



Design and Methods of the Korean National Investigations of 70,000 Suicide Victims Through Police Records (The KNIGHTS Study)

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Objective The suicide rate in South Korea was the second highest among the Organization for Economic Cooperation and Development countries in 2017. The purpose of this study is to understand the characteristics of people who died by suicide in Korea from 2013–2017 and to better prevent suicide.

Methods This study was performed by the Korea Psychological Autopsy Center (KPAC), an affiliate of the Korea Ministry of Health and Welfare. According to the Korea National Statistical Office, the number of suicide victims nationwide was estimated to reach about 70,000 from 2013 to 2017. Comprehensive suicide records from all 254 police stations in South Korea were evaluated by 32 investigators who completed a 14-day didactic training program. Then, we evaluated the characteristics of suicide victims in association with disease data from the National Health Insurance Database (NHID), which is anonymously linked to personal information of suicide victims.

Results Thirty-one of 254 police stations in the Seoul metropolitan area were analyzed by August 10, 2018. Findings showed that the characteristics of suicide victims differed according to the nature of the region.

Conclusion Our results suggest that different strategies and methods are needed to prevent suicide by regional groups.

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Key Words Suicide, Police investigation record, South Korea, Region.

INTRODUCTION

The annual suicide rate in South Korea has been the highest among the Organization for Economic Cooperation and Development countries for the last decade. The annual age-standardized suicide rate in South Korea has gradually increased from 25.1 per 100,000 people in 2005 to 29.1.0 per 100,000 people in 2011.¹ The South Korean government enacted a law (The Act on the Prevention of Suicide and the De-

velopment of a Life-Savings Culture) in 2012² aiming to reduce the ever-increasing suicide rate. Suicide rates have declined slightly since the legislation, but South Korea is still at the top of the list, second only to Lithuania, which was incorporated into the OECD countries in 2018. Therefore, new efforts to reduce suicide in South Korea are sorely needed.

To prevent suicide, the first step is to determine the cause. However, this is not an easy task, as there are many reasons for which individuals may commit suicide. Moreover, suicide is not caused by a single factor but by a combination of various factors. According to Hawton and Saunders,³ multi-factorial causes of suicide are divided into the following: state-dependent or trait-dependent factors, and distal or proximal factors. A detailed analysis of the causes of suicide is needed to develop appropriate measures to prevent suicide. Furthermore, there has recently been an increasing awareness of the importance of evidence-based suicide prevention policies.⁴⁻⁷ Previ-

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ous studies on evidence-based suicide prevention strategies⁸⁻¹⁰ have revealed that different approaches are needed at the individual level and at the social level to prevent suicide.

Similarly to other countries, South Korea has many causes of suicide. A number of research studies¹¹⁻¹⁶ have examined causes of the high suicide rate in South Korea. In addition, a variety of suicide prevention policies are being implemented. However, rather than implementing evidence-based prevention policies by region, general preventive policies based on common causes of suicide are being put into action. For example, the Regional Mental Health Promotion Center, an affiliated organization of the Ministry of Health and Welfare, has policies to prevent suicide, but they do not reflect the nature of particular regions and the characteristics of suicide death in those regions. Therefore, policies implemented throughout the specific region are almost identical. In South Korea, districts have various regional characteristics. However, there is a lack of research on regional characteristics to implement preventive policies suitable for each region in South Korea. Thus, it is important to know the characteristics of each region, so as to implement policies suitable for the region to reduce suicide rates.

Few research studies have examined regional differences in suicides in South Korea. Most studies¹⁷⁻²⁷ have examined only the various risk factors and associations of individuals with specific diseases in South Korea. There has been one report on the topic²⁸ but it only concluded that there were differences in regions and did not study the regional characteristics in detail. In order to find new ways to solve this problem, it is first necessary to analyze the nature of suicides by region.

In accordance with this view, the South Korean government started the Suicide Prevention Action Plan in 2018 to study regional differences between suicide victims. The purpose of this study is as follows: 1) to examine the regional characteristics of suicide victims in South Korea in detail, 2) to enforce evidence-based suicide prevention policies based on regional differences, and 3) to reduce the high suicide rate in South Korea.

