

# Which Stratum of Urban Elderly Is Most Vulnerable for Dementia?

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Many factors associated with a patient's lifestyle may disrupt timely access to dementia diagnosis and management. The aim of this study was to compare characteristics of lifestyle factors at the time of initial evaluation for dementia across degrees of dementia, and to identify risk factors relating to late detection of dementia, in order to understand the various lifestyle barriers to timely recognition of the disease. We reviewed medical records of 1,409 subjects who were diagnosed as dementia among 35,723 inhabitants of Gwangjin-gu. Dementia severity was divided into three degrees. Age, sex, education, income, smoking, heavy drinking, physical activity, religion, and living conditions were evaluated. There was a significantly greater proportion of individuals who were old age, female, less educated, who had never smoked or drank heavily, without physical activity, with no religious activity and living with family other than spouse in the severe dementia group. The lifestyle risks of late detection were old age, lower education, less social interactions, less physical activity or living with family. We can define this group of patients as the vulnerable stratum to dementia evaluation. Health policy or community health services might find ways to better engage patients in this vulnerable stratum to dementia.

**Keywords:** Screening; Dementia; Health Services; Elderly

## INTRODUCTION

Dementia is a growing public health problem and results in cognitive decline and behavioral problems that lead to impairment in activities of daily living. The prevalence of dementia increases with age, at 24% of persons in the seventh decade of life, and up to 40% of those older than 90 years of age (1).

Early detection of dementia can offer a higher quality of life to both patients with dementia and their families (2). Timely recognition of dementia can give the opportunity to evaluate the reversible causes of memory loss promptly. And it helps patients by allowing treatment in the early stages of dementia, when the cause of dementia is suspected to be a degenerative disease. In case of chronic and progressive disease, early pharmacologic intervention may slow cognitive decline and, by extension, control the worldwide impact of the disease (1).

Many factors associated with a patient's lifestyle factors including socioeconomic status (SES) may disrupt timely access to dementia diagnosis and management (3,4). As lifestyle factors can have a big impact on disease management and are often modifiable - although it is hard to change, investigation of these factors is important. However, previous studies regarding the association between SES and dementia are inconsistent, and there is currently a paucity of studies (1,3,5-7). This limited

information might result from the use of heterogeneous definitions and measures of SES. Ethnic, racial and cultural diversity may also interfere with an exact assessment of SES (4,8). Furthermore, the majority of literature only evaluates SES to a certain degree, using education, occupation and income, and excluding social lifestyle characteristics such as living conditions and religious beliefs. An integrated analysis including all lifestyle factors which affect the time of initial dementia diagnosis is needed.

The Seoul Metropolitan Government of South Korea started the Seoul Dementia Management Project to approach the issue of dementia beyond the fragmentary facility care level by setting up the Seoul Metropolitan Center for Dementia in December 2006. The Seoul Dementia Management Project is an integrative management system of dementia and provides greater awareness of the disease, in-advance preventive programs, early diagnosis and proper medical and welfare services according to the stage of dementia (<http://www.seouldementia.or.kr/eng>). The Seoul Metropolitan Center for Dementia is the general body of the project and provides support for regional centers that administer the actual programs, such as dementia screening tests, registration and memory enhancement programs, in each of the 25 districts in Seoul. Among the project, the Dementia screening test project is a routine population screening project. Through

this opportunistic screening program, a Seoulite over 60 years old can be screened for dementia by the Mini-Mental State Examination (MMSE) for free.

The aim of this study was to compare characteristics of lifestyle at the time of initial evaluation for dementia at a single ethnic, racial and cultural environment in urban elderly across degrees of dementia, and to identify risk factors relating to late detection of dementia in order to understand the various lifestyle factors including SES to timely recognition of the disease.

## MATERIALS AND METHODS

### Participants

The Gwangjin-gu Center for dementia (GCD) is one of the 25 regional Centers for Dementia, which is managed by the Neurology Department of Konkuk University Medical Center. Among many activities of GCD, the early dementia detection project screens at-risk elderly populations within the community and aims at preventing the development of serious dementia by means of effective diagnosis and management of the disease at its early stages. The early dementia detection team of GCD administers large scale screening services targeting approximately 54,715 elderly (older than 65 years) among 380,000 inhabitants.

