Ethnic-specific Sociodemographic Factors as Determinants of Cognitive Performance: Cross-sectional Analysis of the Malaysian Elders Longitudinal Research (MELoR) Study Article

Nur Fazidah Asmuje[a,b,] Sumaiyah Mat[c], Phyo Kyaw Myint[e,f], Maw Pin Tan[b,g,h]

[a] Kolej Genius Insan, Universiti Sains Islam Malaysia

[b]Ageing and Age Associated Disorders Research Group, Department of Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur

[c]Physiotherapy Programme and Center of Healthy Ageing and Wellness, Faculty of Health Sciences, Universiti Kebangsaan Malaysia

[e]Ageing Clinical & Experimental Research (ACER) Team, Institute of Applied Health Sciences, University of Aberdeen, Aberdeen, UK

[f]Department of Medicine for The Elderly, NHS Grampian, Aberdeen Royal Infirmary, Aberdeen, UK

[g]Centre for Innovations in Medical Engineering, University of Malaya

[h]Department of Medical Sciences, Faculty of Healthcare and Medical Sciences, Sunway University, Bandar Sunway

Short Title: Ethnic-specific Sociodemographic Factors as Determinants of Cognitive Performance

Corresponding Author:

Maw Pin Tan,

Department of Medicine, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia.

Email: mptan@ummc.edu.my

Tel: +60 3 79492429 Fax: +60 3 79564613

Number of Tables: 3

Word count: 3161 words

Keywords: Ethnicity, cognition, aged, dementia

Abstract

Introduction Despite cognitive impairment being a major health issue within the older population, limited information is available on factors associated with cognitive function among Asian ethnic groups. The objective of this study was to identify ethnic-specific sociodemographic risk factors which are associated with cognitive performance. **Methods** Cross-sectional analysis of the Malaysian Elders Longitudinal Research (MELoR) study involving community-dwelling individuals aged >55 years was conducted. Information on sociodemographic, medical history and lifestyle were obtained by computer-assisted interviews in participants' homes. Cognitive performance was assessed with the Montreal Cognitive Assessment (MoCA) tool during subsequent hospital-based health checks. Hierarchical multiple linear regression analyses were conducted with continuous MoCA scores as the dependent variable. **Results** Data was available for 1140 participants, mean(SD)=68.48(7.23) years, comprising 377(33.1%) ethnic Malays, 414(36.3%) Chinese, and 349(30.6%) Indians. Mean (SD) MoCA scores were 20.44(4.92), 23.97(4.03) and 22.04(4.83) for Malays, Chinese and Indians, respectively (p=0.01). Age >75 years, <12 years of education and low functional ability were common risk factors for low cognitive performance across all three ethnic groups. Cognitive performance was positively associated with social engagement among the ethnic Chinese (β(95% CI)= 0.06(0.01,0.11)) and Indians (β(95% CI)= 0.16(0.09,0.23)), and with lower depression scores (β(95% CI)= -0.08(-0.15,-0.01)) among the ethnic Indians. **Conclusion** Common factors associated with cognitive performance include age, education and functional ability, and ethnic-specific factors were social engagement and depression. Interethnic comparisons of risk factors may form the basis for identification of ethnic-specific modifiable risk factors for cognitive decline and provision of culturally acceptable prevention measures.

KEYWORDS: Cognition, Ethnic-specific, Malaysia, Sociodemographic factors

Introduction

Dementia is a progressive condition and represents a syndrome characterised by a gradual loss of function resulting from degenerative changes in the central nervous system [1]. The global prevalence of dementia has increased by two-folds every 20 years due to rapid population ageing, and is expected to affect a staggering 65.7 million persons by 2030 [2]. Individuals with cognitive decline are likely to have a combination of risk factors, which include age, gender, socioeconomic status, physical activity, educational level, depression and cardiovascular disease [3].

Most published studies to date have evaluated cognitive impairment in Caucasian populations, though an increasing number of studies are now being published from East Asian populations [2,4,5]. While factors influencing cognitive function related to ethnic differences have been explored in some Northern American studies comparing risk factors between individuals of Afro-Caribbean, Hispanic White and White ethnicities [6,7] few ethnic comparisons have been conducted among Asian populations [8], since the populations studied in East Asia have tended to be homogenous. Ethnic differences within populations are likely to occur as a result of genetic factors, shared cultural practices, or common social and environmental factors such as social engagement, building characteristics and household composition [6].

Malaysia, a higher middle-income nation in South East Asia, is expected to have ~261,000 people with dementia by 2030 [9]. The prevalence of dementia within the population of Malaysia aged 60 years and over has been reported as 8.5% according to the National Health and Morbidity Survey 2018, with a significant negative impact on society [10]. While differences in demographic, behavioural and other comorbidities may alter the occurrence of cognitive impairment in older people [11] the role of these factors in the development of cognitive impairment across ethnicities remains unclear.

The population of Malaysia comprises three main ethnic groups: Malays (69.9%), Chinese (22.6%) and Indians (1.0%) [12]. Each ethnic group has retained its unique cultures leading to measurable discrepancies in life expectancy, which have been largely attributed to dietary, socioeconomic and lifestyle differences [13]. This lands itself an opportunity to examine the potential impact of

sociodemographic, health and lifestyle factors on cognitive performance within three major Asian ethnic groups.

