The Relationship between the Prevalence of Suicidal Ideation among Older Adults and Individual · Regional Factors

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Purpose: The purpose of this study was to find out the suicidal ideation rate of the elderly including individual and regional factors by sex. **Methods:** This is secondary analysis study that combines the data of the 2017 Community Health Survey with the e-indicator data set of the National Statistical Office, and a descriptive correlation study. Statistical analysis used hierarchical logistic regression by SAS 9.4. **Results:** The 11.5% of the elderly had suicidal ideation within the last year, and 18.4% in Chungnam is the highest. Individual characteristics include females, older people, lower education levels, no job or housewife, no spouse, less than seven hours of sleep per day on the average, low subjective health, high subjective stress, and the worse their economic conditions, the more they had suicide ideation. Considering regional characteristics, suicidal ideation tended to increase significantly as the number of hospital beds per 1,000 people and the rate of obesity was lower, the rate of stress perception was higher, and the odds value was small. When both individual and regional factors were considered, the model conformity of the suicidal ideation improved (ICC=0.0814). **Conclusion:** In order to lower the suicidal rate of the elderly, it seems that both individual and community factors need to be comprehensively approached from the stage of suicidal ideation in the community.

Key Words: Aged; Suicidal ideation; Geography; Sex; Health surveys

INTRODUCTION

1. Background

In South Korea, the age-adjusted suicide rate in 2018 was 26.6 per 100,000 population, more than double the Organization for European Economy Cooperation (OECD) average suicide rate of 11.5 per 100,000 population, and South Korea has been ranked first or second in the suicide rate among OECD countries since 2010[1]. In particular, suicide becomes a more important health problem for the elderly as age increases, considering that the suicide rate is 32.9 per 100,000 population in the 60~69 age group, 48.9 in the 70~79 age group, and 69.8 in the 80 and over age group, far exceeding 26.6 per 100,000 population, the suicide rate

in the total population of Korea [2].

Suicide usually begins with the thought of 'I want to die' and suicidal ideation is a risk factor for suicide attempts. An analysis of the Community Health Survey data of older adults aged 65 and older from 2013 to 2017 showed that the prevalence of suicidal ideation was 15.7% among women and 9.9% among men, and the suicide attempt rates were 3.5% among men and 2.7% among women [3]. In addition, it was found that the prevalence of suicidal ideation was 10.6% among the elderly living alone in Korea, and 15.4% among those reporting having suicidal thoughts had the experience of actually making a suicide attempt [4]. Similarly, in Japan, among older adults, the prevalence of suicidal ideation was 12.3% and 3.4% of the older adults who had suicidal thoughts attempted suicide within two

weeks after suicidal ideation, showing that suicidal ideation is the prodromal stage of suicide attempts [5]. In particular, since older adults tend to use more lethal methods than younger people and tend to make suicide attempts without expressing their intention to commit suicide directly to others, there is a higher possibility of death at the first attempt, so the necessity for management from the suicidal ideation stage before suicide attempts is emphasized [6].

Suicide occurs as a result of a combination of personal factors, relationships between individuals, and various factors related to the community. Thus, it is emphasized that in order to prevent and reduce suicide, there is a need to comprehensively consider both individual factors, such as the diseases and functional levels of individuals, physical health status such as pain, depression, living alone, educational level and economic status [3], and regional factors affecting suicide [3-7]. Living in the same residential areas means sharing the entire social culture, including public infrastructure which is directly related to daily life, such as health, medical and welfare services and leisure facilities, values, and social atmospheres. Social perceptions or atmospheres have an important influence in determining health behaviors. In particular, systematic literature reviews reported that individuals' suicidal ideation and behaviors show regional patterns and there are regional characteristics affecting them [7].

So far, regional factors affecting suicide have been found to be related to the average income level of residents in the area [9,11,12], the average educational level, the employment or unemployment rate [9], socioeconimic characteristics of the region such as the financial independence of the region [7], the percentage of single-person households in the area [10], the population density [7,10], the divorce rate [7], the health and welfare budget [7], and social infrastructure such as medical institutions and leisure facilities [7]. In other words, the suicide rate was reported to be higher in economically disadvantaged regions [9,11,12] and in regions with a higher divorce rate [10]. In addition, areas with a low population density and with a high percentage single-person households were reported to have a higher rate of suicide related to loneliness [10], and the self-harm rate was higher in areas with a higher unemployment rate and a higher average age [9]. In addition, social characteristic variables such as the percentage of the elderly population and the birth rate, and regional characteristic variables which are individual health behaviors converted into percentages, such as the perceived rate of stress, the prevalence of obesity, and the suicide rate, have also been explored as regional risk factors for suicide [13].

Korea has also periodically announced differences in the suicide rate by region. In 2018, Chungcheongnam-do was the region with the highest suicide rate among people aged 60~69 (43.7 per 100,000 population), and Sejong City was the region with the highest suicide rate among people aged 70~79 (83.1) and among people aged 80~89 (132.8), showing that the suicide rate in Chungcheong Region is a serious level [4]. Moreover, the age-adjusted suicide rate was also highest in Chungcheongnam-do [4]. Studies have been conducted to examine regional differences and identify factors affecting such differences, but previous studies have been mostly based on the units of cities and provinces [4,8]. Since each unit of cities and provinces includes wide geographically widely distributed areas with very different regional characteristics, there is the risk that regional characteristics may be diluted. Therefore, analysis units need to be subdivided into the units of cities, counties, and districts, which have similar socioeconomic levels and lifestyles in closer proximity. In addition, suicide rates analyzed in previous studies were based on completed suicides, so there are limitations in using the study findings as the basic data for the development of interventions for suicide prevention.

Therefore, this study aimed to comprehensively review and explore factors affecting suicidal ideation, which is the prodromal stage of the completion of suicide, by considering not only individual factors but also regional factors in order to obtain basic knowledge needed to develop policies or nursing interventions to reduce the elderly suicide rate.

2. Purpose

The purpose of this study is to investigate the prevalence of suicidal ideation among older adults in Korea and identify factors affecting suicidal ideation. The specific objectives of this study are as follows:
- To investigate differences in the prevalence of suicidal ideation according to general characteristics among older adults and differences in the prevalence of suicidal ideation by region in 16 cities and provinces;
- to identify an explanatory model of suicidal ideation;
- to identify individual and regional variables affecting suicidal ideation among older adults.

METHODS

1. Study Design

This study is a secondary analysis study using both the

data from the 2017 Community Health Survey and data of e-Regional Indicators of the Statistics Korea, and it is a descriptive correlation study to identify individual and regional factors affecting the prevalence of suicidal ideation and suicidal ideation among older adults in Korea.

