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ORIGINAL ARTICLE

Factors Affecting Cognitive Impairment and Depression in the Elderly Who Live Alone: Cases in Daejeon Metropolitan City

Juyoun Lee,[1] Min Joo Ham,[2] Jae Young Pyeon,[2] Eungseok Oh,[1]
Seong Hae Jeong,[1] Eun Hee Sohn,[1] Ae Young Lee[1,2]

[1]Department of Neurology, College of Medicine, Chungnam National University Hospital, Daejeon, Korea
[2]Daejeon Metropolitan Dementia Center, Daejeon, Korea

Background and Purpose   With the rapid increase in the number of elderly people in Korea, multiple socio-economic problems have emerged. In 2015, 6.4 million people accounting for about 13% of the total population in Korea were aged 65 years and over. As the elderly population continues to grow, the elderly who live alone are also increasing. They have potential risks in medical and neuropsychological aspects. The purpose of this study was to investigate the association between cognition and socio-environmental status in the elderly who live alone.

Methods   This study was conducted on 512 people who live alone (equivalent to 1% of the total elderly people) in Daejeon Metropolitan City between April and November 2015. Structured questionnaires were used to investigate the general characteristics, socio-economic status, physical status, and mood for participants. Simple tests using Mini-Mental Status Examination–Demetia Screening, Geriatric Depression Scale and Korean– instrumental activities of daily living were also performed.

Results   Among the 512 participants, 109 participants (21.3%) had cognitive impairment, and 128 participants (25.0%) had depression. The number of daily meals, frequency of meeting with family, and depression were independent risk factors for cognitive impairment. Factors including the duration of living alone, cognitive impairment, poor self-perceived health status, frequency of meeting with family and duration of education were considered an independent risk factor for depression.

Conclusions   This study showed that the elderly who live alone are susceptible to cognitive impairment and depression, and factors including the number of daily meals, social contact, and self-perceived health status may affect cognition and depressive mood. Thus, physicians need to pay attention to management of major factors that may cause cognition impairment and depression in the elderly who live alone; in addition, they require ongoing community interest and support.

Key Words   the elderly who live alone, cognitive impairment, depression, factors.

INTRODUCTION

The elderly population aged 65 years and over was 6.25 million people, which was equivalent to 13.2% of Korea's total population in 2015. With a rapid annual rise in the number of elderly people, Korea is projected to become an aged society in 2019 and a super-aged society in 2026.[1] As our country is becoming the most rapidly ageing population in the world, we need to prepare for the increasing socio-economic burden. The proportion of elderly couple-only households and single elderly households is increasing due to aging and changes in social structure. The proportion of elderly people living alone in Korea increased from 13.6% in 1994 to 23.0% in 2014, and the number of people aged 65 years and over who were living alone was about 1.38 million people in 2015; the number is

predicted to reach 3.43 million people in the next 20 years.

Elderly people are confronted with difficulties in their daily lives due to normal aging, chronic diseases such as dementia or depression, and loss of physical function. In particular, they are vulnerable to difficulties in health care, sense of alienation due to depression and social isolation, and poor living conditions. These factors are known to affect a decline in cognitive functions. As the aging population is on the rise, several investigations on elderly people or elderly people living alone have been conducted. However, there are lack of studies that systemically examined and analyzed socio-demographic factors affecting cognitive functions and depression in elderly people living alone.

In this study, we investigated the health conditions, cognitive functions and socio-demographic factors for elderly people aged 65 years and over who live alone and analyzed the effects of these factors on cognitive functions and depression.

METHODS

Subjects

In this study, 512 people, equivalent to 1% of the total population who lives alone in Daejeon, between April and November 2015 were selected by using stratified random sampling. Data were collected using structured questionnaires in face-to-face interviews. All subjects were assessed using Mini-Mental Status Examination-Dementia Screening (MMSE-DS),[2] Korean versiom of Geriatric Depression Scale (K-GDS)[3] and Korean-instrumental activities of daily living (K-IADL).[4]

Sociological assessment tools

Basic demographic characteristics (i.e., age, sex, and educational level), family relationship (i.e., the frequency of meeting with family, frequency of contact with family and duration of living alone) and economic status (i.e., the presence of a job and presence of income) were investigated using a structured questionnaire as part of sociological assessment. Family history of dementia, lifestyle such as exercise, meals, smoking and drinking, self-perceived health status, major cardiovascular diseases and history of depression were also identified using a structured questionnaire.