From May 2009 to November 2013, 35,723 inhabitants were screened. Patients were referred by themselves or by their family members or recruited by the staff of the regional public health center. Additional efforts to include vulnerable patients were made through increased screenings at the GCD. The MMSE was used as the screening tool (9). A total of 1,742 patients were diagnosed with dementia. Diagnosis of dementia was based on the Diagnostic and Statistical Manual of Mental Disorders (4th edition) (10). Assessment included all available patient information, including basic demographic characteristics (e.g., age, sex), SES information, lifestyle information (history of smoking, drinking, physical activity, religious activity, and living condition) and global cognitive assessments (Clinical Dementia Rating Scale [CDR] scores). All data were collected during the first visit, on the same day and before screening using the MMSE. Excluded were 333 patients with missing lifestyle information. Therefore, medical records of 1,409 subjects were completely evaluated. Dementia severity was divided into 3 degrees of severity using CDR scores: CDR 0.5 Group; CDR 1 Group; and CDR 2 or 3 Group. In total, 429 mild dementia, 426 moderate dementia and 554 severe dementia patients were included in this study.

### Assessment of lifestyle factors and dementia severity

When assessing the SES, education, income and occupation comprised the majority of the evaluation. However, we excluded occupation in this study because less than 5% of our participants had an occupation. Years of education and income were

evaluated based on a previous study that revealed that low levels of income and education are due to higher risk behaviors (3). Further factors related to lifestyle characteristics, such as smoking, heavy drinking, physical activity, religion and living conditions were also evaluated.

Information on years of education was ascertained through questionnaires. Years of education was recorded as the highest number of years of schooling and treated as a continuous variable. Information of income was based on the National Health Insurance Contribution, because individual's National Health Insurance Contribution is automatically positioned by the household's whole income in Korea. The low income group was defined as patients who earn 0 through 603,403 KRW for 1 person; 0 through 1,027,417 KRW for 2 persons; 0 through 1,329,118 KRW for 3 persons; 0 through 1,630,820 KRW for 4 persons and 0 through 1,932,522 KRW for 5 persons, as this is the cut-off amount below 40% of median value of Korean's income. The high income group included all the other incomes. Smoking was coded as 'never' smoked or 'past or current' smokers based on self-reporting. Heavy drinking was based on self-reporting of the daily consumption of more than 3 glasses of any alcoholic beverage and grouped into 2 categories: 'never' or 'past or current' drinking. Physical activity was categorized as a physically inactive group, which consisted of patients who did not do either 20 minutes of vigorous activity on 3 or more days or 30 minutes of moderate activity on 5 or more days per week, or a physically active group. Religion was categorized as an active religious group that believed in some type of religion and attended a place of worship more than once per week and a non-religious group that included atheists or religious believers who did not participate in any religious activities. Living conditions were grouped into 3 categories: alone; with spouse; with family other than spouse.

### Statistical methods

The Spearman correlation analysis was used to examine the relationship between factors. The statistical significance of differences of group means was determined by one-way analysis of variance (ANOVA) with post hoc analysis by Tukey's multiple comparison test. For non-parametric variables, group comparisons were done using the Kruskal-Wallis test and the Mann-Whitney U-test. SPSS (version 17.0, SPSS Inc., Chicago, IL, USA) was used and  $P < 0.05$  was considered as the threshold of significance.

We used a multiple logistic regression model to identify risk factors associated with lifestyle factors relating to late detection of dementia. Although this is a cross-sectional study, the lifestyle factors usually precede the dementia and risk factors of dementia. So we regarded the lifestyle factors as independent variables and the severe dementia as a dependent variable. For the logistic model, we combined the CDR 0.5 Group and CDR 1

Group as a non-severe dementia group and compared this group with the CDR 2 or 3 Group. As CDR 2 states 'severe memory loss; only highly learned material retained; severely impaired in handling problems, and social judgement', we defined the patients CDR 2 and over at the time of initial evaluation as 'severe' dementia group (SG) in the logistic model; the representative group for late detection.

