



Determinants of cognitive impairment among adults 50 years and older in Thailand

Orawan Jetwarapong, Orapin Laosee*, and Aroonsri Mongkolchati

ASEAN Institute for Health Development, Mahidol University, Nakhon Pathom 73170, Thailand.

Abstract

One of the major causes of disability and dependency in older people worldwide is dementia. However, few studies have been conducted on determinants of cognitive impairment among people 50 years and older. The purpose of this study was to describe the prevalence and explain determinants of cognitive impairment among adults aged 50 years and older in Thailand. A cross-sectional study was conducted from September 2015 to March 2016. The participants were randomly selected from sixteen districts, fourteen provinces across four regions of Thailand. A total of 3021 completed questionnaires were used for analysis. Cognitive impairment was measured by the Montreal Cognitive Assessment (MoCA) and established questionnaire from the study of Global Ageing 2014 (SAGE). The prevalence of cognitive impairment was 23.20%. Four variables were associated with cognitive impairment as aged 65 years and older, female, without spouse, and low frequency of social interaction attended. Multiple logistic regression revealed that aged 65 years and older (AOR: 1.61, 95% CI: 1.35-1.93), female (AOR: 1.41, 95% CI: 1.16-1.70), completed primary school and lower (AOR: 0.73, 95% CI: 0.55-0.96), and low frequency of social interaction attended (AOR: 1.25, 95% CI: 0.98-1.60) were found to be significant predictors of cognitive impairment among adults aged 50 years and older. Annual screening for cognitive impairment of adults aged 50 years and older should be done. Provide health promotion in risk group and care for older cases with impaired cognitive function to achieve well-being in their lives.

Keywords: Cognitive impairment, older, Thailand

Article history: Received 15 January 2019, Accepted 18 October 2019

1. Introduction

The prevalence of age-related health and increasingly aging of global population will be important public health concerns [1]. One of the major causes of disability and dependency in older people worldwide is dementia [2]. The prevalence of dementia is expected to increase by about 74.7 million in 2030 and 131.5 million by 2050. Majority are in low and middle income especially in Asia-Pacific region [3]. In this region, people with dementia will increase from 23 million in 2015 to almost 71 million in 2050 which more than half of worldwide [4].

Dementia is a syndrome of irreversible cognitive decline and too severe to support daily functioning [5]. Cognitive impairment and mild cognitive impairment have cognitive deficit less severe than dementia and daily functioning is normal. After diagnosis, up to 50% of Mild Cognitive Impairment (MCI) developed to dementia within five years [6]. Alzheimer's disease is the most common type about 50–70% of

dementia [7, 8]. The other types include vascular dementia, dementia with Lewy bodies [3]. Being with dementia affect individuals, their caregivers and society. For people with dementia, there is increased risk of functional dependence and poor quality of life [9]. For caregivers, they suffered of emotional stress, depression and health problem in family and caregivers themselves [10–12]. For society, health services costs and informal costs of unpaid caregiving for dementia are growing too high. Total estimated cost of dementia care worldwide is US\$ 818 billion in 2015, it will be rising to US\$ 1 trillion in 2018 and US\$ 2 trillion in 2030 [3]. High income countries has the highest proportion of direct costs on social care (community and residential care) while low income countries rely on informal care (unpaid care by family) more than others. Furthermore, no current treatment can cure or stop progression of dementia even many new therapies are still in various stages of clinical trials and investigations [13].

In Thailand, the health survey 2014 reported that 8.1% of people aged over 60 years had dementia. People over 80 years old had highest prevalence of demen-

*Corresponding author; email: orapin.lao@mahidol.edu

tia with 22.6 % [14]. The population census in Thailand 2010 has shown 12% of aging population and estimated to reach to 17% in 2020 from which at least 300,000 people have dementia [15]. The findings from Thai elderly report in 2013 has highlighted that 63% of Thai cohort has at least one chronic disease to comorbidity of dementia [16]. A study in Thailand revealed that people with dementia have difficulties to perform their basic activities of daily living [17]. Limited national strategies to support those people to maintain their quality of life [4].