2. Participants

In order to select samples representing the population of the Republic of Korea for the Community Health Survey, the sampling frame was created with adults aged 19 or older as the population by linking the population data based on the resident registration data of the Ministry of the Interior and Safety with the housing data of the Ministry of Land, Infrastructure and Transport, and the samples for the survey were selected by systematic sampling based on the first and second extraction units [14].

From August 16 to October 31, 2017, trained interviewers personally visited households selected as samples and conducted a face-to-face interview survey (electronic survey) using a laptop loaded with a survey program. The Korea Centers for Disease Control and Prevention selected a third institution for the verification and quality management of the survey data, rechecked survey data by phone by re-extracting 10% of those who completed the survey, and continuously managed the checking results through the computer system [14]. Out of 228,381 people who completed the survey in 2017, 67,835 cases, which were the total data of older adults aged 65 or older, were utilized for the analysis of this study.

3. Research Variables

The variables grouped as independent variable group I and the dependent variable (the presence of suicidal ideation) among the research variables were analyzed using the interview survey data of the 2017 Community Health Survey, and they were classified according to the definitions of the indicators presented in the guidelines on the use of data [14].

For the independent variable group II, which were regional characteristic variables, data of the e-Regional Indicators from the Statistics Korea were used as they were without reclassification or recategorization.

1) Independent variable group I: individual characteristic variables

The variables grouped as independent variable Group 1 are individual characteristic variables. Based on the 2017 Community Health Survey data, individual variables used in this study were as follows: gender (male, female), age (65~74 years, 75~84 years, 85 years or older), educational level (under elementary school, elementary school, middle school/high school, and junior college or higher), marital status (current presence or absence of the spouse), daily sleep duration (less than 7 hours, 7 hours or more), monthly alcohol consumption (non-drinker, once a month, 2~4 times a month, 2~3 times a week, 4 or more times a week), perceived stress level (very high, high, low, very low), perceived health status (good or very good, fair, and poor or very poor), types of past occupations (manager/professional, worker in service and production sectors, simple labor/agricultural/forestry/fishing worker, housekeeper, unemployed), current number of household members (1, 2~3, 4~5, 6 or more), the Basic Livelihood Security Program (BLSP) benefit recipient status (current recipient, past recipient, non-recipient), current household income (less than 1 million won, 1 million to less than 3 million won, 3 million to less than 6 million won, 6 million won or more), the presence or absence of a dementia patient among household members, the degree to which desired foods can be obtained to examine the degree of affluence (both the desired amount and kinds satisfied, the desired quantity satisfied but desired kinds not satisfied, sometimes shortages experienced due to economic conditions, often shortages experienced due to economic conditions). Age, educational level, marital status, daily sleep duration, and the occupational groups of past jobs were classified by referring to the classification criteria which were found to be significant in previous studies, and other variables from the survey data were used as they were without reclassifying them.

2) Independent variable group II: Regional characteristic variables

The variables grouped as Independent Variable Group II are regional-level variables related to the community around individual older adults. Using the data of e-Regional Indicators from the Statistics Korea (http://kosis.kr/), the percentage of the elderly population in 244 municipalities (cities, counties, and districts), the number of cultural infrastructure facilities (per 100,000 population), the number of physicians in medical institutions (per 1,000 population), the number of hospital beds (per 100,000 population), the suicide rate (per 100,000 population), the perceived rate of stress, the prevalence of obesity, and financial independence (after the reform of revenue account titles), the ratio of the social welfare budget to the total budget, and the crude divorce rate were included in the analysis, and these variables were considered continuous variables because there were no regional reference data.

3) Dependent variable: the presence of suicidal ideation

The prevalence of suicidal ideation was examined using data of the responses (Yes or No) to the question "Have you ever wanted to die within the past one year?" from the 2017 Community Health Survey data.

4. Data Collection

The variables reported to be relevant in previous studies on suicide in the elderly were selected and analyzed by linking the 2017 Community Health Survey data from the Korea Centers for Disease Control and Prevention and the e-Regional Indicator data from the Statistics Korea by using the codes of municipalities (cities, counties, and districts)

The data used to analyze the variables grouped as independent variable group I, which are related to individual older adults and their family, and the dependent variable, the presence of suicidal ideation, was the 2017 Community Health Survey data downloaded from the website of the Korea Centers for Disease Control and Prevention (http://chs.cdc.go.kr) after obtaining approval for the use of the data (July 19, 2019) by submitting a research plan at the website. The data on the independent variable group II related to regional factors was downloaded from the e-Regional Indicator database of the Statistics Korea (http://kosis.kr), which is the data based on the administrative units of municipalities (cities, counties, and districts).

The 2017 Community Health Survey data is general statistics approved by the Statistics Korea (approval number 117075), based on Article 4 of the Regional Public Health Act (the Community Health Survey) and Article 2 of the Enforcement Decree of the Act (the method and contents of the Community Health Survey), and it was collected in compliance with ethical principles [14]. This study was conducted after receiving an exemption determination for the research plan using secondary data from the institutional review board of the university where the researcher belongs (IRB No.: SM-201910-063-1)

5. Statistical Analysis

Statistical analysis was conducted using the Proc Glimmix procedure provided in SAS 9.4 and since the data of the Community Health Survey used for analysis was collected by the complex sampling design, it was used by reconstructing a weighted data set. The general characteristics of the participants and regional characteristics were analyzed by calculating the weighted N, %, the average

and standard deviation, and the Rao-Scott x^2 test was performed to analyze differences in suicidal ideation according to the general characteristics of the participants.

Factors affecting suicidal ideation were analyzed using a weighted multilevel logistic regression model. This is an appropriate analysis method for hierarchical data analysis which takes into account both individual and group levels unlike a general logistic regression model considering only a single level [15], and it is an expanded form of a general logistic regression model.

In the logit link function used in a multilevel logistic regression model, it is assumed that Equation y_{ij} represents the individual *ith* dependent variable for the *jth* region and follows a binomial distribution as shown in (5.1).

$$p_{ij} = P(y_{ij} = 1) \tag{5.1}$$

In a multilevel logistic regression model, the models for level 1 (individual level) and level 2 (regional level) where there is a single explanatory variable at each of the individual and regional levels are shown in (5.2) and (5.3). In (5.2), x_{ij} is the individual *i*-th explanatory variable for the *j*-th region at the individual level, β_{0j} is the intercept, and β_{1j} represents the effect of the explanatory variable on the dependent variable at the individual level. Regarding the decomposed form of the level-1 β_{0j} at the level 2, β_{0j} includes the intercept γ_{00}, the explanatory variable z_j for the *j*-th region, and the error term δ_{0j} of the group *j*.

$$\text{level-1 (individual): } \log\left(\frac{p_{ij}}{1 - p_{ij}}\right) = \beta_{0j} + \beta_{1j}x_{ij} \tag{5.2}$$

$$\text{level-2 (regional): } \beta_{0j} = \gamma_{00} + \gamma_{01}z_j + \delta_{0j}, \ \beta_{1j} = \gamma_{10}, \ \delta_{0j} \sim N(0, \sigma_\delta^2) \tag{5.3}$$

The multilevel logistic model modelled by combining level-1 (individual) and level-2 (regional) independent variables is shown in (5.4) below.

$$\log\left(\frac{p_{ij}}{1 - p_{ij}}\right) = \gamma_{00} + \gamma_{01}z_j + \gamma_{10}x_{ij} + \delta_{0j}, \ \delta_{0j} \sim N(0, \sigma_\delta^2) \tag{5.4}$$

Multilevel logistic regression analysis was performed by considering three models to identify variables that have a significant impact at each level by dividing independent variables into level-1 (individual) variables related to the individual-level prevalence of suicidad ideation and level-2 (regional) variables. With the three kinds of models, the models including all participants, men only, and women only were separately analyzed.

