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Predictors of and health services utilization related to depressive symptoms among elderly Koreans

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Abstract

While the prevalence, comorbidity, risk profile and health care utilization for late-life depression have been described for many Western countries, much less is known about the recent epidemiology of late-life depression in East Asian countries such as Korea. We investigated predictors for depressive symptoms and the association between depressive symptoms and the utilization of both medical care and preventive services in elderly Koreans. Data were obtained from a nationally representative sample of Koreans aged 60 and above (2226 men, 2911 women) who participated in the 2008 wave of the Korean Longitudinal Study of Ageing. Depressive symptoms were measured using the 10-item Center for Epidemiological Studies-Depression scale. Risk factors considered included sociodemographics, health behaviors, chronic diseases, and physical function. Health care utilization factors included hospitalization, outpatient clinic use and basic medical checkup. Being female, being unmarried, and having less education, lower household income, physical inactivity and lower weight were associated with depressive symptoms. Presence of chronic diseases and limited physical function also showed a significant association with depressive symptoms. Depressive symptoms were associated with increased odds of hospitalization and outpatient visits, but decreased the odds of utilization of basic medical checkup after controlling for potential confounders. Findings on most risk factors, except lower weight, were consistent with reports from Western countries. It is important to recognize the burden of depressive symptoms in the elderly. The interaction of such symptoms with chronic diseases should be acknowledged and considered in the clinical setting as well as in health care planning and policymaking.

Keywords

Late-life depression; Korea; Predictors; Health care utilization

Background

Depression is an important public health issue considering its high prevalence and established association with major comorbidities such as cardiovascular disease, cerebrovascular disease and cancer (Meeks, Murrell, & Mehl, 2000; Wells, Golding, & Burnam, 1989). The prevalence of clinically significant depressive symptoms among the elderly in Western countries varies from 7.2% to 49% (Djernes, 2006), which is similar in Asia (Hahn, Yang, Yang, Shih, & Lo, 2004; Jain & Aras, 2007; Wada et al., 2005). In Korea, the estimated prevalence of late-life depression is between 15.2% and 33% (Cho, Hahm, Jhoo, Bae, & Kwon, 1998; Kim, Shin, Yoon, & Stewart, 2002; Lee & Shinkai, 2005; Suh et al., 1998). Moreover, some studies suggest that Korean elderly have a higher prevalence of depressive symptoms than those in other Asian countries such as Japan, Indonesia, Vietnam, and Lao PDR (Sakagami et al., 2005).

Elderly Korean people of today have experienced dramatic socio-cultural changes in their lifetimes: they were born in Korea's Japanese colonization era and their period of adolescence or young adulthood was interrupted by the Korean War in the 1950s. Rapid westernization and industrialization during the 1970s and 1980s brought additional burdens. This unique historical background can potentially impact mental health and possibly give rise to a high prevalence of depression. Owing to the dramatic declines in fertility and increasing life expectancy, Korea is one of the most rapidly aging countries in Asia. In 2006, the average life expectancy in Korea was 75.7 for men and 82.4 for women. Over the past decade alone, average life expectancy has increased by 5.7 years for men and 4.6 years for women. The proportion of elderly aged 65 and older was 7.2% in 2000, and is expected to increase to 24.4% by 2030 (Korean National Statistics Office, 2006, pp. 5–355). In terms of public health planning and clinical practice, it is important to identify and better understand groups among the elderly who are at increased risk for depression. Despite the assumed high levels of depressive symptoms among the elderly, previous studies have been largely limited to selected communities (Cho et al., 1998; Kim et al., 2002; Lee & Shinkai, 2005).

