Importance of Hypertension and Social Isolation in Causing Sleep Disruption in Dementia

Sima Ataollahi Eshkoor, MD, PhD[1], Tengku Aizan Hamid, PhD[1],
Siti Sa'adiah Hassan Nudin, BSc[2], and Chan Yoke Mun, PhD[1]

Abstract

This study aimed to determine the effects of diabetes mellitus (DM), hypertension (HT), heart disease, social isolation, and sociodemographic factors on sleep in the elderly patients with dementia. Samples included 1210 noninstitutionalized, Malaysian elderly patients with dementia. The multiple logistic regression analysis was applied to estimate the risk of sleep disturbances among respondents. Approximately 41% of the patients experienced sleep problems. The results showed that age (odds ratio [OR] = 1.02), social isolation (OR = 1.33), and HT (OR = 1.53) significantly increased sleep disruption in respondents (P <.05). Furthermore, education (OR =.63) and non-Malay ethnicity (OR = 0.63) significantly decreased sleep problems (P <.05). It was found that DM, heart disease, sex differences, and marital status were not significant predictors of sleep disturbances (P >.05). It was concluded that age, social isolation, and HT increased sleep disruption but education and ethnic non-Malay reduced the risk of sleep problems. Moreover, HT was the most important variable to increase sleep disturbances in the elderly patients with dementia.

Keywords

elderly, dementia, diabetes mellitus, heart disease, hypertension, sleep

Introduction

Approximately one-fourth of the adults with dementia[1] including 40% of patients with Alzheimer's disease[2] report sleep disturbances. Although sleep problems cause much burden to people and society, mostly (80%-90%) they remain undiagnosed.[3] Sleep quality is associated with accidents, mental problems, cardiovascular diseases,[3] cognitive impairments, executive functions,[2] and quality of life.[3] It has been established that sleep disruption can cause hypertension (HT),[4] diabetes mellitus (DM),[3] and heart disease.[5] The DM is an age-related chronic disease[6] associated with glucose intolerance. It manifests less classical symptoms in the elderly patients.[7] It can increase the risk of cognitive decline and dementia in older adults by 20%-70% and 60% respectively.[8] Sleep problems in the elderly patients with diabetes are related to age, obesity, medications as well as complications such as depression, cardiovascular diseases, and neuropathy.[3] Cardiovascular diseases have great impacts on society and public health. It has been reported that the prevalence of cardiovascular diseases and dementia is increasing[9] that is associated with HT, hypercholesterolemia, dyslipidemia, DM, and coronary or carotid artery disease.[10] Both heart disease[5] and HT[4] can affect sleep quality in the elderly patients. It seems that sleep problems in the patients with heart disease are due to negative effects of specific medications, anxiety, physical inactivity, depression, and cardiac problems such as myocardial infarction (MI), congestive heart failure, and angina.[5] The effect of HT on

sleep[11] is associated with blood pressure levels and side effects of hypotensive medications.[12]

Social support is a component that plays important roles in healthy sleep in older adults.[13] Social isolation and dissatisfaction with social activities can elevate health damages in the elderly patients living in communities[14] to increase age-related sleep disturbances.[13] Since sleep disruption is associated with health[4] and cognitive level,[15] therefore, this study investigated the effects of social isolation, chronic diseases including DM, HT, and heart disease as well as sociodemographic factors on sleep problems in the elderly patients with dementia.

Methodology

The project was registered in the National Medical Research Register (Project Code: NMRR-09-443-4148). Approval and permission for conducting the study were received from the Ethical Committee of the Ministry of Health. The research was a national cross-sectional survey titled "Determinants of

[1] Institute of Gerontology, Universiti Putra Malaysia, Selangor, Malaysia
[2] Institute for Behavioral Research, Kuala Lumpur, Malaysia

Corresponding Author:
Tengku Aizan Hamid, PhD, Institute of Gerontology, Universiti Putra Malaysia, Selangor, Malaysia.
Email: aizan@putra.upm.edu.my

Health Status among Older Malaysians" and carried out in cooperation with Institute for Health Behavioral Research, National Institute of Health, Ministry of Health and Institute of Gerontology, Universiti Putra Malaysia. The research included 1210 elderly patients with dementia who were Malaysian population aged 60 years and more residing in noninstitutional places. The elderly patients living in institutions and bedridden were excluded. Samples represented the Malaysian population in terms of age and were collected from Peninsular Malaysia divided into 4 zones of North, South, West, and Central. The trained interviewers who had prior experiences collected data from each patient within approximately 60 minutes.