### Ethics statement

All the patients provided written informed consent for the use of the data. This study was approved through the institutional review board of Konkuk University Hospital (KUH1170127).

## RESULTS

### Demographics and clinical characteristics

The prevalence of dementia in Gwangjin-gu district was 4.8%. There were significant differences in age, sex and lifestyle factors (except for income) between the 3 groups (Table 1). There

was a significantly greater proportion of individuals who were old age, female, less educated, who had never smoked or drank heavily, without physical activity, without religious activity and living with family other than spouse in the CDR 2 or 3 Group ( $P < 0.001$ ). Income did not influence severity at the first time of diagnosis ( $P = 0.098$ ), although post-hoc analyses found a significant difference when comparing only the CDR 0.5 Group and CDR 2 or 3 Group ( $P = 0.049$ ). In comparison with the CDR 0.5 group, all variables were significantly different in the CDR 2 or 3 Group.

Age, years of education, history of heavy drinking, physical activity, religious activity and living condition were variables that were appropriate to a logistic model for the SG (Table 2). Odds ratios (OR) of severe dementia were 1.045 (95% confidence interval [CI], 1.026-1.064) for age and 0.956 (95% CI, 0.926-0.986) for years of education. The risk of severe dementia at initial diagnosis was decreased for those who had history of drinking (OR, 0.507; 95% CI, 0.310-0.830) or who were physically (OR, 0.271; 95% CI, 0.182-0.405) or religiously active (OR, 0.454; 95%

**Table 1.** Demographics and socioeconomic and lifestyle characteristics

Category	CDR 0.5 group (n = 429)	CDR 1 group (n = 426)	CDR 2 or 3 group (n = 554)	Overall P value	CDR 0.5 vs. CDR 1, P value	CDR 0.5 vs. CDR 2 or 3, P value	CDR 1 vs. CDR 2 or 3, P value
Age, yr	76.2 (7.5)	80.5 (7.8)	83.2 (8.1)	$F[2,1406] = 96.56, < 0.001$	$< 0.001$	$< 0.001$	$< 0.001$
Education, yr	5.9 (4.9)	4.4 (4.9)	3.0 (4.2)	$F[2,1406] = 48.36, < 0.001$	$< 0.001$	$< 0.001$	$< 0.001$
Sex (% female)	290 (67.6)	314 (73.7)	454 (81.9)	$\chi^2[2] = 27.22, < 0.001$	0.050	$< 0.001$	0.002
Income (% low income)	52 (12.1)	38 (8.9)	46 (8.3)	$\chi^2[2] = 4.65, = 0.098$	0.091	0.049	0.917
Smoking				$\chi^2[2] = 15.57, < 0.001$	0.490	$< 0.001$	$< 0.001$
Never	353 (82.3)	348 (81.7)	502 (90.6)				
Past or current	76 (17.8)	75 (17.6)	46 (8.3)				
Heavy drinking				$\chi^2[2] = 43.55, < 0.001$	0.026	0.001	$< 0.001$
Never	317 (73.9)	332 (77.9)	498 (89.9)				
Past or current	112 (26.1)	88 (20.7)	50 (9.1)				
Physical activity (% physical inactive)	252 (58.5)	336 (78.9)	509 (91.9)	$\chi^2[2] = 171.00, < 0.001$	$< 0.001$	$< 0.001$	$< 0.001$
Religion (% non-religious)	190 (44.3)	222 (52.1)	372 (67.1)	$\chi^2[2] = 54.23, < 0.022$	0.022	$< 0.001$	$< 0.001$
Living condition				$\chi^2[2] = 141.62, < 0.001$	$< 0.001$	$< 0.001$	$< 0.001$
Alone	88 (20.5)	71 (16.7)	39 (7.0)				
With spouse	209 (48.7)	114 (26.8)	111 (20.0)				
With family other than spouse	121 (28.2)	218 (51.2)	372 (67.1)				

Values are mean (standard deviation) and numbers (%) in continuous and categorical variables, respectively. CDR, clinical dementia rating.

