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Association of Fruit and Vegetable Consumption with Mild Cognitive Impairment Among Older Persons Living in Low-Cost Residential Areas in Kuala Lumpur

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ABSTRACT

Introduction: The benefits of sufficient fruits and vegetables consumption for health are well known. This study investigated the adequacy of fruit and vegetable intake among older persons and its association with mild cognitive impairment (MCI). The study also identified motivation and barrier factors affecting fruit and vegetables consumption. **Methods:** A total of 114 respondents aged 60-years and above (25 and 89 respomdents with and without MCI, respectively) from low cost housing areas in Kuala Lumpur participated in the study. Participants were interviewed using a standardised questionnaire with neurocognitive testing scales to determine their cognition level. **Results:** Of the non-MCI participants, 15.7% met World Health Organisation's (WHO) (2003) recommendations for fruit and vegetable consumption of 400 g/day compared to 12.0% of the subjects with MCI ($p<0.05$). Participants without MCI also had a significantly higher intake of fruit and vegetables (281.6 ± 77.2 g/day) compared to those with MCI (250.4 ± 51.3 g/day). Total daily intake of vegetables and fruits was significantly correlated with the digit span score of the participants ($r=0.214$, $p<0.02$). Total daily intake of leafy green vegetables was correlated with the verbal memory domain score of the total digit span ($r=0.254$, $p<0.01$). The main motivating factor for taking fruits, vegetables, and *'ulam'* (salad) was their belief in its health benefits. The main barriers to their consumption were dental problems, and a dislike of their taste. **Conclusion:** Generally, the intake of fruits and vegetables among older persons was inadequate and was associated with poorer cognitive functions. Improvement of oral health status and the provision of more choices of fruits and vegetables for older persons may increase their daily intake.

Key words: Barriers, cognitive, fruits, motivation, older persons, vegetables

INTRODUCTION

A lack of food or nutrient intake and an imbalanced diet often occur among older persons. This condistion not only increases their risk to new illnesses or worsen any existing diseases, but can also lower their quality of life (Allison & Kim, 2001). Micronutrient deficiencies are reported to play a role in the development of diseases and can cause deterioration of neurocognitive functions in old age (Rosenberg & Miller, 1992).

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Consistent with past studies linking fruits and vegetables with education, income and a healthy diet, it was shown that better educated individuals are more likely to spend more for, and put greater emphasis on, fruits and vegetables (Stewart, Harris & Guthrie, 2004). A low intake of fruits and vegetables has often been reported among low-income older persons (Casagrande *et al.*, 2007). Little, however, is known about the motivation for and barriers against the consumption of fruits and vegetables among older persons. Previous studies have found that the selection of vegetables and fruits is influenced by factors such as price, childhood habits, media influence, preparation time, cultural norms, taste preferences, reluctance to try new foods and limited market choices (Marleen & Jos, 2011).

The adequate consumption of fruits and vegetables may be beneficial for reducing the risks of cognitive decline (Nan *et al.*, 2013; Kim *et al.*, 2015; Lamport *et al.*, 2014). On the other hand, a systematic literature review conducted by Plassman *et al.* (2010), reported that the intake of vegetables and fruits did not conclusively lower the risks of cognitive decline. Thus, more studies are needed to elucidate the role of the intake of fruits and vegetables on the cognition in older persons. This study aimed to determine the levels of adequacy of fruits and vegetables intake and its association with cognitive function among older persons from lower cost residential areas in the Klang Valley. Furthermore, the motivations for and barriers against the consumptionof fruits and vegetables were explored.

METHODS

Setting and study design

This cross-sectional comparative study was conducted among older persons from low cost residential areas in Kuala Lumpur. Low cost residential areas are affordable housing appropriate for the needs of a range of very low to moderate income households and priced to ensure that housing costs do not prevent them from meeting other basic living costs (Family & Community Services, 2015). This study's inclusion criteria were individuals aged 60-years, and an absence of terminal illnesses related to renal failure or not taking warfarin medication due to the fact that these health conditions may require participants to reduce their intakes of fruits and vegetables. Subjects with dementia or Alzheimer's disease were also excluded. The health status of subjects was self reported. Subjects who fulfilled the inclusion criteria were invited to participate at nearby senior citizens' club centres. A total of four senior citizens' club centres around the low cost residential areas in Klang Valley were chosen for data collection, namely Kelab Warga Emas Jalan Siakap Cheras, Kelab Warga Emas Bandar Tun Razak Kuala Lunpur, Kelab Warga Emas Sri Kota Bandar Tun Razak Cheras and Kelab Warga Emas Sri Petaling Selangor.