Due to functional impairment of memory processing speed and executive functions of those people, only few are seeking treatment [5, 18]. Early recognition of cognitive impairment is beneficial to help patients, care givers and doctors to determine comorbidities and reversible causes of cognitive impairment, discuss initiation of therapy and planning of appropriate advance care [19]. In addition, early identification enables older people, their families and friends to appropriately adjust and prepare for future risks [19, 20]. Moreover, early detection could improve prognosis and decrease morbidity [5]. Simultaneously address modifiable risk factors may be is the most effective strategy [21, 22]. The aims of this cross-sectional survey were to identify prevalence of cognitive impairment and associated factors among adults aged 50 years and older in Thailand; to understand current situation for policy making and to make implementation plan for the promotion of modifiable factors to reduce of cognitive impairment in the populations.

2. Methodology

2.1. Study design and sample

A household cross-sectional study was conducted for Thai adults aged 50 years and older from September 2015 to March 2016. A total of 3,977 participants were randomly selected from 16 districts in 14 provinces across four regions of Thailand. The study population was comprised of adults aged 50 years and older who had been living in the selected districts at least 6 months. They were willing and responsive to the study. Multi-stage cluster sampling was applied to select the villages in 14 provinces representing all regions. Community leader and health staff in each village were approached to request collaboration and selection of participants. Simple random sampling was employed to enroll eligible adults 50 years and older in the household.

2.2. Measurement

The established questionnaire from the study of Global Ageing 2014 (SAGE) [23] and used the Montreal Cognitive Assessment (MoCA) translated from English language version into Thai in March 15 2007

by Solasinee Hemrungronj [24, 25]. The questionnaire consisted of five parts: 1) introduction 2) cognitive functions 3) demographic factors 4) health state-related factors 5) social factors. It was revised for validity and reliability by the research team. MoCA was used to evaluate cognitive function score. The participants were asked with eight questions in different domains: visuospatial skills/executive functions, naming, memory, attention, language, abstraction, delayed recall, orientation. A maximum score of 30, one point was added for an individual who has less than 12 years of education. Cognitive functions were classified as being: severe dementia (total scores 4 and below), moderate dementia (5–15 scores), mild dementia (16–21 scores), preclinical (22–25 scores), and normal (total scores 26 and above). For statistical purpose cognitive function was divided into two groups: group I normal (normal to mild dementia) and group II cognitive impairment (moderate to severe dementia).

2.3. Data and collection procedures

The data were collected by trained research assistants through a face-to-face interview using questionnaire. Two research assistants per study site were recruited from selected sixteen districts. They were trained to ensure competency to fill in the questionnaire and to get the appropriate anthropometric measurements. Two-day workshop was organized to train assistants about the questionnaire and ethical issues. An electronic form was developed for data entering from all 16 study sites via on-line application (<http://ageingbackend.damasac.com>). The proposal was approved by the ethical committee of Mahidol University, COA. NO. 2014/266.3009. No individual level identifiers were included in any public data set and no individual identifiers were sent to the authors.

2.4. Data analysis

The statistical tests were analyzed using SPSS version 21.0 for Windows. Descriptive analysis was conducted to calculate mean, standard deviation (SD), minimum and maximum, numbers and percentage to identify the prevalence of cognitive impairment and each independent variable among adults aged 50 years and older in the selected communities. Then, bivariate analysis was applied to identify associations between each independent variable and cognitive impairment. Finally, multiple logistic regression analysis was used to identify the significant predictors related to cognitive impairment among adults aged 50 years and older in Thailand. All variables statistically significant at p -value < 0.25 in bivariate analyzes were included in the multiple logistic regression.

3. Results

A total of 3,977 participants were interviewed, 956 were excluded due to missing data on key variables.