First, in the null model, only the intercepts were included, and level-1 (individual) and level-2 (regional) variables were not added to examine the basic information of data. Second, Model I was the model which included only level-1 (individual) variables based on the null model, and explanatory variables reflected in Model I were only demographic characteristics, the socio-economic environment, health status, and lifestyles. Finally, Model II was the model built by adding both level-1 (individual) variables and level-2 (regional) variables to the null model. First, with the between-group variance at the level 2 (regional level) and the within-group variance at the level 1 (individual level), the intra-class correlation (ICC), which is the ratio of the between-group variance, can be calculated. The ICC is the proportion of the group-level variance compared to the total variance of the dependence variable. The method of calculating the ICC is shown in (5.5).

$$ICC = \frac{\widehat{\sigma_\delta^2}}{\widehat{\sigma_\delta^2} + \pi^2/3} \tag{5.5}$$

RESULTS

1. Prevalence of Suicidal Ideation according to General Characteristics

Among a total of 67,835 older adults aged 65 years and older who participated in a survey, 8,076 respondents reported having suicidal thoughts, and as a result of calculating the weighted prevalence of suicidal ideation, 853,037 out of 7,439,841 people (11.0%) were found to have had suicidal ideation.

With respect to the prevalence of suicidal ideation according to the characteristics of participants, there were significant differences in the prevalence according to individual characteristic variables, such as gender, age, educational level, current presence of the spouse, daily sleeping duration, drinking status, perceived stress, experience of depression, perceived health status, and the type of past occupation. There were also significant differences according to the number of family members, household composition, the Basic Livelihood Security Program (BLSP) benefit recipient status, total household income, the presence of a dementia patient among household members, and financial stability in terms of the purchase of food materials (Table 1). Figure 1 shows the distribution of the prevalence of suicidal ideation by region based on the administrative units of municipalities (cities, counties, and districts).

The prevalence of suicidal ideation was higher in older women (13.7%) than in older men (8.6%) (x^2=247.28, $p <$ .001). In addition, the prevalence of suicidal ideation was increased with increasing age, with 9.5% in the 65~74 age group, 13.7% in the 75~84 age group, and 13.7% in the 85 and over age group (x^2=209.37, $p <$.001).

In terms of educational level, the prevalence of suicidal ideation was 18.5% in the group with the educational level of under elementary school, 11.7% in the group with the educational level of elementary school, 8.4% in the group with the educational level of middle or high school, and 5.2% in the group with the educational level of junior college or higher, showing that a lower educational level is associated with a higher prevalence of suicidal ideation (x^2=597.07, $p <$.001). Regarding the types of past occupations, the housekeeper group showed the highest prevalence of suicidal ideation (13.6%), followed by the unemployed group (12.8%), the simple labor/agriculture/forestry/fishing group (8.7%), the service/manufacturing group (6.0%), and the managerial/professional occupation group (2.4%) (x^2=320.44, $p <$.001).

The group without the spouse showed a higher prevalence of suicidal ideation (15.6%), compared to the group with the spouse (9.3%) (x^2=306.80, $p <$.001). Also, regarding daily sleep duration, the prevalence of suicidal ideation was higher in the group with a daily sleep duration of less than 7 hours (13.3%) than the group with a daily sleep duration of 7 hours or more (9.5%)(x^2=122.57, $p <$.001).

Regarding perceived health status, the prevalence of suicidal ideation was 4.1% in people with good or very good perceived health status, 7.1% in those with fair perceived health status, and 19.3% in those with poor or very poor perceived health status, showing that poorer perceived health status was associated with a higher prevalence of suicidal ideation (x^2=1,507.37, $p <$.001).

Regarding perceived stress levels, the prevalence of suicidal ideation was 51.6% in the group with a very high level of stress, 29.1% in the group with a high level of stress, 8.7% in the group with a low level of stress, and 4.5% in the group with a very low level of stress, showing that the perceived stress level was positively correlated with the prevalence of suicidal ideation (x^2=3,744.38, $p <$.001). With respect to depression, the prevalence of suicidal ideation was 63.0% in the group that recently experienced a depressive disorder and received psychiatric counseling, 52.6% in the group that recently experienced depression but not received psychiatric counseling, and 7.8% in the group without any experience of depressive disorders, indicating that the level of depression was associated with the prevalence of suicidal ideation (x^2=5,450.84, $p <$.001).

In terms of the number of household members, the prevalence of suicidal ideation was highest in older adults

