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CURCUMIN CONSUMPTION AND COGNITIVE FUNCTION IN ELDERLY

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ABSTRACT: Cognitive impairment in elderly is a growing public health concern, and is mainly caused by dementia of various etiologies. Hence, it is important to explore possible measures to mitigate the risk of dementia. Curcumin, active ingredient of turmeric (*Curcuma longa*) is used in curry and has shown protective effect on cognition. This study aims to explore the association between curcumin consumption in curry form and cognitive function in elderly population. This cross-sectional study was conducted in 14 randomly selected residential homes for elderly in Ipoh, Malaysia. A total of 162 subjects aged ≥ 60 years without major physical and mental health problems were selected. The variables included demographic variables, fitness and social activities and frequency of curry consumption. Association of cognitive function with curry consumption and other variables was tested using Mini-Mental State Examination (MMSE). The data was analysed by chi-square and logistic regression using SPSS17.0. Curry consumption, at least once a week was a significant protective factor for cognition based on logistic regression analysis (OR = 0.152; 95% CI: 0.038-0.614; p = 0.008) when combined with other variables like higher level of education (secondary level, p = 0.002; college or university level, p = 0.016) and engagement in fitness activities (p = 0.010). Females (OR = 4.085; 95% CI: 1.559-10.705) and higher age group *i.e.*75 years and above (OR = 4.441; 95% CI: 1.656-11.907) were at significant risk of cognitive impairment.

INTRODUCTION: Dementia refers to an acquired global impairment of higher cortical functions. It is a growing public health concern as it can bring huge psychological disturbance and economic impact. In 2015, there are 46.8 million people worldwide living with dementia [1]. The number will be increasing with rising life expectancy and increasing proportion of old people. Hence greater concern should be given to discover more possible risk reduction measures for dementia.

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Curcumin from turmeric (*Curcuma longa*), a yellow spice, is used commonly in curries and many cuisines in Asia. For thousands of years, curcumin has been used in traditional Indian Ayurvedic and Chinese medicine for its antioxidant and anti-inflammatory properties [2, 3]. It is also attributed to have anti-cancer properties [4, 5]. It has shown to have neuro-protective effect against Alzheimer's disease (AD) through interventional studies [6, 7]. Dietary curcumin in Alzheimer transgenic rats can clear Alzheimer amyloid plaque by lowering oxidized proteins and interleukin-1a that are involved in neuritic plaque formation [6]. It is found that low doses of curcumin given over longer period were more effective than high doses in reducing plaque burden and curcumin may also help macrophages to clear amyloid plaques in AD [7, 8].

An expert review in molecular medicine concludes that curcumin has been shown to inhibit β-secretase and Aβ aggregation and thus it is one of the most promising compounds for development of AD therapy [9]. Alzheimer's Drug Discovery Foundation stated that curcumin is very likely to be safe with strong evidence, but limited support to show its possibility to prevent dementia as more randomized clinical trials need to be done to declare its usefulness in dementia prevention [10].

Some observational studies also suggest that those who consume more curcumin in curry form may be less likely to develop dementia [11, 12]. The prevalence of AD among adults aged 70-79 years is 4.4 times less in India where curry is commonly consumed compared to the same age group in United States [11]. A study done in Singapore showed that even those who consume curry occasionally, *i.e.*, at least once in six months, had better MMSE score compared to those who never or rarely consume curry [12].

It is also a common practice to use curcumin in most Malaysian cuisines. Currently, there are very limited observational studies to support the relation between dietary curcumin consumption and cognitive function in the elderly. Therefore, this study aims to explore the evidence to establish this association.

METHODS: The study was a cross-sectional descriptive study on subjects aged 60 years and above conducted in 14 residential homes for the elderly in Ipoh, Malaysia. Stratified random method was used to select residential homes and 162 subjects were recruited. They were divided into the age groups of 60 to 74 years, and 75 years and above. Those elders diagnosed with significant medical problems such as stroke, dementia, Parkinson's disease or any form of mental illness were excluded. Those with visual and hearing difficulties were also excluded. General information on socio-demography, curry consumption and lifestyle were collected.

Mini-Mental State Examination (MMSE) was done on each subject, tested five areas of cognitive function, namely orientation, registration, attention and calculation, recall and language [13]. The MMSE was done in the subject's preferred language. Validated Chinese version of MMSE obtained from Shanghai and Singapore studies was used for Chinese speaking subjects [14, 15]. Malay version was obtained from the study of Ibrahim NM *et al.*, [16]. The question about season in orientation was replaced with time, considering the nearest one hour difference as no seasonal variation is experienced in Malaysia. Our study variables were described according to a previous study done in Singapore [12]. The level of curry consumption was described as "never or rarely" (never or less than once in 6 months), "occasional" (at least once in 6 months but less than once a month), "often" (at least once a month but less than once a week, and "very often" (at least once a week).