Table 1. Distribution of respondents by cognitive functioning among adults aged 50 years and older ($n = 3,021$)

Variable	All		Male		Female	
	Number	Percentage	Number	Percentage	Number	Percentage
Cognitive function						
Normal	632	20.90	218	19.70	414	21.60
Preclinical	621	20.60	237	21.50	384	20.00
Mild dementia	1067	35.30	430	38.90	637	33.20
Moderate dementia	653	21.60	201	18.20	452	23.60
Severe dementia	48	1.60	18	1.60	30	1.60
Cognitive function categories						
Group I Normal	2,320	76.80	885	80.20	1,435	74.80
Group II Impairment	701	23.20	219	19.85	482	25.20

In total 3,021 completed questionnaires were used for the analysis. Adults aged 50 years and older who have cognitive function have been illustrated in the Table 1. One-third (35.30%) were mild dementia and they are the biggest sub-group in the classification. The prevalence of cognitive impairment among adults aged 50 years and older was 23.20%, higher in women than men (25.20% and 19.80%).

Demographic characteristics of the sample are shown in Table 2. One-third (38.70%) were aged between 50 to 59 years. The median age was 63 years old (Mean 63.58, SD.9.23). The findings indicated that two-third (63.50%) were females. Over two-third (67.40%) were currently married, and two-third (63.30%) completed primary school and lower as the highest education level. The numbers and percentages of health state in Table 2 showed that hypertension rate was 13.00% and depression rate was 13.00%. One third (33.10%) were obese (BMI ≥ 25 kg/m²). Proportion of respondents smoking tobacco were 10.60%, alcohol consumption 11.30%, high physical activity 8.80% and high exercise 5.60%.

Cognitive impairment in bivariate analysis was described in Table 3. Four factors were found to be significantly associated with cognitive impairment: aged 65 years and older, female, without spouse, and low frequency of social interaction (p -value < 0.05).

Multiple logistic regression showed that factors with strong evidence with p -value < 0.05 which aged 65 years and older (Adjusted OR 1.61; 95% CI=1.35–1.93), female (Adjusted OR 1.41; 95% CI=1.16–1.70), completed primary school and lower (Adjusted OR 0.73; 95% CI=0.55–0.96) and low frequency of social interaction (Adjusted OR, 1.25; 95% CI=0.98–1.60) were found to be significant predictors of cognitive impairment among adult aged 50 years and older as shown in table 4.

4. Discussion

This study showed that four factors were found to be significantly associated with cognitive impairment: aged 65 years and older, female, without spouse, and

low frequency of social interaction attended. The prevalence of cognitive impairment among adults aged 50 years and older in the communities of Thailand was 23.20% (male 19.8%, female 25.2%). When compared with other countries, the result was close to Japan 21.50% (21.3% of male and 21.8% of female) [26]. In contrast, our finding was higher than Malaysia where prevalence of cognitive impairment was 11.0% [27].

Demographic factors, age was positively associated with cognitive impairment. The respondents aged 65 years and older were 1.60 (OR: 1.60, 95% CI: 1.35–1.89) times more likely to have cognitive impairment than those who were younger. Many studies reported that cognitive impairment was strongly associated with age [28–30]. Age was the greatest risk factor for Alzheimer's disease [4, 31, 32] and cognitive impairment [33]. Female respondents were 1.36 (OR: 1.36, 95% CI: 1.13–1.63) times more likely to develop cognitive impairment than males. Similar to studies, conducted in rural areas of northern China in which the odds of cognitive impairment were significantly higher among women [29, 34]. The prevalence of cognitive impairment was 1.8-fold higher in women than men among people aged 80 years and older [29], and 2.3-fold higher in women than men among people aged 60 years and older [34]. In contrast, some studies found that gender was not in association with cognitive impairment [28, 30]. Multiple logistic regression found that gender was a significant predictor of cognitive impairment among female adults aged 50 years and older. One reason could be the loss of estrogen in menopause may cause high prevalence of cognitive impairment in women [35, 36].

Respondents without spouse were 1.28 (OR: 1.28, 95% CI: 1.07–1.54) times which was more likely to develop cognitive impairment than those with spouse. Similar to the finding of other studies, without spouse was positively associated with cognitive impairment [37, 38]. Social interaction between couples could help avoid the disease. Solitary individuals who were less involved in social activities and had less opportunity to communicate may result in high risk of cog-

Table 2. Distribution of respondents' characteristics ($n = 3,021$)