Neuropsychological assessment

Neuropsychological assessment was conducted to assess cognitive functions, degree of depression, and activities of daily living. The MMSE-DS, a screening tool for cognitive function that has a score range from 0 to 30, was used to identify the presence of cognitive impairment. Cognitive impairment was defined as a score <1.5 standard deviation away from the normative data of age-, sex-, and education-matched tests.[5] The degree of depression was assessed using the K-GDS with a score range from 0 to 30. The activity of daily living was evaluated using the K-IADL comprised of 11 items.

Statistical analysis

Descriptive statistics and frequency analysis were used to describe basic features, and the differences in factors between the groups were tested by a chi-squared test and a t-test. Multiple logistic regression including factors that showed statistical significance in univariate analysis ($p<0.05$) was performed to investigate factors related to the cognitive impairment group or the depression group. These analyses were performed using SPSS statistics software version 21.0 (SPSS Inc., Chicago, IL, USA), and the significance level was defined as <0.05.

RESULTS

Cognitive function and degree of depression

A total of 512 subjects showed a mean MMSE-DS score of 24.2 points, a mean age of 78.5 years and a mean educational level of 5.6 years. Women comprised 77.1% of the total subjects included in the study. Among the 512 subjects, 109 subjects (21.3%) were included in the cognitive impairment group based on the normative data stratified by age, sex, and educational level; and 67.0% of the cognitive impairment group were women. The cognitive impairment group had a mean age of 78.7 years, a mean MMSE-DS score of 19.5 points and a mean K-GDS of 14.3 points. This group showed more severe depressed mood with a mean depression score of 12.0 points (p=0.003) and history of depression was more frequent in this group, as compared to the normal-cognition group (Table 1). Subjects with lower educational levels had a lower MMSE-DS score and poorer ability of daily living. In the cognitive impairment group, the mean K-IADL score for uneducated elderly people was 0.72 points, 0.41 points for elderly people with only elementary education, and 0.24 points for elderly people with higher education than college dropouts.

Of the total subjects, 128 subjects (25%) were included in the depression group based on K-GDS (Table 1). There was a significant negative correlation between cognitive function and degree of depression (rho=-0.03, p<0.001). The risk of depressive mood was 1.76 fold higher in the cognitive impairment group than the normal cognition group [odds ratio (OR)=1.76, p=0.016]. The risk of cognitive impairment was also 1.76 times higher for depressed people than for non-depressed people (OR=1.76, p=0.016).

General characteristics of elderly people living alone

Of the 512-elderly people living alone, 395 (77.1%) were women. The proportion of women was lower in the cognitive impairment group (67.0%) than in the normal cognition group (79.9%); whereas, the proportion of women was higher in the depression group (83.6%) than in the non-depression group. Mean duration of education was lower in the depression group and the mean K-IADL scale was also worse as 0.6 points in the depression group than in those of the non-depression group (Table 1). The prevalence of cardiovascular risk factors such as hypertension, hyperlipidemia, diabetes, stroke, and heart disease showed no differences between the cognitive impairment and normal cognition group. The proportion of participants with a history of diabetes, heart disease and head trauma was higher in the depression group than in the non-depression group. Of all included subjects, 16% had a history of head trauma and received a diagnosis of depression, without significant difference between the two groups (Table 1).