Late-life depression also presents substantial rates of comorbidity with other chronic diseases. To explain this association, some studies have suggested an immunological link between depression and chronic diseases (Kiecolt-Glaser & Glaser, 2002; Kobrosly & van Wijngaarden, 2010). Several mechanisms have also been suggested to explain how depression may lead to the limited use of health resources, poor adherence (behavioral pathways), biased health decision process (cognitive pathways), or deterioration of social networks (social pathways) (Cohen & Rodriguez, 1995). The underuse of preventive services may then increase chronic disease morbidity. However, little research has been conducted on the association between the receipt of screening for chronic diseases and having depressive symptoms among the elderly. More specifically, it has been reported that depression among Caucasian elderly was associated with high utilization of several types of

medical care including inpatient admissions, laboratory tests, prescription medications, and outpatient visits (Katon et al., 2003; Lubet et al., 2001).

In 1988, the Korean government established universal public health insurance and a medical aid policy for the poor and aged, which provides basic health coverage for all Korean citizens. In an effort to lower the prevalence of chronic diseases – including hypertension, diabetes and cancer – public health insurance covers a free national health screening program every other year. The system consists of three parts: a screening test to detect chronic diseases, a confirmative test, and a consultation with a physician if the screening test is positive or indicates that the patient is at high risk for disease. As health examination agencies carrying out national health examinations increased from about 2000 in 2002 to 14,000 in 2010, the total screening rate for health examinations increased from 43% in 2002 to 66% in 2010 (National Health Insurance Corporation, 2011). In assessing the Korean health care system, it is important to evaluate the availability of clinical preventive services as well as the predictors of their utilization.

The aims of the present study were twofold: to assess the key predictors of late-life depressive symptoms, and to assess the impact of depressive symptoms on health service utilization for both medical care and prevention, while adjusting for medical comorbidities. In particular, this study aims to assess whether or not having depressive symptoms has a differential effect on medical care and preventive services. The findings may point to an explanation for the excess comorbidity associated with late-life depression and advance better public health interventions for the elderly.

Methods

Study population

We used data from the 2008 wave of the Korean Longitudinal Study of Ageing (KLoSA). The KLoSA is a nationally representative cohort study conducted by the Korea Labor Institute. This survey collected a broad set of data including employment status, income, assets, family relations, health status and health utilization for middle/old-aged population. The KLoSA allows for comparative studies with the US, UK and other European countries that already have similar longitudinal studies in place. The 2006 baseline survey was conducted among Koreans aged 45 years or older and used multistage, stratified probability sampling (based on geographical area) to select households that are representative of the national population (Korea Labor Institute, 2010). A total of 10,254 individuals completed the interviews conducted by a trained interviewer in 2006. In the 2008 follow-up survey, 8875 respondents from the original sample were included (86.6% response rate), of which we restricted the analysis to 5137 individuals aged 60 years and older who had complete data on depressive symptoms. The survey consisted of eight detailed sections: demographics, family, health (including physical and psychological conditions and health behaviors), employment, income, wealth, subjective life expectancy, and quality of life. Sampling weights accounted for the sampling rate and the response rate in various subgroups. Written informed consent was obtained from all respondents prior to the interviews. The research was approved by the Duke University Medical Center Institutional Review Board.

Measures

Outcome measures—The short-form (10-item) Center for Epidemiological Studies-Depression (CES-D10) scale was used to assess depressive symptoms. The CES-D 10 is a short scale developed to assess depressive symptoms in the prior week in population studies. The 10-item screening questionnaire shows good predictive accuracy when compared to the full-length 20-item version of the CES-D ($k = 0.97$, $p < 0.001$) (Andresen, Malmgren, Carter, & Patrick, 1994). The CES-D 10 includes questions about symptoms experienced during the last week, focusing on five subscales: mood (five items), energy level (two items), irritability, concentration, and sleep (one item each) (Irwin, Artin, & Oxman, 1999; Kohout, Berkman, Evans, & Cornoni-Huntley, 1993). The response set is the same for each question, with four possible answers: “less than 1 day” (0 points), “1–2 days” (1 point), “3–4 days” (2 points), and “5–7 days” (3 points). The total score of the 10 items ranges from 0 to 30, with scores reversed for two positively phrased items. This score was used as the outcome measure, with higher scores indicating greater distress. Internal consistency of the CES-D10 was high for this sample ($\alpha = 0.86$). The correlation between each subscale (mood, energy level, irritability, concentration, and sleep) and the overall CES-D10 score were 0.37, 0.87, 0.78, 0.76, and 0.67, respectively ($p < 0.001$), suggesting that energy level, irritability and concentration were contributing more strongly to depressive symptoms than were mood and sleep.