Alcohol intake by our subjects was categorized as "yes" (those who consumed daily at least one alcoholic drink) or "no" (those who consume less than one alcoholic drink daily). Smoking was categorized as current smoker, former smoker or non-smoker. The level of fitness activities was rated according to the frequency of engagement in exercise or brisk walking: "often" (at least 3 times a week) and "sometimes" (less often than 3 times a week) and "none" (do not exercise at all).

The level of social and productive activity was assessed by the frequency of participation in entertainment, recreational, club, religious activities and in self-development activities: "often" (at least once a week), "sometimes" (less often than once a week) and "none" (do not participate at all). SPSS version 17.0 was used for data entry and analysis. The association between level of curry consumption and MMSE score was analyzed. Logistic regression was done for the variables, which showed significance in chi-square test.

The participants were explained about the nature of the research and confidentiality. Written informed consent was obtained from them. All the reports and information recorded from the participants were kept strictly confidential. The study was conducted after obtaining ethical clearance from Medical Research Ethical Committee of University Kuala Lumpur Royal College of Medicine Perak. The necessary permission was also obtained from the authorities of respective residential homes before conducting the study.

RESULTS: A total of 162 subjects participated in the study. Majority of the participants (61.7%) were females. The mean age of subjects was 75.13 years (range: 60-99 years). Majority of them were Chinese, 70.4%, followed by 16% Indians and 13.6% Malays. The mean MMSE score was 24.25 (Standard deviation: 5.173) and the median score was 26.00.

TABLE 1: ASSOCIATION OF SOCIODEMOGRAPHIC FACTORS, CURRY CONSUMPTION AND LIFESTYLE WITH MMSE SCORES

	Normal 24-30 n (%)	Impaired Cognition			Chi-squared p-value
		Mild 21-23 n (%)	Moderate 10-20 n (%)	Severe <10 n (%)	
Gender					
Male	46(74.1)	7 (11)	8 (12.9)	1 (1)	0.003
Female	51 (51)	24 (24)	25 (25.0)	0 (0.0)	
Age Category					
60-74	53 (72.6)	10 (13.6)	10 (13.6)	0 (0.0)	0.004
≥75	44 (49.4)	21 (23.5)	23 (25.8)	1 (1.1)	
Ethnicity					
Malay	13 (59.1)	3 (13.6)	6 (27.2)	0 (0.0)	0.018
Chinese	62 (54.3)	27 (23.7)	24 (21.0)	1 (0.8)	
Indian	22 (84.6)	1 (3.8)	3 (11.5)	0 (0.0)	
Education level					
None	8 (26.6)	8 (26.6)	14 (46.6)	0 (0.0)	0.000*
Primary level	24 (43.6)	14 (25.4)	16 (30.0)	1 (0.6)	
Secondary level	54 (83.0)	8 (12.3)	3 (4.6)	0 (0.0)	
College or University level	11 (91.6)	1 (8.3)	0 (0.0)	0 (0.0)	
Curry consumption					
Never/rarely	11 (33.3)	11 (33.3)	10 (30.3)	1 (3.0)	0.000
Occasional	16 (51.6)	6 (19.3)	9 (29.0)	0 (0.0)	
Often	14 (53.8)	9 (34.6)	3 (11.5)	0 (0.0)	
Very often	56 (77.7)	5 (6.9)	11 (15.2)	0 (0.0)	
Smoking					
Non-smoker	82 (60.2)	27 (19.8)	26 (19.1)	1(0.7)	0.697*
Former smoker	10 (52.6)	3 (15.7)	6 (31.5)	0 (0.0)	
Current Smoker	5 (71.4)	1 (14.2)	1 (14.2)	0 (0.0)	
Alcohol					
No	87 (57.6)	31 (20.5)	32(21.2)	1(0.6)	0.051*
Yes	10 (90.9)	0 (0.0)	1(9.0)	0(0.0)	
Fitness activities					
No	13 (36.1)	10 (27.7)	13 (36.1)	0 (0.0)	0.000
Sometimes	15 (50.0)	7 (23.3)	8 (26.6)	0 (0.0)	
Often	69 (71.8)	14 (14.5)	12 (12.5)	1 (1.0)	
Social and productive activities					
No	13 (44.8)	9 (31.0)	7 (24.1)	0 (0.0)	0.018
Sometimes	15 (46.8)	9 (28.1)	8 (25.0)	0 (0.0)	
Often	69 (68.3)	13 (12.8)	18 (17.8)	1 (0.9)	

*Fisher's exact test

In total, 97 (59.9%) had normal MMSE score while 31 (19.1%) had mild, 33 (20.4%) had moderate and 1 (0.6%) had severe impaired cognition. Based on **Table 1**, MMSE was significantly related to gender, age, ethnicity, education level, frequency of curry consumption, engagement in fitness activities and social and productive activities. All the significant variables were analysed further using logistic regression to find out the protective and risk factors.

Based on the logistic regression shown in **Table 2**, subjects who consumed curry very often *i.e.* at least once a week, subjects with higher education and elderly who often engaged themselves in fitness activities had significantly less risk of developing cognitive impairment. But female gender and increased age *i.e.* 75 years and above were significant risk factors for developing cognitive impairment.