**Table 2.** Results from logistic regression final model: correlates of severe dementia at initial presentation (method 'enter')

Category	Reference	B	S.E.	Wals	OR (95% CI)	P value
Age, yr		0.044	0.009	22.321	1.045 (1.026-1.064)	$< 0.001$
Education, yr		-0.045	0.016	7.923	0.956 (0.926-0.986)	0.005
Sex	Female = 1	0.281	0.213	1.755	1.325 (0.874-2.010)	0.185
Income	Low income = 1	-0.317	0.244	1.690	0.728 (0.452-1.175)	0.194
Smoking	Never smoking = 1	-0.216	0.271	0.637	0.806 (0.474-1.370)	0.425
Heavy drinking	Never drinking = 1	-0.679	0.251	7.308	0.507 (0.310-0.830)	0.007
Physical activity	Physical inactive = 1	-1.304	0.205	40.661	0.271 (0.182-0.405)	$< 0.001$
Religious activity	Religious inactive = 1	-0.790	0.135	34.047	0.454 (0.348-0.592)	$< 0.001$
Living condition	Alone = 1			35.463		$< 0.001$
	With spouse	0.715	0.251	8.135	2.044 (1.251-3.340)	0.004
	With family other than spouse	1.267	0.223	32.273	3.549 (2.291-5.493)	$< 0.001$

CI, 0.348-0.592). Patients who lived with a spouse (OR = 2.044; 95% CI, 1.251-3.340) or family other than a spouse (OR = 3.549; 95% CI, 2.291-5.493) had a higher risk of diagnosis for severe dementia at the initial evaluation than those who lived alone.

## DISCUSSION

In the present study, there were significant differences in all lifestyle factors except income between the three groups. The differences in these characteristics between the 3 groups were prominent and more noticeable when the CDR 0.5 Group was compared to the CDR 2 or 3 Group. The impact of various lifestyle factors on the initial clinical presentation was also examined. An older age, low education, history of never drinking, physical inactivity, no religious practices and living with a spouse or family other than a spouse were much more common in the late detection group represented as SG at the time of first screening of urban elderly.

While previous literature reported that the prevalence of dementia is higher among individuals with older age and low educational years (6,11-15), our study identified the impact of aging and education on screening test. We found an inverse relationship between dementia severity and education, consistent with a previous study that reported decreasing education was associated with greater severity of disease at presentation (15). This is because individuals with less education may be less likely to be involved in cognitive tasks or occupational roles where subtle changes in cognitive functions could be detected and lead to an earlier diagnosis (15,16). Moreover, the low self-perception of the dementia could be the cause of late detection in less-educated people.

Our findings are inconsistent with a previous study, in that an economic barrier was the only category to correlate with a delayed diagnosis (4). As income information was based on the Korean medical insurance system, which supports medical expenses for certain low-income brackets through the National Health Insurance Corporation and, operated by the Ministry of Health and Welfare in Korea, it is regarded the accuracy of the reports as good. The impact of income might be much attenuated in our study because the purpose of the Seoul Dementia Management Project is 'screening' to detect patients in early stages of dementia. So we can only interpret that low income is not a screening barrier among Seoul elderly, or 'screening' project of GCD is working well.

Factors which are associated with being a social outsider, such as non-drinking, physical inactivity and religious inactivity were the barriers to timely access to healthcare services. The roles of smoking and alcohol on the development of dementia remain controversial (17-19). Moreover, the relationship between alcohol consumption and dementia 'detection' is rarely evaluated. Our study showed a reduced risk of late detection in

patients who were past or current heavy drinker. Drinking could be interpreted as a surrogate marker of social interactions. Social interaction is significantly correlated with alcohol use measures, even after controlling for SES and demographic variables (20). Drinking is the indicator of social interaction which is more strongly associated than classical SES (21). As activities of drinking can include certain cognitive tasks and social interactions, patients who never drank may have had a delay in medical attention until the disease had progressed to dementia. More detailed investigations about drinking patterns, such as beverage preferences, place where people drink, alcohol consumption periods or change of social, occupational, and recreational pursuit due to alcohols, are required. The non-smoking, however, was not a factor of late detection. Smokers usually smoke alone, so the social networking is much weak in smoking or smoking is related with less neighbourhood social capital.