To estimate the prevalence of depression and investigate the impact of the depressive symptoms on health care utilization, we classified elderly with a score of ≥ 10 (cut-off 9/10) as “having clinically significant depressive symptoms”. Although the cut-off 9/10 has not been validated for Koreans, this has been validated among elderly in Western and other Asian countries: in one Western study (Andresen et al., 1994), it had a sensitivity of 96% and a specificity of 100% with a κ of 0.97 and in a Chinese study (Boey, 1999), it had a sensitivity of 82% and a specificity of 98% with a κ of 0.84, when compared with the original CES-D 20.

The use of health care services was arranged by self-report and categorized as follows:

1. Hospitalizations in the past 12 months;
2. Outpatient clinic visits (public health clinic, doctor’s office and hospital outpatient office) for treatment in the past 12 months;
3. Basic medical checkup as covered by the National Health Insurance to screen for chronic diseases in the past 2 years.

Predictor variables—Demographic and socioeconomic variables included age (10-year intervals), education (elementary school or less/middle school/high school/college or more), marital status (married and unmarried [divorced, widowed and never married]) and household income. Household income was calculated as the total household income divided by the square root of the number of household members; these scores were then divided into quartiles. Health behaviors included smoking (never, former, current), alcohol (never, former, current) and physical activity (active vs. inactive: <3 times per week). BMI was based on self-reported weight and height. The subjects were classified by the International

Obesity Task Force (IOTF) for Asian adults in the Asian and Pacific regions (WHO, 2000) into five categories: underweight (less than 18.5 kg/m²); normal weight (18.5–22.9 kg/m²); overweight (≥ 23 kg/m² and <25 kg/m²); obese class I (25.0–29.9 kg/m²); and obese class II (≥ 30 kg/m²). Self-report of eight chronic diseases reported to be diagnosed by a physician included: hypertension, diabetes mellitus, cancer, chronic lung disease, liver disease, cardiac disease, cerebrovascular disease, and arthritis.

Physical functioning was assessed by seven activities of daily living (ADL) items, and 10 instrumental ADL (IADL) items. For every activity, subjects rated their independence between 1 and 3 (1, completely independent; 2, needs some help; and 3, completely dependent). ADL dependency was defined as either “needs some help” or “completely dependent” in one or more ADLs: dressing, washing, bathing, eating, getting out of bed, using toilet, and controlling urination and defecation. IADL dependency was derived in the same way as ADL dependency: either some need or complete dependency in grooming, cleaning, cooking, doing laundry, traveling a short distance, using public transportation, shopping, managing money, making phone calls, or taking medicine.

Statistical analyses

We calculated the frequencies and weighted proportions of the explanatory variables. Bivariate association between depressive symptoms and predictors were analyzed using student *t*-tests and one-way analyses of variance. Simple and multiple regression analyses were used to further examine the contribution of individual predictive factors to variance in the CES-D 10 scores. Considering the dichotomous nature of the outcome (i.e., using or not using health care service), unadjusted and adjusted logistic regression models were used to assess the impact of depressive symptoms on health care utilizations. Initially, the total CES-D10 score was used as a continuous variable, but, to better illustrate the association between the presence of clinically significant depressive symptoms and health care utilization, the CES-D10 was dichotomized using a 9/10 cut-off. SPSS for Windows, version 17 (SPSS Inc., Chicago, Ill, USA) was used for data management and analysis.

