ORIGINAL ARTICLE

The Effects of Socio-demographic Characteristics, Nutritional Status, Physical Activity and Physical Function on Cognitive Function of Community-dwelling Older Adults in the Klang Valley, Malaysia

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ABSTRACT

Introduction: Cognitive decline and cognitive impairment among older adults is a rising public health concern because of its association with increased risk of dementia, disability and mortality. In Malaysia, early identification of cognitive impairment is uncommon due to lack of understanding of risk profile of the elderly population. The objective of this study was to determine factors associated with cognitive impairment among community-dwelling older adults. **Methods:** This cross-sectional study was conducted among 698 community-dwelling older adults aged 60 years old and above in Klang Valley, Malaysia by using multi-stage sampling to determine the risk factors and predictors of cognitive impairment from a multidimensional approach. Multivariate logistic regression analysis was performed to determine the relationship between socio-demographic characteristics, physical activity, physical functional status and cognitive impairment. **Results:** Increased of age (OR = 1.056), being female (OR = 2.219) and Indian (OR = 2.722) were the risk factors for cognitive impairment, while years of education (OR = 0.765), physically active (OR = 0.823) and better physical function (OR = 0.843) were significantly associated with decreased risk of cognitive impairment. Marital and nutritional status failed to predict the risk of cognitive impairment. **Conclusion:** Given the protective effects of physical activity and physical function on the cognitive decline at later age, relevant policymakers should formulate appropriate health education programmes to promote regular physical activity to improve physical and cognitive function among Malaysians across all ages.

Keywords: Cognitive impairment, Physical activity, Physical function, Older adults, Malaysia

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INTRODUCTION

Cognitive impairment is a transitional state between normal cognitive function and the presence of clinical symptoms of dementia (1-4). The decline in memory or other cognitive functions including executive function, attention, language and visuospatial skills are the most typical symptoms of cognitive impairment (1-4). Although patients with cognitive impairment may return to the normal state of cognitive function, most patients would have higher risk being dementia (5-7), disable and higher mortality rate (8-11). Despite cognitive impairment and dementia have been identified as public health concern with incur substantial economic burden on individuals, families and countries, early diagnosis is often uncommon and public awareness is poor.

The prevalence of cognitive impairment in Malaysia ranged from 11-22.4% (12-17), which was comparable to other population (1, 5). Prevalence of cognitive impairment varied greatly across publications due to the differences in definitions, diagnostic criteria, as well as sampling and assessment methods. It is however projected that the number would further increase considering the substantial increase in the proportion and number of the older population in Malaysia.

While most studies on cognitive impairment in Malaysia focused on its prevalence, associations with non-modifiable risk factors such as age, sex, socioeconomic status and impact or burden on caregivers (14-16,

18, 19), limited study had been conducted to assess the risk profile among Malaysians, in particular, its relationships with other modifiable risk factors such as cardiovascular risk factors, nutritional status, physical activity and functional status. Nonetheless, a recent community-based longitudinal study conducted by Hussin et al that investigated possible predictors of MCI among older Malaysian found that being male and lack of participation in mental activities were the predictors of MCI (17). While most of these studies have shown that both insufficient and excessive energy intake, malnutrition, physical inactivity and reduced physical function were associated with increased risk of cognitive impairment (20-25), studies on the interaction between these factors, other modifiable and non-modifiable risk factors and cognitive impairment are scarce.

In light of the above, this study aimed to investigate the risk factors of cognitive impairment from multidimensional aspects, particularly the interactions between socioeconomic status, cardiovascular risk factors, nutritional status, physical activity and physical functional status, based on a representative sample of the elderly Malaysian population.

MATERIALS AND METHODS

This was a cross-sectional household survey conducted in Klang Valley, across nine districts in the state of Selangor, Federal Territory of Kuala Lumpur and Putrajaya, by using multi-stage sampling. Cluster sampling was applied at the first stage,based on the sampling frame provided by the Department of Statistics, Malaysia, which divided Klang Valley according to a geographically continuous area with identified boundary, classified as "Census Circles (CC)". According to the 2010 census data provided by the Department of Statistics, Malaysia, there was a total of 3,043 CCs in the Klang Valley, with 2,267 (74.4%) CCs in Selangor, 738 (24.3%) CCs in Kuala Lumpur and 38 (1.3%) CCs in Putrajaya. A total of 36 (25 in Selangor, 7 in Kuala Lumpur and 4 in Putrajaya) CCs were randomly selected based on the proportion of CCs in Selangor: Kuala Lumpur: Putrajaya or 7:2:1. Systematic random sampling was conducted at the second stage to select 24 eligible respondents (older Malaysian aged 60 years and above who were not terminally ill, physically or mentally disabled) from each cluster.