Table 1. Suicidal Ideation Rate by Characteristics of Subject Investigated

| Variables | Categories | Subject investigated | | Weighted | | | | Rao-Scott x^2 (p) |
| | | | | All | | Suicidal ideation | | |
		n	n	n	%	n	%	
Total		67,835	8,076	7,439,841	100.0	853,037	11.5	-
Sex	Male	27,979	2,472	3,268,693	43.9	279,861	8.6	247.28
	Female	39,856	5,604	4,171,148	56.1	573,176	13.7	(<.001)
Age (year)	65~74	36,380	3,443	4,355,179	58.5	414,747	9.5	209.37
	75~84	26,630	3,731	2,637,655	35.5	361,289	13.7	(<.001)
	≥85	4,825	902	447,007	6.0	77,000	17.2	
Education level (graduated)	Less than primary school	21,826	3,873	1,746,235	23.5	322,448	18.5	597.07
	Elementary school	22,747	2,489	2,285,000	30.8	266,885	11.7	(<.001)
	Middle and high school	19,107	1,499	2,654,309	35.8	223,614	8.4	
	Over college	4,065	206	740,041	10.0	38,847	5.2	
Occupation	Manager and professional	1,199	34	212,332	2.9	5,192	2.4	320.44
	Service and goods producing	4,220	268	547,201	7.4	33,079	6.0	(<.001)
	Simple workers, agricultural and forestry workers	21,198	1,863	1,421,388	19.1	124,111	8.7	
	Housewife	18,783	2,683	2,408,077	32.4	327,152	13.6	
	Inoccupation	22,398	3,226	2,845,239	38.3	363,061	12.8	
Existence of spouse	Yes presently	42,684	4,085	4,858,745	65.4	450,372	9.3	306.80
	No presently	25,105	3,987	2,576,586	34.7	402,339	15.6	(<.001)
Sleeping time per day	Less than 7 hours	33,483	4,641	3,831,446	51.5	509,057	13.3	122.57
	More than 7 hours	34,352	3,435	3,608,395	48.5	343,980	9.5	(<.001)
Perceived health status	Good or better	12,861	562	1,562,525	21.0	63,586	4.1	1507.37
	Usually	24,146	1,630	2,829,191	38.0	200,208	7.1	(<.001)
	Bad or less	30,823	5,882	3,047,801	41.0	588,990	19.3	
Perceived stress	Feel very much	1,626	870	194,105	2.6	100,012	51.6	3744.38
	Feeling a lot	10,656	3,188	1,171,555	15.8	340,304	29.1	(<.001)
	Feel a little	29,135	2,685	3,334,806	44.9	289,995	8.7	
	Hardly feel	26,334	1,317	2,731,351	36.8	121,685	4.5	
Recent depressive disorder experience	Experienced with counseling	710	454	90,624	1.2	57,071	63.0	5450.84
	Experienced but no counseling	3,970	2,116	492,758	6.6	259,008	52.6	(<.001)
	Inexperienced	63,122	5,494	6,852,833	92.2	535,579	7.8	
The number of family members	1 person	17,704	2,877	1,779,890	29.5	247,327	16.2	182.29
	2~3 people	28,908	4,587	3,571,147	59.2	506,190	10.1	(<.001)
	4~5 people	3,278	465	542,590	9.0	77,797	11.5	
	Over 6 people	948	147	144,085	2.4	21,722	10.7	
Living with dementia patients	Yes presently	917	280	114,160	1.9	37,010	21.6	66.45
	No	49,920	7,795	5,923,156	98.1	815,602	11.2	(<.001)
Recipient for basic lives	Current recipient	3,441	940	436,887	7.2	112,928	24.0	344.84
	Past recipient	691	173	76,955	1.3	16,939	20.0	(<.001)
	Never	46,685	6,961	5,521,599	91.5	722,999	10.5	
Household income	<1 million won	26,699	5,342	2,531,661	42.3	480,905	16.5	459.56
	1~<3 million won	16,535	1,981	2,179,153	36.4	239,919	8.4	(<.001)
	3~<6 million won	5,750	563	973,803	16.3	93,973	7.8	
	≥6 million won	1,485	156	298,441	5.0	33,373	8.7	
Food purchasing stability	Meet all wanted quantity and type	21,741	2,388	2,876,056	47.7	278,672	7.6	848.52
	Meet desired amount / not meet type	24,496	4,276	2,603,627	43.2	415,485	13.2	(<.001)
	Sometimes insufficient due to economic conditions	3,830	1,110	453,826	7.5	121,968	23.9	
	Often insufficient due to economic conditions	743	295	99,914	1.7	36,383	33.1	
Region	Seoul	2,808	486	306,072	16.5	140,386	10.2	198.87
	Busan	1,160	410	126,440	6.8	58,006	10.0	(<.001)
	Daegu	530	120	57,770	3.1	26,514	7.5	
	Incheon	808	242	88,072	4.7	40,410	11.6	
	Gwangju	438	116	47,742	2.6	21,886	12.7	
	Daejeon	332	83	36,188	2.0	16,600	9.4	
	Ulsan	135	38	14,715	0.8	6,773	6.0	
	Gyeonggi-do	3,587	960	390,983	21.0	179,350	12.1	
	Gangwon-do	734	685	80,006	4.3	36,721	13.1	
	Chungcheongbuk-do	708	539	77,172	4.2	35,419	13.7	
	Chungcheongnam-do	1,346	735	146,714	7.9	67,292	18.4	
	Jeollabuk-do	1,063	910	115,867	6.2	53,139	14.7	
	Jeollanam-do	959	1,036	104,531	5.6	47,971	11.5	
	Gyeongsangbuk-do	1,128	825	122,952	6.6	56,424	10.8	
	Gyeongsangnam-do	1,081	736	117,829	6.3	54,032	10.8	
	Jeju special self-governing-do	172	135	18,748	1.0	8,615	8.9	
	Sejong special self-governing-si	70	20	7,630	0.4	3,498	13.8	
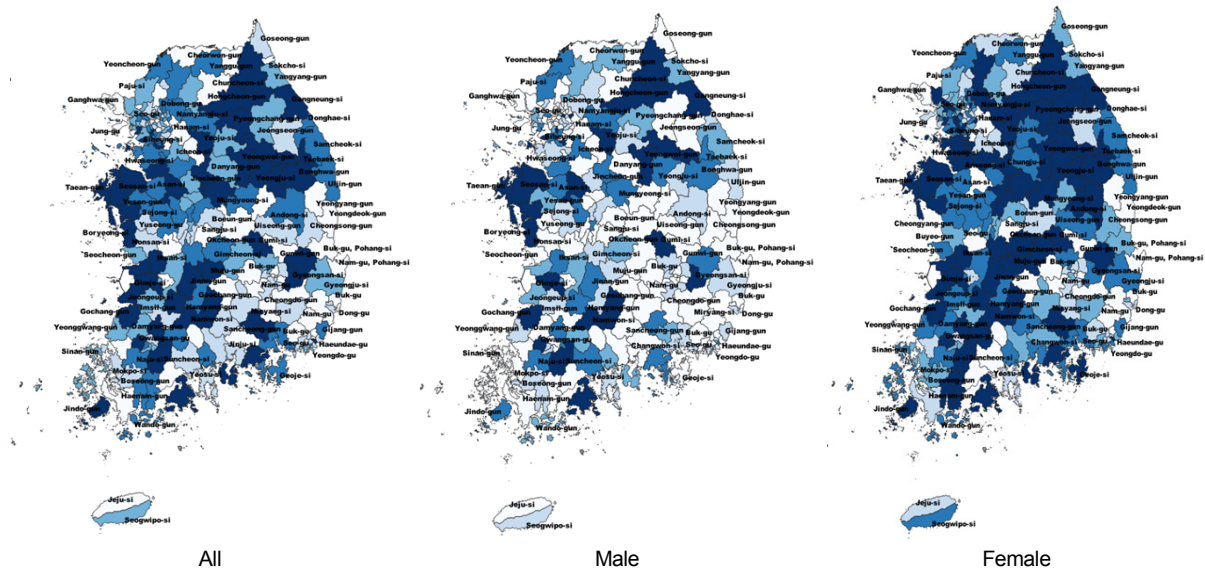
Figure 1. The regional distribution of the suicidal ideation rate of the elderly.

living alone constituting single-person households (16.2%), and the prevalence was 10.1% in people with 2~3 household members, 11.5% in those with 4~5 household members, and 10.7% in those with 6 or more household members (x^2=182.29, p<.001). The prevalence of suicidal ideation was also higher in people currently living with a dementia patient (21.6%) than the group not living with a dementia patient (11.2%) (x^2=66.45, p<.001).