Results

There were 2226 (43.4%) male and 2911 (56.6%) female elderly enrolled in this study. The mean age was 69.6 (±7.0) and the mean CES-D 10 score was 8.5 (±6.0). The estimated prevalence of clinically significant depressive symptoms among Korean elderly was 37.5%. Table 1 shows characteristics of the sample and bivariate associations between the CES-D 10 score and each category of the predictor variables. Over half of the elderly were in their sixties and had lower education and household income; 41% of the elderly had hypertension and 28% had arthritis. Almost 15% reported having been hospitalized and 75% had used outpatient clinics in the past 12 months. Almost 60% had undergone basic medical checkups to screen for chronic diseases in the last 2 years.

Older age, being female, having less education, having a lower income and being unmarried were factors significantly associated with a higher CES-D 10 score. Elderly who were not smoking or consuming alcohol had higher mean depression scores. Those physically inactive had higher CES-D 10 scores, as did those with the lowest BMI. All comorbid

conditions including hypertension, diabetes, cancer, chronic lung disease, liver disease, cardiac disease, cerebrovascular disease, arthritis and limited physical functions were significantly associated with higher CES-D 10 scores. Elderly who had been hospitalized or used outpatient clinics had higher CES-D 10 scores, as did those who did not receive basic medical checkups.

The association between depressive symptoms and sociodemographic factors, health behaviors, chronic disease and physical functions were investigated further in linear regression analysis (Table 2). The significant effects of certain individual predictors in unadjusted analyses, including age, smoking, alcohol consumption, and hypertension, became non-significant in multivariate analysis. The following factors remained significant predictors of depressive symptoms even after multivariate adjustment: female gender, less education, lower household income, unmarried status, physical inactivity, low BMI, diabetes mellitus, cancer, chronic lung disease, cardiac disease, cerebrovascular disease, and arthritis, as well as dependency in ADL and IADL.

Through logistic regression analysis, we observed positive dose–response relationships between increasing the CES-D 10 scores and outpatient clinic visits and hospitalization, and an inverse dose–response relationship between increasing the CES-D 10 scores and basic medical checkups (data not shown). However, from a public health perspective, it is more important to assess how the group with or without disease affects health care utilization; thus, the presence of clinically significant depressive symptoms was used as a dichotomous independent variable instead of a depressive symptom score (Table 3). Controlling for sociodemographic factors and health-related factors including comorbidities and functional status, having clinically significant depressive symptoms was associated with a 22% higher odds of outpatient clinic visits (OR, 1.22; 95% CI, 1.18–1.27) and 19% of hospitalization (OR, 1.19; 95% CI, 1.11–1.24). However, having clinically depressive symptoms was associated with an 18% lower odds of utilization of a basic medical checkup (OR, 0.82; 95% CI, 0.77–0.86) even after controlling for outpatient clinic visits and hospitalization as well as sociodemographic and health-related factors.

Discussion

The overall proportion of Korean elderly with clinically significant depressive symptoms was 37.5%. This proportion was somewhat higher than previously reported in community studies in Korea: in urban residents, 18% of elderly had significant depressive symptoms measured by the original CES-D (Cho et al., 1998) and a national sample showed a prevalence of 25.3% in elderly aged 55–69 years screened by the original CES-D (Suh et al., 1998). However, many other Korean and Asian samples have shown rates comparable to ours, namely 33.5% of Koreans using the Geriatric depression Scale (Kim et al., 2002), 39.1% of Japanese (Matsubayashi et al., 2005), 27.3% neighbouring (Ishine et al., 2006) and 33.8% of Indonesians (Wada et al., 2005). However, these differences in prevalence should be interpreted with caution given the different instruments and cut-off points used.