Table1. General characteristics according to cognition and depression

Variables	Total (n=512)	Cognitive impairment (n=109)	Normal cognition (n=403)	p value*	Depression (n=128)	No depression (n=384)	p value*
Gender (%)							
Female	77.1	67.0	79.9	0.004	83.6	75.0	0.013
Age (%)							
Mean±SD	78.5±5.8	78.7±6.7	78.4±5.6	0.742	78.3±5.3	78.5±6.0	0.733
60-69	5.7	8.3	5.0		3.9	6.3	
70-79	49.2	46.3	50.0	0.253	55.1	47.3	0.050
80-89	21.0	39.8	42.3		38.6	42.8	
≥90	3.3	5.6	2.7		2.4	3.7	
Education (%)							
Mean±SD	5.6±4.7	6.6±4.9	5.3±4.6	0.015	4.0±4.2	6.1±4.8	<0.001
<Elementary	26.3	19.3	28.2		38.3	22.3	
Elementary	42.7	43.1	42.6	0.114	43.0	42.7	<0.001
Middle-high	25.9	29.4	24.9		17.2	28.8	
≥College	5.1	8.3	4.2		1.6	6.3	
Hypertension (%)							
Yes	62.3	64.2	61.8	0.364	59.4	63.3	0.061
Hyperlipidemia (%)							
Yes	31.6	26.6	33.0	0.123	35.2	30.5	0.053
Diabetes mellitus (%)							
Yes	27.9	31.2	27.0	0.230	32.8	26.3	0.033
Stroke							
Yes	13.3	17.4	12.2	0.102	20.3	10.9	0.004
Heart disease (%)							
Yes	18.8	20.2	18.4	0.379	25.0	16.7	0.012
Head trauma (%)							
Yes	16.4	15.6	16.6	0.463	25.8	13.3	0.001
Depression (%)							
Yes	16.2	18.3	15.6	0.291	32.8	10.7	<0.001
MMSE-DS	24.2±2.3	19.5±4.4	25.4±3.3	-	22.3±4.6	24.8±4.0	<0.001
K-GDS	12.5±6.9	14.3±7.6	12.0±6.6	0.003	22.0±3.2	9.3±4.4	-
K-IADL	0.3±0.4	0.4±0.5	0.3±0.4	0.001	0.6±0.5	0.2±0.3	<0.001
Dementia family history (%)							
Yes	8.8	9.2	8.7	0.500	8.6	8.9	0.143

Performed by chi test for categorical variants and t-test for continuous variables.
*p value<0.05.
K-GDS: Korean version of Geriatric Depression Scale, K-IADL: Korean-instrumental activities of daily living, MMSE-DS: Mini-Mental Status Examination-Dementia Screening, SD: standard deviation.

Table2. Comparisons of risk factors according to cognition and depression

Variables	Total (*n*=512)	Cognitive impairment (*n*=109)	Normal cognition (*n*=403)	*p* value*	Depression (*n*=128)	No depression (*n*=384)	*p* value*
Socio-economic factors							
Working (%)							
Yes	7.4	6.4	7.7	0.414	3.1	8.9	0.014
Income (%)							
Yes	66.0	67.0	65.8	0.454	67.2	65.6	0.082
Frequency of meeting family (%)							
≥once a week	28.4	27.9	28.6	0.498	25.0	29.4	0.220
<once a week	71.6	72.1	71.4		75.0	70.6	
Frequency of contact with family (%)							
≥once a week	57.1	44.8	60.6	0.003	43.5	61.1	0.001
<once a weak	42.9	55.2	39.4		56.5	38.9	
Duration of living alone (years) (%)							
Mean±SD	16.1±13.7	13.6±11.6	16.9±14.2	0.013	17.4±13.0	15.8±14.0	0.236
0–10	49.4	56.9	47.4	0.091	41.3	52.1	0.025
11–20	23.3	24.8	22.9		23.3	21.4	
21–30	13.5	11.0	14.2		13.5	12.0	
≥31	13.7	7.3	15.5		13.7	14.6	
Lifestyle							
Number of meals (%)							
3 times	75.0	73.4	75.4	0.003	65.6	78.1	0.001
2 times	22.3	19.3	23.1		28.9	20.1	
1 time	2.7	7.3	1.5		5.5	1.8	
Excercise (%)							
None	21.1	28.4	19.1	0.220	28.9	18.5	<0.001
–15 min	15.2	16.5	14.9		18.0	14.3	
–30 min	19.3	18.3	19.6		19.5	19.3	
–60 min	23.0	20.2	23.8		18.0	24.7	
>60 min	21.3	16.5	22.6		15.6	23.2	
Smoking (%)							
None	91.4	85.3	93.0	0.022	88.3	92.4	0.022
<1/2 pack	4.5	5.5	4.2		4.7	4.4	
1/2–1 pack	2.7	6.4	1.7		5.5	1.8	
≥1 pack	1.4	2.8	1.0		1.6	1.3	
Drinking (%)							
None	84.9	83.5	85.3	0.840	91.7	82.7	0.008
–1 cup	9.2	8.7	9.3		5.0	10.5	
–1 bottle	5.1	6.8	4.6		2.5	5.9	
>1 bottle	0.8	1.0	0.8		0.8	0.8	
Physical/psychiatric factors (%)							
Self-perceived health							
Very good	9.8	11.9	9.2	0.460	3.1	12.0	<0.001
Good	28.1	28.4	28.0		14.1	32.8	
Fair	18.8	12.8	20.3		10.9	21.4	
Poor	34.0	36.7	33.3		53.1	27.6	
Very poor	9.4	10.1	9.2		18.8	6.3	