Subjects who met the inclusion criteria and had agreed to participate in this study were requested to sign a consent form. Ethical approval for the study was obtained from the Research Ethics Committee of Universiti Kebangsaan Malaysia prior to the study (UKM 1.5.3.5/244/NN-135-2011). This study was part of a larger project investigating factors affecting cognitive function among older persons called the 'Kuala Lumpur Aging Study' (KLAS) (Universiti Kebangsaan Malaysia, 2014).

Sampling

Convenience sampling was used in this study. Based on Fleiss formula (Lwanga & Lemeshow, 1991), 119 subjects were required for this study. A ratio of 1: 3 of participants with mild cognitive impairment (MCI) to those without was required (Altman, 1990). Thus 30 participtants were required to have MCI and 89 were required to be non-MCI

subjects. The criteria for subjects to be judged as having MCI were adapted from Petersen (2004) and modified by Lee (2011) as shown in Table 1.

Data collection

Prior to the actual study, a pilot test was carried out in one of the senior citizens' clubs in Kuala Lumpur. A total of 15 older persons were interviewed for their frequency of consumption of vegetables and fruits using a questionnaire adapted from Nurul Izzah *et al.* (2012) and modified to suit this study. The questionnare was then amended based on the feedback obtained from participants of the pilot test.

The subjects were part of the KLAS and were invited to participate in this study. Out of a list of 399 older persons from the KLAS, only 120 consented to participating in this study. The subjects were asked to sign the consent and agreement form and were interviewed to obtain information on their demographic and socio-economic data, and their health status. The study was conducted at the aforementioned senior citizens' clubs in four locations in Kuala Lumpur, purposively selected for close proximity to the participants' homes.

The questionnaire contained three parts, namely parts A (socio-demography), B (dietary intake) and C (cognition). A description of the relevant variables in the respective sections is shown below.

Part A – Socio-demographic data, health status, and instrumental activities of daily living (IADL) adapted from Katz *et al.* (1963).

Part B - Questionnaire on intake of vegetables and fruits adapted from Nurul Izzah (2007) and list of vegetables from Nurul Izzah *et al.* (2012).

Part C - Mini-mental state examination (MMSE) (Folstein, Folstein & McHugh, 1975), Geriatric Depression Scale (GDS-15) (Sheikh & Yesage, 1986), Rey Auditory Verbal Learning Test (RAVLT) (Rey, 1964), Clock Drawing Test (CDT) and Digit Span (Sunderland, Hill & Mellow, 1989).

Data analysis

All statistical analyses were conducted using SPSS (Statistical Package for Social Science) version 20.0. The statistical tests used included descriptive tests, independent *t*-tests, and correlation analyses. Descriptive tests included percentage, mean and standard deviation

Table 1. Summary of MCI criteria

Criteria	*Definition*
Self- or informant-reported memory complaint	Answering "Yes" in a single item 'Do you think that you have a memory problem?'
Essentially preserved general cognitive functioning	Mini-Mental State Examination (MMSE) Score (Folstein *et al.*, 1975). MCI if score ≥ 17.
Preserved independence in functional abilities	Instrumental Activity of Daily Living (IADL) Index (Katz *et al.*, 1963). Not normal if < 1.5 SD from norm.
Absence of depression	Geriatric Depression Scale (GDS) (Sheikh & Yesage, 1986). MCI if score ≤ 4.
Objective memory impairment	Rey Auditory Verbal Learning Test (RAVLT) T5 (Rey, 1964). Not normal if > 1.5 SD from norm.
Objective cognitive impairment	Digit Span (Sunderland *et al.*, 1989). Not normal if >1.5 SD from norm.
Objective cognitive impairment	Clock Drawing tTest (CDT) (Sunderland *et al.*, 1989). Not normal if CDT score <5.

for a particular parameter. The Pearson correlation test was used to determine the association level of the intake of vegetables and fruits with scores of cognitive tests. Categorical data were analysed using the Chi-squared test.