Variables	Number	Percentage
Age in years		
50-59	1170	38.70
60-69	1105	36.60
≥ 70	746	24.70
(Mean = 63.58 SD = 9.23, Min = 50, Max = 97)		
Gender		
Male	1104	36.50
Female	1917	63.50
Marital status		
Never married	166	5.50
Currently married	2035	67.40
Cohabiting	100	3.30
Separated/Divorced	124	4.10
Widowed	596	19.7
Body mass index: ≥ 25 kg/m²	999	33.10
Education level		
Never been to school	100	3.30
Less than primary school	511	16.90
Primary school	1912	63.30
Secondary school	181	6.00
High school and higher	162	5.40
Life style and disease		
Tobacco use: Yes	320	10.60
Alcohol consumption: Yes	342	11.30
Physical activity: Yes	267	8.80
Exercise: Yes	170	5.60
Depression: Yes	392	13.00
Hypertension: Yes	392	13.00
Social life		
Work with neighborhood to improved something: No	719	23.80
Social interaction: Low frequency	831	27.50
Social meeting attended: Low frequency	509	83.20

nitive impairment [38, 39]. Multiple logistic regression found that without spouse was not a significant predictor of cognitive impairment among adults aged 50 years and older in Thailand. Education level was not significantly associated with cognitive impairment 0.87 (OR: 0.87, 95% CI: 0.66–1.13) ($p = 0.296$). Multiple logistic regression found that education level was a significant predictor of cognitive impairment among adult aged 50 years and older in Thailand. Evidence from previous studies showed that low education level was risk factor for cognitive impairment [28–30]. Consistent with previous finding, older people with education levels of < 6 years compare to older people with education levels of 9 years or more, with a 3.8 fold increase in the illiterate group and a 1.7-fold increased with 1-5 years of education. People with higher education might adopt healthier lifestyles that are associated with good cognitive functioning [40].

Social factors consisted of three variables; worked with your neighborhood to improve something, social interaction attendance, and social meeting attended.

Our finding indicated that respondent with low frequency of social interaction attendance were 0.76 (OR: 0.76, 95% CI: 0.62–0.92) time more likely to have cognitive impairment than those who have high frequency of social interaction attended. Multiple logistic regression found that low frequency of social interaction attended was a significant predictor of cognitive impairment among adults aged 50 years and older. Similar to other studies, the relationship between engagement in social activity and cognitive function showed that social engagement and active lifestyle improved cognitive function amongst ageing [41, 42]. Joining hobby groups such as playing Mahjong, chess and cards could prevent cognitive decline because it provides variety challenge, complex problem solving and mental training [43]. On the other hand, hypertension, depression, body mass index, tobacco use, alcohol consumption, high physical activity, high exercise, working with neighborhood to improve something and attending social meeting were not found to be associated with cognitive impairment.

Table 3. Association between cognitive impairment and independent variables

Independent variables	n	Cognitive functions			p-value
		Normal(%)	Impairment (%)	Crude OR (95% CI)	
Age					
≥65	1226	71.80	28.20	1.60 (1.35-1.89)	0.000
50 - 64	1795	80.20	19.80	1	
Gender					
Female	1917	74.90	25.10	1.36 (1.13-1.63)	0.001
Male	1104	80.20	19.80	1	
Marital status					
Without spouse	886	73.60	26.40	1.28 (1.07-1.54)	0.007
Spouse	2135	78.10	21.90	1	
Education					
Primary school completed and lower	2704	77.10	22.90	0.87 (0.66-1.13)	0.296
Higher than primary school completed	317	74.40	25.60	1	
Hypertension					
Yes	392	75.50	24.50	1.09 (0.85-1.39)	0.518
No	2629	77.00	23.00	1	
Depression					
Yes	392	73.20	26.80	1.25(0.98-1.59)	0.072
No	2,629	77.30	22.70	1	
Body mass index					
Obesity	999	78.40	21.60	0.87(0.73-1.05)	0.148
Non-obese	2,022	76.00	24.00	1	
Tobacco use					
Yes	320	75.90	24.10	1.06 (0.80-1.38)	0.701
No	2,701	76.90	23.10	1	
Alcohol consumption					
Yes	342	76.60	23.40	1.01 (0.78-1.32)	0.930
No	2,679	76.80	23.20	1	
High physical activity					
No	2,754	76.50	23.50	1.21 (0.89-1.65)	0.228
Yes	267	79.80	20.20	1	
High exercise					
No	2,851	76.70	23.30	1.13 (0.78-1.65)	0.519
Yes	170	78.80	21.20	1	
Work with neighborhood to improved well-being					
Low frequency	719	47.15	52.85	0.84 (0.68-1.03)	0.089
High frequency	2,302	44.62	55.38	1	
Social interaction attended					
Low frequency	831	80.30	19.70	0.76 (0.62-0.92)	0.005
High frequency	2,190	75.50	24.50	1	
Social meeting attended					
Low frequency	509	79.00	21.00	0.86 (0.68-1.08)	0.201
High frequency	2,575	76.40	23.60	1	