The study investigated the effects of age, ethnicity, sex differences, marital status, DM, HT, heart disease, educational level, and social support on sleep disturbances. Based on ethnicity, patients were divided into 2 groups including Malays and non-Malays. Non-Malays group included Chinese, Indian, and the other citizens living in Malaysia.

The Mini-Mental State Examination (MMSE) score less than 26 was used to select respondents with dementia.[16] Sleep disruption was identified by asking " Do you feel fresh and relax after waking up in the morning"[17] and the response was (1) yes and (0) no. Lubben Social Network Scale 6 was used to measure social support. The cut point of 12 was used to identify isolated and socialized patients.[18,19] In addition, DM, HT, and heart disease were diagnosed and approved by physicians and reported as 1 for yes and 0 for no.

Statistical Analysis

The prevalence of sleep disturbances was computed for whole samples with regard to their age, ethnicity, HT, DM, heart disease, sex differences, marital status, educational level, and social isolation. A series of chi-square (χ^2) tests were applied to examine the association of sleep disruption with each variable. The multivariate logistic regression analysis was used to test the effects of variables on sleep problems in samples. Odds ratios (ORs) with 95% confidence intervals (95% CIs) were computed. Furthermore, a *P* value of 5%, 2-tailed, was considered as the critical level for rejection of the null hypothesis. The Statistical Package for the IBM Social Sciences (SPSS) software version 20.0 (Chicago, Illinois) was used to perform analyses.

Results

Analysis was run on data collected from 1210 respondents who were the Malaysian elderly patients with dementia. The prevalence of sleep disturbances was 41% among patients (95% CI: 38.25-43.79; Table 1). The results showed that sleep problems in diabetic samples (50%) were higher than nondiabetic samples (39.1%). Furthermore, the percentage of sleep disruption in patients with HT (47.5%) was higher than that of normotensive individuals (36.3%). In addition, sleep problems in samples with heart disease (43.2%) were greater than those without heart disease (40.8%).

Table 1. Prevalence of Sleep Disturbances Among 1210 Elderly Patients With Dementia.

Character	n	n%	95% CI
Sleep disturbances			
No	714	59	56.21-61.75
Yes	496	41	38.25-43.79

Abbreviation: CI, confidence interval.

The findings showed that 43.1% of females and 37.2% of males experienced sleep disturbances. The prevalence of sleep disruption was 42.1% in single patients and 39.6% in married patients. It was found that the proportion of sleep problems was 44.9% in noneducated respondents and 34.2% in educated respondents. Among all samples, 46.6% of Malay and 36.2% of non-Malay ethnicities reported sleep problems. Bivariate analyses using a series of χ^2 tests showed the association of sleep disruption with each variable in patients. The results showed that sleep disturbances were significantly related to DM ($\chi^2 = 8.75$, $P = .002$), ethnicity ($\chi^2 = 13.34$, $P < .001$), HT ($\chi^2 = 15.35$, $P < .001$), educational level ($\chi^2 = 13.12$, $P < .001$), and sex differences ($\chi^2 = 4.05$, $P = .025$). It was found that neither heart disease nor marital status was significantly associated with sleep disturbances in respondents ($P > .05$; Table 2). The results of multivariate logistic regression analysis showed that age ($P = .026$), HT ($P = .001$), ethnicity ($P < .001$), educational level ($P = .001$), and social support status ($P = .017$) significantly affected sleep disruption among patients ($P < .05$). The findings indicated that age (OR = 1.02, 95% CI: 1.00-1.04), HT (OR = 1.53, 95% CI: 1.19-1.97), and social isolation (OR = 1.33, 95% CI: 1.05-1.69) increased sleep problems. Furthermore, educational level (OR = 0.63, 95% CI: 0.48-0.83) and ethnic non-Malay (OR = 0.66, 95% CI: 0.47-0.94) decreased sleep disturbances. The DM, heart disease, sex differences, and marital status were not significant predictors of sleep disruption among patients ($P > .05$; Table 3).