METHODS

Pilot study

The Korea Psychological Autopsy Center conducted a pilot study that examined suicide victims in seven districts over two years, from 2016 to 2017. Before the pilot study, we reviewed the law with legal experts to prevent possible problems related to personal information in study and went through prior consultation with the National Police Agency and regional police station to examine data on all suicide victims officially recorded in police investigation records. In order to examine the characteristics of suicide victims in each region, we selected

districts that had unique characteristics of urban and rural areas. After this examination, we proved the validity and the necessity of this study that will be the cornerstone of local suicide prevention.

Process of investigation

Preparation of investigation

The South Korean government decided to expand its study on the characteristics of suicide victims by region across the country as one of the Suicide Prevention Action Plans in 2018. We organized an advisory committee, including experts from different fields (psychiatry, social welfare, statistics, law and public office) to examine the causes of suicide from a more diverse perspective. We held several meetings with the advisory committee to discuss the examination content, methods of analysis and interpretation of data based on the preliminary findings during the pilot study. We checked for errors and amendments confirmed through the pilot study in seven districts over two years. We proceeded with the research process in two sequential steps for a more in-depth investigation and analysis. First, we collected and analyzed more accurate data on personal information (ID number, age, sex and so on), locations, methods and main causes of suicide victims through police investigation records from 2013 to 2017. Second, we studied characteristics of suicide victims in association with disease data from the National Health Insurance Database (NHID), which is anonymously linked to the personal information (ID number, especially to identify an individual) of suicide victims. Because Korean health insurance is provided by the government through a universal health insurance system, every citizen is obligatorily inducted into the Korea National Health Insurance in their lifetime without exception.

Study population and districts

The study was performed by the Korea Psychological Autopsy Center, an affiliate of the Korea Ministry of Health and Welfare operated by the Sungkyunkwan University Research and Business Foundation. We made a plan to execute complete enumeration for examining all suicide victims during a five-year span, from 2013 to 2017, that were officially recorded in police investigation records in South Korea. The data examination for this study will be conducted from May 2018 to December 2019. This study was approved by the Institutional Review Board (IRB) of Samsung Medical Center. Informed consent was waived by IRB because we obtained data of deceased persons, therefore not violating the Personal Information Protection Act (SMC 2019-01-097).

South Korea is divided into 17 regions (1 Seoul metropolitan government; 1 autonomous city; 6 metropolitan cities; 9

provinces) according to administrative districts, and the 17 regions have 254 police stations in total. All 254 police stations in the 17 regions were included in the examination. According to the Korea National Statistical Office, the number of suicide victims nationwide was estimated to reach about 70,000 from 2013 to 2017. Among the 17 regions, the examination of 8 regions was completed in December 2018, and the examination for the rest of the regions is planned for next year, from January 2019 to December 2019 (Figure 1).

Selecting and educating investigators

A total of 32 investigators were recruited nationwide in May 2018, including mental health professionals: certified psychiatric and mental health nurses, mental health psychologists, and mental health social workers with experience in psychiatric epidemiologic surveys. All investigators received a 14-day training with didactic sessions including psychopathology related to suicide, understanding the examination items, and practical training for the examination. The practical training was utilized to facilitate acquisition of new knowledge of the examination, and group discussions were used to check inter-rater reliability. Furthermore, stress workshops were conduct-

ed twice before the investigation to prevent indirect and direct trauma that might occur during the investigation because the police investigation records include not only the details of suicide but also various photo data related to suicide. Also, our research team established regulations that one could receive treatment and emotional support related to trauma at any time if an unexpected direct or indirect trauma occurred during the investigation.

Measurement of examination

According to Edwin S. Shneidman, the original creator of the term psychological autopsy (PA), PA means to clarify an equivocal death and to arrive at the correct or accurate mode of that death. The Korea Psychological Autopsy Center²⁹ was established in 2014 for the examination of suicide victims and to support suicide survivors. It created the Korea-Psychological Autopsy Checklist (K-PAC), which we used to develop the Korea-Psychological Autopsy Checklist for Police Records (K-PAC-PR 1.0). We consulted with the advisory committee to correct and supplement this checklist based on K-PAC, which identifies the cause of death of suicide victims in the Korea Psychological Autopsy Center. In the first step, the examination