Methods

Study Design and Setting

This was a cross-sectional population-based study utilizing first-wave data from the Malaysian Elders Longitudinal Research (MELoR). Participants were recruited from 2013 to 2015 from three parliamentary constituencies within the Klang Valley of Malaysia with the objective of identifying issues related to population ageing. Details on recruitment and response rates have been published previously [14]. Individuals aged 55 years and above were selected using simple random sampling, stratified by age and ethnicity. The above age cut-off was selected as it was the mandatory retirement age in Malaysia at the time study was conceived. Individuals who were unable to communicate due to advanced dementia or speech impediments were excluded. Ethical approval was obtained from the University of Malaya Medical Centre Medical Research Ethics Committee (MEC: 943.6).

Data Collection

Basic demographics, medical history and cognitive assessments were obtained during home-based computer-assisted interviews. Computer-assisted interviews were conducted by trained interviewers using a standardized questionnaire in respondents' preferred language, including English, Malay, Mandarin, or Tamil, at participants' own homes. Sociodemographic, medical history, psychological status and lifestyle information were obtained during this visit. Cognitive performance was assessed at a subsequent hospital-based health check. Written informed consent was obtained from all participants prior to enrolment.

Psychological status including depression, anxiety and stress were assessed using the 21-item Depression, Anxiety and Stress Scale (DASS-21) [15]. The DASS-21 comprises seven questions for each of its three domains [16]. The total sum score was obtained for each of the domains of depression, anxiety and stress separately. Each domain score was multiplied then by two. The maximum domain score was therefore 42, with a higher score indicating greater severity.

The Lubben Social Network Scale (LSNS-6) was used to assess participants' social engagement with their families and friends [17]. Social network was assessed through six items which examined the number of relatives and friends with whom participants were in contact with, at ease with, and able to call on, on a six-point Likert's scale [18]. The maximal total score was 30, with the lower score delineating the risk of social isolation.

The Lawton's instrumental activities of daily living (ADL) scale was utilized to assess the ability of the individual to successfully perform daily tasks including using the telephone, getting around, grocery shopping, meal preparation, housework, laundry, taking medications, and managing money over the course of one or two days [18,19]. There was a total of eight items, with a lower score indicating a lower functional ability.

Quality of life (QoL) was evaluated using the 12-item Control, Autonomy, Self-Realisation and Pleasure (CASP-12) questionnaire [20]. The CASP-12 is truncated into two domains of control/autonomy and self-relation/pleasure. Each of the 12 items was assessed using a four-point Likert's scale. The range of scores varied from 12 to 48, with higher total scores indicating better QoL [18].

The Montreal Cognitive Assessment (MoCA) test, designed as an early detection test for cognitive impairment [21], is influenced by language and culture [22]. Multiple language translations within the same version of a cognitive assessment tool reduces the need for oral translations, which can result in bias. At the point of study commencement, only the validated English, Malay, Chinese, and Tamil versions of the Singapore-MoCA test were available. As Malaysia and Singapore shared significant historical and cultural affinities, any potential influence of linguistic, cultural and demographic differences on the performance of the cognitive assessment tool is likely to be minimal. The MoCA test evaluated seven domains of short-term memory; visuospatial ability; executive function; attention, concentration and working memory; language; orientation. The maximal total score was 30, with a one-point adjustment for participants with less than 12 years of formal education. A higher score indicates better cognitive performance.

Statistical analysis

Statistical analyses were carried out using the Statistical Package for Social Science (SPSS) version 22.0 (IBM, USA). Continuous data were presented as mean and standard deviation (SD), and categorical data as frequencies and percentages (%). The chi-squared test and ANOVA were used to perform descriptive analyses between ethnic groups for categorical and continuous data respectively (Malay, Chinese and Indian). Univariate linear regression analyses were conducted to establish associations between potential factors with cognitive performance. Only significant factors with a p-value of less than 0.05 were included in the subsequent hierarchical stepwise multiple linear regression analysis. Separate multivariate analyses were conducted for each ethnic group. Collinearity diagnostics revealed that psychosocial factor including depression, anxiety, and stress were moderately correlated with variance inflation factors (VIF) of 2.23, 1.51, and 2.10 respectively. This study, therefore, selected

only one psychosocial factor (depression) for adjustment as it has a higher population attributable fraction of modifiable risk factors for dementia [23].

Results

Basic Characteristics and Cognitive Performance by Ethnicity

This study included 1140 community dwellers with mean age (SD) of 68.48 (7.23) years, comprising 377 (33.1%) Malays, 414 (36.3%) Chinese and 349 (30.6%) Indians (shown in Table 1). Age, education, alcohol consumption, presence of hypertension, depression, anxiety and stress, social engagement, functional status and quality of life differed significantly between the three ethnic groups.

Univariate analyses

The mean (SD) total MoCA scores for the ethnic Chinese, Indians and Malays were 23.97(4.03), 22.04(4.83) and 20.44(4.92), respectively. Table 2 demonstrates the mean difference (MD) and 95% confidence intervals (CI) for factors which were associated with differences in MoCA scores within the three ethnic groups.

Malay ethnicity

Compared to individuals aged 55-64 years, those aged 75 years and above had significantly lower MoCA scores (MD=-1.92; 95%CI=-3.35 to -0.49) but no significant difference in MoCA was observed among individuals aged 65-74 years (MD=-0.38; 95%CI=-1.43 to 0.66). Individuals with more than 12 years of education, alcohol consumption, social engagement and higher functional ability had significantly higher mean MoCA scores (MD=4.88; 95%CI=3.85 to 5.92), (MD=2.35; 95%CI=0.73 to 3.97), (MD=0.11; 95%CI=0.03 to 0.18) and (MD=1.35; 95%CI=0.70 to 1.99) respectively. Higher levels of depression (MD=-0.14; 95%CI=-0.27 to -0.01) and anxiety (MD=-0.22; 95%CI=-0.33 to -0.10) were significantly associated with lower mean MoCA scores.

