD in Hong Kong. Second, even after excluding LTC residents, the prevalence of NCD among community-dwelling older adults in Hong Kong remained higher. This difference may be attributed to longer life expectancy (83.7 vs 78.6 years) and an age structure characterised by a greater proportion of the oldest-old (population aged ≥ 80 years: 5.3% vs 2.3%) in Hong Kong^{28,29} compared with the Chinese Mainland. Nevertheless, comparison of age-specific prevalence rates revealed a lower prevalence of major NCD in younger-old groups in Hong Kong^{28,29} (age 60-69 years: 1.0% vs

TABLE 5. Psychosocial and physical health correlates of neurocognitive disorders (unweighted)

	Mild NCD		Major NCD		Any NCD	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Demographic characteristics						
Gender (Ref: Male)						
Female	1.01 (0.88-1.16)	(Controlled)	1.23 (1.03-1.47)*	(Controlled)	1.08 (0.96-1.22)	(Controlled)
Age	1.10 (1.09-1.11)†	(Controlled)	1.22 (1.20-1.24)†	(Controlled)	1.13 (1.12-1.14)†	(Controlled)
Years of education	0.83 (0.81-0.84)†	(Controlled)	0.74 (0.72-0.76)†	(Controlled)	0.80 (0.79-0.82)†	(Controlled)
Marital status (Ref: Married/ co-habiting)						
Widowed	1.97 (1.65-2.36)†	(Controlled)	4.66 (3.77-5.76)†	(Controlled)	2.69 (2.31-3.13)†	(Controlled)
Divorced/separated	1.54 (1.23-1.92)†		1.49 (1.06-2.09)*		1.53 (1.25-1.86)†	
Never married	0.89 (0.64-1.23)		2.96 (2.14-4.09)†		1.44 (1.12-1.85)†	
Housing type (Ref: Owned)						
Rented	2.19 (1.90-2.53)†	(Controlled)	8.02 (6.53-9.85)†	(Controlled)	3.36 (2.97-3.81)†	(Controlled)
Household income, HK\$ (Ref: <6000)						
6000-14 999	1.10 (0.92-1.31)	(Controlled)	0.47 (0.38-0.59)†	(Controlled)	0.79 (0.68-0.92)†	(Controlled)
15 000-29 999	0.68 (0.56-0.84)†		0.14 (0.10-0.20)†		0.42 (0.35-0.50)†	
≥30 000	0.40 (0.32-0.50)†		0.10 (0.06-0.14)†		0.25 (0.21-0.31)†	
Physical health factors						
Hypertension (Ref: No)						
Yes	1.81 (1.58-2.08)†	1.36 (1.16-1.58)†	2.82 (2.35-3.38)†	1.62 (1.24-2.13)†	2.10 (1.87-2.37)†	1.43 (1.24-1.65)†
Diabetes mellitus (Ref: No)						
Yes	1.60 (1.37-1.86)†	1.37 (1.15-1.62)†	2.32 (1.94-2.77)†	1.78 (1.35-2.35)†	1.85 (1.62-2.10)†	1.46 (1.25-1.71)†
History of stroke (Ref: No)						
Yes	2.13 (1.67-2.71)†	1.88 (1.45-2.44)†	3.68 (2.88-4.70)†	3.53 (2.52-4.96)†	2.73 (2.22-3.35)†	2.20 (1.74-2.78)†
Balance test (Ref: Pass)						
Fail	2.97 (2.32-3.80)†	1.62 (1.21-2.15)†	19.6 (13.9-27.5)†	5.81 (3.72-9.08)†	4.78 (3.85-5.94)†	2.13 (1.64-2.77)†
Vision (Ref: Normal)						
Abnormal	2.46 (1.86-3.27)†	1.88 (1.37-2.59)†	6.58 (4.54-9.52)†	2.88 (1.68-4.93)†	3.18 (2.47-4.09)†	2.05 (1.52-2.77)†
Hearing (Ref: Normal)						
Abnormal	2.88 (2.08-4.00)†	1.69 (1.17-2.43)†	6.89 (4.53-10.5)†	2.58 (1.42-4.70)†	3.61 (2.69-4.86)†	1.84 (1.31-2.59)†
Oral health problems (Ref: No)						
Yes	1.64 (1.40-1.91)†	1.51 (1.27-1.79)†	0.86 (0.69-1.07)	0.93 (0.68-1.27)	1.35 (1.18-1.54)†	1.38 (1.18-1.62)†
Not applicable (no teeth)	4.88 (3.87-6.17)†	2.42 (1.86-3.15)†	9.83 (7.71-12.5)†	2.19 (1.51-3.18)†	6.72 (5.51-8.19)†	2.46 (1.93-3.13)†
SARC-F score (Ref: 0)						
1	1.75 (1.45-2.11)†	1.55 (1.26-1.91)†	1.53 (1.00-2.33)*	0.99 (0.59-1.66)	1.72 (1.44-2.05)†	1.49 (1.22-1.82)†
≥2	4.03 (3.41-4.76)†	2.96 (2.44-3.59)†	26.7 (20.5-34.8)†	9.27 (6.55-13.1)†	7.40 (6.39-8.57)†	3.86 (3.23-4.62)†
No. of co-morbidities (CIRS) [Ref: 0-1]						
2-3	1.55 (1.21-1.98)†	1.24 (0.95-1.63)	2.27 (1.52-3.39)†	1.26 (0.71-2.24)	1.72 (1.38-2.14)†	1.25 (0.97-1.62)
4-5	2.44 (1.91-3.12)†	1.64 (1.25-2.15)	4.25 (2.86-6.31)†	2.00 (1.15-3.49)*	2.86 (2.31-3.56)†	1.69 (1.31-2.19)†
≥6	4.12 (3.20-5.31)†	2.39 (1.81-3.16)	10.5 (7.08-15.5)†	3.49 (2.00-6.07)†	5.62 (4.49-7.02)†	2.65 (2.03-3.45)†