RESULTS

The study was conducted at four senior citizens' clubs in different locations in the Klang Valley. Initially, 120 subjects were interviewed. However, 6 participants were excluded from the final data analyses as their neurocognitive test scores were too low, thus considered as outliers. Therefore, 114 (25 with MCI and 89 without) subjects were included in this study; their mean age was 65.9±4.6 years (Table 2).

As shown in Table 2, 36 participants were men (32.0%) and 78 were women (68.0%). This study involved participants from two ethnic backgrounds, namely Malays (73.7%) and Chinese (26.3%). Indians were excluded due to difficulties in

Table 2. Socio-demographic profile of subjects by study groups and distribution of subjects with MCI and non-MCI based on gender (stated in numbers and %)

Sociodemographic profile	*Total (n=114)*		*MCI subjects (n=25)*		*Non-MCI subjects (n=89)*		*p value*
	n	%	*n*	%	*n*	%	
Gender							
Men	36	32	9	36	27	30	0.590[a]
Women	78	68	16	64	62	70	
Ethnicity							
Malay	84	73.7	25	100	59	66.3	0.000[b]
Chinese	30	26.3	0	0	30	33.7	
Age (Mean±SD)							
Age	65.9± 4.6		65.5 ± 4.4		67.5 ± 4.6		0.052[c]
Marital Status							
Married	36	32.0	20	80.0	58	65.2	0.590[a]
Divorced/Widowed	78	68.0	5	20.0	31	34.8	
Years of education received							
< 6 years	78	68.0	20	80.0	58	65.0	0.159[b]
> 6 years	36	32.0	5	20.0	31	35.0	
Work Status							
Not working / Housewife	112	98.0	23	92.0	89	100.0	0.189[a]
Still working	2	1.8	2	8.0	0	0.0	
Total household income per/ month							
< RM1000 (310.95 USD)	59	52.0	14	56.0	45	51.0	0.631[b]
> RM1000 (310.95 USD)	55	48.0	11	44.0	44	49.0	
Living Arrangement							
Alone	4.	3.5	2	8.0	2	2.2	
With partner	38	33.3	12	48.0	26	29.2	
With children	59	51.8	10	40.0	49	55.1	
With children and grandchildren	7	6.1	1	4.0	6	6.7	
With siblings	6	5.3	0	0.0	6	6.7	

[a] Chi-squared test
[b] Fishers exact test
[c] $p>0.05$ not significant between age group for subjects with MCI and Non-MCI subjects; Independent *t*-test.

communication and their small population size in the sampled areas. Most of the participants were married (80.0% with MCI and 65.2% without); had less than six years of schooling (80.0% with MCI and 65.0% without); most were not working or were housewives (92.0% with MCI and 100% without); and had a total household income of less than RM1000 (56.0% with MCI and 51.0% without). Most participatns with MCI lived with a partner (48.0%), whereas most participants without MCI lived with their children (55.1%).

Participants with MCI had a lower mean intake of 250.4 ± 51.3 g/day for fruits and vegetables compared with those without who had a mean intake of 281.6 ± 77.2 g/day (p<0.05). More of the participants wthout MCI (15.7%) met the World Health Organization's (WHO) recommendations of 400 g/day for fruits and vegetables consumption compared to those with MCI (12.0%) (p<0.05) (Figure 1).

Correlation between neurocognitive score with the intake of fruits and vegetables and neurocognitive scores with the types of fruits and vegetables intake

Digit span correlated positively with mean daily intakes of vegetables and fruits (r=0.214, p<0.05), fruits only (r=0.185, p<0.05), and leafy green vegetables (r=0.254, p<0.05). However, fruit-like vegetables correlated negatively with digit span (r=-0.125, p<0.05) and CDT (r=-0.322, p<0.05) (Table 3).

Factors motivating the intake of fruits and vegetables

Among the main reasons which drove participants to consume fruits were the health benefits (28.0% with MCI and 14.3% without), followed by smooth bowel movements (20.0% with MCI and 19.4% without) and low cost (16.0% with MCI and 15.3% without). As for vegetables, the main motivating factors of the participants