Chinese ethnicity

Compared to individuals aged 55-64 years, those aged 75 years and above had significantly lower MoCA scores (MD=-3.88; 95% CI=-4.85 to -2.91) but no significant difference in MoCA were observed among individuals aged 65-74 years (MD=-0.65; 95%CI=-1.48 to 0.18). Individuals with more than 12 years of education, social engagement, better functional ability and quality of life had significantly higher mean MoCA scores (MD=2.25; 95%CI=1.49 to 3.00), (MD=0.15; 95%CI=0.09 to 0.21), (MD=2.78; 95%CI=2.12 to 3.43) and (MD=0.13; 95%CI=0.06 to 0.20) respectively. Presence of heart failure (MD=-1.28; 95%CI=-2.09 to -0.47) or hypertension (MD=-1.18; 95%CI=-1.93 to -0.44) as well as higher levels

of depression (MD=-0.15; 95%CI=-0.25 to -0.04) were significantly associated with lower mean MoCA scores.

Indian ethnicity

Compared to individuals aged 55-64 years, those aged 75 years and above had significantly lower MoCA scores (MD=-2.32; 95% CI=-3.64 to -1.01) but no significant difference in MoCA were observed among individuals aged 65 to 74 years (MD=-0.86; 95%CI=-2.00 to 0.29). Individuals with more than 12 years of education, alcohol consumption, social engagement, better functional ability and quality of life had significantly higher mean MoCA scores (MD=3.32; 95%CI=2.37 to 4.27), (MD=1.44; 95%CI=0.46 to 2.43), (MD=0.22; 95%CI=0.15 to 0.30), (MD=1.50; 95%CI=0.98 to 2.02) and (MD=0.14; 95%CI=0.05 to 0.23) respectively. Higher levels of depression (MD=-0.12; 95%CI=-0.19 to -0.05) were significantly associated with lower mean MoCA scores.

Multivariate Analyses

Overall Population

Overall, the multivariate adjusted model as shown in Table 3 identified that older age and higher depression scores were associated with lower mean MoCA scores while more than 12 years of education and social engagement were associated with increased mean MoCA scores. Using the ethnic Chinese as the reference category, the ethnic Malays (MD=-2.88; 95% CI=-3.47 to -2.28) and ethnic Indians (MD=-1.46; 95% CI=-2.03 to -0.88) had significantly poorer MoCA scores (Table 3). Compared to individuals aged 55-64 years, being 65 years and above was associated with lower MoCA scores (MD=-0.71; 95% CI=-1.24 to -0.18). Individuals with more than 12 years of education, social engagement and functional ability, had significantly higher mean MoCA scores (MD= 3.47; 95%CI=2.95 to 3.99), (MD=0.08; 95%CI=0.04 to 0.12) and (MD=0.99; 95%CI=0.66 to 1.33), respectively. Higher levels of depression were significantly associated with lower mean MoCA scores (MD=-0.06; 95%CI=-0.11 to -0.01).

Malay ethnicity

In the multivariate adjusted model, being 65 years and older was associated with a poor MoCA score compared to being 55-64 years of age (MD=-1.03; 95%CI=-1.97 to -0.09). Individuals with more than 12 years of education and higher functional ability were significantly associated with higher MoCA scores (MD=5.38; 95%CI= 4.30 to 6.45; MD=0.84; 95%CI= 0.24 to 1.45 respectively). Depression score

(MD=-0.05; 95%CI= -0. 17 to 0.08) and social engagement score (MD= 0.03; 95%CI=-0.04 to 0.10) were no longer associated with differences in MoCA scores.

Chinese ethnicity

Among the Chinese population, individuals aged 75 years and over were significantly more likely to have poorer MoCA scores than those aged 55-64 years (MD=-2.69; 95%CI=-3.65 to -1.72) in the multivariate adjusted model. More than 12 years of education, better social engagement and functional ability were associated with higher MoCA scores (MD=2.36; 95%CI=1.65 to 3.08), (MD= 0.06; 95%CI=0.01 to 0.11) and (MD= 1.86; 95%CI=1.20 to 2.53) respectively. Presence of heart failure and hypertension, depression score as well as quality of life were no longer associated with differences in MoCA scores (MD=-0.44; 95%CI=-1.37 to 0.48), (MD=-0.08; 95%CI=-0.79 to 0.94), (MD=-0.01; 95%CI=-0.11 to 0.09) and (MD=0.02; 95%CI=-0.05 to 0.09) respectively.

Indian ethnicity

Individuals aged 75 years and over were significantly more likely to have poorer MoCA scores than those aged 55-64 years (MD=-2.86; 95%CI=-4.05 to -1.66) in the multivariate adjusted model. Meanwhile, more than 12 years of education, better social engagement and functional ability were associated with higher MoCA scores (MD=3.33; 95%CI=2.40 to 4.26), (MD=0.16; 95%CI=0.09 to 0.23) and (MD= 0.67; 95%CI=0.16 to 1.18) respectively. Increased depression score was associated with decreased MoCA scores (MD=-0.08; 95%CI=-0.15 to -0.01). Alcohol consumption and quality of life were no longer associated with differences in MoCA scores (MD=0.85; 95%CI=-0.02 to 1.73) and (MD=-0.02; 95%CI=-0.12 to 0.08) respectively.