Consistent with previous research in Western (McCall, Parks, Smith, Pope, & Griggs, 2002; Mojtabai & Olfson, 2004; Wilhelm, Mitchell, Slade, Brownhill, & Andrews, 2003) and

Asian countries (Chou, Ho, & Chi, 2006; Hahn et al., 2004; Lee & Shinkai, 2005; Malhotra, Chan, & Østbye, 2010), having less education and lower household income were the demographic factors strongly associated with depressive symptoms. Being unmarried may be associated with a lack of social support and a possible risk factor for depressive symptoms as reported in other studies (Djernes, 2006; Hahn et al., 2004; Jain & Aras, 2007). Our results were consistent with most studies from elsewhere showing that females are at higher risk for depressive symptoms than males (Minicuci, Maggi, Pavan, Enzi, & Crepaldi, 2002; Zunzunegui, Béland, Llácer, & León, 1998), however, it should be noted that this difference has not been universally observed (Barefoot, Mortensen, Helms, Avlund, & Schroll, 2001; Malhotra et al., 2010). Considering the distinctive Korean culture of having evident disparities between males and females, and being ingrained with patriarchal social values, the generation of older women may sense powerlessness and discrimination, leading to depressive symptoms (Jeon, Jang, Rhee, Kawachi, & Cho, 2007). In univariate analysis, age was a significant risk factor for depressive symptoms. However, this association lost significance after adjusting for health status and functional impairment, supporting the notion that age-related effects on depression are mainly due to physical health problem and functional impairment rather than age per se (Roberts, Kaplan, Shema, & Strawbridge, 1997).

Elderly non-smokers and non-alcohol consumers were interestingly more likely to have depressive symptoms in the univariate analysis. Although other studies have shown that smoking (Hämäläinen et al., 2001; Kendler et al., 1993; Klungsøyr, Nygård, Sørensen, & Sandanger, 2006) and alcohol consumption (Blow, Serras, & Barry, 2007; Grant & Harford, 1995) are risk factors for depression, it is possible that nicotine and alcohol might have some positive reinforcing and rewarding effects on Korean elderly who have experienced unique historical difficulties for a long time. However, after adjusting for all covariates, smoking and alcohol consumption were not associated with depressive symptoms. The complex relationship between smoking and alcohol, and sociodemographic factors and health status could explain this finding. A limitation of the smoking and alcohol data was that the actual amounts were not reported. Physical inactivity was significantly associated with depressive symptoms. In contrast to the several studies in Western countries showing a positive relationship between obesity and depression (Luppino et al., 2010; Sachs-Ericsson et al., 2007), an inverse relationship between BMI and depressive symptoms was found in our study. This finding is consistent with the results from two Asian countries with Korea, namely Japan and China (Kuriyama et al., 2006; Li et al., 2004), where a higher weight has also been regarded as a sign of wealth and health in the past (Li et al., 2004). Finally ADL, IADL limitations were also associated with depressive symptoms.

Our study confirmed that most chronic diseases, except hypertension and liver disease, were associated with depressive symptoms. Although causality in the relationship between depression and chronic diseases is ambiguous, it is possible that elderly people with depressive symptoms are less likely to adhere to regular screening for chronic diseases; this missed screening opportunity can lead to the development of medical comorbidities of depressive symptoms. Little is known about screening among depressed elderly, and the findings from the few available studies were inconsistent and limited to the screening for specific cancers and influenza immunization (Lasser et al., 2003; Peytremann-Bridevaux,

Voellinger, & Santos-Eggimann, 2008; Pirraglia, Sanyal, Singer, & Ferris, 2004). We attempted to address this issue by considering a wide range of chronic diseases including hypertension, diabetes, dyslipidemia, liver disease, chronic kidney disease and chronic lung disease, in addition to breast and cervix cancer, which are included in Korea's national health screening program. The 61% screening rate in the total sample was very similar to the 60.2% rate reported in the total population (National Health Insurance Corporation, 2011). We found that depressive symptoms were associated with less frequent screening for chronic diseases. On the other hand, despite controlling for chronic diseases, depressive symptoms were associated with increased hospitalization and use of outpatient medical services; findings which are consistent with studies performed in Western countries (Katon et al., 2003; Lubert et al., 2001; Peytremann-Bridevaux, Voellinger, & Santos-Eggimann, 2008).