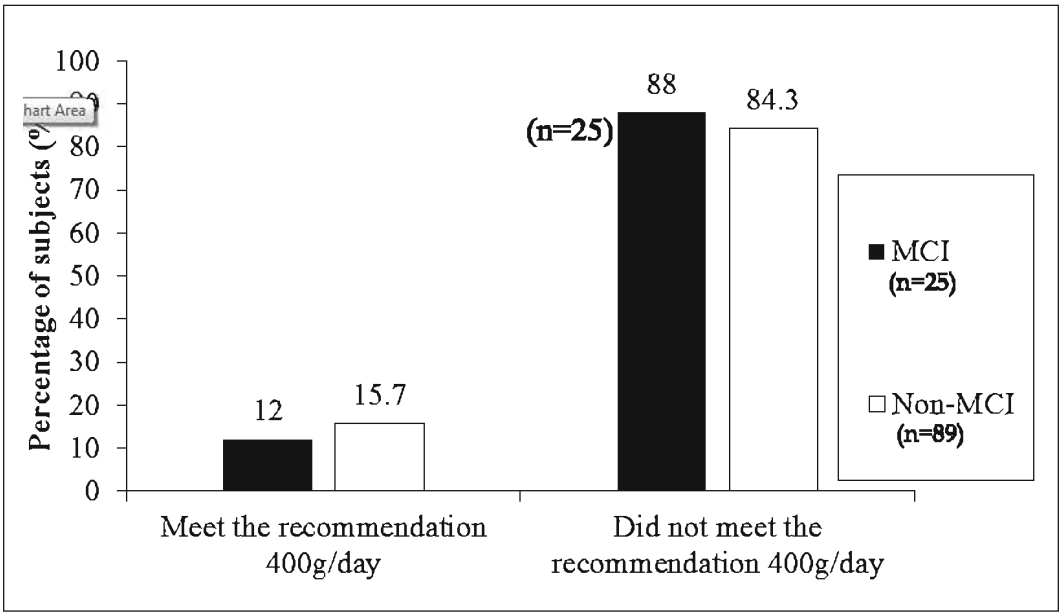

Figure 1. Percentage intake of vegetables and fruits in subjects with MCI and non-MCI compared with the WHO's (2003) recommendations (p<0.05; Chi-square test).

Table 3. Correlation between vegetables and fruits intake with neurocognitive tests' scores

Types of Fruits and Vegetables	*Correlation between cognitive domain*							
	Digit Span		*RAVLT-d*		*CDT*		*MMSE*	
	r	*p*	*r*	*p*	*r*	*p*	*R*	*p*
Vegetables and fruits	0.214	0.023*	0.061	0.521	-0.030	0.756	0.154	0.101
Vegetables only	0.093	0.324	0.071	0.452	-0.066	0.400	0.044	0.640
Fruits only	0.185	0.049*	0.027	0.772	0.020	0.986	0.159	0.092
Types of vegetables								
Green leafy vegetables	0.254	0.006**	0.070	0.461	0.069	0.475	-0.031	0.741
Legume vegetables	0.780	0.408	0.044	0.640	0.076	0.433	0.169	0.072
Brassicaceae vegetables	0.125	0.186	0.118	0.211	0.181	0.060	0.144	0.127
Fruit-like vegetables	-0.125	0.022*	0.078	0.412	-0.322	0.001**	-0.043	0.653
Tuber vegetables	-0.131	0.165	-0.051	0.225	-0.075	0.437	-0.120	0.204
Other vegetables	0.139	0.141	-0.024	0.798	-0.017	0.860	0.079	0.402
Salad	-0.159	0.091	-0.115	0.225	-0.149	0.121	0.005	0.965

* $p<0.05$ significant between groups, **$p<0.01$ highly significant between groups; Pearson correlation test.
DS = Digit Span
RAVLT-d = Ray Auditory Verbal Learning Test-delayed
CDT= Clock Drawing Test
MMSE= Mini Mental State Examination

Table 4. Motivational factors for the intake of fruits, vegetables and salads based on MCI status (stated in %)

Motivational factors for intake	Fruits		Vegetables		Salad	
	MCI (%)	Non-MCI (%)	MCI (%)	Non-MCI (%)	MCI (%)	Non-MCI (%)
Delicious	12.0	14.3	0.0	4.5	16.0	23.6
Healthy	28.0	14.3	32.0	28.1	24.0	21.3
Smooth bowel movement	20.0	19.4	4.0	11.2	12.0	12.4
Low cost	16.0	15.3	8.0	9.0	20.0	11.2
Easy to plant	0.0	5.1	0.0	2.2	0.0	3.4
Mostly available/sold	16.0	10.2	12.0	5.6	16.0	10.1
Easy to prepare	4.0	5.1	0.0	5.6	4.0	6.7
Influenced by health campaigns	0.0	3.1	16.0	10.1	4.0	3.4
Usual part of family meals	4.0	4.1	16.0	18.0	4.0	5.6
Appetite enhancer	0.0	0.0	12.0	5.6	0.0	1.1