With respect to the recipient status for the Basic Livelihood Security Program (BLSP) benefits, current BLSP benefit recipients had the highest prevalence of 24.0%, followed by past BLSP benefit recipients (20.0%), and non-recipients (10.5%) (x^2=344.84, p<.001). As to monthly household income, the prevalence of suicidal ideation was highest in the group with the household income less than 1 million won (16.5%), 8.4% in the group with the household income of 1 million to less than 3 million won, 7.8% in the group with the household income of 3 million to less than 6 million won, and 8.7% in the group with the household income of 6 million won or more. Regarding the stability of food purchases, the prevalence of suicidal ideation was 7.6% in the group where both the desired quantity and kinds were satisfied, 13.2% in the group where the desired quantity was satisfied but desired kinds were not satisfied, 23.9% in the group sometimes experiencing shortages due to economic conditions, and 33.1% in the group frequently experiencing shortages due to economic conditions (x^2=848.52, p<.001). These results indicate that worse economic conditions are associated with a higher prevalence of suicidal ideation.

As for the prevalence of suicidal ideation by region, Chungcheongnam-do had the highest prevalence of suicidal ideation (18.4%), followed by Jeollabuk-do (14.7%) and Sejong City (13.8%). On the other hand, Daejeon Metropolitan City showed the lowest prevalence of suicidal ideation (6.0%), followed by Daegu Metropolitan City (7.5%) and Jeju-do (8.9%), and there were significant differences in the prevalence of suicidal ideation among regions.

2. An Explanatory Model of Suicidal Ideation

Three models were considered in a multilevel logistic regression analysis to identify variables that have a significant effect on suicidal ideation at each level by dividing relevant variables into individual factors (level 1) related to the prevalence of suicidal ideation at the individual level and regional factors (level 2). First, the null model included only the intercept, and individual factors (level 1) and regional factors (level 2) were not entered in the null model to examine basic information of data. The second model, Model I, included only level-1 variables, and the third model, Model II, included both level-1 and level-2 variables. For each of the three models, three kinds of models built by selecting all older adults, only older men, and only older women were analyzed (Table 2).

In the null model, where the influence of independent variables was not considered, regional-level variance for the prevalence of suicidal ideation was 0.29 (standard error: 0.03) in the entire sample of older adults and the ICC was calculated to be about 0.08, showing that regional-

Table 2. The Result of Model Fit

Variables	All			Male			Female		
	Null Model	Model I	Model II	Null Model	Model I	Model II	Null Model	Model I	Model II
ICC	0.08	0.09	0.08	0.15	0.17	0.16	0.09	0.10	0.09
-2LL	5,141,401.00	3,857,073.00	3,810,271.00	1,820,788.00	1,331,728.00	1,318,958.00	3,230,453.00	2,465,014.00	2,431,567.00
AIC	5,141,405.00	3,857,151.00	3,810,373.00	1,820,792.00	1,331,806.00	1,319,060.00	3,2304,57.00	2,465,092.00	2,431,669.00
BIC	5,141,412.00	3,857,288.00	3,810,551.00	1,820,799.00	1,331,942.00	1,319,238.00	3,230,464.00	2,465,228.00	2,431,847.00

ICC=intraclass correlation coefficient; -2LL=-2 log likelihood; AIC=Akaike Information Criterion; BIC=bayesian information criterion; Model I: The model built by adding only individual-level variables to the null model; Model II: The model built by adding both individual- and regional-level variables to the null model.

level variance accounted for about 8.1% of the total variance. In older men, regional-level variance was 0.56 (standard error: 0.05), the ICC was about 0.15, and regional-level variance accounted for about 14.5% of the total variance. In older women, regional-level variance was 0.33 (standard error: 0.03), and the ICC was about 0.09, showing that the proportion of regional-level variance compared to the total variance was about 9.0%. These analysis results showed that the variation between regions was greater among older men than older women.

In this study, in all the models for all older adults, older men, and older women, respectively, the values of -2LL (-2 log-likelihood), AIC (Akaike information criterion), and BIC (Bayesian information criterion), which are measures of goodness of fit, were smaller than in the null model, and Model II, in which both level-1 (individual-level) and level-2 (regional-level) variables were entered, was found to be a better fitting model than others.

3. Influencing Factors for Suicidal Ideation

The analysis results of Model II, where both level-1 (individual-level) and level-2 (regional-level) variables were entered, are shown in Table 3.

With respect to cases where the odds ratio (OR) for suicidal ideation was 1.50 or higher among older adults as a whole, those aged 85 and older were more likely to have suicidal ideation compared to those aged 65~74 (OR= 1.52). Also, those with the educational level of under elementary school had greater odds of having suicidal ideation compared to those with the educational level of junior college or higher (OR=1.60). In addition, compared to those with a very low level of stress, those with a very high level of stress (OR=7.80), those with a high level of stress (OR=5.30), and those with a low level of stress (OR=1.91) were more likely to have suicidal thoughts. In relation to depressive disorders, compared to those without depres-

sive disorders, older adults who had a depressive disorder and received counseling (OR=9.01) and those who had a depressive disorder but did not receive counseling (OR= 6.81) were more likely to have suicidal ideation. As to perceived health status, older adults with poor or very poor perceived health status were more likely to have suicidal ideation compared to those with good or very good perceived health status (OR=2.84). In terms of the types of past occupations, compared to those who were previously engaged in managerial or professional jobs, the unemployed (OR=2.50), those whose job was the housekeeper (OR= 2.30), those previously engaged in simple labor, agriculture or forestry (OR=1.87), and those previously engaged in service or manufacturing jobs (OR=1.58) were more likely to have suicidal ideation. With respect to regional characteristics, the odds ratio for suicidal ideation was 0.99 for the number of hospital beds per 1,000 population, 0.96 for the for the prevalence of obesity, and 1.04 for the perceived rate of stress, showing that the number of hospital beds per 1,000 population and the prevalence of obesity were negatively correlated with the prevalence of suicidal ideation, while the perceived rate of stress had a significant positive correlation with the prevalence of suicidal ideation.