Discussion

Within this population-based study, Malay and Indian ethnic groups had lower total MoCA scores compared to the participants from the Chinese ethnicity. However, the ethnic differences observed may not necessarily reflect differences in cognitive performance as interethnic score differences may be influenced by inherent cultural biases in the tool. Risk factors for lower cognitive performance among community dwellers differed between ethnic groups. Comparisons within ethnic groups revealed that age, educational level and functional ability were common factors influencing cognitive performance. Additionally, higher levels of social engagement were associated with improved cognitive performance in both of the ethnic Indians and Chinese. For the overall population older age, higher depression scores and Malay ethnicity compared to Chinese ethnicity were associated with poorer cognitive performance while higher educational levels, better social engagement and functional ability were associated with improved cognitive performance.

The presence of the APOE-Ɛ4 allele has been linked to the progression from mild cognitive impairment to Alzheimer's Disease (AD) due to its proclivity to accumulate beta-amyloid [24]. It is also associated with a slightly increased risk of sporadic AD. Published studies have reported that the frequency of this allele varies among ethnic groups [25]. A genetic mapping study among Malaysians revealed lower APOE- Ɛ4 frequency among the ethnic Chinese population [26] which could explain why they obtained higher cognitive scores compared to the ethnic Malays and Indians in this study. A previous Malaysian study had also suggested that ethnic Malays were twice as likely as Chinese to develop dementia [27]. Genetic interactions with sociocultural factors including education, diet, mentally challenging occupation in midlife, leisure activities in late life, and social networks in late life may also account for the differences in cognitive performance [9].

Increasing age is a major risk factor for neurocognitive disorder which was also demonstrated within our population. The decline in cognitive performance with age was apparent in the 65-74 years age group among the ethnic Malays, while within the Chinese and Indian ethnic groups this difference was only apparent at the age of 75 years and over. This apparent reduction in cognitive performance at a lower age in the ethnic Malays compared to the other two major ethnic groups in Malaysia may be influenced by the relatively higher number of individuals with 12 or fewer years of education in the Malay ethnic group. A similar pathological process could have occurred in all three ethnic groups, but lack of mentally challenging tasks at midlife, which is associated with lower levels of education, will lead to earlier presentation with cognitive decline. An autopsy study reported the presence of amyloid plaques, neurofibrillary tangles, synaptic dystrophy, loss of neurons and brain volume, even in those with high cognitive performance [28]. Degenerative brain changes are often asymptomatic and correlate poorly with cognitive decline, and this has been attributed to neuroplasticity, whereby individuals who continually indulge in mentally stimulating tasks throughout life, demonstrate greater cognitive reserve, and hence reducing symptom severity in association with a similar level of pathological insult [29].

Education has been established as a protective factor of cognitive impairment through the enhancement of neural function in brain degeneration [30] which is consistent with the cognitive reserve hypothesis [31]. While the influence of education was apparent in all three ethnic groups, the strength of the association was greater among the ethnic Malays within individuals with at least 12 years of education experiencing four times increased odds of improved cognitive performance compared to the ethnic Indians and Chinese which only enjoyed a doubling in odds of improved cognitive performance. Furthermore, only 23% of the ethnic Malays had at least 12 years of education

compared to 35-36% in the other two ethnic groups. Education is influenced by socioeconomic status which may also influence other lifestyle factors including diet and healthcare accessibility [32].

Non-communicable diseases (NCD) such as hypertension, diabetes, and atherosclerosis, have been identified as potential modifiable risk factors for dementia [33]. Despite the fact that diabetes was found to be more prevalent in individuals with cognitive impairment within the same cohort measured by the MoCA-Blind version, it had no effect on the relationship between visual impairment and cognitive function [34]. This study also found that diabetes was not a risk factor for lower cognitive performance within MELoR population, this time using the full version of the MoCA test. While previous studies have found an association between the presence of hypertension and poorer cognitive performance, within this study, hypertension and heart failure were significantly associated with poorer cognitive performance only among the ethnic Chinese, with the differences confounded by age, education and social engagement [35]. The presence of NCD in the other ethnic groups did not influence cognitive performance. It is possible that these conditions are underdiagnosed within these ethnic groups. Previous studies have suggested poorer healthcare utilization among older adults with high levels of undetected chronic diseases such as hypertension, diabetes, hypercholesterolaemia and heart disease [36].

Psychological factors are known to influence cognitive function [4]. Zaremba et.al found slower processing speed and poorer short-term verbal and visuo-spatial memory performance in individuals with depression [37]. Increased depression, anxiety, or stress may also lead to increased social isolation and unsatisfactory relationships with family and friends [38]. Neuroticism especially when combined with social isolation, increases the risk of dementia. The relationship between depression and low social engagement with cognitive function among the ethnic Indians observed in this study was consistent with the above as well as the findings from the National Mental Health Survey of the Elderly, Singapore [39]. Better functional ability, was also found to be a neuroprotective factor of poor cognitive performance in the overall population, which is consistent with the previous findings in Malaysian community dwelling older adults using the MoCA-BM [40] and Singaporeans using the Mini Mental State Examination [39].