The study was conducted from June to October 2016, through face-to-face interviews by trained enumerators with the use of a pretested structured questionnaire. Prior to study enrolment, ethical approval was granted by the Ethics Committee for Research Involving Human Subjects, Universiti Putra Malaysia [Reference No: UPM/TNCPI/RMC/1.4.18.1 (JEKUPM)/F1] and all respondents provided written informed consent.

Cognitive function was assessed by using a validated Malay Mini-Mental State Examination (M-MMSE) (26) and clock drawing test (CDT) (27). The total scores of MMSE ranged from 0 to 30, which composed of 30 items that related to cognitive functions, included of assessment on orientation, attention and calculation, memory and visual-spatial skills (26). The clock drawing test was used as an adjunct test to identify executive cognitive dysfunction in people with a normal mini-mental state examination score. A six points scale, with five points would be given for a "perfect" clock and zero for the most "impaired" clock or inability to make any reasonable representation of a clock, was adopted (28). Respondent was classified as cognitive impaired if the scores for M-MMSE were ≤ 18 (26) or the scores or CDT were ≤ 3 (28).

On the other hand, the Mini Nutritional Assessment Short Form (MNA-SF) was used to assess the risk of malnutrition among older people. The total score for the MNA-SF ranged from 0 to 14 and respondents who scored below 13 were categorised as at risk of malnutrition (29). The level of physical activity of the respondents were assessed using the Rapid Assessment of Physical Activity (RAPA) (30). The assessment is made up of two components and nine "Yes" or "No" questions to evaluate the amount and intensity of physical activity such as aerobic activity and strength and flexibility that an older person aged 50 and above usually does. The total scores for aerobic activity are seven points with higher scores indicated higher amount, frequency and intensity of physical activity. On the other hand, a score of three was given to respondents who carried out both strength and flexibility activities. Four physical performance tests, which included a 10-foot timed walk, handgrip strength test, chair stand test and standing balance test, were also used to assess physical function of respondents (31, 32). A score of 0 to 4 points was given for each test with specific relevant cut-off values were applied to 10-ft timed walk, chair-stand test and grip strength according to sex. The total score for four physical tests ranged from 0 to 16 points, with higher scores indicated better physical function.

Other variables including socio-demographic factors such as age, sex, ethnicity, years of education, marital status and self-reported non-communicable diseases were ascertained using a pre-tested structured questionnaire. Respondents were asked on the medical diagnosis of non-communicable diseases included hypertension, hypercholesterolemia, diabetes mellitus, heart disease and stroke with "1" or "0" score was given for a presence of these diseases or vice versa. Body mass index (BMI) was computed by dividing body weight in kilograms by the square of estimated height [calculated by using demi-arm span - equations for Malaysian: 1.438 x Demi-arm span + 51.28cm (estimation height for an older man) and 1.549 x Demi-arm span + 41.35cm (estimation height for an older woman)] in metres (kg/m^2) (33). The recommended cut-off value for BMI by

the Nutrition Screening Initiative (NSI) was adopted, in which ≤ 23 kg/m^2 was categorized as "underweight", 24 – 27 kg/m^2 was defined as "normal weight" and >27 kg/m^2 was considered "overweight" (34).

Statistical analysis

The IBM SPSS statistics software version 23.0 was used to perform the analysis. Bivariate relationship or differences of each variable with cognitive impairment were examined by independent-samples t-test and chi-square test (χ^2), while multivariate relationships between the cognitive impairment and various variables were determined by logistic regression. The contribution of the variables to variations in the risk of cognitive impairment was determined by coefficient "b", while the probability of cognitive impairment risk over the probability of no risk of cognitive impairment was presented in the form of an odds ratio. All statistical significance was set at $p<0.05$.