Considering that the national health screening program for chronic diseases in Korea focuses on practical barriers to screening such as geographic factors and access to health care, our findings have important public health implications. First, many interventions have been tested to increase the rates of clinical preventive service delivery and lower the medical cost and prevalence of chronic diseases among the elderly. However, before interventions that target the elderly can be effective, it is necessary to further study the mechanism through which risk factors such as depressive symptoms may result in missed opportunities for clinical preventive services. In addition, physicians responsible for primary care – having more opportunities for early detection through their outpatient clinic visits – need a well-established set of interventions that is integrated within routine medical checkups. This would enable better screening for chronic disease among elderly patients with depressive symptoms.

The strengths of the study include its large, nationally representative sample of Korean elderly, and its inclusion of a wide range of demographic factors, health behaviors, chronic diseases and physical functions that could be evaluated as risk factors for depressive symptoms. To our knowledge, this is the first study demonstrating the association between depressive symptoms and less frequent receipt of screening for chronic diseases in Korean elderly.

Several limitations of this study should also be noted. Although the short-form CES-D scale is a widely used screening tool for depressive symptoms, it cannot be used to confirm diagnosis of clinical depression. The reference to symptoms in the past week also does not allow us to draw any inference about the duration or chronicity of symptoms, although some have argued that the CES-D captures both state and trait aspects of depression (Spielberger, Ritterband, Reheiser, & Brunner, 2003). Moreover, epidemiological studies using screening instruments tend to report higher prevalence of depressive symptoms than studies using clinical diagnostic instruments. It should also be noted that data were obtained from a cross-sectional study, thus any causal inference drawn about the relationship between the predictor variables assessed and the depressive symptoms must be made with caution. Finally, the variables considered were based on self-reported data.

In conclusion, this study indicates that depressive symptoms in Korean elderly are associated with being female, being unmarried, having less education, lower income, lower BMI, medical comorbidities and limited physical function. Our finding that depressive symptoms may act as a barrier to screening for chronic disease which may delay appropriate medical attention, suggests that effective health care for the elderly with depressive symptoms must be further investigated and developed.

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Table 1

Sample characteristics, KLoSA, 2008(%) and the CES-D 10 score by subgroups.

Variables	Total(N = 5137)	CES-D 10 score	P-value ^b
	%	Mean(SD)	
Age, years			<0.001
60–69	55.1	7.4(5.6)	
70–79	34.4	9.1(6.0)	
80	10.5	10.8(6.3)	
Gender			<0.001
male	43.4	7.1(5.5)	
female	56.6	9.2(6.1)	
Education			<0.001
Elementary school or less	62.8	9.3(6.1)	
Middle school	13.7	7.2(5.4)	
High school	16.7	6.6(5.5)	
college more	6.8	5.7(4.6)	
Household income category ^a			<0.001
1(lowest)	35.8	10(6.5)	
2	32.0	7.6(5.3)	
3	19.2	7.3(5.6)	
4(highest)	12.9	6.5(5.3)	
Marital status			<0.001
married	71.3	7.6(5.6)	
unmarried	28.7	10.0(6.4)	
Smoking			<0.01
never	80.8	8.4(5.9)	
former	3.3	8.0(6.1)	
current	15.9	7.8(5.8)	<0.001
Alcohol consumption			
never	64.8	8.9(6.1)	
former	4.7	8.5(5.9)	
current	30.5	7.0(5.3)	
Physical activity			<0.001
Inactive(less than once a week)	66.4	9.1(6.2)	
active	33.6	6.8(5.2)	
BMI			<0.001
18.5	5.5	11.0(6.9)	
18.6–22.9	45.1	8.3(5.7)	
23–24.9	26.7	7.9(5.6)	
25–29.9	21.0	7.1(5.5)	
30	1.7	7.7(5.7)	