This study was limited to an urban setting, and hence may not be representative of Malaysia's rural or semi-urban areas. The MoCA test was used in this study was an assessment tool. Future studies should consider an extended evaluation for the diagnosis of cognitive impairment taking into account the DSM-V definitions for major and minor neurocognitive disorders. Its cross-sectional design also precludes the assignment of causality in cognitive impairment. While ethnicity is not considered a

modifiable risk factor, observation of ethnic differences in risk factors and risk of cognitive impairment may inform future studies on lifestyle modification for prevention of cognitive impairment and dementia. Education is a highly modifiable risk factor which has received limited attention, and life-long learning strategies such as distance learning and micro credentialing which removes the barriers towards adult education should be explored as potential preventive public health approaches.

Conclusion

Older age,12 years of education or less and low functional ability represent common risk factors for low cognition assessed using MoCA scores across all three ethnic groups, while higher levels of social engagement was associated with higher cognitive performance among the ethnic Chinese and Indians, and higher depression level was only associated with lower cognitive performance among the ethnic Indians. We, therefore, propose that future population-based strategies to reduce the burden of dementia should consider life-long learning interventions. Community based interventions to reduce the burden of cognitive impairment in the general older population should take into account differential risk factors between the major ethnic groups with consideration for interventions that are specifically tailored to each ethnicity.

Acknowledgement

We are grateful to Prof Dr Chin Ai Vyrn and Prof Dr Shahrul Bahyah Kamaruzzaman from Faculty of Medicine, University of Malaya for their help in MELoR study. We also thank members of the Ageing and Age-Associated Disorders Research Group for helping with patient recruitment and data collection.

Statement of Ethics

Study approval statement: Ethical approval was obtained from the University of Malaya Medical Centre Medical Research Ethics Committee (MEC: 943.6).

Consent to participate statement: Written informed consent was obtained from all participants prior to enrolment.

Conflict of Interest Statement

No conflict of interest

Funding Sources

The Malaysian Elders Longitudinal Research (MELoR) study is now part of the Transforming Cognitive Frailty into Later Life Self-Sufficiency (AGELESS) longitudinal cohort study, currently funded by the Ministry of Higher Education Long Term Research Grant Scheme (LRGS/1/2019/UM/01/1).

Author Contributions

1. A. Nur Fazidah formulated research questions, designed the study, analysed the findings and wrote the paper.

2. M. Sumaiyah supervised the data collection and designed the statistical analysis.

3.KM.Phyo contributed in discussion session and edited article.

4.T. Maw Pin supervised data collection, wrote and edited the article.

Data Availability Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

References

1. National Institutes of Health. National Health and Morbidity Survey 2018: Elderly Health. Volume Two: Elderly Health Findings. Vol. 2, Institute for Public Health, National Institutes of Health (NIH), Ministry of Health, Malaysia. 2018. 132 p.
2. Prince M, Bryce R, Albanese E, Wimo A, Ribeiro W, Ferri CP. The global prevalence of dementia: A systematic review and metaanalysis. Alzheimer's Dement [Internet]. 2013;9(1):63-75.e2. Available from: http://dx.doi.org/10.1016/j.jalz.2012.11.007
3. World Health Organization. Risk reduction of cognitive decline and dementia: WHO guidelines. [Internet]. Who. 2019. Available from: https://www.who.int/mental_health/neurology/dementia/risk_reduction_gdg_meeting/en/
4. Alzheimer's Association. 2021 Alzheimer's disease facts and figures special report Race, Ethnicity and Alzheimer's in America. Alzheimers Dement. 2021;17(3):327–406.
5. Wu YT, Brayne C, Matthews FE. Prevalence of dementia in East Asia: A synthetic review of time trends. Int J Geriatr Psychiatry. 2015;30(8):793–801.
6. Babulal GM, Quiroz YT, Albensi BC, Arenaza-Urquijo E, Astell AJ, Babiloni C, et al. Perspectives on ethnic and racial disparities in Alzheimer's disease and related dementias: Update and areas of immediate need. Alzheimer's Dement. 2019;15(2):292–312.
7. Díaz-Venegas C, Downer B, Langa KM, Wong R. Racial and ethnic differences in cognitive function among older adults in the USA. Int J Geriatr Psychiatry [Internet]. 2016 Sep;31(9):1004–12. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0031938416312148
8. Venketasubramanian N, Sahadevan S, Kua EH, Chen CPL, Ng TP. Interethnic differences in dementia epidemiology: Global and Asia-Pacific perspectives. Dement Geriatr Cogn Disord. 2011;30(6):492–8.
9. Alzheimer's Association. 2020 Alzheimer's disease facts and figures. Alzheimer's Dement [Internet]. 2020 Mar 10;16(3):391–460. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/alz.12068
10. Ganapathy SS, Sooryanarayana R, Ahmad NA, Jamaluddin R, Abd Razak MA, Tan MP, et al. Prevalence of dementia and quality of life of caregivers of people living with dementia in Malaysia. Geriatr \& Gerontol Int [Internet]. 2020;20(S2):16–20. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ggi.14031

11. Hussin NM, Shahar S, Yahya HM, Din NC, Singh DKA, Omar MA. Incidence and predictors of mild cognitive impairment (MCI) within a multi-ethnic Asian populace: A community-based longitudinal study. BMC Public Health. 2019;19(1):1–11.

12. Department of Statistics Malaysia Official Portal;, National Registration Department M of HA (Malaysia). Malaysia Demographic Statistics Quarter 4 2020. Malaysia Dep Stat (Malaysia). 2021;(August).

