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Spatial Dependence in Local Suicide Ideation and Actual Suicide among the Elderly
: A Comparative Study between Men and Women*

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Abstract

This study examined spatial dependence in local suicide ideation and suicide rates among the elderly. Further, we compared the difference in spatial dependence between men and women. For the empirical analysis, we used the 2017 Korea Community Health Survey and spatial analysis. The empirical analysis shows that first, both local suicide ideation and actual suicide among the elderly are spatially dependent. Second, the spatial dependence in local suicide ideation is greater for elderly women while the spatial dependence in local actual suicide rates is greater for elderly men. The empirical results suggest that suicide prevention policies among the elderly should be refined to reflect spatial dependence in local suicides and gender differences between local suicide ideation and actual suicide regarding spatial dependence.

Keywords The Elderly, Suicide Ideation, Actual Suicide, Spatial Dependence
주제어 노인, 자살생각, 자살, 공간적 상호의존성

Ⅰ. Introduction

With the recent development of medical technologies, the average life span of individuals has been extended, resulting in a drastic increase of the elderly population. South Korea has been considered as an aging society since 2020. Considering the increasing trend of the elderly population, South Korea is expected to be a super-aged society by 2026 (National Statistics Office, 2019). While the elderly population now requires social interest and governmental policies more than ever, the most important and urgent problems that the elderly generation is going through are those related to suicide due to the vulnerability of their mental and emotional health conditions.

According to the Health Insurance Review & Assessment Service, as of 2018, the number of the elderly individuals among the elderly population at the age of 60 years or higher, who have a mental disease such as depression and panic disorder, was 530,000, which was about 81% more than the number in 2010. The deterioration of the mental health conditions of the elderly leads to suicide ideation (Seo and Lee, 2015). Although the experiences of suicide ideation do not necessarily cause suicide, the risk of death by suicide is higher among people who have experienced suicide ideation (Park, 2015; Ronald et al., 2015). Such a trend is more distinctive in the elderly population (Miller et al., 2001), hence, the investigation of suicide among the elderly requires the consideration of the presence of an experience

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of suicide ideation as an important predictive factor of actual suicide among the elderly.

On the other hand, a person's behavior is affected by the characteristics and behavior of individuals around the person (Jun, 2017). This means that suicide ideation and suicide actions of the elderly are also affected by the people around them. For example, depressive or suicide feelings found in a specific person may lead to chain reactions including the deterioration of mental health conditions or suicide of the people around them. As a result, elderly suicide may extend to groups, neighbors and regions.

In particular, from the spatial viewpoint, elderly suicide shows spatial dependence. Spatial dependence refers to an increase of the similarity of a certain phenomenon that occurs in spaces by the increase of the accessibility between local regions (Anselin and Bera, 1998). With regard to elderly suicide, spatial dependence means that the occurrence of elderly suicide in a specific region affects the suicide rate among the elderly in a nearby region.

Most of the previous studies on the elderly suicide focused on the analysis of the factors affecting suicide (Kim and Kim, 2011; Kim and Kwon, 2013; Kim and Kim, 2014; Park and Kim, 2017). However, few studies on elderly suicide have focused on spatial dependence. Therefore, reviewing elderly suicide in consideration of spatial dependence may provide new points of view to the problem.

The present study was conducted to investigate elderly suicide in consideration of spatial dependence as well as the dependence upon the gender. A previous study showed that the rates of suicide ideation and suicidal intention are higher among women but the rate of actual suicide is higher among men (Kim and Kim, 2016). The difference is caused by the fixed gender roles, the formation of social networks, and functional differences. A person's behavior is affected by the people around them, and the interactions may be extended to a region. Considering this, spatial dependence of suicide ideation and suicide among the elderly and its pattern may be different between genders.

Study questions were derived from the discussions described above. First, "Are local suicide ideation and actual suicide among the elderly spatially dependent?" Second, "Is spatial dependence in local suicide ideation and actual suicide among the elderly gender specific?" In the present study, the spatial dependence of local suicide ideation and actual suicide among the elderly were analyzed by using data from the Korea Community Health Survey and the Causes of Death Statistics as of 2017. In addition, the difference of spatial dependence between men and women was also analyzed.

This study contributes to the literature in that not only was spatial dependence in elderly suicide at the local level analyzed but also the spatial dependence in both the local suicide ideation and the actual suicide among the elderly was compared. The present study is also significant because the gender difference was considered.

II. Background

1. Spatial dependence in local suicide ideation and actual suicide among the elderly

Suicide may be defined differently, but the general definition of suicide is 'an act of killing oneself'. A wider definition is 'an attempt to kill oneself or a psychological condition to do so' (You, 2014). Considering the wider definition, suicide may be understood as a result of consecutive actions including suicide ideation, attempted suicide and suicidal behavior (Harwood et al., 2002).

Scholars also point out the need for understanding suicide as not only a behavioral result but also a process leading to suicide (Shin et al., 2014). In particular, scholars have indicated that attention should be paid to the presence of a past experience of suicide ideation when considering suicide among the elderly. This is because, although the presence of a past experience of suicide ideation does not always lead to actual suicide, a person who has experienced suicide ideation has a higher risk of death by suicide, and continued suicide ideation is an important factor leading to suicide (Park, 2015; Ronald et al., 2015).

A previous report showed that the presence of more experiences of suicide ideation is more likely to lead to actual suicidal behavior, especially among the elderly (Miller et al., 2001). Therefore, the presence of a past experience of suicide ideation may be an important predictive factor in the suicide rate among the elderly. Therefore, in the present study we consider the experience of suicide ideation as a major predictive factor of suicide among the elderly.

Suicide ideation and actual suicide affect the people

around the victim (Bearman and Moody, 2004; Lee et al., 2010; Seo and Lee, 2015; Robbins and Alessi, 1985). Because of the spatial dependence, the trend is not localized to a specific region; it is highly probable that spatial clustering may occur through interactions with neighboring regions.

Spatial dependence refers to the interactions between geographically proximate individuals, groups, and areas. Upon the existence of spatial dependencethere is a similarity regarding a certain phenomenon between geographically proximate localities (Anselin and Bera, 1998). In other words, the characteristics of individuals, groups or regions that are geographically close are similar due to the spillover effect (Tobler, 1970), and the spatial dependence is represented by the clustering of geographically adjacent spaces.

According to Morenoff (2003), the spatial clusters may be formed as a result of an artifact by the spatial clustering of predictive variables. Therefore, spatial clustering of elderly suicide may be caused by the spatial clustering of the predictive variables related to the elderly suicide in the spatial units. For instance, the suicide rate among the elderly may be high in two geographically adjacent regions, which may be because the policy circumstances regarding elderly welfare are relatively poor in regions due to their low financial independence. This suggests that after the predictive variables of the suicide rate among the elderly are controlled, the spatial dependence of the suicide rate among the elderly should no longer be significant.

Next, the neighborhood effect of spatial clustering is caused by spatial externality. The neighborhood effect refers to the effect that independent causal relationships have on social performance through social networks and interactions (Jencks and Mayer, 1990). According to the neighborhood effect, regions within a certain distance have network of similar probabilities. As a result, the culture, ideology and social network of the regions within a certain distance have more mutual influences in comparison with regions out of the range.

In this regard, the First Law of Geography according to Tobler (1970) states, "Everything is related to everything else, but near things are more related than distant things." In the context of elderly suicide, the law suggests that elderly suicide may have an affect between individuals and between regions, and that spatial clustering of the suicide rate may occur even if the predictive variables are controlled.

Suicide contagion is categorized into indirect suicide contagion through media, which is called the Werther effect, and direct suicide contagion in the middle of direct social relationships. Previous studies on the direct suicide contagion showed that suicide inside a social network is a highly influential factor to suicide-related behavior of others (Robbins and Conroy, 1983; Thoits, 1985; Brent et al., 1989). It was particularly highlighted that suicide by an acquaintance who has been in a high level personal relationship has a more direct effect on the increase of the likelihood of suicide-related behavior by the people around the person (Bearman and Moody, 2004). This suggests that suicide may be caused by not only personal reasons, but also by external factors.

In addition, the elderly have a relatively small range of activity due to physical restrictions (Robert and Li, 2001; Glass et al., 2003). This means that the elderly may be more affected by the interactions between adjacent regions than people of other generations. Therefore, the spatial clustering of elderly suicide may be the result of the homogeneous regional responses to the issues that have a negative impact on the mental health conditions of the elderly.

Until now, studies on elderly suicide have focused on the economic or psychological factors of individuals, including income level and depression (Kim and Kim, 2011; Kim and Kwon, 2013; Kim and Kim, 2014; Park and Kim, 2017). Several studies have recently been conducted considering not only the individual factors but also environmental factors (Noh, 2013). Since individuals' behavior is affected by environmental factors, suicide ideation and behavior are also expected to be affected by environmental factors (Lee and Oh, 2008).

Previous studies on the spatial distribution of suicidal risks have shown that the ratio of economically disadvantaged residents is higher in underdeveloped areas (Latkin and Curry, 2003; Kuramoto et al., 2013). In addition, it was reported that the suicide rate is higher in rural areas than in urban areas (Chang et al., 2011). This may be because rural areas have experienced spatial, social and cultural severance more than urban areas in the rapid industrialization process. Hence, this severance might have acted as a factor that increases the suicide rate.

Previous studies show the possibility of spatial interactions between adjacent regions with regard to the suicide rate among the elderly. The degree of underdevelopment or

characteristics of regions may be mutually affected between regions through the spillover effect mentioned above. Therefore, spatial dependence and clustering may also be found in elderly suicide ideation and actual suicide.

2. Gender difference and spatial dependence in local suicide ideation and actual suicide among the elderly

In addition to the discussion on the spatial dependence in elderly suicide, attention should be paid to the spatial heterogeneity of elderly suicide ideation and suicide rate according to gender. Generally, the rates of suicide ideation and suicidal intent are higher among women, but the actual suicide rate among men is double or triple the suicide rate among women (Kim and Kim, 2016). Hence, despite the presence of spatial dependence of elderly suicide ideation and suicide rate, different spatial clusters may be formed because of the differences between men and women.

First, with regard to suicide ideation among the elderly, elderly women may be more spatially dependent than elderly men because women are affected by others more than men (Jun and Namgung, 2018). According to Graziano et al. (1993), this study suggest, in the context of suicide ideation, elderly women are more affected spatially by others' opinions and behavior.

In addition, women generally provide a higher level of social support to others through social networks than men, and maintain closer emotional relationships with others (Antonucci, 2001; Chang, 2010). On the contrary, men tend to form more diverse and wider network of human relationships to acquire jobs and promote their career (Fischer and Oliker, 1983; Wellman et al., 1983). Recalling that elderly men generally experience loss of their social roles, the social network of elderly men is considered to be much smaller than that of elderly women.

Previous studies on the functions of social networks according to gender showed that the relationships of elderly women with friends and acquaintances are in the type of 'facing each other,' of which the main functions are interests in others and social and emotional exchanges. On the contrary, the relationships of elderly men are in the type of 'standing beside,' of which the main functions are intellectual exchange rather than emotional support (Wright, 1982; Parker and de Vries, 1993; Walker, 1995). In summary, in the context of elderly suicide ideation, elderly women, who are more active in social and emotional exchanges are more exposed to the impact of others' opinions and behavior. This suggests that spatial dependence in suicide ideation may be higher among elderly women than among elderly men.

Next, the suicide rate among the elderly may be more spatially dependent among elderly men than elderly women. Bass and Lambert (2004) reported that men have more negative recognition about environmental factors and are more affected by them in comparison with women. This negative recognition and the impact of the environmental factors may be particularly higher among elderly men who have experienced social retirement due to the loss of the gender roles expected of men. For many years, men have been expected to be more adventurous than women (Girard, 1993), and play the role of a family head to support the family financially (Chuang and Huang, 2007). Accordingly, as the external compression caused by the environmental change continues, men who are restrained in the stereotypical gender role experience a higher level of stress (Kawachi and Berkman, 2001).

In addition, there is a difference between men and women in actual suicidal behavior. While men execute more aggressive actions in suicidal behavior, such as the use of firearms and falling (Kim, 2013), women have a substantially lower level of actual suicidal behavior compared to their suicidal intention because of the high labeling effect on suicide (Ji, 2012).