In older men, regarding cases where the odds ratio for suicidal ideation was higher than 1.5, older men with the educational level of under elementary school were more likely to have suicidal ideation compared to those with the education level of junior college higher (OR=1.93). In addition, older men currently without the spouse were more likely to have suicidal ideation compared to those with the spouse (OR=1.60). Regarding perceived stress levels, compared to older men with a very low level of stress, those with a very high level of stress (OR=7.22), those with a high level of stress (OR=5.5), and those with a low level of stress (OR=2.07) were all more likely to have suicidal ideation. In terms of depressive disorders, compared to older men with-

Table 3. Related Factors of Suicidal Ideation by Model II

Variables	Categories	All			Male			Female		
		β	SE	OR	β	SE	OR	β	SE	OR
Intercept		-3.51**	0.80		-2.91*	1.16		-4.08**	0.83	
Age group (ref: 65~74)	75~84 years	0.10**	0.00	1.11	0.11**	0.01	1.11	0.12**	0.00	1.13
	≥85 years	0.42**	0.01	1.52	0.13**	0.01	1.14	0.53**	0.01	1.70
Education level (ref: over college)	Less than primary school	0.47**	0.01	1.60	0.66**	0.01	1.93	0.31**	0.01	1.36
	Elementary school	0.27**	0.01	1.31	0.29**	0.01	1.33	0.14**	0.01	1.15
	Middle and high school	0.22**	0.01	1.24	0.29**	0.01	1.33	0.05**	0.01	1.05
Existence of spouse (ref: yes)	No presently	0.23**	0.00	1.26	0.47**	0.01	1.60	0.14**	0.01	1.15
Sleeping time (ref: more than 7 hours)	Less than 7 hours per day	0.12**	0.00	1.12	0.03**	0.00	1.03	0.15**	0.00	1.16
Perceived stress (ref: hardly feel)	Feel very much	2.05**	0.01	7.80	1.98**	0.01	7.22	2.12**	0.01	8.34
	Feeling a lot	1.67**	0.00	5.30	1.75**	0.01	5.75	1.63**	0.01	5.13
	Feel a little	0.65**	0.00	1.91	0.73**	0.01	2.07	0.61**	0.00	1.84
Recent depressive disorder experience (ref: Inexperienced)	Experienced with counseling	2.20**	0.01	9.01	2.86**	0.02	17.37	2.04**	0.01	7.70
	Experienced but no counseling	1.92**	0.00	6.81	2.12**	0.01	8.37	1.87**	0.00	6.46
Perceived health status (ref: good or better)	Usually	0.33**	0.01	1.38	0.15**	0.01	1.17	0.46**	0.01	1.59
	Bad or less	0.85**	0.00	2.34	0.77**	0.01	2.15	0.96**	0.01	2.61
Occupation (ref: manager or professional)	Service and goods producing	0.46**	0.02	1.58	0.21**	0.02	1.23	1.23**	0.04	3.41
	Simple workers, agricultural and forestry workers	0.63**	0.02	1.87	0.39**	0.02	1.47	1.40**	0.04	4.07
	Housewife	0.83**	0.02	2.30	1.80**	0.03	6.03	1.55**	0.04	4.70
	Inoccupation	0.92**	0.02	2.50	0.71**	0.02	2.04	1.68**	0.04	5.36
The number of family members (ref: over 6 people)	1 person	0.11**	0.02	1.12	0.11*	0.03	1.11	0.12**	0.02	1.12
	2~3 people	-0.24**	0.01	0.79	-0.37**	0.02	0.69	-0.23**	0.01	0.79
	4~5 people	-0.09**	0.01	0.91	-0.22**	0.02	0.80	-0.06**	0.01	0.94
Recipient for basic lifes (ref: never)	Current recipient	0.19**	0.00	1.21	0.08**	0.01	1.08	0.29**	0.01	1.33
	Past recipient	0.21**	0.01	1.24	0.16**	0.02	1.18	0.26**	0.01	1.29
Household income (ref: 6 million won or more)	<1 million won	0.07**	0.01	1.07	-0.02	0.01	0.98	0.12**	0.01	1.13
	1~<3 million won	-0.22**	0.01	0.80	-0.35**	0.01	0.71	-0.14**	0.01	0.87
	3~<6 million won	-0.20**	0.01	0.82	-0.24**	0.01	0.79	-0.18**	0.01	0.83
Living with dementia patients (ref: no)	Yes presently	0.13**	0.01	0.88	0.38**	0.01	1.47	-0.05**	0.01	0.95
Food purchasing stability (ref: meet all wanted amount, type)	Meet desired amount/not meet type	0.22**	0.00	1.25	0.42**	0.01	1.52	0.12**	0.00	1.13
	Sometimes insufficient due to economic conditions	0.35**	0.01	1.42	0.59**	0.01	1.80	0.21**	0.01	1.23
	Often insufficient due to economic conditions	0.30**	0.01	1.35	0.47**	0.02	1.60	0.17**	0.01	1.19
Community characteristics	Elderly population ratio	-0.01	0.01	0.99	-0.01	0.01	0.99	-0.01*	0.01	0.99
	The number of cultural infrastructures (per 100,000 population)	0.00	0.01	1.00	0.01	0.01	1.01	0.00*	0.01	1.00
	Number of doctors engaged in medical institutions (per 1,000 population)	0.00	0.02	1.00	-0.03	0.03	0.97	0.01*	0.02	1.01
	Hospital beds (per 1,000 people)	-0.01*	0.00	0.99	0.00	0.01	1.00	-0.01*	0.00	0.99
	Suicide rate (per 100,000 population)	0.01	0.01	1.01	0.00	0.01	1.00	0.01*	0.01	1.01
	The rate of perceived stress	0.04*	0.01	1.04	0.03*	0.01	1.03	0.04*	0.01	1.04
	Obesity rate	-0.04*	0.02	0.96	-0.06*	0.03	0.94	-0.03*	0.02	0.97
	Financial independence degree (after tax reorganization)	-0.02	0.01	0.98	-0.01	0.02	0.99	-0.03*	0.01	0.97
	The proportion of social welfare budget	-0.01	0.00	0.99	-0.01	0.01	0.99	-0.01*	0.00	0.99
	Crude divorce rate	-0.01	0.00	0.99	-0.01	0.01	0.99	-0.01*	0.00	0.99

*$p<.05$, **$p<.001$; SE=standard error; OR=odds ratio; This table shows Model II, the model in which both individual and regional variables were entered as independent variables with the null model as the baseline.

out any depressive disorders, people who had a depressive disorder and received counseling (OR=17.37) and those who had a depressive disorder but did not receive counseling (OR=8.37) had greater odds of having suicidal ideation. Older men with poor or very poor perceived health status were also more likely to have suicidal ideation than those with good or very good perceived health status (OR=2.15). Regarding the types of past occupations, the unemployed (OR=2.04) and housekeepers (OR=6.03) were more likely to have suicidal ideation, compared to those who were previously engaged in managerial or professional jobs. With respect to regional characteristics, the odds ratio for suicidal ideation was 1.03 for the perceived rate of stress and 0.94 for the prevalence of obesity, indicating that a higher level of perceived stress and a lower prevalence of obesity were significantly associated with a higher prevalence of suicidal ideation.