TABLE 2: LOGISTIC REGRESSION

	Sig.	Odds ratio	95% Confidence interval for odds ratio	
			Lower	Upper
Curry consumption				
Never/rarely	0.069	Ref.		
Occasionally	0.114	0.350	0.095	1.289
Often	0.107	0.308	0.074	1.289
Very often	0.008	0.152	0.038	0.614
Gender				
Female	0.004	4.085	1.559	10.705
Age Category				
75 and above	0.003	4.441	1.656	11.907
Ethnicity				
Indian	0.320	Ref.		
Chinese	0.195	0.375	0.085	1.653
Malay	0.187	0.312	0.055	1.760
Education level				
None	0.002	Ref.		
Primary level	0.240	0.506	0.162	1.578
Secondary level	0.002	0.136	0.039	0.471
College or university level	0.016	0.056	0.005	0.584
Fitness activities				
None	0.037	Ref.		
Sometimes	0.129	0.360	0.096	1.349
Often	0.010	0.222	0.070	0.699
Social activities				
None	0.688	Ref.		
Sometimes	0.972	0.976	0.256	3.725
Often	0.483	0.656	0.202	2.131

DISCUSSION: Cognition plays an important role in every stage of life. Elderly are at higher risk to develop cognitive impairment and it is important to know the risk and protective factors so that appropriate measures can be carried out. Our study revealed some interesting and valuable findings related to cognition in elderly.

This study revealed that regular use of curcumin offers cognitive protection. It was found that those who consumed curry very often, at least once a week had better cognition which is different from a previous study, which noted that regular use of low or moderate curry consumption, at least once in six months had significant effect on cognition [12]. An experimental study with rats reported that low dose of curcumin reduced β-amyloid and plaque burden [6]. This could be the plausible reason for the cognitive protection of curcumin. It is also cost effective as it is completely a natural product that does not require any processing compared to synthetic products. A systematic review stated that curcumin bioavailability is lower in consuming formulated curcumin, such as purifies and dried curcumin in a capsule compared to consuming curcumin in curry form [9]. Curcumin is soluble in acetone, ethanol and glacial acetic acid and particularly insoluble in water [9]. Due to these properties, curcumin is a pharmacological challenging molecule for oral administration as it has poor systemic bioavailability [9]. Hence, it is recommended that curcumin should be consumed in curry form as it can be better absorbed when dissolved in fat. Since curcumin is safe and well tolerated even at very high doses, its use in different cuisines including curry should be encouraged in all societies irrespective of different ethnic background.

Higher education level is another protective factor against cognitive impairment [17]. Our study observed that subjects who achieved secondary and tertiary education had lower risk of cognitive impairment. This finding is consistent with a number of other studies which showed that people with primary school education had higher risk to develop cognitive impairment [18, 19]. This implies that every country should take appropriate measures to prevent school drop-outs and promote higher education by providing free education at

least up to secondary level. Several studies demonstrated that regular fitness activities like brisk walking have decreased risk of dementia [20-22] which was substantiated by our study. Therefore, active lifestyle should be promoted in the elderly to maintain late-life cognitive function.

Women are more susceptible to develop Alzheimer's disease than men which could be due to their higher longevity [23, 24]. Similar findings were also observed in our study. Aging has been known as the most significant risk factor for cognitive impairment [21]. In accordance, it was observed that aged 75 years and above was found to have significant risk for cognitive impairment. As aging is an unavoidable risk factor for cognitive impairment, elderly should be encouraged to engage themselves regularly in physical activities and adopt healthy lifestyle to prevent cognitive impairment.

Studies have reported that moderate alcohol intake have protective effect on cognitive function [19, 22, 25]. However, the percentage of subjects who consumed alcohol in our study was minimal (7.4%), so no conclusion could be drawn. Similarly, the number of subjects who smoked was not sufficient enough to make any conclusion, though smoking may increase the risk of cardiovascular disease and could be associated with higher risk of dementia [26].

A systematic review concluded that an active and socially integrated lifestyle in late life protects against dementia [27]. This could be due to the fact that the mental, physical and social components of social activities play important role in reducing risk of dementia [28, 29]. Though our study does not correlate this finding in logistic regression, it is essential that every elderly individual should be encouraged to stay connected with their social circle.

A recent large, long-term, randomised controlled trial concludes that multi-domain intervention including diet, exercise and vascular risk monitoring, could be used to improve or maintain cognitive functioning in elderly at risk of developing dementia [30]. Considering the modifiable risk factors of cognitive impairment in elderly, each government should implement national policy in risk reduction of cognitive impairment. This could be a cost saving measure to the individual, family as well as to the nation.

Limitation: The limitations of our study are relatively small sample size and lesser representation of Malays and Indians.

CONCLUSION: Our study revealed strong association between consumption of curcumin in the form of curry and better cognition. Since curcumin is an absolutely harmless natural product, it can be recommended in regular diet. However, there is need for a large scale multicentre randomized controlled trial to establish these findings.

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