In summary of the discussions described above, elderly suicide ideation may be more spatially dependent among elderly women, who are highly influenced by others and have stronger social network with others. Spatial dependence in their mental and emotional stress may be higher among elderly women. On the contrary, the actual suicide behavior may be more spatially dependent among elderly men, who have strongly negative recognition about environmental factors due to their stererotyped gender role and aggressiveness. Therefore, because of the 'Werther effect' through mass media or the impact of the suicide of an acquaintance in a social relationship, the spatial dependence in actual suicide may be stronger among elderly men than elderly women.

3. Literature review and hypotheses setup

Previous studies show that suicide ideation and actual suicide among the elderly are affected by economic and social factors(Kim and Kim, 2011; Kim and Kwon, 2013). Other studies were conducted based on time-series data to analyze the patterns in which the levels of suicide spread and suicidal risks are fixed (Roh, 2017; Joo and Lee, 2014).

Some of the studies about elderly suicide were conducted by considering the spatial factors (Roh, 2017; Joo and Lee, 2014). However, elderly suicide has not been sufficiently studied from the viewpoint of spatial dependence. These studies have a consensus about the spread of suicide due to its social contagion as well as the possibility of the clustering in spatial units. The studies have provided spatial patterns of suicide that occurs within spatial units, but the analysis is still descriptive.

The analysis based on spatial dependence must be based on contextual interpretation. As discussed above, elderly suicide in a specific region may have mutual effects on the adjacent regions in various aspects, and spatial dependence and spatial clustering may thereby take place. In addition, according to Tobler's First Law of Geography, geographically close regions have similar characteristics. This means that spatial dependence and spatial clustering of suicide ideation and actual elderly suicide may be different among different regions. This also means that different suicide-related contexts should be taken into consideration for different regions.

On the other hand, a limitation of the previous studies conducted by considering the spatial factors related to elderly suicide is that they failed to consider the presence of elderly suicide ideation, which may function as an important predictive factor. There is a report that the elderly have a higher probability of carrying out actual suicide, as they have more experiences of suicide ideation (Miller et al., 2001). This suggests that there should be a consideration on the spatial pattern of elderly groups who have had suicide ideation. When clusters related to the elderly suicide ideation are formed in spatial units, it is highly probable that the spatial clusters related to elderly suicide may be formed at the clusters as well.

Based on the discussions described above, we verified not only the spatial dependence of elderly suicide in different regions, but also the difference in the pattern of the spatial dependence according to gender. Through this, the present study may provide a new perspective in relation to elderly suicide with respect to the space. Furthermore, the results obtained from the present study may be used to establish more systematic and meaningful policies for preventing suicide. The research hypotheses set up in the present study based on the discussions above are described below.

Hypothesis 1: Local suicide ideation and actual suicide among the elderly are spatially dependent.

Hypothesis 2: The level of spatial dependence in local suicide ideation is higher for elderly women than elderly men.

Hypothesis 3: The level of spatial dependence in local actual suicide is higher for elderly men than elderly women.

Ⅲ. Methods

1. Data and study area

The scope of the present study is described below. First, the spatial scope of the present study included 225 administrative units in Korea ('si,' 'gun' and 'gu') except the island regions, which were expected to lack spatial dependence due to the absence of adjacent regions (Jeju-do, Ulreung-gun and Ongjin-gun in Incheon).

The subjects of the present study were the elderly aged 60 years or older. From a systematic point of view, those aged 65 years or older are considered as elderly citizens. However, the studies that analyzed the subjective recognition of age by individuals pointed out that the subjective recognition of age may be different from the objective criteria of the elderly (Jeong and Song, 2012; Song and Kim, 2013). According to data from the National Pension Research Institute, the age groups recognized as the elderly vary from those between 60 to 64 years of age or those between 65 to 70 years of age. David (2001) reported that one of the universal symptoms that are generally found among the elderly is geriatric depression. Considering that negative mental health conditions, such as depression, can lead to suicide, as described above, in our study we appropriately defined the elderly as

the people aged 60 years or older who may have geriatric depression.

Next, the variables of local elderly suicide ideation used in the present study were selected by using data from the Korea Community Health Survey, which is conducted each year by 253 public health centers under the supervision of the Korea Center for Disease Control and Prevention. The data includes information related to the health of residents in local communities, such as smoking, drinking, physical activities, mental health and quality of life. Therefore, we considered the data as suitable for determining the presence of an experience of elderly suicide ideation. However, the survey item related to suicide ideation is included in the data in a period of 4 years. Hence, we analyzed the data of 2017, the latest survey data including items related to suicide ideation.

Actual elderly suicide in different localities was analyzed by using data from the Causes of Death Statistics for 2017. The Causes of Death Statistics according to the Statistics Act and the Act on Registration of Family Relations are based on the death notices submitted to the administrative offices of the registered places throughout Korea (eup, myeonn, dong, si and gu), and includes information about personal characteristics such as gender, age, marriage, education and occupation, as well as the causes of death such as disease, accidents and intentional self-injury (suicide). Therefore, we considered that the data is suitable for analyzing local actual suicide among the elderly throughout Korea, and reconstructed the data for our analysis by selecting the individuals whose cause of death was intentional self-injury (suicide).

2. Analytical approach

The analytical methods of the present study are described below. First, local suicide ideation and actual suicide among the elderly, which were used as the key variables in the present study, were reprocessed into 'the number of individuals per 100,000 in the elderly population' from the analytical data. The Community Health Survey data used for the analysis of local suicide ideation among the elderly, is a dataset from the survey that includes a question whether a respondent had an experience of suicide ideation. Thus, the local suicide ideation among the elderly was constructed as the ratio of the elderly who experienced suicide ideationto the entire elderly population within each locality. Given that the very small portion to the entire elderly population, then, the local elderly suicide ideation was was converted into the ratio per 100,000.[1)] The data of the Causes of Death Statistics used for the analysis of local actual elderly suicide was prepared with reference to the death notices submitted to the registration offices of the individuals. For the local actual suicide among the the elderly, the ratio of the elderly whose cause of death was suicide to the entire elderly population in the locality was converted into the ratio per 100,000.[2)]

Second, to investigate spatial dependence in the present study, we established spatial data for the administrative units except for the island regions mentioned above. Subsequently, to verify the hypotheses of the present study, we used Moran's I index to investigate the spatial dependence of elderly suicide ideation and actual suicide in 2017. Moran's I index that is employed to analyze spatial dependence has a value between −1 and 1, and a value closer to 1 indicates the presence of adjacent regions showing more similar characteristics (Lee and Shim, 2011).

Third, Moran's I index has limitations when used to investigate the detailed spatial dependence of small areas. Hence, spatial dependence in local units was investigated to analyze the spatial distribution of the elderly according to gender for the hypotheses 2 and 3.

The Local Indicator of Spatial Association (LISA) analysis is generally used in parallel to verify the spatial autocorrelation of local units, allowing for a more systematic spatial analysis (Anselin, 1995). Spatial correlations are classified by the LISA into 4 types: 1) the HH (High-High) type where there are high values around a high value of a specific region; 2) the HL (High-Low) type where there are low values around a high value; 3) the LH (Low-High) type where there are high values around a low value; and 4) LL (Low-Low) type where there are low values around a low value. The LISA analysis was performed to investigate the spatial clustering of suicide ideation and actual suicide among the elderly by comparing it between men and women.

3. Descriptive statistics

Prior to the main analysis of the present study, the analysis of the spatial dependence of local suicide ideation and actual suicide among the elderly, we reviewed the overall characteristics of the elderly in relation to suicide. We analyzed the

mean values of elderly suicide ideation and suicide in all localities, and performed a t-test with regard to local suicide ideation and suicide among the elderly according to gender. Table 1 shows the analytic results.

The analysis shows that the pattern of local elderly suicide ideation and actual suicide was different between men and women. Local suicide ideation was experienced more by women (12933.63) than men (7953.66). On the contrary, local actual suicide was higher among men (71.31) than women (22.96). An additional t-test was performed to verify the significance of the differences. The analysis showed that the t-values for local suicide ideation and local actual suicide were −10.776 and 19.820, respectively, indicating that the differences are statistically significant. The results shown in Table 1 are consistent with the previous report that suicide ideation is higher among women but actual suicide is higher among men (Kim and Kim, 2016). The results also show that even if spatial clusters of elderly suicide rate are formed at adjacent regions, spatial dependence may be different between men and women.

Table 1. Local suicide ideation and actual suicide among the elderly (per 100,000 persons)

Division (N=225)	Total	Men	Women	t-test
Local Suicide Ideation	10824.04	7953.66	12933.63	-10.776***
Local Actual Suicide	44.21	71.31	22.96	19.820***

*<0.1, **<0.05, ***<0.01

Table 2 shows the overall characteristics of local suicide ideation and actual suicide among the elderly in the 16 provinces except Jeju-do. The analytic results showed that local suicide ideation and actual suicide among the elderly according to gender in the 16 provinces were similar to the results shown in Table 1. The t-test shows that there is a statistically significant difference between men and women in both local suicide ideation and actual suicide in most of the provinces except Gwangju and Ulsan.

Table 2 also indicates that local elderly suicide ideation and actual suicide are relatively high in provinces having a higher ratio of non-urban and rural areas. Among the

Table 2. Local suicide Ideation and actual suicide among the elderly in 16 provinces (per 100,000 population)

Division (N=225)	Local Elderly Suicide Ideation			Local Actual Elderly Suicide			t-test	
	Total (mean)	Men (mean)	Women (mean)	Total (mean)	Men (mean)	Women (mean)	Local Elderly Suicidal Ideation	Local Actul Elderly Suicide
Seoul (25)	9090.81	6706.47	10874.89	35.69	55.68	19.25	-4.454***	11.631***
Busan (16)	9742.35	7125.45	11642.94	38.29	63.39	18.11	-4.335***	12.230***
Daegu (8)	6382.97	4661.70	7710.19	37.92	64.38	17.55	-3.823***	6.270***
Incheon (9)	10792.56	7897.42	13007.78	39.45	65.34	18.09	-2.549**	8.183***
Gwangju (5)	11865.58	9375.19	13754.04	27.98	48.91	11.50	-1.672	5.098***
Daejeon (5)	7453.32	5345.69	9108.20	43.36	56.56	32.56	-2.259*	1.749
Ulsan (5)	5141.03	3793.45	6344.32	44.88	62.54	29.47	-1.412	3.080**
Sejong-si (1)	12888.89	10526.32	14615.38	35.30	67.51	9.74	-	
Gyeonggi (31)	10761.73	7814.09	13045.03	46.65	73.94	23.93	-5.453***	10.599***
Gangwon (18)	11846.64	8815.71	14267.67	62.53	102.53	30.17	-3.021***	7.409***
Chungbuk (11)	12952.52	9517.21	15521.28	50.19	75.47	30.11	-2.569**	3.268***
Chungnam (15)	15044.65	11285.04	17816.72	55.44	86.52	31.04	-2.546**	5.498***
Jeonbuk (14)	15393.22	11617.31	17966.17	40.33	73.72	15.59	-3.516***	-11.824***
Jeonnam (22)	10978.85	8046.94	12903.78	42.41	68.49	23.44	-3.319***	6.044***
Gyeongbuk (22)	9305.89	6474.54	11381.95	37.13	60.57	19.71	-3.236***	6.674***
Gyeongnam (18)	10672.55	7746.54	12638.76	49.90	82.84	25.79	-3.295***	3.484***
Max	15393.22	11617.31	17966.17	62.53	102.53	32.56	-	
Min	5141.03	3793.45	6344.32	27.98	48.91	9.74	-	

*<0.1, **<0.05, ***<0.01

16 provinces, the ratio of elderly having an experience of suicide ideation was higher in the order of Jeonbuk (15393.22), Chungnam (15044.65) and Sejong (12888.89). Local actual suicide was higher in the order of Gangwon (62.53), Chungnam (55.44) and Gyeongnam (51.89). Local elderly suicide ideation and actual suicide of the 225 localities are presented in the Appendix. The localities that showed higher ratios of the elderly having an experience of suicide ideation were Cheonan-si (28750.00), Boryeong-si (23275.86) and Dangjin-si (22740.52). Local actual suicide was higher in the order of Sacheon-si (148.64), Pyeongchang-gun (113.94) and Yangsan-si (111.76).[3)]

The results obtained from the analysis of the 16 provinces and 225 localities are consistent with the previous reports that suicide ideation and actual suicide among the elderly are relatively high in non-urban or rural areas (Kim, 2009; Bae and Eom, 2009; Song et al., 2010; Chang et al., 2011; Son, 2012).