Study limitations

This study used the MoCA rather than gold standard measures (DSM V) to determine cognitive function that we were unable to diagnose dementia. Although, there might be measurement bias comparing MoCA with gold standard measures, but the high test-retest, reliability and validity of MoCA have been assessed

among adults aged 50 years and older at community level of Thailand.

5. Conclusion

Findings of this study indicated cognitive impairment has become a serious public health problem. Annual screening for cognitive impairment in adults aged

Table 4. Full model of multiple regression analysis for predictors of cognitive impairment among adults aged 50 years and older

Independent variables	Adjusted OR	95 % CI		p-value
		Lower	Upper	
Age				
≥ 65	1.61	1.35	1.93	0.000
50 - 64	1			
Gender				
Female	1.41	1.16	1.70	0.000
Male	1			
Marital status				
Without spouse	1.09	0.90	1.32	0.364
Spouse	1			
Education				
Primary school completed and lower	0.73	0.55	0.96	0.023
Higher than primary school completed	1			
Hypertension				
Yes	1.08	0.84	1.39	0.566
No	1			
Body mass index				
Obesity	0.88	0.73	1.06	0.168
Non-obese	1			
Tobacco use				
Yes	1.08	0.79	1.48	0.617
No	1			
Alcohol consumption				
Yes	1.04	0.77	1.42	0.795
No	1			
High physical activity				
No	1.22	0.88	1.68	0.226
Yes	1			
High exercise				
No	1.09	0.74	1.62	0.653
Yes	1			
Depression				
Yes	1.25	0.98	1.60	0.073
No	1			
Social interaction				
Low frequency	1.25	0.98	1.60	0.005
High frequency	1			

50 years and older should be done. The health promotion interventions should focus to those female, who are 65 years and older, without spouse and low social interaction.

Acknowledgements

The authors thank all participants, research team and research assistants for their cooperation. The study was supported by ASEAN Institute for Health Development, Mahidol University and National Health Security Office of Thailand (NHSO).

References

- [1] World Health Organization, The World Health Report: Primary Health Care Now More Than Ever, Geneva, Switzerland (2008).
- [2] World Health Organization, The epidemiology and impact of dementia: Current state and future trends Geneva, Switzerland World Health Organization (2015).
- [3] World Alzheimer Report, The Global Impact of Dementia- An analysis of prevalence, incidence, cost and trends, Available from: <https://www.alz.co.uk/research/WorldAlzheimer-Report2015.pdf> (2015).
- [4] Alzheimer's Association, Alzheimer's Disease Facts and Figures (2014).
- [5] Alzheimer's Disease International, World Alzheimer Report 2011: The benefits of early diagnosis and intervention, Available from: <http://www.alz.co.uk/research/world-report-2011>
- [6] R. Brookmeyer, E. Johnson, K. Ziegler-Graham, H. M. Arighi, Forecasting the global burden of Alzheimer's disease. *Alzheimer's and Dementia* 3(3) (2007) 186–91.
- [7] KI. Seeher, A. Withall, H. Brodaty, The dementia research mapping project - the 2010 update: final reports, Sydney: Dementia Collaborative Research Centre, University of New South Wales (2010).