The finding that patients with dynamic religious activity had a lesser chance of being diagnosed with severe dementia than patients who are non-religious continues in the same vein with social interaction. Participating in religious activities requires social interaction and strategies that involve executive functioning (22,23). Religious activity could be one of another social interaction marker, so absence of this religious activity might make the people alienated, and leads the dementia symptoms concealed.

Our finding of an inverse relationship between physical activity and the severity of dementia is consistent with many previous studies (24-26). As physical inactivity increased the risk of daily activity limitations, dementia patients with physical inactivity may not seek medical attention until the disease has progressed.

Living conditions (including marital status) showed interesting findings. Patients who lived alone had a much lesser risk of late detection than those who live with family. Previous reports showed that the loss of insight that accompanies dementia could result in patients who lived alone being diagnosed late (27,28). However, we considered that daily activity impairment, which accompanies dementia, may put patients who lived alone in a clinically challenging situation. As patients who live alone have to do their all daily activity by themselves, subtle cognitive decline could be detected early. Moreover, elderly who live with family are used to being dependent even simple daily activity on others and take these offers for granted, owing to the Korean tradition of Confucianism. This trend is intensified when there is no spouse and only other family. Limited daily duty is connected to the delayed attention for medical services.

A limitation of the present study includes some investigation based on self-reporting, although the contents were well-constructed and standardized. Another limitation is the limited diversity, in that the study was performed at single ethnic, racial and cultural environment of the urban elderly. There were eth-

no-racial and cultural differences in clinical characteristics (4,8). We could not reflect these characteristics; however, this is rather strength of the present study as the lifestyle factors could be investigated more precisely. The cross-sectional design of this study could be another limitation. Regarding the lifestyle factors as independent could be problem, because severe dementia makes the patients' lifestyle inactive. However, we think the categorizing factors as 'never' or 'past or current' can compensate the defect. The older age of the the CDR 2 or 3 Group could make us think about the survival bias. Furthermore, this result could only be applicable to the 'screening' target, not to the patients who visit the memory clinic voluntarily. Finally, much more female patients than male in our study could create bias which can alleviate the effect of the sex.

Recent reports from the United States Preventive Services Task Force doubt the value of universal screening using formal screening instruments for community-dwelling adults, over age 65 years, in the general primary care population who have no signs or symptoms of cognitive impairment, although the risk versus benefit of screening cannot as yet be determined (29,30). However, the screening test is an indispensable tool in the diagnosis of dementia. Also, timely diagnosis of dementia can improve the quality of life for both patient and caregivers (2,14). Costs of care for patients with mild dementia are significantly lower than for those with moderate dementia (31), and the effect of cognitive enhancers are better when given during mild to moderate stages of dementia compared with severe stages (14,32,33).

In a Korean report analysing the cost-effectiveness of nationwide opportunistic screening program for dementia, the screening project of the Seoul Metropolitan Government did not lead to cost savings for the present (34). Among the several factors, screening all individuals over 65 years who want the test, not targeted to the patients with high risk, was thought to be the main factor. That is, to find out the vulnerable stratum to dementia screening is a cost-effective way to promote health of urban elderly. In the present study, the differences in lifestyle characteristics according to dementia severity and variables related to severe dementia on initial clinical presentation when screening test were examined. Our results suggest that certain lifestyle factors; aging, lower education, less social interactions (drinking, religious activity), less physical activity or living with family who serve the elderly's daily activity are associated with late disease detection. The "severe-stage-at-the-time-of-first-evaluation" means patients were in a "blind spot" in the health-care system. We can define this group as the vulnerable stratum to dementia evaluation, including screening. Health policy or community health services might find ways to better engage patients in this vulnerable stratum to dementia.

This study provides evidence of the significant societal cost of dementia. The study also provides a rich body of information

on the health services and cost of dementia that is essential for policy analysis and formulation as well as the basis for future planning for services of elderly population.

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## DISCLOSURE

The authors have no potential conflicts of interest to disclose.