Discussion

Insufficient sleep is a serious problem caused by comorbidities that is very rare among healthy older people.[2] It has been established that aging[20] and chronic diseases including dementia,[1] heart disease,[6,21-26] DM,[3,27,28] and HT[4,26,29] negatively affect sleep in the elderly patients. Apparently, sleep quality in patients with dementia is associated with age-related changes in the circadian rhythm,[26] lifestyles, medications, polypharmacy, medical conditions, sleep habits, psychiatric problems, environmental changes, and severity of dementia.[1]

This study was designed to determine the predictability of sleep disruption by focusing on age, ethnicity, DM, HT, heart disease, sex differences, marital status, and educational level in the elderly patients with dementia. The HT increased sleep problems among samples probably due to the effect of HT on the onset of dementia,[1,30] which is attributed to hypoxia, ischemia, hypoperfusion, mitochondrial disruption,

Table 2. Prevalence of Sleep Disturbances and Associations With Sociodemographic Factors.[a]

	Whole	n	n%	95% CI	χ^2	P value
Diabetes mellitus						
No	993	388	39.1	36.08-42.14	8.75	.002
Yes	216	108	50	43.39-56.61		
Hypertension						
No	695	252	36.3	32.77-39.9	15.35	<.001
Yes	514	244	47.5	43.19-51.79		
Heart disease						
No	1114	455	40.8	37.99-43.75	0.19	.368
Yes	95	41	43.2	33.66-53.19		
Social support						
Socialized[b]	631	237	37.6	33.87-41.4	6.42	.007
Isolated	579	259	44.7	40.73-48.8		
Sex differences						
Males	438	163	37.2	32.81-41.83	4.05	.025
Females	772	333	43.1	39.68-46.65		
Marital status						
Unmarried	665	280	42.1	38.41-45.9	0.78	.205
Married	543	215	39.6	35.56-43.76		
Ethnicity						
Malays[b]	550	256	46.6	42.42-50.73	13.34	<.001
Non-Malays	658	238	36.2	32.59-39.91		
Educational level						
No	775	348	44.9	41.43-48.42	13.12	<.001
Yes	430	147	34.2	29.86-38.8		

Abbreviations: CI, confidence interval; χ^2, chi-square.
[a] Significant at the .05 level using the chi-square test.
[b] Reference group in the multiple logistic regression analysis.

Table 3. Prevalence of Sleep Disturbances and Associations Derived by Logistic Regression Analysis.[a]

	B	SE	P value	OR	95% CI for OR	
					Lower	Upper
Diabetes mellitus	0.275	0.16	.093	1.32	0.96	1.81
Hypertension	0.427	0.13	.001	1.53	1.19	1.97
Heart disease	−0.044	0.23	.845	0.96	0.61	1.49
Social isolation	0.288	0.12	.017	1.33	1.05	1.69
Sex differences	0.071	0.14	.613	1.07	0.82	1.41
Educational level	−0.458	0.14	.001	0.63	0.48	0.83
Marital status	0.132	0.14	.329	1.14	0.88	1.49
Ethnicity	−0.461	0.12	<.001	0.63	0.50	0.80
Age	0.020	0.01	.026	1.02	1.00	1.04

Abbreviations: CI, confidence interval; SE, standard error; OR, odds ratio.
[a] Significant at the .05 level using the logistic regression analysis, Hosmer-Lemeshow test: $\chi^2(8) = 9.11$; $P = .333$.

cerebrovascular degeneration, reduced glucose oxidation as well as diminished ATP synthesis.[30] As dementia can affect sleep,[1,31] thereby HT potentially aggravated sleep disruption in subjects by initiating dementia. In addition, the correlation of high blood pressure with mental health,[2] insomnia, sleep apnea, and restless leg syndrome[4] probably increased sleep disruption in respondents. Medications and their side effects, nocturia, sleepiness, and shortening of sleep hours[12] in patients with HT could exacerbate sleep problems as well. On the other hand, medical treatments for HT can cause depression[12] and stress,[11] which consequently increase sleep

disturbances. However, strict control of blood pressure can prevent progression of dementia by a neuroprotective effect on the brain,[32] which can consequently protect the patients against sleep problems.[11] It seems that increased sleep problems in heart diseases[33,34] and diabetes mellitus[35,36] are due to their association with HT and consequences. In addition, induced pulmonary HT in heart diseases[37] may increase the risk of sleep disruption.