RESULTS

A total of 698 community-dwelling older person aged 60 and above participated in this study. As shown in Table I, 34.5% or 241 respondents were classified as cognitive impaired. Majority of them were either older, female, had lower education and or not in a marital relationship. Also, the proportion of Indian respondents who had cognitive impairment were significantly higher compared to other ethnic groups. As shown in Table II, nearly half of the respondents were at risk of malnutrition or malnourished and majority of them were physically under-active or had a sedentary lifestyle. Three-quarter of the respondents were either rarely involved in any aerobic activities or only carried out some light or moderate physical activities such as walking leisurely at home or work or doing some light housework on a non-regular basis, while two-fifth of them rarely or never involved in any strength and flexibility activities. The average score for the four performance-based physical functional tests was 9.8 ± 3.2, which indicated the majority of the respondents had a moderate performance in the four physical functional tests.

Respondents who had significantly lower scores in MNA-SF and RAPA had poorer cognitive function or were cognitive impaired as shown in Table III. In addition, respondents who had cognitive impairment were found to perform poorer in physical function tests as compared to those with normal cognition. Correlations between cognitive impairment with its potential determinants were dictated in a multivariate analysis as shown in Table IV. Age, years of education, sex differences, ethnicity, aerobic activity and physical function were significantly associated with cognitive impairment. While non-modifiable risk factors such as increased in age (OR = 1.056; 95% CI = 1.023 – 1.090), being a female (OR = 2.219; 95% CI = 1.350 – 3.649) and Indian (OR = 2.722; 95% CI = 1.233 – 6.006) increased the risk for cognitive impairment, modifiable risk factors such as higher years of education (OR = 0.765; 95% CI = 0.719 – 0.813), aerobic activity (OR = 0.823; 95% CI = 0.713 – 0.951) and better performance in physical function (OR = 0.843; 95% CI = 0.779 – 0.912) were associated with decreased risk of cognitive decline. Other variables such as marital and nutritional status as well as strength and flexibility activity failed to predict the risk of cognitive impairment.

Table I: Comparison of selected characteristics of respondents as stratified by cognition status

	Cognitive Impairment (n = 241) n (%)	Normal Cognition (n = 457) n(%)	Total (n = 698) n(%)	t/χ^2	*p* value
Age**	72.0 ± 7.8	66.8 ± 6.1	68.6 ± 7.2	-8.952	<0.001
60 – 69 years	96 (22.9)	323 (77.1)	419 (60.0)		
70 – 79 years	98 (46.4)	113 (53.6)	211 (30.2)		
≥ 80 years	47 (69.1)	21 (39.9)	68 (9.7)		
Sex					
Male	54 (18.9)	232 (81.8)	286 (41.0)	52.470	<0.001**
Female	187 (54.6)	225 (45.4)	412 (59.0)		
Ethnicity					
Malay/Bumiputera	158 (33.9)	308 (66.1)	466 (66.8)	6.226	0.044*
Chinese	51 (30.9)	114 (69.1)	165 (23.6)		
Indian	32 (47.8)	35 (52.2)	67 (9.6)		
Years of education	3.5 ± 3.6	8.3 ± 4.1	6.7 ± 4.6	15.340	<0.001**
≤ 6 years	211 (50.4)	208 (49.6)	419 (60.0)		
> 6 years	30 (10.8)	249 (89.2)	279 (40.0)		
Marital status					
Married	100 (24.4)	310 (75.6)	410 (58.7)	45.169	<0.001**
Unmarried (Never married, divorced, separated or widowed)	141 (49.0)	147 (51.0)	288 (41.3)		
Classification BMI					
Underweight	119 (35.5)	216 (64.5)	336 (48.1)	1.400	0.497
Normal weight	72 (31.6)	156 (68.4)	229 (32.8)		
Overweight	50 (37.0)	85 (63.0)	133 (19.1)		
Hypertension					
Yes (%)	145 (36.2)	256 (63.8)	401 (57.4)	1.111	0.297
No (%)	96 (32.3)	201 (67.7)	297 (42.6)		
Hypercholesterolemia					
Yes (%)	88 (33.6)	174 (66.4)	262 (37.5)	0.164	0.742
No (%)	153 (35.1)	283 (64.9)	436 (62.5)		
Diabetes Mellitus					
Yes (%)	92 (36.9)	157 (63.1)	249 (35.7)	1.003	0.320
No (%)	149 (33.2)	300 (66.8)	449 (64.3)		
Heart Disease					
Yes (%)	29 (33.7)	57 (66.3)	86 (12.3)	0.028	0.904
No (%)	212 (34.6)	400 (65.4)	612 (87.7)		
Stroke					
Yes (%)	13 (41.9)	18 (58.1)	31 (4.4)	0.788	0.440
No (%)	228 (34.2)	439 (65.8)	667 (95.6)		