Ⅳ. Results

1. Spatial dependence in local suicide ideation and actual suicide among the elderly

We examined Hypothesis 1, which is directed to test the spatial dependence in local suicide ideation and actual suicide among the entire elderly including both men and women. For this, we calculated Moran's I index of local suicide ideation and actual suicide among the elderly. Moran's I index is calculated by defining the spatial weighted matrix, which represents the contiguity between localities, and by measuring the data similarity between localities.

The spatial dependence may be calculated by the queen method, where the contiguity is measured with reference to the regional boundary, or by the rook method, where the contiguity is measured with reference to the regional vertexes. A clear theory has not been established about the selection of the references determining adjacent regions (Chi & Zhu, 2019). Chi & Zhu (2019), in relation to the selection of a spatial weighted matrix, suggested a data-centered approach based on the level of spatial dependence and statistical significance. Accordingly, we employed the spatial weighted matrices prepared by the two methods to calculate Moran's I index, and then performed the analysis based on Moran's I index which was calculated by the rook method and which showed higher values.[4)] Table 3 shows the Moran's I index of global suicide ideation and suicide rate of the entire elderly population and the gender groups according to the contiguity setting.

As shown in Table 3, local suicide ideation and actual suicide had a positive spatial dependence with the Moran's I values of 0.220 and 0.212, respectively. The results were consistent with the previous reports about suicide among the elderly (Joo, 2014; Choi, 2016; Jeon, 2016; Roh, 2017). Joo (2014) and Roh (2017) identified the spatial patterns of elderly suicide in different age groups, and verified the level of spatial clustering of elderly suicide each year in terms of the Moran's I index. Joo (2014) reported that the Moran's I index for yearly elderly suicide was between 0.18 and 0.22. Roh (2017) reported that the Moran's I index for yearly suicide among the elderly was between 0.17 and 0.35. Other studies have shown that the Moran's I value for subjective mental health (Jeon, 2016) and depression (Choi, 2016) in relation to suicide was 0.15 and 0.34, respectively.

Considering that the range of the Moran's I index, being between −1 and 1 and the results from previous studies, spatial dependence of local elderly suicide found in the present study was not very high. Since spatial dependence is caused by physical accessibility, the local spatial dependence may be lower than spatial dependence at a personal level. The results of the present study may reflect this difference. Nevertheless, the Moran's I values calculated in the present study are statistically significant, and the similar Moran's I values from previous studies could support the validity of the analytic results obtained in this study.

The analytic results of the present study mean that there is spatial dependence in local suicide.; thus, geographically proximate localities have similar attributes. The results also mean that elderly suicide ideation and actual suicide are

Table 3. Moran's I values

Division		Contiguity	
		Queen	Rook
Total	Suicide ideation	0.219	0.220
	Actual suicide	0.205	0.212
Men	Suicide ideation	0.174	0.179
	Actual suicide	0.172	0.177
Women	Suicide ideation	0.211	0.210
	Actual suicide	0.087	0.092

affected by the situation of adjacent localities than that of remote localities. In other words, elderly suicide ideation and actual suicide are spatially clustered at similar levels among nearby localities having similar internal characteristics within a certain range. This may be understood as a result of the cultural and ideological influences given on adjacent localities through the network formed among the adjacent localities. In addition, the results support Hypothesis 1, which is that "Local suicide ideation and actual suicide among the elderly are spatially dependent."

Although Moran's I index is useful in investigating the level of spatial dependence in global spatial units, it has limitations in analyzing the clustering in a specific region. Therefore, we additionally performed a LISA analysis to measure the spatial dependence of local suicide ideation and actual suicide of the total elderly population at the local level. Figure 1 shows that the HH types of local elderly suicide ideation and actual suicide are generally found in Gangwon and Chungcheong provinces.[5] This supports the previous reports that the elderly suicide ideation and actual suicide at the local level are higher in non-urban and rural ares than in urban areas (Chang et al., 2011; Son, 2012; Song et al., 2010; Kim, 2009; Bae and Eom, 2009).

In comparison with the elderly living in urban areas, the elderly in rural areas are more vulnerable due to the decrease of social activities and the lack of social support networks. In addition, social and emotional isolation increases depression as well as the possibility of suicide ideation or suicide behavior (Chang et al., 2011; Son, 2012; Song et al., 2010; Kim, 2009; Bae and Eom, 2009). The localities of the HH type found in the analytic results, are also the less urbanized areas. Hence, the spatial clustering of the localities may be understood as the result of a similar level of spatial, social and cultural severance in contrast to urban areas.

The results of the present study also show that the spatial clustering with regard to actual suicide are overlapped or extended at localities showing spatial clustering with regard to suicide ideation. For example, in Gangwon and Chungcheong provinces where the HH type of suicide ideation was found, the HH type of suicide rate was also found to be overlapped or clustered. This suggests that the intensification of the influence of the local network between the localities

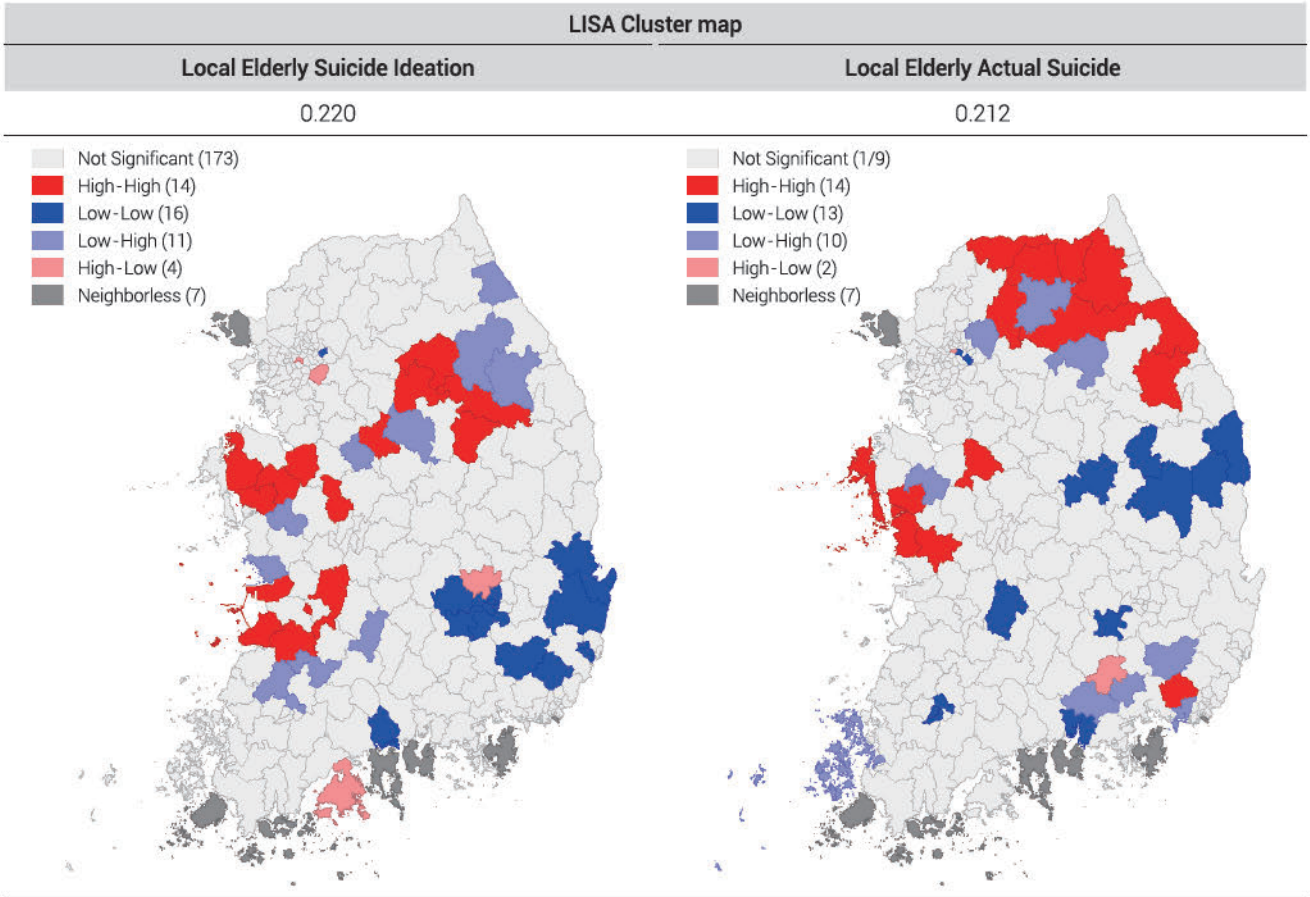

Figure 1. LISA cluster maps of local suicide ideation and actual suicide among the elderly

caused the homogenization of the local residents. The experience of suicide ideation is the most important predictive factor of suicide behavior (Park, 2015; Ronald et al., 2015), and localities within a certain range have a similar network of probability. As the mutual influences increase among the localities through the network, the residents within a specific range are highly likely to be homogenized in their mind set. Therefore, the stress environment may be recognized similarly in the regions surrounding a certain region where the local residents are vulnerable to a stressful environment.

2. Differences in spatial dependence between men and women

Next, to examine Hypotheses 2 and 3 of the present study, we analyzed the difference in spatial dependence between local suicide ideation and actual suicide among the elderly between men and women.

First, we analyzed the global spatial dependence of local elderly suicide ideation according to gender. Table 3 shows that the Moran's I values of local suicide ideation of elderly men and elderly women were 0.179 and 0.210, respectively. The Moran's I values showed that the two groups have positive spatial dependence in common. Nevertheless, it should be noted that the Moran's I value is higher in elderly women than in elderly men.

It was mentioned earlier that the spatial dependence of elderly suicide ideation may be higher in elderly women than in elderly men. Women are affected by others' opinions and behavior more than men (Jun and Namgung, 2018). With regard to social networks, women provide more social support to others and maintain emotionally close relationships compared to men (Antonucci, 2001). Therefore, the analytic results show that elderly women may be more vulnerable to mental and emotional stresses that can affect suicide ideation, such as depression; thus, their spatial dependence may be higher. In addition, the analytic results support Hypothesis 2 that the level of spatial dependence in local suicide ideation is higher for elderly women than elderly men.

Next, the LISA analysis was used to analyze the difference of the spatial clustering of local elderly suicide ideation between men and women. As shown in Figure 2, the spatial