Abbreviations: 95% CI = 95% confidence interval; CIRS = Cumulative Illness Rating Scale; HK\$ = Hong Kong dollars; NCD = neurocognitive disorders; OR = odds ratio; PSQI = Pittsburgh Sleep Quality Index; Ref = reference group in regression analysis; SARC-F = Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls

* P<0.05

† P<0.001

‡ P<0.01

TABLE 5. (cont'd)

	Mild NCD		Major NCD		Any NCD	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Lifestyle factors						
Smoking (Ref: Never)						
Former	1.65 (1.34-2.03) [†]	1.21 (0.94-1.55)	1.28 (0.98-1.67)	0.89 (0.57-1.38)	1.51 (1.26-1.81) [†]	1.13 (0.89-1.43)
Current	1.34 (1.00-1.79)	1.20 (0.85-1.68)	0.49 (0.29-0.84) [‡]	0.96 (0.49-1.90)	1.02 (0.77-1.33)	1.10 (0.79-1.52)
Alcohol consumption (Ref: Never)						
Current/former	0.82 (0.66-1.03)	0.69 (0.53-0.89) [‡]	0.52 (0.35-0.78) [‡]	0.66 (0.38-1.16)	0.74 (0.60-0.90) [‡]	0.67 (0.52-0.86) [‡]
Daily fruit intake (Ref: ≥2 portions)						
<2	1.37 (1.11-1.69) [‡]	1.23 (0.97-1.56)	1.69 (1.18-2.43) [‡]	1.29 (0.79-2.13)	1.43 (1.18-1.74) [†]	1.24 (0.99-1.56)
Daily vegetable intake (Ref: ≥3 portions)						
<3	1.16 (0.83-1.64)	0.99 (0.68-1.44)	3.37 (2.20-5.15) [†]	2.36 (1.26-4.41) [‡]	1.57 (1.17-2.09) [‡]	1.14 (0.81-1.61)
Mind-body exercise (Ref: No)						
Yes	0.60 (0.47-0.77) [†]	0.67 (0.51-0.87) [‡]	0.30 (0.14-0.62) [‡]	0.37 (0.17-0.80) [*]	0.56 (0.44-0.70) [†]	0.64 (0.49-0.83) [†]
Aerobic exercise (Ref: No)						
Yes	0.59 (0.49-0.71) [†]	0.84 (0.69-1.03)	0.26 (0.16-0.44) [†]	0.68 (0.38-1.21)	0.54 (0.45-0.64) [†]	0.82 (0.67-1.00) [*]
Resistance exercise (Ref: No)						
Yes	0.64 (0.48-0.87) [‡]	0.71 (0.51-0.98) [*]	0.34 (0.14-0.85) [*]	0.46 (0.16-1.29)	0.60 (0.45-0.80) [†]	0.68 (0.49-0.94) [*]
Intellectual activity (Ref: No)						
Yes	0.40 (0.32-0.51) [†]	0.60 (0.46-0.79) [†]	0.07 (0.05-0.11) [†]	0.14 (0.09-0.23) [†]	0.30 (0.24-0.37) [†]	0.49 (0.38-0.63) [†]
Emotional loneliness (higher scores indicate worse status)						
	1.33 (1.23-1.44) [†]	1.32 (1.21-1.44) [†]	1.48 (1.24-1.76) [†]	1.53 (1.25-1.89) [†]	1.35 (1.25-1.45) [†]	1.35 (1.24-1.47) [†]
Social loneliness (higher scores indicate better status)						
	0.88 (0.82-0.93) [†]	0.86 (0.80-0.92) [†]	0.81 (0.70-0.94) [‡]	0.83 (0.70-0.99) [*]	0.87 (0.82-0.92) [†]	0.86 (0.80-0.92) [†]
Sleep quality (PSQI) [Ref: Good]						
Poor	1.90 (1.64-2.21) [†]	1.66 (1.41-1.96) [†]	1.71 (1.30-2.25) [†]	1.34 (0.94-1.90)	1.86 (1.63-2.14) [†]	1.62 (1.39-1.90) [†]