Variables		<u>Total(N = 5137)</u>	<u>CES-D 10 score</u>	<i>P-value^b</i>
		%	Mean(SD)	
Chronic disease				
Hypertension	Yes	41.3	8.9(6.2)	<0.001
	No	58.7	7.9(5.7)	
Diabetes mellitus	Yes	17.8	9.7(6.3)	<0.001
	No	82.2	8.0(5.8)	
Cancer	Yes	4	10.5(7.0)	<0.001
	No	96	8.2(5.9)	
Chronic lung disease	Yes	3.6	10.5(7.5)	<0.001
	No	96.4	8.2(5.9)	
Liver disease	Yes	2.2	8.6(6.0)	<0.001
	No	97.8	8.3(5.9)	
Cardiac disease	Yes	8.4	9.6(6.6)	<0.001
	No	91.6	8.2(5.9)	
Cerebrovascular disease	Yes	5.8	12.2(7.3)	<0.001
	No	94.2	8.1(5.8)	
Arthritis	Yes	28	10.2(6.2)	<0.001
	No	72	7.6(5.7)	
Functional status				
ADL dependency	Yes	6.4	7.9(5.6)	<0.001
	No	93.6	15.0(6.9)	
IADL dependency	Yes	16.8	7.7(5.5)	<0.001
	No	83.2	11.8(6.7)	
Health care utilization				
Hospitalization	Yes	15.1	10.5(6.9)	<0.001
	No	84.9	7.9(5.7)	
Outpatient clinic	Yes	75.1	8.0(6.0)	<0.001
	No	24.9	7.6(5.2)	
Basic medical checkup	Yes	61	7.6(5.5)	<0.001
	No	39	9.5(6.4)	

KLoSA, Korean Longitudinal Study of Ageing. CES-D, Center for Epidemiological Studies-Depression. SD, standard deviation.

^aYearly household income was categorized into quartiles; 1) 850,2) 851–2000, 3) 2001–3600,4) >3600 (Unit: 10,000 Korean won, 1US dollar = 1057 Korean won at the time of the study).

^bStudent *t*-test for difference in CES-D by gender, marital status, physical activity, chronic diseases, functional status and health care utilization; ANOVA for difference by age, education, household income, smoking, alcohol consumption, and BMI.

Table 2

Regression models assessing the association between risk factors and number of depressive symptoms.

Variables	Unadjusted			Adjusted		
	β	95% CI	P	β	95% CI	P
Intercept				8.14		
Age						
60–69	–			–		
70–79	1.71	1.70 to 1.72	<0.001	0.32	0.31 to 0.33	0.09
>80	3.42	3.40 to 3.44	<0.001	0.59	0.57 to 0.61	0.06
Gender						
male	–					
female	2.16	2.14 to 2.17	<0.001	1.23		<0.001
Education						
Elementary school or less	–					
Middle school	–2.01	–2.03 to –1.98	<0.001	–0.66	–0.67 to –0.64	<0.01
High school	–2.63	–2.64 to –2.62	<0.001	–0.64	–0.66 to –0.62	<0.01
college more	–3.62	–3.64 to –3.60	<0.001	–1.16	–1.19 to –1.14	<0.001
Household income category ^a						
1(lowest)	–					
2	–2.31	–2.33 to –2.29	<0.001	–1.22	–1.23 to –1.20	<0.001
3	–2.61	–2.63 to –2.58	<0.001	–1.19	–1.21 to –1.18	<0.001
4(highest)	–3.42	–3.44 to –3.40	<0.001	–1.85	–1.86 to –1.83	<0.001
Marital status						
unmarried						
married	–2.35	–2.37 to –2.33	<0.001	–0.78	–0.79 to –0.77	<0.001
Smoking						
never	–					
former	–0.43	–0.46 to –0.40	0.35	–0.15	–0.17 to –0.12	0.74
current	–0.64	–0.66 to –0.65	<0.01	0.37	0.35 to 0.39	0.13
Alcohol consumption						
never	–					
former	–0.39	–0.41 to –0.37	0.32	0.04	0.01 to 0.06	0.91
current	–1.95	–1.97 to –1.94	<0.001	–0.17	–0.18 to –0.15	0.41
Physical activity						
Inactive(less than once a week)	–					
active	–2.30	–2.31 to –2.28	<0.001	–1.17	–1.18 to –1.16	<0.001
BMI						
18.6–22.9	–					
18.5	2.66	2.64 to 2.69	<0.001	1.31	1.28 to 1.32	<0.001
23–24.9	–0.42	–0.43 to –0.41	<0.05	0.05	0.03 to 0.06	0.79
25–29.9	–0.65	–0.66 to –0.63	<0.01	–0.64	–0.66 to –0.63	<0.01
30	0.67	0.64 to 0.71	0.31	–0.79	–0.83 to –0.76	0.19