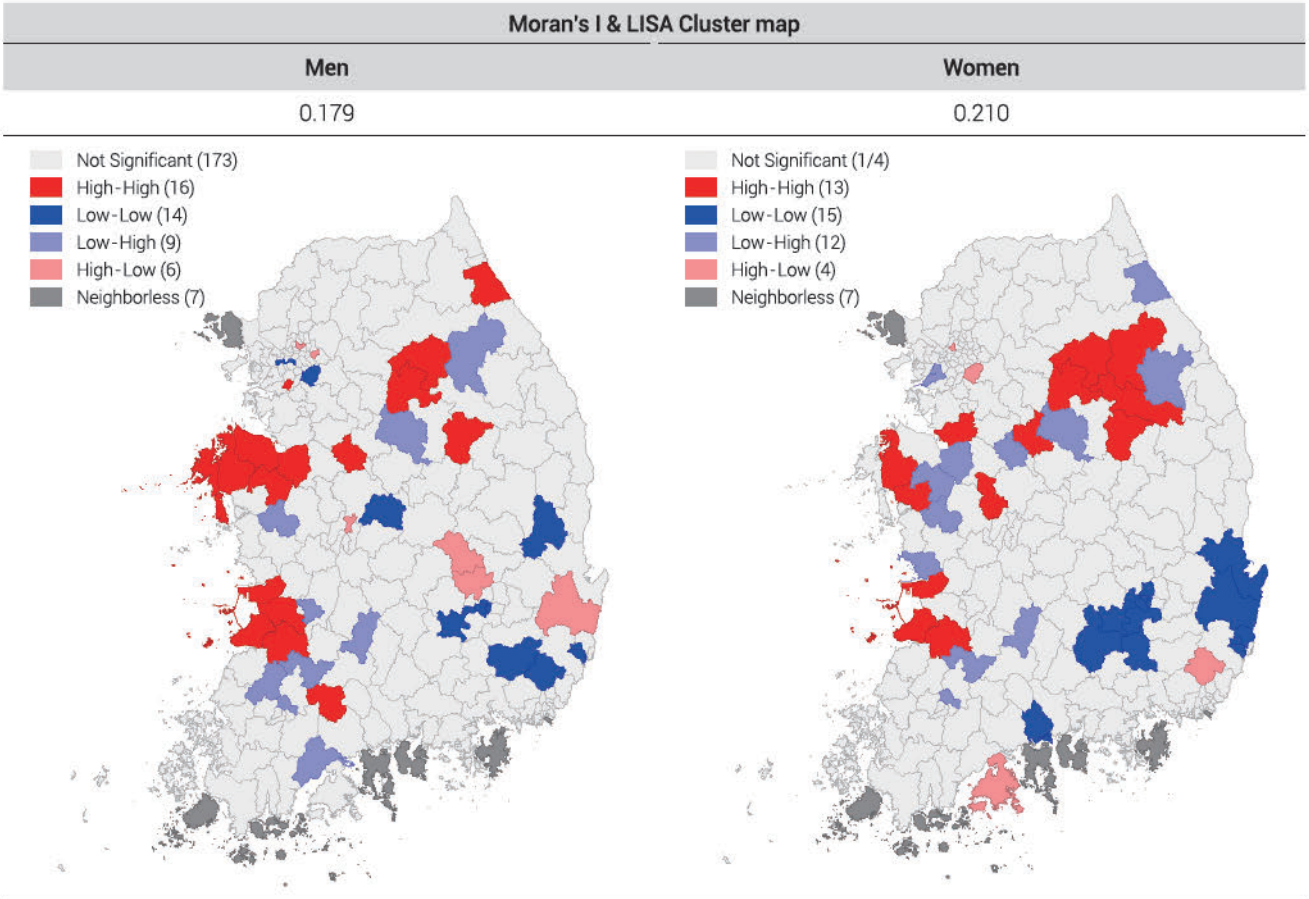

Figure 2. Gender difference in spatial dependence on local suicide ideation

clustering of suicide ideation was found in the non-captial region in both elderly men and elderly women. More specifically, the HH type of local suicide ideation was found in the Chungcheon, Gangwon and Jeonra regions in both elderly men and elderly women. However, the male elderly group showed more spatial clusters in the Chungcheong and Jeonra regions, while female elderly groups showed more spatial clusters in the Gangwon region.[6)]

Next, we analyzed the global spatial dependence of local actual suicide among the elderly according to gender. As shown in Table 3, the Moran's I values of local actual suicide of elderly men and elderly women was 0.177 and 0.092, respectively. That is, spatial dependence in local actual suicide is lower in elderly women while being relatively higher in elderly men.

As mentioned earlier, spatial dependence in local elderly suicide may be higher in men than in women. Generally, men have more negative recognition about environmental factors in comparison with women (Bass and Lambert, 2004). This trend may be stronger among elderly men who have experienced social retirement. Moreover, men, who are generally more aggressive than women, are more likely to actually carry out suicide (Joiner, 2005). On the contrary, the labeling effect generated by the actual execution of suicide is stronger on elderly women than on elderly men (Ji, 2012). Therefore, the substantial execution of suicide by elderly women, as well as its spatial dependence, may be lower in the group of elderly women who are more strongly affected by others.

In summary, the analytic results show that the spatial dependence of actual suicide by the 'Werther effect' through mass media or the impact of the suicide of an acquaintance may be stronger among elderly men than elderly women. Therefore, the results support Hypothesis 3 that the level of spatial dependence in local actual suicide is higher for elderly men than elderly women.

Next, using the LISA analysis, we analyzed the difference of the spatial clustering in the local actual suicide among the elderly between men and women. Figure 3 shows that, as in the case of suicide ideation, the spatial clustering of the actual suicide in both groups was found in the non-capital region. Specifically, the spatial clusters of the actual suicide

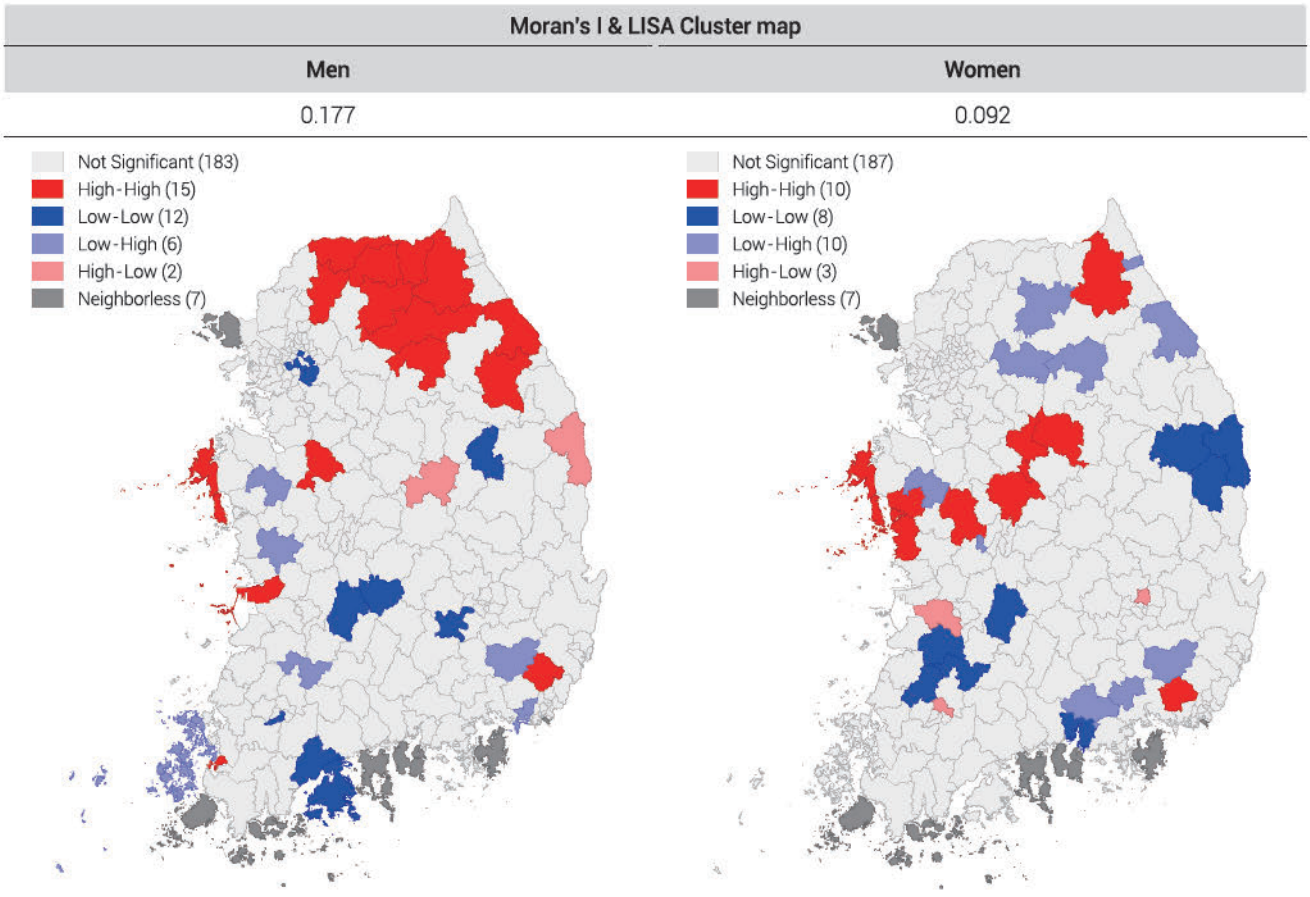

Figure 3. Gender differences in spatial dependence on actual suicide

in the two groups are concentrated in the Gangwon and Chungcheong regions. The HH type was found mostly in Gangwon in the male elderly group, while it was found mostly in Chungcheon in the female elderly group.[7)]

Despite the discussions described above, the weakened social network of women by geographical integration may be understood as one of the causes of spatial clustering of the HH type of suicide in elderly women. The localities where the HH type of suicide ideation and suicide rate of elderly women are found the Chungcheong region, including Sejong-si, Cheongju-si and Gongju-si. In particular, Sejong-si was formed by integrating former Yeonggi-gun, parts of Gongju-si, and former Cheongwon-gun, which was a remaining part of Cheongju-si in the past. The new inflow of population and the rapid development of areas incurred by the reorganization of the administrative areas must have caused a drastic change in the living environment of the indigenous residents. Hence, the level of social networks of elderly women that lasted a long time, might have decreased by the new population inflow and the change of residential areas.

As discussed above, in the actual execution of suicide, the labeling effect of suicide is stronger on elderly women than elderly men. Therefore, the spatial clusters of the suicide rate of elderly women in the localities may have formed because the influence of their social networks decreased due to the reorganization of administrative areas, which failed to offset the influence of the labeling effect related to suicide by elderly women.

V. Conclusion

The present study was conducted to supplement the limitations of previous studies on suicide among the elderly, focusing on spatial dependence. Most of the previous studies on elderly suicide have focused on the economic or psychological factors of individuals. However, this study was conducted by assuming that elderly suicide ideation and actual suicide may have spatial dependence according to Tobler's (1970) First Law of Geography that geographically proximate localities show similar characteristics due to the spill-over effect. The analytic results of the present study are summarized below.

First, local elderly suicide ideation and actual suicide showed spatial dependence. The localities showing high suicide ideation and actual suicide formed spatial clusters with adjacent regions having high suicide ideation and actual suicide, respectively. The spatial clusters were found mostly in Gangwon and Chungcheon. Considering that the two regions are mostly non-urban and rural areas, the spatial clustering may have occurred due to a similar level of spatial, social and cultural severance experienced in the regions in comparison with urban areas.

Second, the spatial dependence in local suicide ideation and actual suicide was different between the male elderly group and the female elderly group. Elderly women showed a higher level of spatial dependence in local suicide ideation than elderly men. This may be because elderly women have a higher level of spatial dependence with regard to mental and emotional stress than men, as elderly women are influenced by others' thoughts and behavior more strongly and they form stronger relationships with others. On the contrary, elderly men showed a higher level of spatial dependence in local actual suicide than elderly women. This may be because elderly men are more likely to recognize the circumstances negatively and to carry out suicide in comparison with elderly women.

The spatial clusters of suicide ideation were formed mostly in Chungcheon, Gangwon and Jeonra in both elderly men and elderly women. The spatial clusters of elderly men were more concentrated in Chungcheon and Jeonra, while those of elderly women were more concentrated in Gangwon. Similarly, the spatial clusters of the suicide rate were formed mostly in Chungcheon, Gangwon and Jeonra in both elderly men and elderly women. The spatial clusters of local elderly suicide among men were more concentrated in Gangwon, while those of among women were more concentrated in Chungcheong. Such a pattern of spatial clustering suggests that the policies related to elderly suicide may affect adjacent localities differently based on gender. Based on the analytic results, we provide the following policy implications. First, when making policies regarding elderly suicide, the impact on adjacent regions should be considered. The present study verified the presence of spatial dependence of local elderly suicide, which means that elderly suicide ideation and actual suicide in a certain locality is caused not only by the influences of the internal environment of the locality, but also through interactions with

the adjacent localities. This also means that the exacerbation or improvement of the suicide-related situation in the adjacent localities may similarly change the situation in the locality. Therefore, efforts should be made to design policies against elderly suicide in consideration of the influences of adjacent localities.

Second, the difference of spatial dependence between men and women should be taken into account when making policies against elderly suicide. The results of the present study showed that spatial dependence in local suicide ideation is stronger in elderly women, and that of local actual suicide is stronger in elderly men. This means that spatial dependence due to the vulnerability of mental and emotional health conditions is relatively strong in female elderly groups. This also means that the spatial dependence of the actual execution of suicide is relatively strong in male elderly groups. Therefore, the central government and local governments need to provide different suicide-preventing policies for different gender groups in consideration of the process leading to suicide. The present study also showed that the spatial clustering of suicide ideation and actual suicide are different between men and women. Hence, the government should make efforts to identify through continuous monitoring the adjacent localities where the elderly suicide becomes severe and to take preemptive measures based on preventive policies.