2.9%; age 70-79 years: 4.7% vs 8.4%⁵), but a higher prevalence among the oldest-old (age ≥80 years: 33.7% vs 16.1%⁵). In contrast, the prevalence of mild NCD was consistently higher across all age-groups in Hong Kong (age 60-69 years: 14.5% vs 11.8%; age 70-79 years: 28.8% vs 19.2%; age ≥80 years: 33.1% vs 25.0%⁵).⁵ These patterns may reflect better management of cardiovascular diseases and other risk factors (eg, lower rates of smoking and alcohol consumption) among the younger-old population, the approximately twofold higher proportion of the oldest-old among older adults (age ≥85 years: 10.7% vs 4.9%⁵), and longer survival following dementia onset in Hong Kong.

Compared with other developed Asian economies, including Japan, South Korea, Taiwan, and Singapore, the prevalence of dementia in Hong Kong is also relatively high, particularly among those aged 80 years or above (online supplementary

Fig).³⁰ Although the high proportion of oldest-old individuals partly contributes to this observation (Hong Kong: 10.7%, Japan: 15.2%, Taiwan: 7.7%, Singapore: 6.6%, South Korea: 6.5%), another important explanation may be the substantial burden of cerebrovascular disease, which is associated with a higher prevalence of dementia (online supplementary Fig).³⁰ In Hong Kong, cerebrovascular risk factors strongly contribute to dementia cases (eg, 43.5% vs 26.7% in Chinese Mainland⁵), whereas among the oldest-old population, cerebral small vessel disease is highly prevalent.

Trends in the prevalence of neurocognitive disorders in Hong Kong

In comparison with the 2008 community-based prevalence study in Hong Kong,⁴ a decrease in the overall prevalence of mild dementia (mild stage of major NCD) was observed (from 5.4% in 2008

to 3.8% in 2022 [Table 4]), with reductions noted across all age-groups. This decline may be attributed to improved management of physical health risk factors, enabling more older adults to remain within the mild NCD range. Contributing factors may include higher educational attainment, reduced smoking and alcohol consumption, and better control of cerebrovascular disease.

Regarding mild NCD (MCI or CDR=0.5), the prevalences of very mild dementia (5.8%) and MCI (23.8%) reported in 2008⁴ are not directly comparable to the prevalence of mild NCD observed in HKMMSOP (21.8%). First, different cognitive screening tools were employed. The 2008 study utilised the CMMSE and AMT,⁴ whereas HKMMSOP adopted the HK-MoCA as the primary screening instrument. The HK-MoCA was designed to be more sensitive in detecting early executive dysfunction associated with vascular or non-Alzheimer's pathology.¹² In practice, the HK-MoCA¹² demonstrates comparable sensitivity (97%) but higher specificity (81% vs 72%) and negative predictive value (93% vs 81%) compared with the CMMSE.⁴ Second, the diagnostic threshold for mild NCD, labelled as very mild dementia (CDR=0.5) in the 2008 study,⁴ has shifted over the past decade in favour of an early-detection paradigm. Advances in screening accuracy and diagnostic algorithms may have contributed to a higher detection rate of mild NCD in HKMMSOP. Finally, due to methodological limitations in the 2008 study,⁴ comparisons across the full spectrum of cognitive impairment are restricted. The CDR assessments were only conducted among participants who screened positive for cognitive impairment and proceeded to Phase 2 clinician evaluation. In contrast, CDR scores in HKMMSOP were determined for all participants during Phase 1 by trained research assistants and subsequently corroborated by experienced psychiatrists.