Performed by chi test for categorical variants and *t*-test for continuous variables.
p value<0.05.
SD: standard deviation.

Socio-economic factors

There were no differences in the presence of a job or income between the cognitive impairment group and the normal cognition group. The frequency of meeting family was mostly less than once a month in both two groups. The frequency of contact with family was more than once a week for 60.6% participants of the normal cognition group and for 44.8% participants of the cognitive impairment group, with statistically significant difference between the two groups (*p*=0.003). The mean duration of living alone was shorter in the cognitive impairment group with a mean duration of 13.6 years than in the normal cognition group (16.9 years). The depression group had fewer participants with a job and lower frequency of contact or meeting with family, as compared with the non-depression group (Table 2). Elderly people in their 60s and 70s with a longer duration of living alone had more severe depression (60s: *p*<0.001, 70s: *p*=0.017). No significant association was found between the duration of living alone and degree of depression for elderly people in their 80s.

Lifestyle and physical/psychological factors

The proportion of participants who consumed only one meal a day was higher in the cognitive impairment group (7.3%) than in the normal cognition group (1.5%). There were no differences in the amount of exercise and alcohol consumption between both groups. However, the frequency of smoking was higher in the cognitive impairment group than in the normal cognition group. Poor self-perceived health status was assessed by 33.3 to 36.7% of participants in each group, with no difference between the two groups (Table 2). The proportion of participants who consumed three meals a day was lower (depression group vs. non-depression group: 65.6% vs. 78.1%), who do not exercise was higher (28.9% vs. 18.5%), and smokers was also higher (11.7% vs. 7.6%) in the depression group than in those of the non-depression group. The proportion of very poor/poor self-perceived health status was significantly higher in the depression group than in the non-depression group (71.9% vs. 33.9%, *p*<0.001) (Table 2).

Factors associated with cognitive impairment

Factors that showed a significant association with cognitive impairment in univariate analysis included sex, duration of education, K-GDS score, frequency of contact with family, duration of living alone, number of meals and smoking. A multivariate logistic regression model was used to identify independent association of these factors with cognitive impairment. The most influential factor on cognitive impairment was the number of meals, and the risk of cognitive impairment was 3.72 times higher for participants who consumed

only one meal a day, as compared to participants who consumed three meals a day (OR=3.72, *p*=0.039). A higher K-GDS score increased the risk of cognitive impairment (OR= 1.06, *p*=0.002). For the frequency of contact with family, the risk of cognitive impairment was lower in participants who have contact with family more than once a week than in those with who have contact with family less than once a week (OR=0.62, *p*=0.047). Generally, a shorter duration of living alone or a longer duration of education was associated with cognitive impairment (Table 3).

Factors related to depression

The depression-related factors identified according to the K-GDS scores in univariate analysis were included in a multivariate logistic regression model to determinate independent association with depression. Self-perceived health status was the most influential factor on the degree of depression. The risk of depression in participants with very poor/poor self-perceived health status was 12.8 fold higher (*p*=0.003) and 9.7 fold higher (*p*=0.002), respectively, as compared to those with very good self-perceived health status. The risk of depression in participants who lived alone for 11–20 years was about 2.2 fold higher than in those who lived alone for ≤10 years. A lower level of education and cognitive function, as well as a decline (less than once a week) in the frequency of contact with family

Table 3. Factors associated with cognitive impairment: adjusted odds ratio from a multivariate logistic regression model