In the present study, we investigated the spatial pattern of local elderly suicide, focusing on the concept of spatial dependence. The limitation of the present study is that the spatial dependence of local elderly suicide ideation and actual suicide was analyzed for only the year of 2017. Local elderly suicide-related data of other years may be required to analyze the spatial distribution of elderly suicide and its pattern more systematically and effectively. Another limitation of the present study is that the factors of spatial clustering of local elderly suicide were not identified. The various factors that may influence local elderly suicide may need to be analyzed to obtain a more thorough understanding of elderly suicide depending on the locality or gender.

Note 1. The following equation was used in the present study to constitute the variable for local elderly suicide ideation:
Local suicidal ideation=(Number of elderly population over the age of 60 years within each locality who have experienced suicide ideation/Total number of elderly population over the age of 60 years within each locality)×100,000

Note 2. The following equation was used in the present study to constitute the variable for local actual elderly suicide:
Local actual suicide=(Number of elderly population over the age of 60 years within each locality whose cause of death was suicide/Total number of elderly population over the age of 60 years within each locality)×100,000

Note 3. Among the 225 administrative regions, the ratio of the elderly who had an experience of suicide ideation was lower in the order of Uljin-gun (1067.62), Gurye-gun (1438.85) and Yeongdeok-gun (1777.06). The actual suicide was lower in the order of Yeongyang-gun (0.00), Danyang-gun (9.15), and Gwangsan-gu in Gwangju (12.79).

Note 4. The Moran's I values for local suicide ideation and actual suicide of the entire elderly population calculated by the queen method were 0.219 and 0.205, respectively. The Moran's I values for local suicide ideation and actual suicide of the male elderly population were 0.174 and 0.172, respectively, and those of the female elderly population were 0.211 and 0.087, respectively. In pursuit of the robustness of the analytic results, we employed the queen method for the analysis. However, the analytic results based on the queen method were not critically different from the results obtained by the rook method, which provides relatively high Moran's I values.

Note 5. The HH type of suicide ideation of the total elderly population including both men and women was found in 14 localities, including Hoingseong-gun, Wonju-si and Yeongwol-gun in Gangwon; Eumseong-gun, Danyang-gun, Asan-si and Seonsan-si in Chungcheong; and Gunsan-si, Jeongeup-si, Wanju-gun and Buan-gun of Jeonbuk. The HH type of the actual suicide of the total elderly population was found in 14 localities, including Gangreung-si, Hongcheon-gun, Jeongseon-gun, Cheolwon-gun, Hwacheon-gun, Yanggu-gun and Inje-gun in Gangwon; and Cheonan-si, Boryeong-si, Buyeo-gun, Hongseong-gun, Taean-gun and Seocheon-si in Chungcheong.

Note 6. The HH type of suicide ideation of the male elderly group was found in 16 regions, including Wonju-si, Hongseong-gun and Yangyang-gun in Gangwon; Asan-si, Seosan-si, Dangjin-si, Yesan-gun, and Taean-gun in Cheongcheong; and Jeongeup-si, Gimjae-si, Buan-gun and Gokseong-gun in Jeonra. The HH type of suicide ideation of the female elderly group was found in 13 regions, including Hoingseong-gun, Wonju-si, Yeongwol-gun and Pyeongchang-gun in Gangwon; Eumseong-gun, Danyang-gun, Seosan-si and Hongseong-gun in Chungcheong; and Gunsan-si, Jeongeup-si and Buan-gun in Jeonbuk.

Note 7. The HH type of the actual suicide of the male elderly group was found in 15 localities, including Chuncheon-si, Gangreung-si, Hongcheon-gun, Jeongseon-gun, Cheolwon-gun, Hwancheon-gun, Yanggu-gun and Inje-gun in Gangwon. The HH type of the actual suicide of the female elderly group was found in 10 localities, including Cheongju-si, Chungju-si, Eumseong-gun, Jeungpyeong-gun, Gongju-si, Boryeong-si and Hongseong-gun in Chungcheong.

References

1. Anselin, L., 1995. "Local Indicators of Spatial Association–LISA", *Geographical Analysis*, 27(2): 93-115.
2. Anselin, L. and Bera, A.K., 1998. "Spatial Dependence in

Linear Regression Models with an Introduction to Spatial Econometrics." in *Handbook of Applied Economic Statistics*, edited by A. Ullah and D.E. Giles, 237-289. New York: Marcel Dekker.

3. Antonucci, T.C., 2001. "Social Relations: An Examination of Social Networks, Social Support, and Sense of Control." in *Handbook of the Psychology of Aging*, edited by J.E. Birren and K.W. Schaie, 427-453. New York: Academic Press.
4 Bae, J.H. and Um, K.W., 2009. "Factors Affecting Suicide Attempt of the Elderly", *Journal of the Korean Gerontological Society*, 29(4): 1427-1444.
배진희·엄기욱, 2009. "노인의 자살 시도에 영향을 미치는 요인", 「한국노년학」, 29(4): 1427-1444.
5. Bass, J.K. and Lambert, S.F., 2004. "Urban Adolescents' Perceptions of Their Neighborhoods: An Examination of Spatial Dependence", *Journal of Community Psychology*, 32(3): 277-293.
6. Bearman, P.S. and Moody, J., 2004. "Suicide and Friendships among American Adolescents", *American Journal of Public Health*, 94(1): 89-95.
7. Brent, D.A., Kerr, M.M., Goldstein, C., Bozigar, J., Wartella, M., and Allan, M.J., 1989. "An Outbreak of Suicide and Suicidal Behavior in a High School", *Journal of the American Academy of Child & Adolescent Psychiatry*, 28(6): 918-924.
8. Chan, H.L., Liu, C.Y., Chau, Y.L., and Chang, C.M., 2011. "Prevalence and Association of Suicide Ideation among Taiwanese Elderly–A Population-based Cross-sectional Study", *Chang Gung Medical Journal*, 34(2): 197-204.
9. Chang, S.J., 2010. "Structural and Functional Aspects of Social Network in Old Age, and the Subjective Quality of Life: Focusing on the Comparison according to Age and Gender", *Social Science Research Review*, 26(1): 75-100.
장수지, 2010. "노년기 사회적 관계망의 구조적, 기능적 측면과 주관적 삶의 질의 관계: 전후기노인 및 성별에 따른 비교를 중심으로", 「사회과학연구」, 26(1): 75-100.
10. Chang, S.S., Sterne, J.A.C., Wheeler, B.W., Lu, T.H., Lin, J.J., and Gunnell, D., 2011. "Geography of suicide in Taiwan: Spatial Patterning and Socioeconomic Correlates." Health and Place, 17: 641-650.
11. Chi, G. and Zhu, J., 2019. *Spatial Regression Models for the Social Sciences*, SAGE Publications.
12. Choi, H.Y., 2016. "Analysis of the Relationship between Community Characteristics and Depression Using Geographically Weighted Regression", Ph.D. Dissertation, Seoul University.
최형윤, 2016. "지리가중회귀모형을 이용한 지역사회 특성과 우울증의 관계 분석", 서울대학교 보건대학원 박사학위논문.
13. Chuang, H.L. and Huang, W.C., 2007. "A Re-examination of the Suicide Rates in Taiwan", *Social Indicators Research*, 83(3): 465-485.
14. Chun, H.J., 2016. "A Study on the Effect of Urban Environment Using GIS and Spatial Econometric Models on Residents Health", *Residential Environment Institute of Korea*, 14(2): 109-118.
전해정, 2016. "GIS와 공간통계를 활용한 도시환경 요인이 지역주민 건강에 미치는 영향에 관한 연구", 「주거환경」, 14(2): 109-118.
15. David, G.D., 2001. "Treating Depression in Old Age: the Reasons to be Positive", *Age and Ageing*, 30(1): 13-17.
16. Fischer, C.S. and Oliker, S.J., 1983. "A Research Note on Friendship, Gender, and the Life Cycle", *Social Forces*, 62(1): 124-133.
17. Girard, C., 1993. "Age, Gender, and Suicide: A Cross-national Analysis", *American Sociological Review*, 58(4): 553-574.
18. Glass, T., Balfour, J., Kawachi, I., and Berkman, L.F., 2003. *Neighborhoods and Health*, Oxford, UK: Oxford University Press.
19. Graziano, W.G., Jensen-Campbell, L.A., Shebilske, L.J., and Lundgren, S.R., 1993. "Social Influence, Sex Differences and Judgments of Beauty: Putting the Interpersonal Back in Interpersonal Attraction", *Journal of Personality and Social Psychology*, 65(3): 522-531.
20. Harwood, D., Hawton, K., Hope, T., and Jacoby, R., 2002. "The Grief Experiences and Needs of Bereaved Relatives and Friends of Older People Dying through Suicide: a Descriptive and Case-control Study", *Journal of Affective Disorders*, 72(2): 185-194.
21. Jang, J.H., Lee, Y.J., Cho, S.J., Cho, I.H., Shin, N.Y., and Kim, S.J., 2014. "Psychotic-like Experiences and Their Relationship to Suicidal Ideation in Adolescents", *Psychiatry Research*, 215(3): 641-645.
22. Jencks, C. and Mayer, S.E.,1990. *The Social Consequences of Growing up in a Poor Neighborhood*, National Academy Press.
23. Ji, C.L., 2012. "A Study on Adolescents' Suicide Thought by Gender: Based on a Sample Survey of Elementary, Middle, and High School Students", Ph.D. Dissertation, Busan University.
지추련, 2012. "청소년의 자살생각에 대한 성별 연구", 부산대학교 박사학위논문.
24. Joo, Y.H. and Lee, H.Y., 2014. "Spatial-Temporal Diffusion of the Elderly Suicide by Gender", *Korea Journal of Population Studies*, 37(3): 1-23.
주유형·이희연, 2014. "성별 노인 자살의 시· 공간적 확산에 관한 연구", 「한국인구학」, 37(3): 1-23.
25. Joo, Y.H., 2014. "Spatial-temporal Diffusion of Elderly Suicide and Analysis of Neighborhood Environmental Factors", Ph.D. Dissertation, Seoul University.
주유형, 2014. "노인 자살의 시·공간적 확산과 지역환경 요인 분석", 서울대학교 대학원 박사학위논문.
26. Jun, H.J., 2017. "The Spatial Dynamics of Neighborhood Change: Exploring Spatial Dependence in Neighborhood Housing Value Change", *Housing Studies*, 32(6): 717-741.
27. Jun, H.J., 2020. "Spillover Effects in Neighborhood Housing Value Change: a Spatial Analysis", *Housing Studies*, 1-28.
28. Jun, H.J. and Namgung, M., 2018. "Gender Difference and Spatial Heterogeneity in Local Obesity", *International Journal of Environmental Research and Public Health*, 15(2): 311.
29. Jung, J.W. and Song, H.J., 2012. "A Study on Subjective Old-

Age Perception and Subjective Life Satisfaction of the Middle-Old Aged in Their 60s", *Korean Journal of Gerontological Social Welfare*, 57: 333-355.
정주원·송현주, 2012. "60대 중고령자들의 주관적 노후인식과 주관적 삶의 만족도에 관한 연구", 「노인복지연구」, 57: 333-355.

30. Kawachi, I. and Berkman, L.F., 2001. "Social Ties and Mental Health", *Journal of Urban Health*, 78(3): 458-467.

31. Kim, H.S. and Kwon, L.K., 2013. "Relationship between Elderly Suicide Rates and Socio-economic Factors in Korea: centering around the Trend of Changes in 1990~2010", *Journal of the Korea Contents Association*, 13(6): 236-245.
김형수·권이경, 2013. "한국 노인자살률과 사회·경제적 요인의 관련성: 1990년~2010년 변화 추이를 중심으로", 「한국콘텐츠학회논문지」, 13(6): 236-245.

32. Kim, H.S. and Kim, S.H., 2014. "Elderly's Suicide Differentials and Their Factors: Focusing on 16 Metropolises and Provinces in Korea", *Journal of the Korea Contents Association*, 14(11): 215-224.
김형수·김신향, 2014. "우리나라 노인자살률의 지역적 편차와 요인에 관한 연구: 16개 광역시·도를 중심으로", 「한국콘텐츠학회논문지」, 14(11): 215-224.

33. Kim, K.W. and Kim, H.G., 2011. "Macro Analysis of Factors Impacting on the Elderly's Suicide Rates in the Republic of Korea", *Korea Journal of Population Studies*, 34(3): 31-54.
김기원·김한곤, 2011. "노인자살률에 영향을 미치는 요인에 대한 거시적 분석", 「한국인구학」, 34(3): 31-54.