*Note: Data were expressed as n (%) or mean SD; Significant difference between risk of dementia was determined by t-test or Chi-square test (χ^2) at 0.05 level of significance; *p<0.05; **p<0.001*

Table II: Distribution of respondents according to nutritional status, physical activity and physical function level

Physical activity and physical function	Total (n = 698)
Mini Nutritional Assessment Short Form (MNA-SF)	11.4 ± 2.1
Classification of nutritional status (MNA – SF)	35 (5.0)
Malnourished	293 (42.0)
At risk of malnutrition	370 (53.0)
Normal nutritional status	
Aerobic activities score	4.0 ± 1.6
Classification of aerobic activities	
Sedentary or under-active	519 (74.3)
Active	179 (25.7)
Strength & flexibility activities score	1.3 ± 1.1
Classification strength & flexibility activities	
Never or rarely involved in strength & flexibility activities	277 (39.7)
Do activities to increase muscle strength once a week or more	14 (2.0)
Do activities to improve flexibility once a week or more	344 (49.3)
Do both strength & flexibility activities	63 (9.0)
Performance-based physical function (PPF) score	9.8 ± 3.2
Classification of PPF	
Poor	51 (7.3)
Fair	152 (21.8)
Moderate	360 (51.6)
Good	135 (19.3)

Note: Data are expressed as n (%) or mean ± SD

DISCUSSION

The decline of cognitive function at later life and cognitive impairment is a major concern for most of the countries including Malaysia attributes to its higher risk to dementia (1, 6, 7), disability and mortality (8-11). The scale of the problem is increasing following the increased of the ageing population in the country. Our findings showed that slightly more than one-third of the respondents had cognitive impairment, which was higher compared to other local studies (12-17). The discrepancy might due to the differences in screening tools, the diagnostic criteria for cognitive impairment and background of the respondents.

Echoing other studies (35-37), most of the older adults in our study were underweight, at risk of malnutrition and physically inactive. Studies had demonstrated the association between malnutrition, physical activity and function decline. While physical inactivity was highly correlated with functional decline (31), functional limitation or disability could also increase the risk of malnutrition (35, 38). As such, it was not surprising that most of the respondents in this study had an average performance in physical function tests, especially in chair stand test and 10-ft timed walk, which could be attributed to their inactive lifestyle. Indeed, the respondents had lower mean score of physical function tests compared

Table III. Associations of nutritional status, physical activity and physical function with cognitive status

	Cognitive Impairment (n = 241)	Normal Cognition (n = 457)	Total (n = 698)	*t*	*p* value
MNA-SF Score - Risk of malnutrition***	10.9 ± 2.3	11.6 ± 2.0	11.4 ± 2.1	4.408	<0.001
RAPA Score - Aerobic activity***	3.5 ± 1.5	4.3 ± 1.6	4.0 ± 1.6	7.193	<0.001
RAPA Score - Strength and flexibility activity***	1.0 ± 1.0	1.4 ± 1.1	1.3 ± 1.1	5.207	<0.001
Performance-based physical function (PPF) score***	8.0 ± 3.3	10.7 ± 2.7	9.8 ± 3.2	11.239	<0.001

*Note: Data were expressed as mean SD; Significant difference between risk of dementia was determined by t-test at 0.05 level of significance; ***p<0.001*

Table IV: Results of binary logistic regression model and odds ratio predicting the risk of cognitive impairment[a]