- [8] B. Draper, *Understanding Alzheimer's & other dementias*. Woollahra: Longueville Books (2011).
- [9] W. A. Report, *The Global Prevalence of Dementia*, Available from: <http://www.alz.co.uk/research/world-report-2009>.
- [10] J. P. Warner, R. Butler, S. Gupta, *Dementia*, *BMJ clinical evidence* (2010).
- [11] K. J. Joling, H. P. J. Van Hout, F. G. Schellevis, H. E. Van Der Horst, P. Scheltens, D. L. Knol, et. al., Incidence of depression and anxiety in the spouses of patients with dementia: A naturalistic cohort study of recorded morbidity with a 6-year follow-up, *American Journal of Geriatric Psychiatry* 18(2) (2010) 146-53.
- [12] A. M. Kolanowski, D. Fick, J. L. Waller, D. Shea, Spouses of persons with dementia: Their healthcare problems, utilization, and costs, *Research in Nursing and Health* 27(5) (2004) 296-306.
- [13] Alzheimer's Disease International, *An analysis of long-term care for dementia*, Available from: <http://www.alz.co.uk/research/world-report-2013>.
- [14] Health Systems Research Institute of Thailand, *Health survey*, Health Systems Research Institute of Thailand (2014).
- [15] National Statistical Office of Thailand, *Population survey in 2010*, National Statistical Office of Thailand (2010).
- [16] V. Senanarong, K. Harnphadungkit, N. Pongvarin, S. Van-nasaeng, S. Chongwisal, T. Chakorn, et. al., The dementia and disability project in Thai elderly: Rational, design, methodology and early results, *BMC Neurology* 13 (2013).
- [17] W. Muangpaisan, R. Praditsuwan, J. Assanasen, V. Srinonprasert, P. Assantachai, S. Intalaporn, et. al., Caregiver burden and needs of dementia caregivers in Thailand: A cross-sectional study. *Journal of the Medical Association of Thailand* 93(5) (2010) 601-7.
- [18] B. J. Small, R. A. Dixon, J. J. McArdle, Tracking cognition-health changes from 55 to 95 years of age, *The Journals of Gerontology Series B, Psychological sciences and social sciences* 66 (2011) Suppl 1:i153-61.
- [19] B. B. Simmons, B. Hartmann, D. DeJoseph, Evaluation of suspected dementia, *American Family Physician* 84(8) (2011) 895-902.
- [20] M. M. Weissman, J. K. Myers, G. L. Tischler, C. E. Holzer, P. J. Leaf, H. Orvaschel, et. al., Psychiatric disorders (DSM III) and cognitive impairment among the elderly in a U.S. urban community, *Acta Psychiatrica Scandinavica* 71(4) (1985) 366-79.
- [21] L. E. Middleton, K. Yaffe, Targets for the prevention of dementia, *Journal of Alzheimer's Disease* 20(3) (2010) 915-24.
- [22] F. Mangialasche, M. Kivipelto, A. Fratiglioni, Dementia prevention: Current epidemiological evidence and future perspective, *Alzheimer's Research and Therapy* 4(1) (2012).
- [23] P. Kowal, S. Chatterji, N. Naidoo, R. Biritwum, W. Fan, R. L. Ridaura, et. al., Data resource profile: The world health organization study on global ageing and adult health (SAGE), *International Journal of Epidemiology* 41(6) (2012) 1639-49.
- [24] S. Tangwongchai, T. Charernboon, M. Phanasathit, L. Akkayagorn, S. Hemrungronj, K. Phanthumchinda, et. al., The validity of Thai version of the Montreal Cognitive Assessment (MoCA), *Dement Neuropsychol* 3(2) (2009) 172.
- [25] Z. S. Nasreddine, N. A. Phillips, V. Bédirian, S. Charbonneau, V. Whitehead, I. Collin, et. al., The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment, *Journal of the American Geriatrics Society* 53(4) (2005) 695-9.
- [26] K. Kitamura, Y. Watanabe, K. Nakamura, K. Sanpei, M. Wakasugi, A. Yokoseki, et. al., Modifiable Factors Associated with Cognitive Impairment in 1,143 Japanese Outpatients: The Project in Sado for Total Health (PROST), *Dementia and Geriatric Cognitive Disorders Extra* 6(2) (2016) 341-9.