Variables	Unadjusted			Adjusted		
	β	95% CI	<i>P</i>	β	95% CI	<i>P</i>
Chronic disease						
Hypertension	0.97	0.96 to 0.98	<0.001	0.18	0.17 to 0.19	0.27
Diabetes mellitus	1.64	1.63 to 1.66	<0.001	1.12	1.11 to 1.13	<0.001
Cancer	2.26	2.24 to 2.27	<0.001	2.43	2.41 to 2.45	<0.001
Chronic lung disease	2.28	2.25 to 2.31	<0.001	1.69	1.67 to 1.71	<0.01
Liver disease	0.30	0.27 to 0.34	0.61	0.41	0.37 to 0.43	0.49
Cardiac disease	1.41	1.39 to 1.43	<0.001	0.87	0.85 to 0.88	<0.01
Cerebrovascular disease	4.12	4.10 to 4.14	<0.001	2.11	2.09 to 2.13	<0.001
Arthritis	2.59	2.58 to 2.60	<0.001	1.38	1.36 to 1.39	<0.001
Functional status						
ADL dependency	7.12	7.10 to 7.14	<0.001	3.55	3.52 to 3.57	<0.001
IADL dependency	4.16	4.15 to 4.17	<0.001	1.54	1.53 to 1.55	<0.001

β , regression coefficients. CI, confidence interval. Adjusted for all other variables shown in this table.

^a Yearly household income was categorized into quartiles; 1) 850, 2) 851–2000, 3) 2001–3600, 4) >3600 (Unit: 10,000 Korean won, 1US dollar = 1057 Korean won at the time of the study).

Table 3

Regression models assessing association between the presence of ‘clinically significant depressive symptoms’ and medical care and preventive services utilization.

	Unadjusted model	Adjusted	
		Model 1 ^a	Model 2 ^b
Medical care service			
Outpatient clinic visit	1.32 (1.25–1.34)	1.25 (1.22–1.28)	1.22 (1.18–1.27)
Hospitalization	1.84 (1.81–1.89)	1.64 (1.62–1.68)	1.19 (1.11–1.24)
Preventive service			
Basic medical checkup	0.60 (0.56–0.63)	0.71 (0.68–0.73)	0.82 (0.77–0.86) ^c

Each health care and preventive service was entered into a regression model separately. Values are odds ratios with 95% confidence intervals.

^a Adjusted for demographic variables including age, gender, education, household income and marital status.

^b Adjusted as for Model 1 plus health-related variables including smoking, alcohol, physical activity, BMI, chronic diseases and disability.

^c Adjusted as for Model 2 plus outpatient clinic visit and hospitalization.