In addition, the findings indicated that social isolation increased sleep problems among patients probably due to behavioral, psychological, and physical problems[38,39] that occurred

by the negative impacts of isolation on health, mental well-being,[40] and physiological responses.[38,39] Accordingly, age, ethnicity, and educational level significantly affected sleep in respondents. Our results confirmed an existing report indicating the correlation of ethnicity with sleep problems[41], which is attributed to culture, religious beliefs, and lifestyle.[42] Increased impact of age on sleep problems in the elderly patients with dementia was probably due to the effect of age on HT,[4,26,29] health conditions,[1,41] and age-related changes in sleep.[43]

The current study showed that educational level decreased sleep disturbances in patients. Such effect is possibly due to better management techniques and the ways that help to deal with sleep problems through suitable expectations and hygiene instructions. Educated patients can minimize the negative effects of risk factors and environmental conditions on sleep.[44] This relationship was found in previous studies[6,45] but not all[41,42,46,47]. In addition, the paradox was further highlighted by Tractenberg and colleagues[31] who suggested that educational level increased sleep problems. Such discrepancy is probably due to a collection of healthier sample population.

Additionally, several research[2,31,46] showed a distinct pattern of sleep disturbances in male and female patients; however, a later report[48] found a similar pattern in accordance with our finding. Such disparity is probably due to the effects of confounding factors including educational level, income,[49] lower rate of seeking helps to manage sleep problems,[43] chronic diseases,[6] ethnicity, and social support. Despite paradoxical reports,[41,46] our results showed no significant correlation between sleep disturbances and marital status. Such differences among studies were possibly due to the effects of factors such as educational level, socioeconomic status,[49] chronic diseases,[6] and ethnicity. Apparently, a chronic disease can decrease the positive effects of living with a partner on sleep to reduce sleep problems that has been noted in a previous research.[50]

It seems that the prevalence of sleep disruption in a research is affected by applied definitions and used methodologies.[49] Thus, the severity of sleep problems in the elderly patients with dementia can be attributed to the stages of progression,[1] cognitive decline[31,48] and the rate of psychiatric problems.[51] It has been shown that age, educational level, and ethnicity can affect MMSE scores[52] among the patients with dementia, but the appropriate cut point of 26 has been established for age and educational level groups.[53]

Undoubtedly, collecting accurate data from patients with dementia is not an easy task, especially when such challenge comes with comorbidity conditions; therefore, quality of sleep can be used as a marker for health status and quality of life. On the other hand, a better sleep in the patients can be achieved through health, well-being, life satisfaction, and cognitive function.[2] Thus, further investigations about the effects of factors such as social support, HT, and other chronic diseases are needed to decrease sleep problems in the patients with dementia.

Conclusion

We concluded that sleep problems in the elderly patients with dementia were significantly associated with age, ethnicity, HT, educational level, and social isolation. The findings indicated that age, HT, and social isolation effectively increased sleep disruption in respondents. Furthermore, educational level and ethnic non-Malay decreased sleep disturbances. As sleep quality is an important issue to improve well-being and quality of life in patients with dementia, further studies are required to test effective contributory factors to sleep in dementia. There were several potential limitations in this study. It was difficult to establish that dementia could cause sleep disturbances or vise versa. Apparently, sleep disruption interferes with long-term memory consolidation, which can increase the risk of dementia. Furthermore, our research was a cross-sectional study, hence identifying the certain causative and confounding factors of sleep problems was difficult. Because there is no cure to stop the progress of dementia and mental decline, improving life quality is an optimal target. As health conditions, dementia, and sleep quality are interrelated, this study can provide a window into how to improve sleep quality in dementia and quality of life consequently.

References

1. Rose KM, Fagin CM, Lorenz R. Sleep disturbances in dementia: what they are and what to do. *J Gerontol Nurs*. 2010;36(5):9-14.
2. Bombois S, Derambure P, Pasquier F, Monaca C. Sleep disorders in aging and dementia. *J Nutr Health Aging*. 2010;14(3):212-217.
3. Plantinga L, Rao MN, Schillinger D. Prevalence of self-reported sleep problems among people with diabetes in the United States, 2005-2008. *Prev Chronic Dis*. 2012;9:E76.
4. Bansil P, Kuklina EV, Merritt RK, Yoon PW. Associations between sleep disorders, sleep duration, quality of sleep, and hypertension: results from the National Health and Nutrition Examination Survey, 2005 to 2008. *J Clin Hypertens*. 2011; 13(10):739-743.
5. Caska CM, Hendrickson BE, Wong MH, Ali S, Neylan T, Whooley MA. Anger expression and sleep quality in patients with coronary heart disease: findings from the heart and soul study. *Psychosom Med*. 2009;71(3):280-285.