13. Tey NP, Siraj SB, Kamaruzzaman SBB, Chin AV, Tan MP, Sinnappan GS, et al. Aging in multi-ethnic Malaysia. Gerontologist. 2016;56(4):603–9.

14. Lim LM, McStea M, Chung WW, Azmi NN, Aziz SAA, Alwi S, et al. Prevalence, risk factors and health outcomes associated with polypharmacy among urban community-dwelling older adults in multiethnic Malaysia. PLoS One. 2017;12(3):1–18.

15. Lovibond, S.H. & Lovibond PF. Manual for the Depression Anxiety & Stress Scales. 2nd ed. Sydney: Psychology Foundation; 1995.

16. Gloster AT, Rhoades HM, Novy D, Klotsche J, Senior A, Kunik M, et al. Psychometric properties of the Depression Anxiety and Stress Scale-21 in older primary care patients. J Affect Disord. 2008;110(3):248–59.

17. Lubben J. Assessing social networks among elderly populations. Fam Community Health [Internet]. 1988 Nov;11(3):42–52. Available from: http://journals.lww.com/00003727-198811000-00008

18. Ashendorf L. A Compendium of Tests, Scales, and Questionnaires: The Practitioner's Guide to Measuring Outcomes After Acquired Brain Impairment. Appl Neuropsychol Adult. 2012;19(1):78–9.

19. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. Gerontologist. 1969;9(3):179–86.

20. Borrat-Besson C, Ryser V-A, Gonçalves J. An evaluation of the CASP-12 scale used in the Survey of Ageing and Retirement in Europe (SHARE) to measure Quality of Life among people aged 50+. [Internet]. 2015. (FORS Working Paper Series). Available from: www.share-project.org

21. Nasreddine ZS, Phillips NA, BÃ©dirian V, Charbonneau S, Whitehead V, Collin I, et al. The Montreal Cognitive Assessment, MoCA: A Brief Screening Tool For Mild Cognitive Impairment. J Am Geriatr Soc [Internet]. 2005 Apr;53(4):695–9. Available from:

https://onlinelibrary.wiley.com/doi/10.1111/j.1532-5415.2005.53221.x

22. Ng KP, Chiew HJ, Lim L, Rosa-Neto P, Kandiah N, Gauthier S. The influence of language and culture on cognitive assessment tools in the diagnosis of early cognitive impairment and dementia. Expert Rev Neurother [Internet]. 2018;18(11):859–69. Available from: https://doi.org/10.1080/14737175.2018.1532792

23. Livingston G, Huntley J, Sommerlad A, Ames D, Ballard C, Banerjee S, et al. Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. Lancet [Internet]. 2020 Aug;396(10248):413–46. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673620303676

24. Li JQ, Tan L, Wang HF, Tan MS, Tan L, Xu W, et al. Risk factors for predicting progression from mild cognitive impairment to Alzheimer's disease: A systematic review and meta-analysis of cohort studies. J Neurol Neurosurg Psychiatry. 2016;87(5):476–84.

25. Blue EE, Horimoto ARVR, Mukherjee S, Wijsman EM, Thornton TA. Local ancestry at APOE modifies Alzheimer's disease risk in Caribbean Hispanics. Alzheimers Dement. 2019;15(12):1524–32.

26. Seet WT, Ai Mary Anne TJ, Yen TS. Apolipoprotein e genotyping in the Malay, Chinese and Indian ethnic groups in Malaysia - A study on the distribution of the different apoE alleles and genotypes. Clin Chim Acta. 2004;340(1–2):201–5.

27. Hamid TA, Krishnaswamy S, Abdullah SS, Momtaz YA. Sociodemographic risk factors and correlates of dementia in older Malaysians. Dement Geriatr Cogn Disord [Internet]. 2011;30(6):533–9. Available from: https://www.karger.com/Article/FullText/321672

28. Elobeid A, Libard S, Leino M, Popova SN, Alafuzoff I. Altered Proteins in the Aging Brain. J Neuropathol Exp Neurol [Internet]. 2016 Apr;75(4):316–25. Available from: https://academic.oup.com/jnen/article-lookup/doi/10.1093/jnen/nlw002

29. Krell-Roesch J, Syrjanen JA, Vassilaki M, MacHulda MM, Mielke MM, Knopman DS, et al. Quantity and quality of mental activities and the risk of incident mild cognitive impairment. Neurology. 2019;93(6):E548–58.

30. Foubert-Samier A, Catheline G, Amieva H, Dilharreguy B, Helmer C, Allard M, et al. Education, occupation, leisure activities, and brain reserve: A population-based study. Neurobiol Aging [Internet]. 2012;33(2):423.e15-423.e25. Available from: http://dx.doi.org/10.1016/j.neurobiolaging.2010.09.023

31. Colombo B, Antonietti A, Daneau B. The Relationships Between Cognitive Reserve and Creativity. A Study on American Aging Population. Front Psychol [Internet]. 2018 May 23;9(764):1–11. Available from: https://www.frontiersin.org/article/10.3389/fpsyg.2018.00764/full

32. Deckers K, Cadar D, Van Boxtel MPJ, Verhey FRJ, Steptoe A, Köhler S. Modifiable Risk Factors Explain Socioeconomic Inequalities in Dementia Risk: Evidence from a Population-Based Prospective Cohort Study. J Alzheimer's Dis. 2019;71(2):549–57.