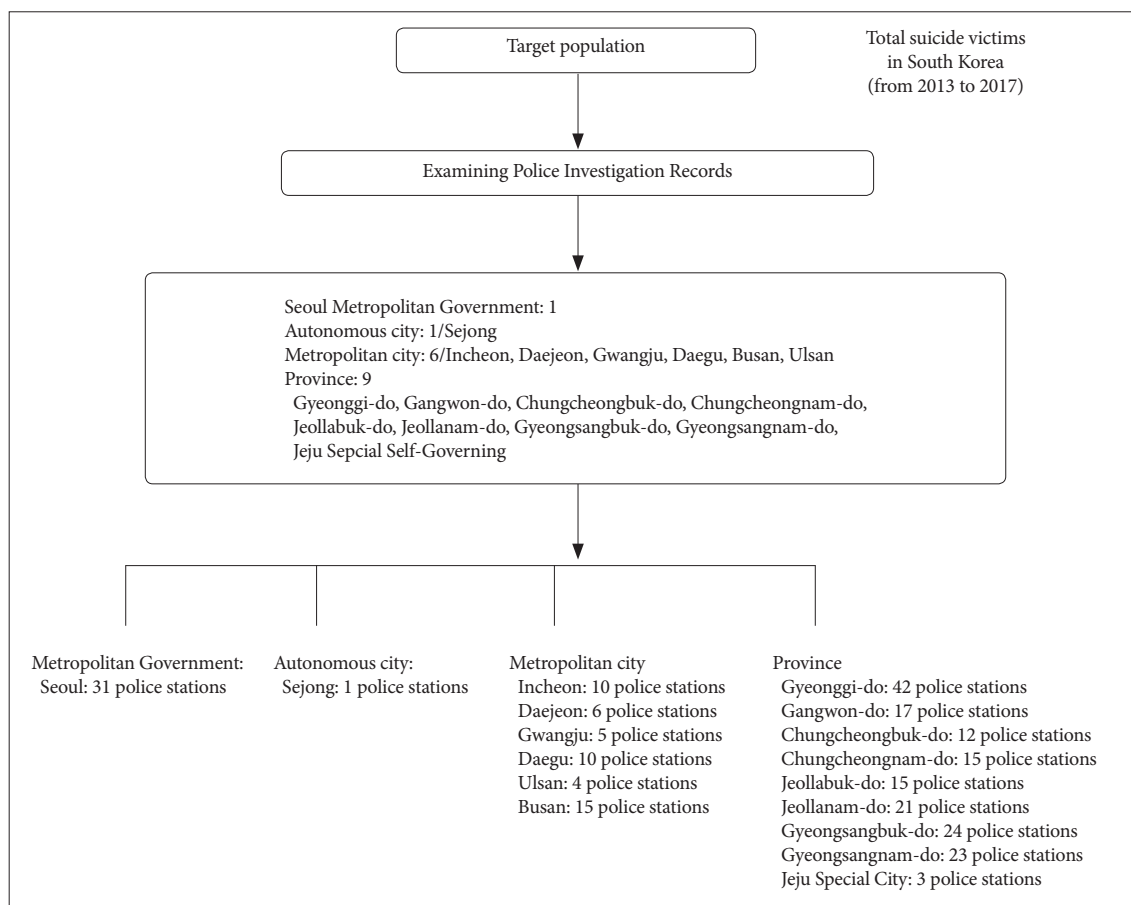


Figure 1. Study sample and investigation regions.

items are as follows: basic personal information on suicide victims, information related to the suicide, information on the suicide causes; and information from the statements of the persons concerned (Table 1). In the next step, the examination considers any mental and physical disorders of suicide victims with data from the National Health Insurance Database (NHID). NHID is based on claims data containing all citizens' demographics such as sex, age [in 5-year units], economic status [income distribution], disability, and healthcare utilization.

We developed a tool to examine the characteristics of suicide victims in police investigation records and made an electronic Case Report Form (eCRF) with the Korea Centers for Disease Control and Prevention (KCDC) for minimizing errors and increasing accuracy in collecting the data of suicide victims.

Statistical analysis

Depending on the type of examination of the characteristics of the suicide victims, it was necessary to vary our methods of analysis accordingly. We sought to perform a descriptive analysis of the personal information of the suicide victims and the information related to the suicide, and to carry out a nested case-control study for the analysis of suicide victims with psychiatric and physical disorders.

For the descriptive analysis, we calculated the absolute number of nationwide suicide victims by 17 regions based on this study and the rate of suicide per cause by regional group in the total study population and in subgroups stratified by sex and age (<19 years, 20–34 years, 35–49 years, 50–65 years, and >65 years). Next, we analyzed differences in locations, methods and main causes of suicide according to the age and sex of suicide victims.