- [27] A. K. Rashid, A. M. Azizah, S. Rohana, Cognitive impairment among the elderly Malays living in rural Malaysia, *Medical Journal of Malaysia* 67(2) (2012) 186-9.
- [28] J. Bai, P. Wei, N. Zhao, Y. Xiao, C. Yang, J. Zhong, et. al., A study of mild cognitive impairment in veterans: role of hypertension and other confounding factors, *Aging, Neuropsychology, and Cognition* 23(6) (2016) 703-15.
- [29] Z. Shi, Y. Zhang, W. Yue, M. Liu, Y. R. Huo, S. Liu, et. al., Prevalence and clinical predictors of cognitive impairment in individuals aged 80 years and older in rural China, *Dementia and Geriatric Cognitive Disorders* 36(3-4) (2013) 171-8.
- [30] A. Lobo, P. Saz, G. Marcos, J. L. Día, C. De-La-Cámara, T. Ventura, et. al., The ZARADEMP Project on the incidence, prevalence and risk factors of dementia (and depression) in the elderly community: II. Methods and first results, *European Journal of Psychiatry* 19(1) (2005) 40-54.
- [31] L. E. Hebert, J. L. Bienias, N. T. Aggarwal, R. S. Wilson, D. A. Bennett, R. C. Shah, et. al., Change in risk of Alzheimer disease over time, *Neurology* 75(9) (2010) 786-91.
- [32] L. E. Hebert, J. Weuve, P. A. Scherr, D. A. Evans, Alzheimer disease in the United States (2010-2050) estimated using the 2010 census, *Neurology* 80(19) (2013) 1778-83.
- [33] Screening for cognitive impairment in older adults: Recommendation statement, *American Family Physician* 91(6) (2015) 388E-H.
- [34] Y. Ji, Z. Shi, Y. Zhang, S. Liu, S. Liu, W. Yue, et. al., Prevalence of dementia and main subtypes in rural northern China, *Dementia and Geriatric Cognitive Disorders* 39(5-6) (2015) 294-302.
- [35] M. S. Sherina, L. Rampal, A. Mustaqim, Cognitive impairment among the elderly in a rural community in Malaysia, *Medical Journal of Malaysia* 59(2) (2004) 252-7.
- [36] V. W. Henderson, Estrogens, episodic memory, and Alzheimer's disease: A critical update, *Seminars in Reproductive Medicine* 27(3) (2009) 283-93.
- [37] L. Ren, Y. Zheng, L. Wu, Y. Gu, Y. He, B. Jiang, et. al., Investigation of the prevalence of Cognitive Impairment and its risk factors within the elderly population in Shanghai, China. *Scientific Reports* volume 8, Article number: 3575. *Scientific Reports* volume 8, Article number: 3575; 2018. Report No.: *Scientific Reports* volume 8, Article number: 3575.
- [38] L. Fratiglioni, H. X. Wang, K. Ericsson, M. Maytan, B. Winblad, Influence of social network on occurrence of dementia: A community-based longitudinal study. *Lancet* 355(9212) (2000) 1315-9.
- [39] L. E. Middleton, K. Yaffe, Promising strategies for the prevention of dementia, *Archives of Neurology* 66(10) (2009) 1210-5.
- [40] S. A. van Hooren, A. M. Valentijn, H. Bosma, R. W. Ponds, M. P. van Boxtel, J. Jolles, Cognitive functioning in healthy older adults aged 64-81: a cohort study into the effects of age, sex, and education, *Neuropsychology, development, and cognition Section B, Aging, neuropsychology and cognition* 14(1) (2007) 40-54.
- [41] H. Litwin, K. J. Stoeckel, Social network, activity participation, and cognition: A complex relationship, *Research on Aging* 38(1) (2016) 76-97.
- [42] H. X. Wang, Y. Jin, H. C. Hendrie, C. Liang, L. Yang, Y. Cheng, et. al., Late life leisure activities and risk of cognitive decline, *Journals of Gerontology - Series A Biological Sciences and Medical Sciences* 68(2) (2013) 205-13.
- [43] J. Lü, W. Fu, Y. Liu, Physical activity and cognitive function among older adults in China: A systematic review, *Journal of Sport and Health Science* 5(3) (2016) 287-96.