33. Mecocci P, Boccardi V. The impact of aging in dementia: It is time to refocus attention on the main risk factor of dementia. Ageing Res Rev [Internet]. 2021 Jan;65(2021):101210. Available from: https://doi.org/10.1016/j.arr.2020.101210

34. Effendi-Tenang I, Tan MP, Khaliddin N, Jamaluddin Ahmad M, Amir NN, Kamaruzzaman SB, et al. Vision impairment and cognitive function among urban-dwelling malaysians aged 55 years and over from the Malaysian Elders Longitudinal Research (MELoR) study. Arch Gerontol Geriatr [Internet]. 2020;90:104165. Available from: https://doi.org/10.1016/j.archger.2020.104165

35. Anstey KJ, Ee N, Eramudugolla R, Jagger C, Peters R. A Systematic Review of Meta-Analyses that Evaluate Risk Factors for Dementia to Evaluate the Quantity, Quality, and Global Representativeness of Evidence. J Alzheimer's Dis. 2019;70(s1):S165–86.

36. Frost M, Wraae K, Gudex C, Nielsen T, Brixen K, Hagen C, et al. Chronic diseases in elderly men: Underreporting and underdiagnosis. Age Ageing. 2012;41(2):177–83.

37. Zaremba D, Schulze I, Förster K, Redlich R, Grotegerd D, Leehr EJ, et al. Progress in Neuropsychopharmacology & Biological Psychiatry The effects of processing speed on memory impairment in patients with major depressive disorder. Prog Neuropsychopharmacol Biol Psychiatry [Internet]. 2019;92(March):494–500. Available from: https://doi.org/10.1016/j.pnpbp.2019.02.015

38. Qiu C, Kivipelto M, Von Strauss E. Epidemiology of Alzheimer's disease: Occurrence, determinants, and strategies toward intervention. Dialogues Clin Neurosci. 2009;11(2):111–28.

39. Ng TP, Niti M, Chiam PC, Kua EH. Physical and cognitive domains of the Instrumental Activities of Daily Living: Validation in a multiethnic population of Asian older adults. Journals Gerontol - Ser A Biol Sci Med Sci. 2006;61(7):726–35.

40. Din NC, Shahar S, Zulkifli BH, Razali R, Vyrn CA, Omar A. Validation and Optimal Cut-Off Scores of the Bahasa Malaysia Version of the Montreal Cognitive Assessment (MoCA-BM) for Mild Cognitive Impairment among Community Dwelling Older Adults in Malaysia. Sains Malaysiana. 2016;45(9):1337–43.

Table 1. Basic Sociodemographic and MoCA Score by Ethnicity

	Malay (n= 377)	Chinese (n= 414)	Indian (n= 349)	P values
SOCIODEMOGRAPHIC				
Age				≤0.001*
55-64 years	147 (39.0%)	114 (27.5%)	99 (28.4%)	
65-74 years	171 (45.4%)	200 (48.3%)	160 (45.8%)	
≥75 years	59 (15.6%)	100 (24.2%)	88 (25.8%)	
Sex (ref: Male)				0.149
Female	211 (56.0%)	254 (61.4%)	186 (53.3%)	
Formal Education				≤0.001*
≤ 12 years education	290 (76.9%)	265 (64.0%)	220 (63.0%)	
> 12 years education	87 (23.1%)	149 (36.0%)	127 (37.0%)	
HEALTH				
History of Smoking	82 (21.8%)	71 (17.1%)	66 (18.9%)	0.271
Alcohol Consumption	36 (9.5%)	150 (36.2%)	141 (40.4%)	≤0.001*
History of Comorbidities (ref: No)				
cardiac arrythmia	14 (3.7%)	15 (3.62%)	16 (4.6%)	0.763
heart failure	270 (71.6%)	287 (69.3%)	267 (76.5%)	0.212
hypertension	218 (57.8%)	221 (53.4%)	185 (53.0%)	0.028*
hypercholesterolemia	201 (53.3%)	200 (48.3%)	196 (56.2%)	0.681
diabetes	17 (4.5%)	13 (3.1%)	8 (2.3%)	0.242
Total depression Scores	2.27 (3.48)	2.13(3.48)	4.38 (6.52)	≤0.001*
Total anxiety scores	3.82 (4.04)	3.10 (3.41)	4.56 (5.06)	≤0.001*
Total stress scores	3.64 (4.60)	3.70 (4.64)	6.06 (7.43)	≤0.001*
LIFESTYLE				
Social Engagement	17.02 (6.34)	15.99 (6.29)	15.97 (6.39)	0.034**
Activities of Daily Living	6.53 (0.72)	6.82 (0.53)	6.46 (0.90)	≤0.001*
Quality of Life	29.71 (4.50)	27.56 (5.09)	27.15 (5.11)	≤0.001*
MOCA SCORE	20.44 (4.92)	23.97 (4.03)	22.04 (4.83)	≤0.001*

* p-value= <0.001; ** p-value = <0.005

Table 2: Univariate Analysis for Factors Associated with Cognitive Performance MoCA scores by Ethnicity