6. Foley D, Ancoli-Israel S, Britz P, Walsh J. Sleep disturbances and chronic disease in older adults: results of the 2003 National Sleep Foundation Sleep in America Survey. *J Psychosom Res*. 2004; 56(5):497-502.

7. Sharma V, Aggarwal S, Sharma A. Diabetes in elderly. *J Endocrinol Metab*. 2011;1(1):9-13.

8. Xu W, Caracciolo B, Wang HX, et al. Accelerated progression from mild cognitive impairment to dementia in people with diabetes. *Diabetes*. 2010;59(11):2928-2935.

9. Bursi F, Rocca WA, Killian JM, et al. Heart disease and dementia: a population-based study. *Am J Epidemiol*. 2006;163(2):135-141.

10. Fillit H, Nash DT, Rundek T, Zuckerman A. Cardiovascular risk factors and dementia. *The Am J Geriatr Pharmacother*. 2008; 6(2):100-118.

11. Suka M, Yoshida K, Sugimori H. Persistent insomnia is a predictor of hypertension in Japanese male workers. *J Occup Health*. 2003;45(6):344-350.

12. Bulpitt C, Dollery C, Carne S. Change in symptoms of hypertensive patients after referral to hospital clinic. *Brit Heart J*. 1976; 38(2):121-128.

13. Troxel WM, Buysse DJ, Matthews KA, et al. Marital/cohabitation status and history in relation to sleep in midlife women. *Sleep*. 2010;33(7):973-981.

14. Nicholson NR. A review of social isolation: an important but underassessed condition in older adults. *J Prim Prev*. 2012; 33(2-3):137-152.

15. Kutner NG, Zhang R, Huang Y, Bliwise DL. Association of sleep difficulty with kidney disease quality of life cognitive function score reported by patients who recently started dialysis. *Clin J Am Soc Nephrol*. 2007;2(2):284-289.

16. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state" a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189-198.

17. Dewald JF, Meijer AM, Oort FJ, Kerkhof GA, Bogels SM. The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: a meta-analytic review. *Sleep Med Rev*. 2010;14(3):179-189.

18. Lubben J, Gironda M. Centrality of social ties to the health and well-being of older adults. In: Berkman B, Harooytoan LK, eds. *Social Work and Health Care in an Aging Society*. New York, NY: Springer; 2003;319-350.

19. Crooks VC, Lubben J, Petitti DB, Little D, Chiu V. Social network, cognitive function, and dementia incidence among elderly women. *Am J Public Health*. 2008;98(7):1221-1227.

20. Hornung OP, Danker-Hopfe H, Heuser I. Age-related changes in sleep and memory: commonalities and interrelationships. *Exp Gerontol*. 2005;40(4):279-285.

21. Asplund R. Sleep disorders in the elderly. *Drugs Aging*. 1999; 14(2):91-103.

22. Ancoli-Israel S, Ayalon L. Diagnosis and treatment of sleep disorders in older adults. *Am J Geriatr Psychiatry*. 2006;14(2): 95-103.

23. Roepke SK, Ancoli-Israel S. Sleep disorders in the elderly. *Indian J Med Res*. 2010;131(2):302-310.

24. Haseli-Mashhadi N, Dadd T, Pan A, Yu Z, Lin X, Franco OH. Sleep quality in middle-aged and elderly Chinese: distribution, associated factors and associations with cardio-metabolic risk factors. *BMC Public Health*. 2009;9(1):130.

25. Bellia V, Catalano F, Scichilone N, et al. Sleep disorders in the elderly with and without chronic airflow obstruction: the SARA study. *Sleep*. 2003;26(3):318-323.

26. Alattar M, Harrington JJ, Mitchell CM, Sloane P. Sleep problems in primary care: a North Carolina family practice research network (NC-FP-RN) study. *J Am Board Fam Med*. 2007;20(4):365-374.

27. Cunha MCBd, Zanetti ML, Hass VJ. Sleep quality in type 2 diabetics. *Rev Latino-am Enfermagem*. 2008;16(5):850-855.

28. Touma C, Pannain S. Does lack of sleep cause diabetes? *Cleve Clin J Med*. 2011;78(8):549-558.

29. Ram S, Seirawan H, Kumar SKS, Clark GT. Prevalence and impact of sleep disorders and sleep habits in the United States. *Sleep Breath*. 2010;14(1):63-70.