Variables	Odds ratio (95% CI)	*p* value*
Gender		
Male	Reference	
Female	0.83 (0.472–1.471)	0.529
Education (years)	1.06 (1.003–1.114)	0.039
K-GDS (score)	1.06 (1.020–1.095)	0.002
Frequency of contact with family		
<once a week	Reference	
≥once a week	0.62 (0.386–0.993)	0.047
Duration of living alone (years)	0.98 (0.960–0.999)	0.044
Number of meals		
3 times	Reference	
2 times	0.89 (0.500–1.582)	0.690
1 time	3.72 (1.065–12.958)	0.039
Smoking		
None	Reference	
<1/2 pack	1.15 (0.388–3.432)	0.795
1/2–1 pack	4.32 (0.976–19.133)	0.054
≥1 pack	2.05 (0.381–11.077)	0.403

*p value<0.05.
CI: confidential interval, K-GDS: Korean version of Geriatric Depression Scale.

Table 4. Factors associated with depression: adjusted OR from a multivariate logistic regression model

Variables	OR (95% CI)	p value*
Gender		
Male	Reference	
Female	1.241 (0.561–2.747)	0.594
Age		
60–69	Reference	
70–79	2.837 (0.551–14.597)	0.212
80–89	1.453 (0.273–7.736)	0.661
≥90	0.383 (0.031–4.709)	0.584
Education (years)	0.927 (0.862–0.997)	0.035
MMSE-DS (score)	0.886 (0.829–0.948)	0.001
Working		
Yes	0.647 (0.186–2.254)	0.494
Time of contact with family		
<once a week	Reference	
≥once a week	0.572 (0.333–0.982)	0.043
Duration of living alone		
0–10	Reference	
11–20	2.162 (1.117–4.185)	0.022
21–30	1.713 (0.754–3.893)	0.199
≥31	0.533 (0.192–1.478)	0.226
Number of meals		
3 times	Reference	
2 times	1.316 (0.686–2.523)	0.409
1 time	0.915 (0.166–5.048)	0.919
Exercise		
None	Reference	
–15 min	0.666 (0.272–1.631)	0.374
–30 min	0.941 (0.417–2.124)	0.884
–60 min	0.533 (0.233–1.221)	0.137
>60 min	0.677 (0.275–1.668)	0.397
Smoking		
None	Reference	
<1/2 pack	0.829 (0.181–3.81)	0.810
1/2–1 pack	1.002 (0.123–8.123)	0.999
≥1 pack	0.318 (0.017–5.879)	0.442
Drinking		
None	Reference	
–1 cup	0.593 (0.208–1.693)	0.329
–1 bottle	0.75 (0.131–4.292)	0.747
>1 bottle	0.53 (0.016–17.41)	0.722
Self-perceived health		
Very good	Reference	
Good	2.321 (0.458–11.765)	0.309
Fair	4.380 (0.97–24.897)	0.070
Poor	9.726 (2.329–51.574)	0.003
Very poor	12.794 (2.741–79.445)	0.002

Table 4. Factors associated with depression: adjusted OR from a multivariate logistic regression model (continued)

Variables	OR (95% CI)	p value*
Diabetes mellitus		
Yes	0.899 (0.486–1.662)	0.734
Stroke		
Yes	1.421 (0.657–3.074)	0.372
Heart disease		
Yes	0.892 (0.457–1.743)	0.739
Head trauma		
Yes	1.315 (0.625–2.768)	0.470

*p value<0.05.
CI: confidential interval, MMSE-DS: Mini-Mental Status Examination-Dementia Screening, OR: odds ratio.

were associated with an increased risk of depression (Table 4).

DISCUSSION

In this study, we investigated cognitive function, the degree of depression, and factors related to cognitive function or depression in elderly people living alone. Of the included subjects who live alone, 21.3% showed cognitive impairment. Elderly people living alone who account for 20% of the elderly Korean population, increased by 18.5% for the past 5 years. The rise in the elderly population is expected to have a considerable impact on the increase in patients with dementia. Therefore, it may be important to analyze and control factors affecting cognitive impairment to lower the risk of dementia in elderly people living alone.

Elderly people with a K-GDS score >18 points comprised 25% of all subjects in the study which were similar to previous studies. Living alone itself was an independent risk factor for depression.[6] In addition, cognitive function is known to be associated with depression. This study showed that the risk of cognitive impairment was 1.76 fold higher in participants with depression than in participants without depression. Consequently, depression in elderly people living alone increased the risk of cognitive impairment.