## AUTHOR CONTRIBUTION

Conception and design of study: Moon Y, Han SH. Recruiting the patients, analyzing, and interpreting the data: Moon Y, Lee H, NamGung OK, Han SH. Drafting and revising the manuscript: Moon Y, Han SH. Final approval: all authors.

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## REFERENCES

- Handels RL, Wolfs CA, Aalten P, Joore MA, Verhey FR, Severens JL. Diagnosing Alzheimer's disease: a systematic review of economic evaluations. *Alzheimers Dement* 2014; 10: 225-37.
- Bradford A, Kunik ME, Schulz P, Williams SP, Singh H. Missed and delayed diagnosis of dementia in primary care: prevalence and contributing factors. *Alzheimer Dis Assoc Disord* 2009; 23: 306-14.
- Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J. Socio-economic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. *JAMA* 1998; 279: 1703-8.
- Ortiz F, Fitten LJ. Barriers to healthcare access for cognitively impaired older Hispanics. *Alzheimer Dis Assoc Disord* 2000; 14: 141-50.
- Russ TC, Stamatakis E, Hamer M, Starr JM, Kivimäki M, Batty GD. Socio-economic status as a risk factor for dementia death: individual participant meta-analysis of 86 508 men and women from the UK. *Br J Psychiatry* 2013; 203: 10-7.
- Sattler C, Toro P, Schönknecht P, Schröder J. Cognitive activity, education and socioeconomic status as preventive factors for mild cognitive impairment and Alzheimer's disease. *Psychiatry Res* 2012; 196: 90-5.
- Wilson RS, Scherr PA, Hoganson G, Bienias JL, Evans DA, Bennett DA. Early life socioeconomic status and late life risk of Alzheimer's disease. *Neuroepidemiology* 2005; 25: 8-14.
- Livney MG, Clark CM, Karlawish JH, Cartmell S, Negrón M, Nuñez J, Xie SX, Entenza-Cabrera F, Vega IE, Arnold SE. Ethnoracial differences in the clinical characteristics of Alzheimer's disease at initial presentation at an