34. Kim, M.Y., 2013. "An Analysis on the Suicide Rates of Korea: Focusing on the Social, Cultural and Economical Factors of the Community", Ph.D. Dissertation, Seoul National University.
김민영, 2013. "한국사회의 자살률에 관한 분석", 서울대학교 행정대학원 박사학위논문.

35. Kim, J.Y. and Kim, C.Y., 2016. "Impact Analysis of Community Suicide Rate: Focusing on Social Capital and Social Economy Status of Community", *Health and Social Science*, 41(1): 33-60.
김지연·김창엽, 2016. "사회자본과 지역인구사회학적 특성이 지역 자살률에 미치는 영향-서울시 자치구별 패널자료를 중심으로", 「보건과 사회과학」, 41(1): 33-60.

36. Kim, Y.J., 2009. "Mediating Effects of Social Supports on the Decrease of Depression of the Rural Elderly", *Korean Journal of Gerontological Social Welfare*, 46(1): 77-104.
김영주, 2009. "농촌노인의 우울에 대한 사회적 지지의 매개효과", 「노인복지연구」, 46(1): 77-104.

37. Kuramoto, S.J., Wilcox, H.C., and Latkin, C.A., 2013. "Social Integration and Suicide-related Ideation from a Social Network Perspective: A Longitudinal Study among Inner-city African Americans", *Suicide and Life-Threatening Behavior*, 43(4): 366-378.

38. Latkin, C.A. and Curry, A.D., 2003. "Stressful Neighborhoods and Depression: A Prospective Study of the Impact of Neighborhood Disorder", *Journal of Health and Social Behavior*, 44(1): 34-44.

39. Lee, B.J. and Oh, Y.J., 2008. "Household Types and Suicide Ideation among Elderly People in Korea", *Korean Journal of Family Medicine*, 46(10): 49-57.
이봉재·오윤진, 2008. "가구형태에 따른 노인의 자살생각 관련요인에 관한 연구", 「대한가정의학회지」, 46(10): 49-57.

40. Lee, H.Y. and Sim, J.H., 2011. *GIS Geographic Information Technology Theory and Practice*, Paju: Beobmunsa.
이희연·심재헌, 2011. 「GIS 지리정보학」, 파주: 법문사.

41. Lee, M.A., Kim, S.H., Park, J.H., and Shim, E.J., 2010. "Effects of Exposure to Suicidal Factors in Social Relationships and Family Factors on Suicidal Ideation and Behavior", *Korea Journal of Population Studies*, 33(2): 61-84.
이민아·김석호·박재현·심은정, 2010. "사회적 관계 내 자살경험과 가족이 자살생각 및 자살행동에 미치는 영향", 「한국인구학」, 33(2): 61-84.

42. Miller, S.J., Segal, D.L., and Coolidge, F.L. 2001. "A Comparison of Suicidal Thinking and Reasons for Living among Younger and Older Adults", *Death Studies*, 25(4): 357-365.

43. Morenoff, J.D., 2003. "Neighborhood Mechanisms and the Spatial Dynamics of Birth Weight", *American Journal of Sociology*, 108(5): 976-1017.

44. Noh, S.Y., 2013. "A Study on the Elderly's Suicide Rates caused Changes in Neighborhood Environment: An Empirical Study of the Leisure Welfare Facilities for the Elderly", Master Dissertation, Seoul National University.
노서영, 2013. "근린환경 변화에 따른 노인 자살률에 관한 연구: 노인여가복지시설을 중심으로", 서울대학교 대학원 석사학위논문.

45. Park, H.J., 2015. "Effect of Sleep Duration on Suicidal Ideation in Korean Adolescents", *The Journal of the Korean Society of School Health*, 28(1): 1-9.

46. Park, Y.M. and Kim, B.K., 2017. "The Study on Factors on Suicide Rates for the Elderly: Focused on Senior Job Creation", *Korean Public Administration Quarterly*, 29(4): 693-717.
박영미·김병규, 2017. "노인자살률에 미치는 영향 분석: 노인일자리창출사업을 중심으로", 「한국행정논집」, 29(4): 693-717.

47. Parker, S. and de Vries, B., 1993. "Patterns of Friendship for Women and Men in Same and Cross-Sex Relationships", *Journal of Social and Personal Relationships*, 10(4): 617-626.

48. Robbins, D. and Conroy, R., 1983. "A Cluster of Adolescent Suicide Attempts: Is Suicide Contagious?", *Journal of Adolescent Health Care*, 3(4): 253-255.

49. Robbins, D.R. and Alessi, N.E., 1985. "Suicide and the Dexamethasone Suppression Test in Adolescence", *Biological Psychiatry*, 20(1): 107-110.

50. Robert, S.A. and Li, L.W., 2001. "Age Variation in the Relationship between Community Socioeconomic Status and Adult Health", *Research on Aging*, 23(2): 234-259.

51. Roh, B.R., 2017. "The Regional Gap of Suicide Risk and the Spatio-Temporally Persistence Structures in South Korea", *Health and Social Welfare Review*, 37(4): 213-237.
노법래, 2017. "한국 자살 위험의 지역적 격차와 그 시공간적 고착 구조에 관한 연구", 「보건사회연구」, 37(4): 213-237.

52. Ronald, C.K., Patricia, B., Guilherme, B., Matthew, N., and Philip, S.W., 2015. "Trends in Suicide Ideation, Plans, Ges-

tures, and Attempts in the United States, 1990-1992 to 2001-2003", *American Medical Association*, 293(20): 2487-2495.

53. Salmon, P., 1987. "Decentralisation as an Incentive Scheme", *Oxford Review of Economic Policy*, 3(2): 24-43.

54. Seo, I.K. and Lee, Y.S., 2015. "Mediated Effects of Depression on the Relationship between Community Environment and Suicidal Ideation: A Comparative Study on the Elderly People Who Live Alone and Those Who Do Not", *Korean Journal of Gerontological Social Welfare*, 69: 383-415.
서인균·이연실, 2015. "지역사회환경과 자살 생각 간의 관계에 대한 우울의 매개효과: 독거노인과 비독거노인 비교연구", 「노인복지연구」, 69: 383-415.

55. Shin, H.J., Jung, I.J., Lee, S.A., Lee, H.Y., and Park, J.Y., 2014. "Factors Affecting Depression, Suicidal Ideation, Suicide Plans and Suicide Attempts in Adolescence", *Journal of School Social Work*, 27(1): 25-50.

56. Sohn, J.N., 2012. "A Study on Factors Influencing the Suicidal Ideation in Elderly People Who Live Alone or Live with Family", *Journal of Korean Academy of Psychiatric and Mental Health Nursing*, 21(2): 118-126.
손정남, 2012. "독거노인과 비독거노인의 자살생각 관련요인", 「정신간호학회지」, 21(2): 118-126.

57. Song, H.J. and Kim, G.H., 2013. "The Determinants on Existence of Independent Financial Resource by Aging Recognition Types of the Old Aged in Their 60s", *Korean Journal of Gerontological Social Welfare*, 61: 383-403.
송현주·김균희, 2013. "60대 고령자의 노후 인식 유형별독립적 경제력 유무에 미치는 영향 요인", 「노인복지연구」, 61: 383-403.

58. Song, Y.D., Son, J.A., and Park, S.M., 2010. "An Analysis of Eco-systematic Factors Influencing Suicidal Ideation of the Elderly Who Are Living Alone", *Journal of the Korean Gerontological Society*, 30(2): 643-660.
송영달·손지아·박순미, 2010. "독거노인의 자살생각에 영향을 미치는 생태체계적 요인분석", 「한국노년학」, 30(2): 643-660.

59. Statistics Korea, 2019. *Special Estimate of Future Population: 2017-2067*. Seoul.
통계청, 2019. 「장래인구특별추계: 2017-2067년」, 서울.

60. Thoits, P.A., 1985. "Social Support and Psychological Well-being: Theoretical Possibilities in Social Support: Theory", *Research and Applications*, 24: 51-72.

61. Tobler, W.R., 1970. "A Computer Movie Simulating Urban Growth in the Detroit Region", *Economic Geography*, 46(2): 234-240.

62. Walker, K., 1995. "Always There for Me: Friendship Patterns and Expectations among Middle and Working Class Men and Women", *Sociological Forum*, 10(2): 273-296.

63. Wellman, B., Carrington, P., and Hall, A., 1983. *Networks as Personal Communities*, Cambridge, UK: Cambridge University Press.

64. Wright, P.H., 1982. "Men's Friendships, Women's Friendships and the Alleged Inferiority of the Latter", *Sex Roles*. 8(1): 1-20.

65. You, Y.J., 2014. "A Study on Effective Factors on Elderly Suicide Rate of Si·Gun Area", Ph.D. Dissertation, Mokpo University.
유영직, 2014. "시·군지역의 노인자살률에 영향을 미치는 요인에 관한 연구", 목포대학교 대학원 박사학위논문.

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Appendix

Appendix 1. Suicide ideation and actual suicide among the elderly in localities

Division	Local suicide ideation			Local actual suicide		
	Total	Men	Women	Total	Men	Women
Seoul (25)						
Jongno-gu	7051.28	4838.71	8510.64	48.26	79.46	22.16
Jung-gu	7861.64	8730.16	7291.67	46.82	63.48	32.97
Yongsan-gu	6228.37	4201.68	7647.06	30.20	49.02	15.41
Seongdong-gu	13167.26	15503.88	11184.21	36.97	50.72	25.67
Gwangjin-gu	8677.69	5660.38	11029.41	25.69	42.07	11.85
Dongdaemun-gu	5015.67	2941.18	6557.38	25.04	46.27	7.26
Jungnang-gu	8955.22	3305.79	13605.44	37.79	59.23	19.63
Seongbuk-gu	10909.09	11475.41	10457.52	26.59	44.91	11.95
Gangbuk-gu	8510.64	6081.08	10497.24	47.18	77.09	23.49
Dobong-gu	11666.67	8333.33	14285.71	50.30	60.78	41.46
Nowon-gu	8771.93	4597.70	11347.52	48.37	85.30	20.10
Eunpyeong-gu	8208.96	8411.21	8074.53	31.44	53.12	14.13
Seodaemun-gu	12158.05	7407.41	15463.92	30.74	49.30	16.36
Mapo-gu	7251.91	4123.71	9090.91	34.61	55.62	18.57
Yangcheon-gu	10344.83	7317.07	13043.48	25.94	48.46	6.85
Gangseo-gu	12550.61	13888.89	11510.79	40.82	66.67	19.75
Guro-gu	8088.24	6422.02	9202.45	31.16	49.03	15.67
Geumcheon-gu	11846.69	5737.70	16363.64	49.98	76.05	27.28
Yeongdeungpo-gu	6410.26	970.87	10687.02	31.45	44.31	20.36
Dongjak-gu	11923.08	5309.73	17006.80	39.33	53.89	27.54
Gwanak-gu	7581.23	3968.25	10596.03	39.40	68.58	15.18
Seocho-gu	8755.76	8163.27	9243.70	27.98	40.81	17.18
Songpa-gu	4245.28	0.00	7500.00	30.92	47.41	16.53
Gangdong-gu	10483.87	12037.04	9285.71	34.72	51.78	20.05
Busan (16)						
Jung-gu	10059.17	8219.18	11458.33	29.95	51.27	13.33
Seo-gu	10964.91	7831.33	12758.62	39.47	62.63	21.55
Dong-gu	11111.11	9356.73	12260.54	28.53	57.52	6.30
Yeongdo-gu	16129.03	8783.78	20982.14	51.95	89.37	23.02
Busanjin-gu	11411.41	10218.98	12244.90	42.93	63.50	26.45
Dongnae-gu	6985.29	3361.34	9803.92	35.84	57.57	17.86
Nam-gu	8524.59	5555.56	11180.12	44.76	73.90	21.47
Buk-gu	5902.78	5384.62	6329.11	39.06	78.31	6.00
Haeundae-gu	8794.79	7500.00	9625.67	40.68	65.64	20.85
Saha-gu	7114.62	4629.63	8965.52	45.02	74.80	20.06
Geumjeong-gu	6158.36	5555.56	6598.98	38.62	56.13	24.36
Gangseo-gu	10256.41	8264.46	11842.11	30.66	32.24	29.23