were health benefits (32.0% with MCI and 28.1% without), followed by it being part of the usual family meals (16.0% with MCI and 18.0% without), and finally, the influence of health campaigns (16.0% with MCI and 10.1% without). Lastly for salads, the main motivating factors were health benefits (24.0% with MCI and 21.3% without), followed by taste (16.0% with MCI and 23.6% without), and finally, its availability (16.0% with MCI and 10.1% without MCI) (Table 4).

Barriers to the consumption of fruits and vegetables

Both participants without MCI (18.0%) and those with MCI (24.0%) mainly claimed that they consumed less fruits because of dental problems, followed by a lack of choice (20.0% with MCI and 27.0% without),

Table 5. Barriers to intake of fruits, vegetables and salad based on MCI status (stated in %)

Barriers to intake	*Fruits*		*Vegetables*		*Salad*	
	MCI (%)	*Non-MCI (%)*	*MCI (%)*	*Non-MCI (%)*	*MCI (%)*	*Non-MCI (%)*
Dental problems	24.0	18.0	20.0	10.1	4.0	3.4
No choices	20.0	27.0	0.0	1.1	4.0	2.2
No place for storage	0.0	2.2	0.0	1.1	4.0	2.2
Limited choices when eating out	4.0	13.5	12.0	11.2	0.0	6.7
Absence of places in vicinity to purchase	8.0	12.4	12.0	3.4	0.0	4.5
Family members' preferences	8.0	9.0	16.0	34.8	8.0	21.3
Ragularly eating outside limits choices	0.0	2.2	4.0	14.6	4.0	5.6
High cost	0.0	1.1	-	-	4.0	0.0

and finally, a lack of convenient points to purchase fruits (8.0% with MCI and 12.4% without (Table 4). As for vegetables, the main barriers were dental problems (20.0% with MCI and 10.1% without), followed by the preferences of family members (16.0% with MCI and 34.8% without), and finally taste (16.0% with MCI and 3.4% without). A total of 24.7% of participants without MCI and 20.0% with MCI reported that they consumed less salads because they disliked the taste, followed by the preferences of family members (8.0% with MCI and 21.3% without MCI), and finally, concerns about pesticide residue (8.0% with MCI and 3.4% without) (Table 5).

DISCUSSION

Participants without MCI consumed more fruits and vegetables than their peers with MCI and although more of them met WHO's (2003) recommendation of 400 g/day, the mean intakes of both groups fell below this level. This finding agreed with that of Nurul Izzah *et al.* (2012) who found that older persons in Selangor (Malaysia) consumed, on average, 179 g/day of fruits and 133 g/day of vegetables.

Most of the older persons in this study lived with their spouse or family members, where the purchase of vegetables was based on family members' preferences thus limiting the variety consumed. This prevents experimentation and learning through exposure which further limits choices of preferred fruits and vegetables (Tionni *et al.*, 2010). Intake of fruits and vegetables was significantly lower in edentate than dentate older persons and their perceived chewing ability increased with increasing number of teeth, thus influencing their nutritional status (Sheiham & Steele, 2000).

Most participants in this study stated that they had difficulty finding salad or *ulam*, which caused them to consume it less. This might be due to the fact that all participants were located in urban areas and many reported that certain types of salad or *ulam* were more readily found in rural areas than in the cities. The lack of a supply of fresh vegetables or salad in urban areas, particularly in the low cost residential areas, led to low vegetable intake among the participants. Kamphuis *et al.* (2006) state that those living in the rural areas have easier access to salad because vegetables are widely grown in people's gardens or on open land. Subjects in this study also claimed they were concerned about pesticide residue on the vegetables, preventing them from consuming salad. This agreed with the findings of the Charlton Research Company (2012) which

stated that the fear of pesticide residue has become a barrier preventing Americans from consuming fruits and vegetables.

This study found a positive and significant correlation between the consumption of vegetables (including leafy green vegetables) and fruits with digit span scores (p <0.05), which indicates memory function. Morris *et al.* (2006) also found a positive association with the intake of specific vegetables (particularly green leafy vegetables) and fruits with the cognitive function in older persons. This positive correlation suggests that, for older persons, the higher the consumption of vegetables (particularly green leafy vegetables) and fruits, the better their cognitive status.