VARIABLES	All		MALAY		CHINESE		INDIAN	
	B	**95% CI**	**B**	**95% CI**	**B**	**95% CI**	**B**	**95% CI**
SOCIODEMOGRAPHIC								
Age (reference: 55-64 years)								
65-74 years	-0.33	-0.94, 0.28	-0.38	-1.43 , 0.66	-0.65	-1.48, 0.18	-0.86	-2.00, 0.29
≥75 years *	**-2.33**	**-3.07, -1.60**	**-1.92**	**-3.35, -0.49**	**-3.88**	**-4.85, - 2.91**	**-2.32**	**-3.64, -1.01**
Sex (reference: Male) Female	-0.05	-0.60, 0.49	-0.27	-1.24, 0.70	-0.31	-0.46, 1.09	0.31	-0.46, 1.09
Formal Education (reference group: ≤ 12 years education)								
> 12 years education*	**3.60**	**3.06, 4.14**	**4.88**	**3.85, 5.92**	**2.25**	**1.49, 3.00**	**3.32**	**2.37, 4.27**
HEALTH (reference: no and never)								
History of Smoking	0.33	-0.36, 1.01	0.81	-0.36, 1.97	-0.25	-1.25, 0.75	0.95	-0.28, 2.19
Alcohol Consumption	**1.82**	**1.23, 2.40**	**2.35**	**0.73, 3.97**	0.63	-0.16, 1.41	**1.44**	**0.46, 2.43**
History of Comorbidities								
Cardiac arrhythmia	0.73	-0.65, 2.12	1.41	-1.13, 3.96	0.28	-1.74, 2.29	0.65	-1.68, 2.98
Heart failure	**-0.72**	**-1.32, -0.12**	-0.46	-1.53, 0.60	**-1.28**	**-2.09, - 0.47**	0.01	-1.12, 1.13
Hypertension	**-1.00**	**-1.54, -0.46**	-0.86	-1.83, 0.12	**-1.18**	**-1.93, -0.44**	-0.22	-1.20, 0.76
Hypercholesterolemia	-0.12	-0.66, 0.42	0.22	-0.74, 1.18	-0.55	-1.31, 0.20	-0.04	-0.95, 1.02
Diabetes	-1.28	-2.78, 0.22	-0.96	-3.23, 1.36	-1.50	-3.65, 0.66	-0.58	-3.84, 2.68
Depression Scores*	**-0.13**	**-0.19, -0.08**	**-0.14**	**-0.27, -0.01**	**-0.15**	**-0.25, -0.04**	**-0.12**	**-0.19, -0.05**
Anxiety Scores*	**-0.14**	**-0.20, -0.07**	**-0.22**	**-0.33, -0.10**	-0.02	-0.13, 0.09	-0.09	-0.18, 0.01

VARIABLES	All		MALAY		CHINESE		INDIAN	
	B	**95% CI**	**B**	**95% CI**	**B**	**95% CI**	**B**	**95% CI**
Stress Scores*	-0.01	-0.06, 0.03	-0.01	-0.12, 0.10	0.01	-0.07, 0.09	-0.02	-0.09, 0.04
LIFE STYLE								
Social Engagement*	**0.14**	**0.10, 0.18**	**0.11**	**0.03, 0.18**	**0.15**	**0.09, 0.21**	**0.22**	**0.15, 0.30**
Activities of Daily Living*	**1.93**	**1.58, 2.28**	**1.35**	**0.70, 1.99**	**2.78**	**2.12, 3.43**	**1.50**	**0.98, 2.02**
Quality of Life*	0.05	-0.01 0.11,	0.03	-0.08, 0.14	**0.13**	**0.06, 0.20**	**0.14**	**0.05, 0.23**

Dependent variable is MoCA score. Significant factors in bold. B represents mean difference for categorical variables age groups, gender. *Correlation coefficient*

Table 3: Multivariate Models for Cognitive Score According to Ethnicity

	All **β† (95% CI)**	**Malay** **β† (95% CI)**	**Chinese** **β† (95% CI)**	**Indian** **β† (95% CI)**
Ethnicity (reference: Chinese)				
Malay	-2.88 (-3.47, -2.28)**-	-	-	-
Indian	-1.46 (-2.03,-0.88)**	-	-	-
Age (reference: 55-64 years)				
65-74 years	-0.71 (-1.24,-0.18)**	-1.03 (-1.97,-0.09)*	-0.57 (-1.34,0.22)	-0.94 (-1.94,0.07)
≥75 years	-2.40 (-3.05,-1.74)**	-1.91 (-3.21, -0.61)**	-2.69 (-3.65,-1.72)**	-2.86 (-4.05,-1.66)*
Formal Education (reference: ≤ 12 years education)				
> 12 years education	3.47 (2.95, 3.99)**	5.38 (4.30,6.45)**	2.36 (1.65,3.08)**	3.33 (2.404.26)**
Alcohol	0.60 (-0.024,1.13)	1.08 (-0.41,2.56)	-	0.85 (-0.02,1.73)
Heart Failure	0.15 (-0.52,0.83)	-	-0.44 (-1.37,0.48)	-
Hypertension	-0.30 (-0.91,0.32)	-	-0.08 (-0.79,0.94)	-
Depression‡	-0.06 (-0.11,-0.01)*	-0.05 (-0.17,0.08)	-0.01 (-0.11,0.09)	-0.08 (-0.15,-0.01)*
Social Engagement‡	0.08 (0.04,0.12)**	0.03 (-0.04,0.10)	0.06 (0.01,0.11)*	0.16 (0.09,0.23)**
Activities of Daily Living‡	0.99 (0.66, 1.33)**	0.84 (0.24, 1.45)**	1.86 (1.20, 2.53)**	0.67 (0.16,1.18)*
Quality of Life	-0.01 (-0.06,0.01)	-	0.02 (-0.05, 0.09)	-0.02 (-0.12,0.08)
R^2	0.32	0.28	0.32	0.30

** P≤0.001, * P <0.05, †adjusted mean difference unless otherwise indicated. ‡adjusted. Correlation.