- urban Alzheimer's disease center. *Am J Geriatr Psychiatry* 2011; 19: 430-9.
9. Shin MH, Lee YM, Park JM, Kang CJ, Lee BD, Moon E, Chung YI. A combination of the Korean version of the mini-mental state examination and Korean dementia screening questionnaire is a good screening tool for dementia in the elderly. *Psychiatry Investig* 2011; 8: 348-53.
  10. McKhann G, Drachman D, Folstein M, Katzman R, Price D, Stadlan EM. Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA work group under the auspices of department of health and human services task force on Alzheimer's disease. *Neurology* 1984; 34: 939-44.
  11. Beydoun MA, Beydoun HA, Gamaldo AA, Teel A, Zonderman AB, Wang Y. Epidemiologic studies of modifiable factors associated with cognition and dementia: Systematic review and meta-analysis. *BMC Public Health* 2014; 14: 643.
  12. Bae JB, Kim YJ, Han JW, Kim TH, Park JH, Lee SB, Lee JJ, Jeong HG, Kim JL, Jhoo JH, et al. Incidence of and risk factors for Alzheimer's disease and mild cognitive impairment in Korean elderly. *Dement Geriatr Cogn Disord* 2015; 39: 105-15.
  13. Kim KW, Park JH, Kim MH, Kim MD, Kim BJ, Kim SK, Kim JL, Moon SW, Bae JN, Woo JI, et al. A nationwide survey on the prevalence of dementia and mild cognitive impairment in South Korea. *J Alzheimers Dis* 2011; 23: 281-91.
  14. Qian W, Schweizer TA, Fischer CE. Impact of socioeconomic status on initial clinical presentation to a memory disorders clinic. *Int Psychogeriatr* 2014; 26: 597-603.
  15. Moritz DJ, Petitti DB. Association of education with reported age of onset and severity of Alzheimer's disease at presentation: implications for the use of clinical samples. *Am J Epidemiol* 1993; 137: 456-62.
  16. Roe CM, Xiong C, Grant E, Miller JP, Morris JC. Education and reported onset of symptoms among individuals with Alzheimer disease. *Arch Neurol* 2008; 65: 108-11.
  17. García AM, Ramón-Bou N, Porta M. Isolated and joint effects of tobacco and alcohol consumption on risk of Alzheimer's disease. *J Alzheimers Dis* 2010; 20: 577-86.
  18. Hagger-Johnson G, Sabia S, Brunner EJ, Shipley M, Bobak M, Marmot M, Kivimaki M, Singh-Manoux A. Combined impact of smoking and heavy alcohol use on cognitive decline in early old age: Whitehall II prospective cohort study. *Br J Psychiatry* 2013; 203: 120-5.
  19. Anstey KJ, Mack HA, Cherbuin N. Alcohol consumption as a risk factor for dementia and cognitive decline: meta-analysis of prospective studies. *Am J Geriatr Psychiatry* 2009; 17: 542-55.
  20. Seid AK. Social interactions, trust and risky alcohol consumption. *Health Econ Rev* 2015; 6: 3.
  21. Bloomfield K, Grittner U, Rasmussen HB, Petersen HC. Socio-demographic correlates of alcohol consumption in the Danish general population. *Scand J Public Health* 2008; 36: 580-8.
  22. Agli O, Bailly N, Ferrand C. Spirituality and religion in older adults with dementia: a systematic review. *Int Psychogeriatr* 2015; 27: 715-25.
  23. Coin A, Perissinotto E, Najjar M, Girardi A, Inelmen EM, Enzi G, Manzato E, Sergi G. Does religiosity protect against cognitive and behavioral decline in Alzheimer's dementia? *Curr Alzheimer Res* 2010; 7: 445-52.
  24. Blankevoort CG, van Heuvelen MJ, Boersma F, Luning H, de Jong J, Scherder EJ. Review of effects of physical activity on strength, balance, mobility and ADL performance in elderly subjects with dementia. *Dement Geriatr Cogn Disord* 2010; 30: 392-402.
  25. Rist PM, Marden JR, Capistrant BD, Wu Q, Glymour MM. Do physical activity, smoking, drinking, or depression modify transitions from cognitive impairment to functional disability? *J Alzheimers Dis* 2015; 44: 1171-80.
  26. Potter R, Ellard D, Rees K, Thorogood M. A systematic review of the effects of physical activity on physical functioning, quality of life and depression in older people with dementia. *Int J Geriatr Psychiatry* 2011; 26: 1000-11.
  27. Lehmann SW, Black BS, Shore A, Kasper J, Rabins PV. Living alone with dementia: lack of awareness adds to functional and cognitive vulnerabilities. *Int Psychogeriatr* 2010; 22: 778-84.
  28. Sundström A, Westerlund O, Mousavi-Nasab H, Adolffson R, Nilsson LG. The relationship between marital and parental status and the risk of dementia. *Int Psychogeriatr* 2014; 26: 749-57.
  29. Lin JS, O'Connor E, Rossom RC, Perdue LA, Eckstrom E. Screening for cognitive impairment in older adults: a systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med* 2013; 159: 601-12.
  30. Moyer VA; U.S. Preventive Services Task Force. Screening for cognitive impairment in older adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med* 2014; 160: 791-7.
  31. Schwarzkopf L, Menn P, Kunz S, Holle R, Lauterberg J, Marx P, Mehlig H, Wunder S, Leidl R, Donath C, et al. Costs of care for dementia patients in community setting: an analysis for mild and moderate disease stage. *Value Health* 2011; 14: 827-35.
  32. Huang YJ, Lin CH, Lane HY, Tsai GE. NMDA neurotransmission dysfunction in behavioral and psychological symptoms of Alzheimer's disease. *Curr Neuropharmacol* 2012; 10: 272-85.
  33. Standridge JB. Pharmacotherapeutic approaches to the prevention of Alzheimer's disease. *Am J Geriatr Pharmacother* 2004; 2: 119-32.
  34. Yu SY, Lee TJ, Jang SH, Han JW, Kim TH, Kim KW. Cost-effectiveness of nationwide opportunistic screening program for dementia in South Korea. *J Alzheimers Dis* 2015; 44: 195-204.