Lower scores in digit span and CDT were obtained with increasing consumption of fruit-like vegetables (p<0.05, p<0.01) such as red and green chili, eggplant (*terung belanda*), brinjal (*terung panjang*), snake gourd (***petola ular***) and tomato. This negative correlation might be due to the increased added fat due to the usual cooking methods such as frying, used to cook these vegetables. If they were taken raw, it was most likely that their nutrient contents would be higher. Furthermore, Morris *et al.* (2006) state that the intake of saturated oils had a strong influence on the increased risk of cognitive decline among older persons.

No significant correlation was found between the consumption of fruits and vegetables with other cognitive tests. Possible reasons for this might be because that the participants were better at memorising lists of numbers (digit san) than lists of words (RAVLT), drawings (CDT) and combination of numbers, words and drawings (MMSE) due to the complexity and difficulty levels of these tests. Older persons can remember specific numerical information such as the grocery prices, hence a list of numbers (digit span) is easier for them to remember (Castel, 2005). Although p-value for RAVLT was not significant, but as shown in Table 5, it was lower than the p-values for CDT and MMSE for vegetables and fruits, green leafy vegetables and fruit-like vegetables. Thus, this shows that the participants had better memory and recalling ability for specific information such as remembering lists of numbers and lists of words given to them as compared to MMSE and CDT, which were more complex and harder for the participants to recall and perform specific tasks with their mind. The ability to remember general and more specific levels of associative information depended on the participants' ability, which is influenced by factors such as motivation, specificity of the materials, context and also expertise. Older persons might not allocate sufficient attention to specific numerical information that was low in semantic value; however in some cases, such as remembering grocery prices, lists of groceries and hotel room numbers, older persons had the capacity to memorise (Castel, 2007).

Study limitations

This study only included Malaysian of Malay and Chinese ethnicities and might not be representative of all of Malaysian's population of elderly. Older Malaysians of Indian ethinicity living in lower cost residential areas were not recruited in this study due to a language barrier. Despite these limitations, findings from this study highlighted information to be considered when planning education strategies to increase the intake of fruits and vegetables particularly among older persons in the urban lower cost residential areas.

CONCLUSIONS

Fruits and vegetables consumption was higher among older persons without MCI compared to their peers with MCI. Moreover, there were more non-MCI subjects who were able to meet the WHO's recommended level for the daily intake of fruits and vegetables. The main motivation for the intake of fruits, vegetables and salad

was the believed health benefits, whilst dental problems, family preferences, and a lack of availibility were the main barriers. Proper management of oral health status of the elderly and increasing the accessibility of fruits and vegetables in the lower cost residential areas may increase their intake of fruits and vegetables. Such a move might improve the cognitive function and general well-being of older persons in consideration of the various health benefits of fruits and vegetables. Family members should also play an important role in motivating older persons to consume more fruits and vegetables.

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Conflict of Interest

The authors declare they had no conflict of interest when the conclusions were drawn from this study.

REFERENCES

Allison SP & Kim MJ (2001). Nutrition and ageing. *Curr Opin Clin Nutr Metab Care* 4(1): 1-4.

Altman DG (1990). Practical Statistics for Medical Research. Chapman and Hall, London.

Casagrande SS, Wang Y, Anderson C & Gary TL (2007). Have Americans increased their fruit and vegetable intake? The trends between 1988 and 2002. *Am J Prev Med* 32(4): 257-263. Doi: 10.1016/j.amepre.2006.12.002.

Castel AD (2005). Memory for grocery prices in younger and older adults: The role of schematic support. *Psychol Aging* 20: 718–721.

Castel AD (2007). Aging and memory for numerical information: The role of specificity and expertise in associative memory. *J Gerontol B Psychol Sci Soc Sci* 62B(3): 194–196.

Charlton Research Company (2012). Final Report: Alliance for Food & Farming Survey. United States.

Family & Community Services (2015). Centre for affordable housing. From *http://http://www.housing.nsw.gov.au/Centre+For+Affordable+Housing/About+Affordable+Housing#1.* [Retrieved September 3 2015]

Folstein MF, Folstein SE & McHugh PR (1975). 'Mini-mental state examination'. A practical method for grading the cognitive state of patients for the clinician. *J Psyhiatr Res* 2 (46): 189-196.