	B	SE	Wald Statistic	*P* value[b]	OR	95%CI	
						Lower	Upper
Age	0.054	0.016	11.343	**0.001**	1.056	1.023	1.090
Years of education	-0.269	0.031	73.001	**<0.001**	0.765	0.719	0.813
Female (vs. male)	0.797	0.254	9.879	**0.002**	2.219	1.350	3.649
Ethnicity (ref: Chinese)							
Malay	0.514	0.276	3.453	0.063	1.671	0.972	2.873
Indian	1.001	0.404	6.146	**0.013**	2.722	1.233	6.006
MNA-SF Score – Risk of malnutrition	0.021	0.051	0.170	0.680	1.021	0.924	1.130
RAPA Score -Aerobic activity	-0.194	0.074	6.982	**0.008**	0.823	0.713	0.951
RAPA Score – Strength and Flexibility	0.082	0.103	0.637	0.425	1.086	0.887	1.330
Performance-based physical function score	-0.171	0.040	18.072	**<0.001**	0.843	0.779	0.912

Abbreviations: CI, confidence interval; OR, odds ratio; SE, standard error
[a] Nagelkerke R^2 = 0.492; Hosmer-Lemeshow test: χ^2 (8) = 11.657; p = 0.167
[b] Significant at the 0.05 level using the logistic regression analysis

to population-based prospective cohort study among older adults in Seattle using the same instruments (31, 32), which signifiy the need for appropriate intervention for our older persons.

Our study confirmed that both non-modifiable risk factors such as age, sex, ethnicity and modifiable risk factors such as education, physical activity and physical function affected cognitive function at later life, which was in line with many other studies (13-15, 20-22, 31, 32, 39-43). Despite advancing age was identified as the main risk factor for cognitive impairment in this study, it should be reminded that age should not be seen as a normal ageing process. On the other hand, while most studies suggested older women were at higher risk of cognitive impairment due to anatomical differences such as lower brain size, volume and grey matter volume and hormone change after menopause (40, 43) as well as ethnicity played a significant role in cognitive impairment (13), other studies also cautioned that modifiable risk factors such as educational background, cardiovascular diseases, lifestyles factors, depression and leisure time activities should take into consideration when interpreting the results (41). In fact, a more study published by Hussin et al. showed that older Malaysian men might have higher risk to develop MCI compared to women attributed to mental distress incurred by the change of social role such as divorce, loss of spouse, retirement and poor social support (17). As such, more studies are deemed necessary to determine the actual role of sex and ethnicity in cognitive function at a later life.

The associations of cognitive impairment and modifiable risk factors such as lower education attainment (14, 15, 42), physical inactivity (20-22), poor physical function (31, 32) and risk of cognitive impairment had been consistent. Higher education attainment reserves higher cognitive status which may further delay the clinical symptoms of cognitive impairment (47). In addition, individuals with higher education might also have better performance in the cognitive screening tests, better socio-economic status and practice of healthy lifestyles that might contribute to lower risk of cognitive impairment (44, 48).

The finding of the inverse relationship between physical activity level and risk of cognitive impairment was parallel with other studies (20-22), which indicated that older persons who were physically active or had exercise habits had a better cognitive function or a reduced risk of cognitive decline. The beneficial effects of physical activity might be through the reduction of amyloid burden or increased of synaptic plasticity in the brain (50) or mediated through vascular and metabolic pathway such as hypertension, hypercholesterolemia, diabetes and obesity (51). However, our study failed to observe the relationship between cardiovascular risk factors and cognitive impairment. The insignificant relationship between these factors might be due to the differences in the design and methodology of the study as the present study was a cross-sectional study conducted in late life and status of diseases was self-reported in nature. Nonetheless, a Cochrane review study on the effect of physical activity on cognitive function among older persons indicated that there was insufficient evidence to date to demonstrate such mediating relationship and it was difficult to conclude that the improvement in cognitive function through aerobic activity was attributed by cardiovascular fitness (52). More work in this aspect is highly needed.

While the present study found that older persons with cognitive impairment had poorer performance in physical function tests, some studies had suggested that poor physical function might be an early marker, reflection or an outcome of cognitive impairment (31). As such, more evidence is needed to draw the causal relationship between physical activity, physical function performance and cognitive impairment.

CONCLUSION

This study was conducted in Malaysia to understand the risk profile of older Malaysian for cognitive impairment from a multidimensional perspective. The study has shown that non-modifiable risk factors such as advancing age, being a female, India as the risk factors, whereas modifiable risk factors including education, physical activity and better physical function preserve cognitive function among old persons. Acknowledging the well-documented beneficial effects of physical activity beyond the preservation of cognitive function, appropriate health education programmes should be designed for Malaysian across all ages to engage in regular physical activity to promote both physical and cognitive functions.

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