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Division	Local suicide ideation			Local actual suicide		
	Total	Men	Women	Total	Men	Women
Yeonje-gu	13597.73	10596.03	15841.58	37.34	55.10	22.71
Suyeong-gu	7653.06	5357.14	9375.00	39.16	63.93	19.51
Sasang-gu	9122.81	6250.00	11464.97	36.58	66.01	11.33
Gijang-gun	12091.50	7142.86	15555.56	32.03	66.36	5.66
Daegu (8)						
Jung-gu	5655.53	3750.00	6986.90	39.06	80.45	8.49
Dong-gu	8235.29	6451.61	9729.73	48.77	100.54	8.66
Seo-gu	5263.16	5194.81	5319.15	42.26	64.45	25.02
Nam-gu	7323.94	5263.16	8867.00	30.75	49.76	16.53
Buk-gu	5555.56	2020.20	8148.15	41.45	64.89	23.09
Suseong-gu	6504.07	6306.31	6666.67	33.71	63.47	10.68
Dalseo-gu	7346.94	4385.96	9923.66	41.12	56.20	28.98
Dalseong-gun	5179.28	3921.57	6040.27	26.26	35.27	18.99
Incheon (9)						
Jung-gu	8794.79	5555.56	11049.72	34.75	56.90	16.03
Dong-gu	14438.50	8750.00	18691.59	39.50	64.36	20.09
Michuhol-gu	10000.00	9734.51	10218.98	32.30	60.80	8.47
Yeonsu-gu	7471.26	4819.28	9890.11	50.04	85.54	21.12
Namdong-gu	19469.03	13043.48	23880.60	50.07	83.44	23.11
Bupyeong-gu	9963.10	8181.82	11180.12	49.77	76.99	26.78
Gyeyang-gu	12500.00	10000.00	14754.10	44.65	69.14	23.93
Seo-gu	8888.89	6172.84	11111.11	35.03	49.51	23.27
Ganghwa-gun	5607.48	4819.28	6293.71	18.90	41.41	0.00
Gwangju (5)						
Dong-gu	9444.44	8045.98	10752.69	30.43	59.42	6.89
Seo-gu	11583.01	8490.57	13725.49	23.09	39.20	10.34
Nam-gu	9785.93	7382.55	11797.75	34.65	59.38	15.40
Buk-gu	9243.70	7766.99	10370.37	38.94	56.51	24.87
Gwangsan-gu	19270.83	15189.87	22123.89	12.79	30.04	0.00
Daejeon (5)						
Dong-gu	7076.92	5263.16	8670.52	42.29	68.65	20.90
Jung-gu	8588.96	4285.71	11827.96	25.02	32.09	19.34
Seo-gu	4147.47	3191.49	4878.05	44.09	77.18	16.61
Yuseong-gu	7878.79	4166.67	10752.69	59.69	41.88	74.62
Daedeok-gu	9574.47	9821.43	9411.76	45.69	62.99	31.34
Ulsan (5)						
Jung-gu	7751.94	6837.61	8510.64	25.81	51.05	4.34
Nam-gu	6896.55	5194.81	8247.42	49.48	58.62	41.28
Dong-gu	4433.50	1010.10	7692.31	69.71	86.95	53.15
Buk-gu	5555.56	5194.81	5882.35	36.78	49.87	25.59
Ulju-gun	1067.62	729.93	1388.89	42.64	66.23	22.99

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Division	Local suicide ideation			Local actual suicide		
	Total	Men	Women	Total	Men	Women
Sejong (1)						
Sejong-si	12888.89	10526.32	14615.38	35.30	67.51	9.74
Gyeonggi (31)						
Suwon-si	11990.11	11602.21	12304.25	37.75	63.74	16.77
Seongnam-si	11958.76	7616.71	15097.69	47.13	70.79	27.58
Uijeongbu-si	12075.47	7964.60	15131.58	56.58	88.71	30.96
Anyang-si	14354.07	12834.22	15584.42	31.92	49.51	17.08
Bucheon-si	8103.98	3378.38	12011.17	35.70	64.01	11.84
Gwangmyeong-si	12442.40	5555.56	17322.83	30.07	55.73	9.55
Pyeongtaek-si	14579.06	11848.34	16666.67	62.79	114.52	21.23
Dongducheon-si	8750.00	5263.16	11229.95	40.73	83.60	7.98
Ansan-si	16065.57	14925.37	16959.06	51.32	80.66	26.68
Goyang-si	7923.93	6293.71	9275.36	45.14	81.68	16.01
Gwacheon-si	8108.11	6363.64	9395.97	36.87	42.15	32.77
Guri-si	9704.64	6542.06	12307.69	59.18	74.99	45.87
Namyangju-si	11600.00	6930.69	14765.10	39.04	55.42	25.42
Osan-si	11258.28	2985.07	17857.14	36.13	62.59	14.57
Siheung-si	7792.21	4054.05	11250.00	45.72	68.89	25.85
Gunpo-si	11363.64	10280.37	12389.38	43.10	55.14	33.15
Uiwang-si	14007.78	10084.03	17391.30	29.71	48.40	13.76
Hanam-si	6030.15	5747.13	6250.00	30.80	32.65	29.15
Yongin-si	8491.95	8561.64	8439.90	38.43	57.48	22.88
Paju-si	9634.55	10434.78	9139.78	52.34	66.26	41.15
Icheon-si	4477.61	1652.89	6802.72	47.86	75.55	24.51
Anseong-si	12101.91	6201.55	16216.22	57.09	92.58	28.23
Gimpo-si	9543.57	1904.76	15441.18	36.88	49.23	26.53
Hwaseong-si	11173.18	6944.44	14018.69	47.44	84.95	15.71
Gwangju-si	3968.25	2608.70	5109.49	52.25	87.90	19.93
Yangju-si	7624.63	4516.13	10215.05	34.71	53.76	18.40
Pocheon-si	14367.82	10067.11	17587.94	86.74	142.99	36.93
Yeoju-si	16666.67	16022.10	17209.30	62.41	75.91	51.06
Yeoncheon-gun	12398.37	11274.51	13194.44	50.82	112.66	0.00
Gapyeong-gun	9424.08	8875.74	9859.15	61.56	99.52	28.71
Yangpyeong-gun	15632.75	12903.23	17972.35	57.88	100.04	21.55
Gangwon (18)						
Chuncheon-si	5835.54	4907.98	6542.06	42.76	82.56	11.71
Wonju-si	12500.00	9565.22	14765.10	58.15	92.19	31.05
Gangneung-si	16860.47	13636.36	19473.68	47.96	92.75	13.12
Donghae-si	12994.35	9271.52	15763.55	63.59	91.60	41.02
Taebaek-si	18130.31	11888.11	22380.95	54.77	123.62	0.00
Sokcho-si	4923.08	4081.63	5617.98	47.52	85.02	18.68

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Division	Local suicide ideation			Local actual suicide		
	Total	Men	Women	Total	Men	Women
Samcheok-si	13571.43	9523.81	16269.84	35.02	58.17	17.55
Hongcheon-gun	20704.85	16826.92	23983.74	73.59	89.53	59.88
Hoengseong-gun	13686.53	8372.09	18487.39	43.51	80.58	11.57
Yeongwol-gun	17062.63	15789.47	18110.24	58.13	96.25	26.57
Pyeongchang-gun	10483.87	4022.99	16161.62	113.94	171.71	65.47
Jeongseon-gun	7296.14	6091.37	8178.44	56.74	89.52	29.63
Cheorwon-gun	6553.40	2923.98	9128.63	72.85	111.29	43.09
Hwacheon-gun	10913.14	8163.27	13043.48	75.63	135.32	27.36
Yanggu-gun	4285.71	3921.57	4568.53	104.22	195.05	31.31
Inje-gun	19726.03	14689.27	24468.09	73.94	132.96	22.97
Goseong-gun	7526.88	4368.93	10038.61	40.98	47.44	36.06
Yangyang-gun	10185.19	10638.30	9836.07	62.16	69.91	55.95
Chungbuk (11)						
Chungju-si	8206.69	4964.54	10638.30	53.64	76.55	35.55
Jecheon-si	20000.00	16867.47	22429.91	45.11	75.02	20.54
Cheongju-si	11724.81	7095.34	15318.42	49.61	81.38	24.47
Boeun-gun	7706.77	4651.16	9779.18	51.69	102.14	13.04
Okcheon-gun	3711.34	1793.72	5343.51	44.34	87.88	9.92
Yeongdong-gun	13721.41	10606.06	15901.06	60.60	77.05	48.25
Jincheon-gun	10752.69	9032.26	11981.57	98.97	167.11	44.52
Goesan-gun	16763.01	11160.71	21016.95	25.51	14.31	34.52
Eumseong-gun	14029.85	10666.67	16756.76	62.35	90.87	38.30
Danyang-gun	13194.44	10638.30	15163.93	9.15	0.00	16.45
Jeungpyeong-gun	22666.67	17213.11	26404.49	51.07	57.90	45.68
Chungnam (15)						
Cheonan-si	28750.00	16923.08	36842.11	52.15	79.70	29.54
Gongju-si	12709.83	10344.83	14403.29	75.60	136.01	27.23
Boryeong-si	23275.86	14444.44	28873.24	60.90	95.32	34.16
Asan-si	12083.33	11224.49	12676.06	58.00	86.55	35.66
Seosan-si	19371.73	16666.67	21495.33	91.82	142.37	51.74
Nonsan-si	6024.10	4864.86	6956.52	47.78	84.79	18.90
Gyeryong-si	6550.22	2857.14	9677.42	16.63	38.25	0.00
Dangjin-si	22740.52	18831.17	25925.93	58.69	89.06	33.92
Geumsan-gun	14619.88	10747.66	17391.30	20.66	35.52	9.16
Buyeo-gun	10053.86	7173.00	12187.50	55.30	67.72	45.72
Seocheon-gun	10273.97	8730.16	11445.78	53.14	92.89	23.27
Cheongyang-gun	7619.05	3619.91	10526.32	75.47	85.99	67.24
Hongseong-gun	18635.17	15476.19	21126.76	74.16	130.03	31.23
Yesan-gun	11368.91	9644.67	12820.51	20.56	23.27	18.41
Taean-gun	21593.29	17727.27	24902.72	70.67	110.33	39.46

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Division	Local suicide ideation			Local actual suicide		
	Total	Men	Women	Total	Men	Women
Jeonbuk (14)						
Jeonju-si	7986.11	6034.48	9302.33	42.81	81.59	12.04
Gunsan-si	17628.21	14843.75	19565.22	44.34	73.35	20.82
Iksan-si	15864.02	13836.48	17525.77	54.14	97.30	20.76
Jeongeup-si	11740.04	8585.86	13978.49	58.37	119.83	14.32
Namwon-si	19957.98	17486.34	21501.71	52.04	97.77	19.17
Gimje-si	20765.03	16113.74	23668.64	56.73	97.28	27.23
Wanju-gun	11555.56	10106.38	12595.42	31.42	70.83	0.00
Jinan-gun	16000.00	11567.16	19578.31	19.26	22.30	16.94
Muju-gun	16801.62	9045.23	22033.90	31.20	49.73	17.88
Jangsu-gun	10485.44	7389.16	12500.00	22.25	0.00	38.33
Imsil-gun	16693.42	12446.35	19230.77	33.72	79.24	0.00
Sunchang-gun	8363.64	7511.74	8902.08	26.15	64.57	0.00
Gochang-gun	21388.37	16289.59	25000.00	39.87	64.51	22.60
Buan-gun	20275.59	11386.14	26143.79	52.28	113.76	8.16
Jeonnam (22)						
Mokpo-si	7835.82	4132.23	10884.35	41.11	84.28	7.68
Yeosu-si	8012.82	7142.86	8720.93	37.72	60.87	19.07
Suncheon-si	7164.18	8633.09	6122.45	46.65	72.22	26.62
Naju-si	13936.43	13953.49	13924.05	26.04	38.81	16.82
Gwangyang-si	9375.00	7766.99	10457.52	44.15	81.10	14.47
Damyang-gun	16283.52	13084.11	18506.49	40.95	96.20	0.00
Gokseong-gun	14882.03	9134.62	18367.35	49.32	101.79	13.78
Gurye-gun	1438.85	1834.86	1183.43	28.93	47.51	16.23
Goheung-gun	15130.43	12601.63	17021.28	38.67	39.36	38.20
Boseong-gun	4192.55	2469.14	5236.91	32.11	26.37	36.03
Hwasun-gun	21632.65	18378.38	23606.56	40.72	62.19	25.85
Jangheung-gun	14953.27	6930.69	19819.82	19.19	15.80	21.50
Gangjin-gun	12568.31	7655.50	15588.24	41.55	103.19	0.00
Haenam-gun	7835.82	4347.83	10030.40	29.43	44.61	18.78
Yeongam-gun	9218.44	6565.66	10963.46	63.99	84.42	49.59
Muan-gun	7416.27	6145.25	8368.20	80.57	134.71	41.02
Hampyeong-gun	7420.49	4888.89	9090.91	49.98	106.55	11.94
Yeonggwang-gun	11284.05	8653.85	13071.90	42.78	76.98	18.34
Jangseong-gun	10093.46	5803.57	13183.28	50.47	88.77	22.00
Wando-gun	12734.08	9803.92	14545.45	35.70	48.13	26.56
Jindo-gun	18019.80	12060.30	21895.42	64.32	39.64	81.16
Sinan-gun	10106.38	5045.87	13294.80	28.66	53.29	10.06
Gyeongbuk (23)						
Pohang-si	5263.16	2758.62	7418.40	36.91	58.53	18.70
Gyeongju-si	10077.52	9803.92	10256.41	27.63	51.09	10.15
Gimcheon-si	8292.68	3260.87	12389.38	58.51	95.94	30.93