Finally, optimisation of dementia risk management, along with changes in the population age structure, may also help explain the increased concentration of moderate and severe cases among the oldest-old participants in HKMMSOP.

Multidimensional associated factors

This study identified several risk factors associated with NCD, many of which were common to both mild and major NCD. These included increasing age, lower educational attainment, being widowed, divorced or separated, and poorer socio-economic status as indicated by living in rented housing and reporting a lower household income. These findings are consistent with previous studies.^{5,8,31} Female gender was associated with major NCD, but not with mild NCD, among older adults in Hong Kong.

Regarding physical health conditions, in addition to cardiovascular disease, poorer postural

balance, higher sarcopenia scores, visual and hearing impairment, and oral health problems were associated with the presence of NCD. A greater number of co-morbidities was associated with major NCD, while poor sleep quality was associated with an increased risk of mild NCD. With respect to potentially modifiable lifestyle factors, consuming three portions of vegetables or more per day was associated with a lower prevalence of major NCD. Regular physical exercise, engagement in intellectual activities, and lower levels of loneliness were associated with a reduced prevalence of NCD. The cross-sectional associations observed between potentially modifiable factors and NCD in this study may enrich the existing evidence base and provide converging directions for future research into causal relationships. These findings may also inform policy development aimed at the dementia prevention worldwide.

Limitations

The findings of HKMMSOP should be interpreted in light of several limitations. First, this was a cross-sectional study; therefore, causal relationships between NCD and associated factors cannot be inferred. Second, sampling bias is an inherent limitation in prevalence studies, as individuals with an existing diagnosis and ongoing treatment may be less likely to participate (due to reduced activity levels resulting in underestimation) or more motivated to enrol, potentially leading to overestimation). Hard-to-reach populations may also have been underrepresented due to factors such as poor physical or cognitive function, limited mobility, or the absence of family caregivers. The COVID-19 pandemic likely exacerbated sample bias in this study: the household response rate was merely 8.4%, and the sample over-represented women and younger-old adults, potentially underestimating NCD severity among the oldest-old.

Third, participants who did not attend Phase 2 assessments were older and had a greater burden of physical morbidity. The main reasons for non-participation among individuals with positive screening results in Phase 1 included 'assessment centre too far from home', 'too old or too frail', 'no accompanying caregiver', and 'no perceived necessity'. While Phase 1 assessments demonstrated satisfactory positive and negative predictive values for NCD diagnosis (90% and 93%, respectively), differences in participation profiles between those who did and did not complete Phase 2 may have influenced prevalence estimates.

Finally, HKMMSOP was conducted during periods when Hong Kong was affected by various phases of the COVID-19 pandemic. Infection control measures adversely impacted participant recruitment (low household response rate: 8.4%)

and interview arrangements. Surveys involving residents of care homes and hostels were particularly restricted due to stringent lockdown policies. As a result, only a limited number of in-person, telephone, or online assessments could be conducted with older participants. Most information was obtained from family caregivers or formal carers within the respective institutions, which may have influenced the reliability and validity of the assessment instruments.

Implications

Despite these limitations, the findings of this study remain valuable for informing future clinical practice, public health interventions, and research priorities. First, the HKMMSOP revealed that nearly one in five older adults in Hong Kong had mild NCD. This pattern is likely not unique to Hong Kong and may also apply to other Asian metropolitan cities characterised by increasing life expectancy and a high burden of physical co-morbidities among older populations. Mild NCD represents an at-risk state with variable clinical trajectories. In a 5-year prospective study of Chinese older adults with MCI, approximately 30% progressed to dementia, while others either remained stable or improved to normal cognitive function.³² Given the spectrum from normal cognition to mild and major NCD encountered in primary care, prevention and timely intervention should address a broad range of associated health factors, particularly common and modifiable ones operating across the life course of cognitive health, such as educational attainment, socio-economic status, sensorimotor function, physical exercise, and intellectual activity.^{7,33} Although the cross-sectional design of the HKMMSOP does not permit causal inference, early intervention and management of these modifiable health risks may help reduce progression to major NCD, improve quality of life and functional capacity among individuals living with MCI, and yield meaningful clinical and economic benefits.