30. Arboix A. Arterial hypertension, cerebrovascular diseases and dementia. *World J Hypertens*. 2011;1(1):7-9.

31. Tractenberg RE, Singer CM, Kaye JA. Symptoms of sleep disturbance in persons with Alzheimer's disease and normal elderly. *J Sleep Res*. 2005;14(2):177-185.

32. Nagai M, Hoshide S, Kario K. Hypertension and dementia. *Am J Hypertens*. 2009;23(2):116-124.

33. Hazarika N, Biswas D, Mahanta J. Hypertension in the elderly population of Assam. *J Assoc Physicians India*. 2003;51:567-573.

34. Babatsikou F, Zavatsanou A. Epidemiology of hypertension in the elderly. *Health Sci J*. 2010;4(1):24-30.

35. Grossman E, Messerli FH. Hypertension and diabetes. *Adv Cardiol*. 2008;45:82-106.

36. Cheung BM, Li C. Diabetes and hypertension: is there a common metabolic pathway? *Curr Atheroscler Rep*. 2012;14(2):160-166.

37. Guglin M, Khan H. Pulmonary hypertension in heart failure. *J Card Fail*. 2010;16(6):461-474.

38. Cacioppo JT, Hawkley LC. Social isolation and health, with an emphasis on underlying mechanisms. *Ann N Y Acad Sci*. 2003; 46(3):S39-S52.

39. Cacioppo JT, Hawkley LC, Norman GJ, Berntson GG. Social isolation. *Ann NY Acad Sci* 2011;1231:17-22.

40. Cattan M, White M, Bond J, Learmouth A. Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions. *Ageing Soc*. 2005;25(1):41-67.

41. Gu D, Sautter J, Pipkin R, Zeng Y. Sociodemographic and health correlates of sleep quality and duration among very old Chinese. *Sleep*. 2010;33(5):601-610.

42. Jean-Louis G, Magai C, Cohen C, et al. Ethnic differences in self-reported sleep problems in older adults. *Sleep*. 2001;24(8):926-936.

43. Vitiello MV. Recent advances in understanding sleep and sleep disturbances in older adults growing older does not mean sleeping poorly. *Curr Dir Psychol Sci*. 2009;18(6):316-320.

44. Rogojanski J, Carney CE, Monson CM. Interpersonal factors in insomnia: a model for integrating bed partners into cognitive behavioral therapy for insomnia. *Sleep Med Rev*. 2012;17(1):55-64.

45. Su TP, Huang SR, Chou P. Prevalence and risk factors of insomnia in community-dwelling Chinese elderly: a Taiwanese urban area survey. *Aust N Z J Psychiatry*. 2004;38(9):706-713.

46. Liu X, Liu L. Sleep habits and insomnia in a sample of elderly persons in China. *Sleep*. 2005;28(12):1579.

47. Oh JJ. Sleep disturbances of community elderly in Korea. *J Korean Acad Nurs*. 2002;32(7):992-998.

48. Tractenberg RE, Singer CM, Cummings JL, Thal LJ. The sleep disorders inventory: an instrument for studies of sleep disturbance in persons with Alzheimer's disease. *J Sleep Res*. 2003;12(4):331-337.

49. Paparrigopoulos T, Tzavara C, Theleritis C, Psarros C, Soldatos C, Tountas Y. Insomnia and its correlates in a representative sample of the Greek population. *BMC Public Health*. 2010;10(1):531.

50. Eshkoor S, Hamid T, Nudin S, Mun C. The effects of social support and having a partner on sleep quality in dementia. *Am J Alzheimers Dis Other Demen*. 2013;28(3):253-257.

51. Voderholzer U, Al-Shajlawi A, Weske G, Feige B, Riemann D. Are there gender differences in objective and subjective sleep measures? A study of insomniacs and healthy controls. *Depress Anxiety.* 2003;17(3):162-172.

52. Ostrosky-Solis F, Lopez-Arango G, Ardila A. Sensitivity and specificity of the mini-mental state examination in a Spanish-speaking population. *Appl Neuropsychol*. 2000;7(1):25-31.

53. Ylikoski R, Erkinjuntti T, Sulkava R, Juva K, Tilvis R, Valvanne J. Correction for age, education and other demographic variables in the use of the mini mental state examination in Finland. *Acta Neurol Scand*. 1992;85(6):391-396.