In the case of older women, those aged 85 or older were more likely to have suicidal ideation compared to those aged 65~74 (OR 1.70). Regarding perceived stress levels, compared to those with a very low level of stress, those with a very high level of stress (OR=7.80), those with a high level of stress (OR=5.30), and those with a low level of stress (OR=1.84) were more likely to have suicidal ideation. Compared to older adults without depressive disorders, those who had a depressive disorder and received counseling (OR=7.70) and those who had depressive disorder but did not receive counseling (OR=6.46) had greater odds of having suicidal ideation. In addition, compared to those with good or very good perceived health status, those with poor or very poor perceived health status (OR=2.61) and those with fair perceived health status (OR=1.59) were more likely to have suicidal ideation. As to the types of past occupations, compared to those who were previously engaged in managerial or professional jobs, the unemployed (OR=5.36), housekeepers (OR=4.70), those engaged in simple labor, agricultural, forestry or fishing jobs (OR=4.07), and those engaged in service or manufacturing (OR=3.41) were all more likely to have suicidal ideation. In terms of regional factors, the odds ratio for suicidal ideation was 1.01 for the number of physicians in medical institutions per 1,000 population, 1.01 for the suicide rate, and 1.04 for the perceived rate of stress, showing that the variables were positively correlated with the prevalence of suicidal ideation. On the other hand, the OR for the ratio of social welfare budget to the total budget was 0.99, and the OR for the crude divorce rate was 0.99, showing that the variables were significantly negatively associated with the prevalence of suicidal ideation. Overall, the odds ratio values for regional characteristics were slightly larger or smaller

than 1.00.

The results of the comparison of the odds ratios for suicidal ideation between older men and women were as follows. Among older men, those who had depressive disorder and received counseling showed the highest odds ratio for suicidal ideation (OR=17.37), followed by those who had depressive disorder but did not receive counseling (OR=8.37), those with a very high level of stress (OR=7.22), and those whose job had been the housekeeper (OR=6.03). On the other hand, among older women, those with a very high level of stress had the highest odds ratio for suicidal ideation (OR=8.34), followed by those who had a depressive disorder and received counseling (OR=7.70), those who had a depressive disorder but did not receive counseling (OR=6.46), and the unemployed (OR=5.36). Individual factors were found to have a greater influence on suicidal ideation than regional factors.

DISCUSSION

This study attempted to investigate the prevalence of suicidal ideation among Korean older adults and individual and regional factors influencing suicidal ideation by combining the raw data of the 2017 Community Health Survey and the e-Regional Indicator data from the Statistics Korea. In this study, the prevalence of suicidal ideation was 11.5% among older adults as a whole, 8.6% among older men, and 13.7% among older women. As for the prevalence of suicidal ideation by region, Chungcheongnam-do had the highest prevalence of 18.4%, followed by Jeollabuk-do (14.7%), and Sejong City (13.8%). These results were consistent with the fact that Chungcheongnam-do had the highest suicide death rate per 100,000 population in 2018, and Jeollabuk-do and Sejong City had relatively high suicide rates [2]. The prevalence of suicidal ideation among older adults as a whole was found to be 11.5%, but this is lower than 26.9% among older women living alone in Korea [4] and 25.2% among low-income older adults living alone [18]. This result is thought to be related to the fact that female gender, living alone, and poor health status are risk factors for suicide. This finding is also consistent with the findings from previous studies which reported that female gender [18], living alone [19], and lower economic status [5] are associated with a higher prevalence of suicidal ideation. The comparison of the prevalence of suicidal ideation between older adults in Korea and those aged 65 and older in other Asian countries revealed that the prevalence of 11% among Korean older adults was higher than 6.1% in Taiwan [19] but slightly lower than 12.3% in Japan [5].

With respect to individual factors influencing the pre-

valence of suicidal ideation in the entire sample of older adults, female gender (Rao-Scott x^2=247.28, p<.001), age of 85 years and over (OR=1.52), educational level of under elementary school (OR=1.60), unemployment (OR=2.50) or the occupation of the housekeeper (OR=2.30), no spouse (OR=1.26), daily sleep duration of less than 7 hours (OR=1.12), poorer perceived health status (OR=2.34), higher perceived stress level (OR=7.80), living alone (OR=1.12) and the Basic Livelihood Security Program (BLSP) benefit recipient status (OR=1.21) were associated with a higher prevalence of suicidal ideation. As for regional factors, as the number of hospital beds per 1,000 population (OR=0.99) and the prevalence of obesity (OR=0.96) were significantly negatively associated with the prevalence of suicidal ideation while the perceived stress level (OR=1.04) was significantly positively correlated with the prevalence of suicidal ideation. The comparison of odds values showed that the odds values of individual factors were higher than those of regional factors, indicating that individual factors have a greater impact than regional factors.

The findings of this study are in agreement with those of a previous study which reported that female gender, old age, low income level, unemployment, the absence of the spouse, and poor health status (stress, self-rated health status level, and untreated depression) were found to be factors affecting suicidal ideation [13]. In addition, the results of this study are thought to be consistent with a study in Taiwan which found that a higher prevalence of suicidal ideation was associated with the age of 85 years and over, a lower education level, living alone, unemployment, the lack of income, the presence of a disability, poor or very poor perceived health status, and the presence of depression, physical symptoms (heart disease, diabetes, asthma, and osteoporosis), or pain (arthritis, low back pain, sciatica, neck pain, and headache) [25]. Furthermore, the results of this study are also thought to be in line with the findings of previous studies in Japan which reported that factors such as unemployment, the number of family members and a high educational level were factors affecting the suicide rate among men, and factors such as the number of family members and divorce were influencing factors for the suicide rate among women [20].