(Continue on next page)

Division	Local suicide ideation			Local actual suicide		
	Total	Men	Women	Total	Men	Women
Andong-si	11951.22	7865.17	15086.21	25.23	43.92	11.08
Gumi-si	16142.56	13364.06	18461.54	23.97	44.87	7.20
Yeongju-si	15801.35	10000.00	20576.13	41.13	61.11	25.90
Yeongcheon-si	18777.29	12432.43	23076.92	64.87	87.96	47.03
Sangju-si	7608.70	5181.35	9363.30	46.41	85.46	18.67
Mungyeong-si	10204.08	5434.78	13071.90	42.47	83.08	13.27
Gyeongsan-si	13855.42	11111.11	15533.98	48.93	47.27	50.23
Gunwi-gun	4915.25	3493.45	5817.17	44.46	40.38	47.68
Uiseong-gun	8264.46	2439.02	12256.27	50.97	92.49	20.42
Cheongsong-gun	8365.02	5309.73	10666.67	53.60	82.05	31.65
Yeongyang-gun	6694.56	4568.53	8185.05	0.00	0.00	0.00
Yeongdeok-gun	1777.06	1250.00	2110.82	30.21	75.44	0.00
Cheongdo-gun	3208.56	3791.47	2857.14	53.00	87.38	27.63
Goryeong-gun	4656.32	5154.64	4280.16	25.06	38.20	14.85
Seongju-gun	2564.10	2884.62	2307.69	29.87	40.48	21.44
Chilgok-gun	11803.28	8633.09	14457.83	27.44	62.82	0.00
Yecheon-gun	6304.73	2857.14	8895.71	35.91	48.31	26.76
Bonghwa-gun	17406.75	12711.86	20795.11	14.37	32.87	0.00
Uljin-gun	10795.45	8133.97	12539.18	35.89	72.92	10.14
Changwon-si	10947.93	9451.22	12114.01	16.02	23.55	9.77
Gyeongnam (17)						
Jinju-si	5414.01	1600.00	7936.51	16.70	19.54	14.58
Tongyeong-si	14241.49	15384.62	13471.50	22.54	43.83	5.76
Sacheon-si	11320.75	6206.90	14601.77	148.64	292.23	46.29
Gimhae-si	6250.00	5208.33	7142.86	18.66	30.09	9.57
Miryang-si	7912.09	4736.84	10188.68	33.43	79.48	0.00
Geoje-si	10606.06	6410.26	13333.33	80.47	117.24	49.45
Yangsan-si	4564.32	2777.78	6015.04	111.76	177.08	58.76
Uiryeong-gun	17721.52	16097.56	18678.16	91.91	105.37	83.07
Haman-gun	14939.76	9248.55	19008.26	41.24	72.33	18.02
Changnyeong-gun	7356.32	5263.16	8979.59	34.77	63.20	14.80
Goseong-gun	18052.74	12371.13	21739.13	31.40	74.69	0.00
Namhae-gun	13780.26	9633.03	16614.42	30.65	38.49	25.46
Hadong-gun	8440.37	5479.45	10429.45	37.24	77.79	9.02
Sancheong-gun	10507.25	6190.48	13157.89	59.81	80.39	45.31
Hamyang-gun	16039.60	13829.79	17350.16	69.90	111.59	42.26
Geochang-gun	6306.31	5494.51	6870.23	29.34	48.08	16.49
Hapcheon-gun	7705.19	4054.05	9866.67	23.73	36.19	15.65

Appendix 2. Number of elderly suicides in localities

Division	Number of Elderly Suicides	
	Men	Women
Seoul (25)		
Jongno-gu	12	4
Jung-gu	8	5
Yongsan-gu	10	4
Seongdong-gu	13	8
Gwangjin-gu	12	4
Dongdaemun-gu	16	3
Jungnang-gu	23	9
Seongbuk-gu	18	6
Gangbuk-gu	26	10
Dobong-gu	21	17
Nowon-gu	39	12
Eunpyeong-gu	24	8
Seodaemun-gu	14	6
Mapo-gu	16	7
Yangcheon-gu	18	3
Gangseo-gu	33	12
Guro-gu	19	7
Geumcheon-gu	17	7
Yeongdeungpo-gu	15	8
Dongjak-gu	19	12
Gwanak-gu	30	8
Seocho-gu	14	7
Songpa-gu	12	7
Gangdong-gu	25	10
Busan (16)		
Jung-gu	3	1
Seo-gu	9	4
Dong-gu	7	1
Yeongdo-gu	15	5
Busanjin-gu	25	13
Dongnae-gu	16	6
Nam-gu	22	8
Buk-gu	22	2
Haeundae-gu	25	10
Saha-gu	25	8
Geumjeong-gu	15	8
Gangseo-gu	3	3
Yeonje-gu	12	6
Suyeong-gu	13	5
Sasang-gu	15	3
Gijang-gun	9	1
Daegu (8)		
Jung-gu	7	1
Dong-gu	36	4
Seo-gu	14	7
Nam-gu	9	4
Buk-gu	22	10
Siheung-si	16	7
Suseong-gu	23	5
Dalseo-gu	25	16
Dalseong-gun	6	4
Incheon (9)		
Jung-gu	6	2
Dong-gu	5	2
Michuhol-gu	12	2
Yeonsu-gu	33	10
Namdong-gu	35	12
Bupyeong-gu	17	7
Gyeyang-gu	22	9
Seo-gu	19	11
Ganghwa-gun	5	0
Gwangju (5)		
Dong-gu	7	1
Seo-gu	9	3
Nam-gu	12	4
Buk-gu	20	11
Gwangsan-gu	6	0
Daejeon (5)		
Dong-gu	16	6
Jung-gu	8	6
Seo-gu	27	7
Yuseong-gu	8	17
Daedeok-gu	10	6
Ulsan (5)		
Jung-gu	10	1
Nam-gu	14	11
Dong-gu	11	7
Buk-gu	5	3
Ulju-gun	12	5

(Continue on next page)

Division	Number of Elderly Suicides	
	Men	Women
Sejong (1)		
Sejong-si	11	2
Gyeonggi (31)		
Suwon-si	46	15
Seongnam-si	53	25
Uijeongbu-si	32	14
Anyang-si	22	9
Bucheon-si	41	9
Gwangmyeong-si	14	3
Pyeongtaek-si	39	9
Dongducheon-si	8	1
Ansan-si	33	13
Goyang-si	61	15
Gwacheon-si	2	2
Guri-si	11	8
Namyangju-si	29	16
Osan-si	7	2
Chungnam (15)		
Gunpo-si	11	8
Uiwang-si	6	2
Hanam-si	6	6
Yongin-si	41	20
Paju-si	22	17
Icheon-si	13	5
Anseong-si	16	6
Gimpo-si	14	9
Hwaseong-si	32	7
Gwangju-si	24	6
Yangju-si	10	4
Pocheon-si	24	7
Yeoju-si	10	8
Yeoncheon-gun	7	0
Gapyeong-gun	9	3
Yangpyeong-gun	16	4
Gangwon (18)		
Chuncheon-si	22	4
Wonju-si	26	11
Gangneung-si	22	4
Donghae-si	9	5
Taebaek-si	7	0
Sokcho-si	7	2
Samcheok-si	5	2
Hongcheon-gun	9	7
Hoengseong-gun	6	1
Yeongwol-gun	6	2
Pyeongchang-gun	11	5
Jeongseon-gun	5	2
Cheorwon-gun	6	3
Hwacheon-gun	4	1
Yanggu-gun	5	1
Inje-gun	5	1
Goseong-gun	2	2
Yangyang-gun	3	3
Chungbuk (11)		
Chungju-si	17	10
Jecheon-si	12	4
Cheongju-si	50	19
Boeun-gun	6	1
Okcheon-gun	7	1
Yeongdong-gun	6	5
Jincheon-gun	12	4
Goesan-gun	1	3
Eumseong-gun	10	5
Danyang-gun	0	1
Jeungpyeong-gun	2	2
Hampyeong-gun	6	1
Yeonggwang-gun	6	2
Jangseong-gun	6	2
Wando-gun	4	3
Jindo-gun	2	6
Sinan-gun	4	1
Gyeongbuk (23)		
Pohang-si	29	11
Gyeongju-si	15	4
Gimcheon-si	16	7
Andong-si	9	3
Gumi-si	10	2
Yeongju-si	9	5
Yeongcheon-si	13	9
Sangju-si	13	4
Mungyeong-si	9	2
Gyeongsan-si	11	15

(Continue on next page)

Division	Number of Elderly Suicides	
	Men	Women
Gunwi-gun	2	3
Uiseong-gun	10	3
Cheongsong-gun	4	2
Yeongyang-gun	0	0
Yeongdeok-gun	5	0
Cheongdo-gun	7	3
Goryeong-gun	2	1
Seongju-gun	3	2
Chilgok-gun	6	0
Yecheon-gun	4	3
Bonghwa-gun	2	0
Cheonan-si	31	14
Gongju-si	20	5
Boryeong-si	13	6
Asan-si	19	10
Seosan-si	24	11
Nonsan-si	14	4
Gyeryong-si	1	0
Dangjin-si	15	7
Geumsan-gun	3	1
Buyeo-gun	8	7
Seocheon-gun	9	3
Cheongyang-gun	5	5
Hongseong-gun	16	5
Yesan-gun	3	3
Taean-gun	11	5
Jeonbuk (14)		
Jeonju-si	43	8
Gunsan-si	20	7
Iksan-si	29	8
Jeongeup-si	18	3
Namwon-si	11	3
Gimje-si	13	5
Wanju-gun	8	0
Jinan-gun	1	1
Muju-gun	2	1
Jangsu-gun	0	2
Imsil-gun	4	0
Sunchang-gun	3	0
Gochang-gun	6	3
Buan-gun	10	1

Division	Number of Elderly Suicides	
	Men	Women
Jeonnam (22)		
Mokpo-si	17	2
Yeosu-si	18	7
Suncheon-si	17	8
Naju-si	5	3
Gwangyang-si	9	2
Damyang-gun	7	0
Gokseong-gun	5	1
Gurye-gun	2	1
Goheung-gun	5	7
Boseong-gun	2	4
Hwasun-gun	5	3
Jangheung-gun	1	2
Gangjin-gun	6	0
Haenam-gun	5	3
Yeongam-gun	6	5
Muan-gun	12	5
Uljin-gun	5	1
Changwon-si	20	10
Gyeongnam (17)		
Jinju-si	6	6
Tongyeong-si	6	1
Sacheon-si	36	8
Gimhae-si	10	4
Miryang-si	12	0
Geoje-si	18	9
Yangsan-si	44	18
Uiryeong-gun	5	6
Haman-gun	6	2
Changnyeong-gun	6	2
Goseong-gun	6	0
Namhae-gun	3	3
Hadong-gun	6	1
Sancheong-gun	5	4
Hamyang-gun	7	4
Geochang-gun	4	2
Hapcheon-gun	3	2