Within Hong Kong, the development of District Health Centres provides an opportunity to support primary care providers in planning screening and early intervention programmes for cognitive and mental health. Optimal management of cardiovascular disease and related risk factors from midlife is essential as cerebral small vessel disease contributes to—and may play a causal role in—a substantial proportion of vascular and mixed dementia cases.³⁴ Additionally, sensory function, oral health, and musculoskeletal integrity should be emphasised and integrated into primary healthcare screening. Lifestyle interventions also warrant attention, as clinicians may promote cognitive benefits through various forms of physical exercise and intellectual activities, as well

as interventions targeting sleep hygiene and social connectedness.^{25,35-37}

Second, considering the high prevalence of major NCD (dementia) among the oldest-old population, an integrated medico-social support system should be established. Among participants with major NCD in the HKMMSOP, utilisation rates of specialist services (psychiatric, neurological, and psychological outpatient care) were far from optimal (<40%). This gap may substantially hinder the timely treatment and management of cognitive or behavioural complications, thereby increasing family, economic, and societal burdens.³⁸ At present, primary care consultations specifically addressing cognitive decline are not well established in Hong Kong. While not all individuals with NCD require specialist medical attention, the observed 60% service gap underscores the importance of strengthening primary care management to optimise cognitive function in the community.³⁸ Given that NCD comprises heterogeneous neurodegenerative conditions, appropriate and tiered medical assessments and interventions across both primary and specialist settings play a critical role in accurate subtype diagnosis, personalised management planning, and monitoring of disease progression.

Third, approximately 70% of residents in LTC facilities were affected by major NCD. Coordinated efforts and the integration of multidisciplinary care are essential to recognise and address the complex cognitive, physical, and mental health needs of individuals living in LTC facilities, as well as those of their caregivers.

Finally, considering the limitations of this cross-sectional prevalence study, further research is warranted in the following two areas: (1) investigation of potentially modifiable health and lifestyle factors for healthy cognitive ageing through longitudinal, cohort, and clinical trial designs to elucidate causal relationships; and (2) focused evaluation of cognitive impairment among the oldest-old population, individuals with complex socio-medical conditions (eg, hard-to-reach groups, those living alone, those with high co-morbidity burden, or limited access to health and social resources), and residents of LTC facilities.

Conclusion

The HKMMSOP study provides updated estimates of NCD prevalence among community-dwelling adults aged 60 years or above in Hong Kong during the COVID-19 pandemic period. The weighted prevalence of major NCD in Hong Kong was estimated at 9.7%, with the greatest increase observed among the oldest-old. Given the steep rise in the proportion of the population reaching advanced age, the total number of people living with major NCD is expected to continue increasing

over the coming decade. Approximately one in five adults aged 60 years or above had mild NCD. Public health education for older adults should focus on optimising the management of chronic medical and cerebrovascular diseases, promoting regular physical exercise, correcting sensory impairments, and encouraging active engagement in intellectual and social enrichment activities. Equally important, the complex needs of older adults residing in residential care homes should not be overlooked—nearly seven in ten LTC residents were affected by major NCD.

Author contributions

Concept or design: LCW Lam, WC Chan, ATC Lee, AWT Fung, SL Ma, CPW Cheng, ST Cheng, FHY Lai, BHK Yip, SYS Wong.

Acquisition of data: LCW Lam, WC Chan, ATC Lee, Z Huo, VC Lin.

Analysis or interpretation of data: LCW Lam, WC Chan, ATC Lee, Z Huo, VC Lin.

Drafting of the manuscript: All authors.

Critical revision of the manuscript for important intellectual content: All authors.

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Declaration

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Ethics approval

This research was approved by the Survey and Behavioural Research Ethics Committee (Ref No.: SBRE 18-628) and the Clinical Research Ethics Committee of The Chinese University of Hong Kong, Hong Kong (Ref No.: CREC NTEC CUHK 2018-0529). Written consent was obtained from each participant or their first-degree relative (for those with profound cognitive impairments or sensory deficits) before joining the study.

Supplementary material

The supplementary material was provided by the authors and some information may not have been peer reviewed. Accepted supplementary material will be published as submitted by the authors, without any editing or formatting. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by the Hong Kong Academy of Medicine and the Hong Kong Medical Association. The Hong Kong Academy of Medicine and the Hong Kong Medical Association disclaim all liability and responsibility arising from any reliance placed on the content. To view the file, please visit the journal online (<https://doi.org/10.12809/hkmj2412656>).

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