In the analysis model for suicidal thoughts, when both individual and regional factors were considered, the goodness of fit was improved. The regional factors influencing suicidal ideation among both older men and women were found to be the number of hospital beds per 1,000 population (OR=0.99), the prevalence of obesity (OR=0.96), and the perceived rate of stress (OR=1.04). Among older men, the perceived rate of stress (OR=1.03) and the preva-

lence of obesity (OR=0.94) were significant influencing factors. Among older women, the percentage of the elderly population (OR=0.99), the crude divorce rate (OR=0.99), the perceived rate of stress (OR=1.04), the suicide rate (OR=1.01), the prevalence of obesity (OR=0.97), financial independence (OR=0.97), the ratio of social welfare budget to the total budget (OR=0.99), the number of physicians in medical institutions per 1,000 population (OR=1.01), and the number of hospital beds per 1,000 population (OR=0.99) were shown to have a significant influence on suicidal ideation. The regional-level variance accounted for about 14.5% of the total variance explaining suicidal ideation among older men, and regional-level variance accounted for about 9.0% of the total variance among older women, showing that the variation between regions was greater among men than women. However, differences in the influence were insignificant in that the odds values for regional factors entered in the analysis model were 1.0±0.1.

A lower ratio of financial independence of the local government and a lower ratio of the social welfare budget to the total budge were associated with a higher prevalence of suicidal ideation. Similarly, in a previous study that analyzed regional characteristics influencing the suicide rate based on the administrative units of cities, counties, and districts, the financial independence of the local government (β=-.66, p<.001) and the social welfare budget (β=-.75, p<.001) were found to be significant influencing factors even after adjustment for other variables [21]. According to another previous study, a higher percentage of the National Basic Livelihood Security Program (BLSP) benefit recipients, a higher percentage of old-age pension beneficiaries [8], and a higher ratio of social welfare budget to the total budget of the local government were associated with a lower elderly suicide rate in the region, and the effects were found to be greater in rural areas than in urban areas [8]. In addition, a previous study found that although the elderly suicide rate increased with the increase in the percentage of the elderly population, this effect was offset when there were many service facilities [22]. A study in Japan also found that lower financial support of the local community was associated with a higher suicide mortality rate, showing the same tendency as shown in this study [23]. These findings suggest that there is a need to expand welfare budgets and services for older adults in the vulnerable class.

Although old age is a significant risk factor for suicide [24], the elderly suicide rate was found to be lower in communities with a higher percentage of the older population, which has been thought to be due to the fact that the effect of social support among older adults is small [13]. In this

study, a similar tendency was found in that a lower percentage of the older population was correlated with a higher prevalence of suicidal ideation. Therefore, it is necessary to explore and provide a mechanism for activating exchanges among older adults in communities with a lower percentage of the elderly population and to pay more active attention to elderly suicide.

The results of this study were also consistent with previous studies reporting that a higher suicide rate in a region was correlated with a higher prevalence of suicidal ideation, and these findings are thought to be related to the social transmission power of suicide called the Werther effect [25]. Since it has been previously reported that the perceived stress level [13] is associated with a higher prevalence of suicidal ideation, it was included as a regional factor in the analysis and as a result, it was shown to have a significant effect.

On the other hand, the results regarding the divorce rate in this study were not consistent with those of previous studies. In previous studies, it has been emphasized that since the suicide rate tends to increase with an increase in the divorce rate, interventions for suicide prevention for divorced people are required [5,22], and in Japan, a suicide mortality rate was found to be higher among divorced people [20]. In this study, the crude divorce rate in the local community had no significant impact among older adults as a whole and among older men, and a lower crude divorce rate was associated with a higher prevalence of suicidal ideation only among older women (OR= 0.99). In terms of individual factors, people without the spouse showed a higher prevalence of suicidal ideation among all older adults (OR=1.26), among older men (OR= 1.60), and among older women (OR=1.15). Individuals' divorce or unmarried status seems to have a stronger influence than the divorce rate of the local community. In addition, there is a need to continuously monitor whether the sensitivity to divorce decreases to some extent due to the social trend of the increasing divorce rate.

A systematic literature review on obesity and suicide in individuals reported that obese women are more likely to have suicidal ideation or make a suicide attempt, while obese men are less likely to do so [25]. In this study, a lower prevalence of obesity in the community was associated with a higher prevalence of suicidal ideation (OR=0.97), and this result may be interpreted in view of the fact that different results were obtained according to gender even at the individual-level in previous studies.

Despite the fact that the number of physicians in medical institutions and the number of hospital beds per 1,000 people are substantially similar indicators for health care

infrastructure, they were found to have contrary effects on suicidal ideation. In previous studies, the number of mental health professionals per 100,000 population and the number of basic mental health welfare centers per 100,000 population were found to be related to the elderly suicide rate [8]. However, there is a need to study these variables repeatedly as there is inconsistency in the study findings.

This study has the following limitations. First, since this study conducted a secondary data analysis, there was a limitation in considering regional variables that influence suicidal ideation, so further research should be conducted in various ways by including more diverse regional variables. For example, considering that the suicide rate was reported to be higher in areas with a higher population density and a high crude birth rate [13], it is required to consider these variables as well and it is also necessary to examine whether individual characteristic variables found to be significant influencing factors also have a significant effect as regional characteristics.

Second, even though there may be fewer exchanges among residents in the same city, country or district in terms of administrative units, or there may be larger regions where there are closer relationships between adjacent municipalities, these aspects were not taken into account in this study. Therefore, an in-depth follow-up study is required focused on living areas rather than administrative units.

A significant aspect of this study is that it conducted a comprehensive analysis of factors related to suicidal ideation, which is the preceding stage of currently rapidly increasing elderly suicide, by considering both individual and regional characteristics. Individual factors were found to have a greater influence on suicidal ideation than regional factors, but considering that the explanatory power of the model for suicidal ideation among older adults increased when regional factors were entered, interventions reflecting regional characteristics should be developed and carried out when implementing interventions for elderly suicide prevention in the future. Considering that the perceived stress level of individual older adults and the perceived rate of stress or the suicide rate in the overall local community were found to have an influence on suicidal ideation, a comprehensive community-based approach is required for suicide prevention.

CONCLUSION

In this study, 11.5% of Korean older adults were found to have suicidal ideation within the past one year. As for the prevalence of suicidal ideation among older adults by

region, Chungcheongnam-do had the highest prevalence of 18.4%, followed by 14.7% in Jeollabuk-do, and 13.8% in Sejong City, and there were significant differences among regions.

Among individual factors, high risk factors for suicidal ideation were shown to be gender (female), age of 85 years and over, low educational level, stress, depression, perceived health status, unemployment or the occupation of the housekeeper. As for regional factors, influencing factors were found to be the number of hospital beds per 1,000 people, prevalence of obesity, and perceived rate of stress. The regional-level variance accounted for about 14.5% of the total variance explaining suicidal ideation among older men, and it accounted for about 9.0% of the total variance among older women, showing that the variation between regions was greater among men than among women. The odds values for the regional factors were not significant, but the goodness of fit was improved as both individual-level and regional-level factors were considered in the analysis model for suicidal ideation. Therefore, these study results suggest that it is necessary to develop and implement comprehensive community-based nursing interventions which reflect not only individual characteristics but also regional characteristics in order to decrease the elderly suicide rate.

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