Kamphuis CBM, Giskes K, de Buijn GJ, Wendel-Vos W, Brug J & Van Lenthe FJ (2006). Environmental determinants of fruits and vegetables consumption among adults: A systematic review. *Br J Nutr* 96(4): 620-635.

Katz S, Ford A, Moskowitz R, Jaffe M & Cleveland M (1963). Studies of illness in the aged. *J Am Med Assoc* 185: 914-919.

Kim S, Yu A, Choi BY, Kim MK, Nam JH, Oh DH & Yang YJ (2015). Fruit and Vegetable Consumption is Inversely Related to Mild Cognitive Impairment among Older Adults. *FASEB J* 29(1 Suppl): 736.1.

Lamport JD, Saunders C, Butler TL & Spencer JP (2014). Fruits, vegetables, 100% juices and cognitive function. *Nutr Rev* 72(12): 774-789.

Lee LK (2011). The risk factors and effectiveness of fish oil supplementation on cognitive function of elderly people with mild cognitive impairment. Thesis for Doctor of Philosophy, Universiti Kebangsaan Malaysia.

Lwanga SK & Lemeshow S (1991). Sample Size Determination in Health Studies: A Practical Manual. World health Organization, Geneva.

Marleen CO & Jos B (2011). Which perceived characteristics make product innovations appealing to the consumer? A study on the acceptance of fruit innovations using cross-cultural consumer segmentation. *Appetite* 57: 50-58.

Morris MC, Evans DA, Bienis JL, Tangney CC, and Wilson RS (2006). Association of vegetable and fruit consumption with age-related cognitive change. *Neurology* 67: 1370-1376.

Nan H, Jin-Tai Y, Lin T, Ying-Li W, Lei S & Lan T (2013). Nutrition and the Risk of Alzheimer's Disease. *Biomed Res Int* 2013: 1-12.

Nurul Izzah A (2007). Tabiat pengambilan ulam-ulaman di kalangan orang dewasa pelbagai etnik di Selangor. *JSKM* 8(2): 27-35.

Nurul Izzah A, Aminah A, Md Pauzi A, Lee YH, Wan Rozita WM & Siti Fatimah D (2012). Patterns of fruits and vegetables consumption among adults of different ethnics in Selangor, Malaysia. *Int Food Res J* 19(3): 1095-1107.

Petersen RC, Caracciolo B, Brayne C, Gauthier S, Jelic V & Fratiglioni L (2004). Mild cognitive impairment: A concept in evolution. *J Intern Med* 275: 214–228.

Plassman BL, Williams JW, Burke JR, Holsinger T & Benjamin S (2010). Systematic review: Factors associated with risk for and possible prevention of cognitive decline in later life. *Ann Intern Med* 153: 182-193.

Rey A (1964). *L'examen Clinique en Psychologie.* Presses Universitaires de France, Paris.

Rosenberg IH & Miller JW (1992). Nutritional factors in physical and cognitive functions of elderly people. *Am J Clin Nutr* 55(6 Suppl): 1237s-1243s.

Sheiham A & Steele J (2000). Does the condition of the mouth and teeth affect the ability to eat certain foods, nutrient and dietary intake and nutritional status amongst older people? *Public Hlth Nutr* 4(3): 797-803.

Sheikh JA & Yesage JA (1986). Geriatric Depression Scale (GDS): recent findings and development of a shorter version. In *Clinical Gerontolgy: A Guide to Assessment and Intervention.* Brink TL (eds). Howarth Press, New York.

Stewart H, Harris JM & Guthrie J (2004). What determines the variety of a household's vegetable purchases? Agriculture Information Bulletin. *ERS* pp. 729-3.

Sunderland T, Hill JL & Mellow AM (1989). Clock Drawing test in Alzheimer's disease: A novel measure of dementia severity. *J Am Geriatr Soc* 37: 725-729.

Tionni R, Lynne Brown J, Michelle MD, Kevin JK & Eugene JL (2010). Family members' influence on family meal vegetable choices. *J Nutr Educ Behav* 42(4): 225–234.

Universiti Kebangsaan Malaysia (2014). Final Report: Kuala Lumpur Aging Study. Kuala Lumpur, Malaysia.

WHO (2003). Report: Reducing Risks and Promoting Healthy Life. WHO Press, Geneva.