In addition, variables such as sex, the duration of education, the duration of living alone, the frequency of contact with family, the number of meals and smoking were factors that affected cognitive impairment among elderly people living alone. The risk of cognitive impairment in elderly people who consumed only one meal a day was 3.7 fold higher than in those who consumed three meals a day, which is in agreement with the importance of regular meals from previous studies. If each meal is not based on healthy meal plans, it may be difficult to maintain a regular and well-balanced diet, which may cause undernutrition and consequent affect cognitive

function. Cognitive impairment also may be caused by vitamin B12 and folate deficiency or anemia[7] and recovered by addressing the corresponding nutrient deficiency.[8,9] Eating regular meals is very important for elderly people since people with dementia have a 2.7 fold higher risk for nutrient deficiencies and decline in activities of daily living and the nutrient deficiency may increase death rates in the elderly.[10] However, most elderly people living alone who participated in this study responded that they usually eat two or three meals a day. The number of elderly people eating one meal a day (2.7%) was very few, and thus cautious interpretation of the results is required. In addition, the frequency of contact with family was associated with cognitive impairment. The risk of cognitive impairment was lower in elderly people who had contact with family more than once a week than in those who contact with family less than once a week, corroborating findings from previous studies that factors such as lower frequency of contact with family or social isolation increased the risk of cognitive impairment.[11,12] Contrary to expectations, this study showed that the risk of cognitive impairment increased with a higher level of education and shorter duration of living alone. Considering that the existing elderly people living alone with severe cognitive impairment are most likely to move into a nursing home or long-term care facility, or stay with their family, the subjects of this study were mainly comprised of elderly people living alone who had mild or no cognitive impairment. This point may be supported by the following: first, the mean MMSE-DS score was 24 points in most elderly people participating in this study and less than 14 points in only 8 elderly people: second, elderly people with a lower level of education among subjects with cognitive impairment had more severe impairment in instrumental activities of daily living. Thus, elderly people who have relatively better cognitive function are likely to have a long duration of living alone; moreover, elderly people with a low level of education and concurrent severe cognitive impairment were excluded from the study. Although low level of education is generally known as a risk factor of cognitive impairment,[13] some studies showed that the level of education does not affect cognitive impairment. Accordingly, further studies are needed to confirm these findings.

Based on the existing studies,[14-17] the low level of education, cognitive impairment, poor self-perceived health status and low frequency of contact with family were included in risk factors related to depression in elderly people living alone. The duration of living alone was also associated with depression, and elderly people in their 60s and 70s showed more severe depression with increases in the duration of living alone. Elderly people in their 80s showed a similar degree of

depressive symptom that appeared in elderly people in their 70s. Since the number of elderly people in their 90s who participated in this study was relatively few, it was difficult to determine the association between the duration of living alone and depression in elderly people in their 90s. The prevalence of geriatric depression has been reported as up to 33.0% with a rapid increase in the incidence of depression in elderly people in Korea.[18]

The Health and Welfare Policy Forum 2016 report indicates that 10.3% of elderly people in Korea have ever thought about suicide, and the rate of elderly people aged 75 years was higher compared to those aged 65 to 74 years among the total respondents. Living alone itself is a risk factor for depression, and therefore active measures against depression in elderly people living alone are needed.

Our study has certain limitations. First, since this study was conducted on only elderly people living alone in a specific area, the results of this study cannot be generalized to the entire population of elderly people living alone in Korea; second, the causal relationship between cognitive function or depression in elderly people and risk factors could not be determined since this was a cross-sectional study. Although multiple factors such as living alone, cognitive function, degree of depression and social factors have inter-relatedness, we could not identify all relevant factors; third, there is a possibility that the attitude or cognitive function of subjects who participated in the survey using a self-administered questionnaire had an influence on the results.

Depression is a known risk factor of cognitive function and vice-versa.[19] In this study, we confirmed the correlation between the two factors for elderly people living alone and identified several factors that affect depression and cognitive impairment in elderly people living alone. In conclusion, this study will contribute to enhancing social support to prevent dementia and depression in elderly people living alone.

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