To investigate whether the medical conditions of suicide victims were related to suicide, it was necessary to compare suicide victims versus the general population. In a retrospective study, a nested case-control design was appropriate to compare psychiatric and physical disorders of suicide victims

versus the general population. To determine whether the risk of suicide was increased with selected psychiatric and physical disorders, odds ratios (ORs) and two-tailed 95% confidence intervals were estimated using conditional logistic regression models for matched case-control pairs. Crude models were inherently adjusted for sex and age by the study design with each disorder as exposure. In adjusted models, we included economic status (four categories), disability, and all psychiatric and physical disorders. To examine whether the effect of the disorder on the risk of suicide differed by sex and age, the same analysis was conducted for subgroups stratified by sex and age groups. All statistical analyses were performed with SAS version 9.4 (SAS Institute, Cary, NC, USA).

RESULTS

The results of this study are based on the data investigated until the end of 2018. We investigated suicide victims distributed among 31 police stations in the city of Seoul city and analyzed the characteristics of suicide victims in 25 districts. This report presents the framework of the analysis that we will continue until 2020 and shows the unique District A, which has somewhat different characteristics of suicide victims than Seoul. The study will continue to investigate 254 police stations until the end of December 2019. The analysis will be conducted in 229 regions, and reports from these regions will be provided to those responsible for local health care.

Demographic profiles of suicide victims by regional group

Table 2 describes the number of suicide victims and the demographic characteristics [sex, age, elderly (>65), marital status, solitary condition and employment status] of suicide victims in District A of Seoul from 2013–2017. It shows the year-by-year changes in the number of suicide victims in District A and their demographic characteristics, compared to all of Seoul. Therefore, Table 2 can help to better explain the characteristics

Table 1. Investigation factors list

Investigation factor	Detailed factors
Demographic characteristics	Name, Gender, Resident registration-based address, Actual residence address, Place of residence category, Education status, Employment status, Occupation, Marital status, Existence of cohabitant, Detail information of cohabitant, etc.
Information related to the suicide	Date of suicide, Date of Finding, Time of Finding, Estimated-time of death, Categories of location where found, First finder, Method of suicide, etc.
Information on the causes of suicide	Occupational Problem, Economic Problem, Family-related problem, Interpersonal problem, Physical health problem, Mental health problem, Symptoms of mental health problem, Estimated mental illness, History of psychiatric diagnosis or treatment, etc.
Informants' interview information	Relationship with the victim, Changes in the victim before death, warning signs: verbal, behavioral, emotional, etc.

of suicide victims in District A.

Locations, methods and causes of suicide victims

Table 3 describes the locations, methods and main causes

of suicide victims in District A of Seoul from 2013–2017. This table also represents specific information related to suicide and how different District A is from Seoul. In particular, District A has different features related to suicide method compared to

Table 2. Demographic profiles of suicide victims in District A

	District A					Seoul	
	2013	2014	2015	2016	2017	Total of district A	Total of Seoul
Number	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)
Sex							
Male	65 (48.9%)	78 (57.4%)	46 (42.6%)	62 (57.4%)	59 (67.8%)	310 (54.2%)	6,629 (67.0%)
Female	68 (51.1%)	58 (42.6%)	62 (57.4%)	46 (42.6%)	28 (32.2%)	262 (45.8%)	3,262 (33.0%)
Unknown	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.0%)
Total	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)
Age							
Under 10's	2 (1.5%)	6 (4.4%)	3 (2.8%)	6 (5.6%)	1 (1.1%)	18 (3.1%)	248 (2.5%)
20's	22 (16.5%)	26 (19.1%)	20 (18.5%)	23 (21.3%)	10 (11.5%)	101 (17.7%)	1,086 (11.0%)
30's	46 (34.6%)	40 (29.4%)	32 (29.6%)	24 (22.2%)	30 (34.5%)	172 (30.1%)	1,628 (16.5%)
40's	20 (15.0%)	18 (13.2%)	20 (18.5%)	20 (18.5%)	20 (23.0%)	98 (17.1%)	1,788 (18.1%)
50's	23 (17.3%)	21 (15.4%)	13 (12.0%)	15 (13.9%)	11 (12.6%)	83 (14.5%)	1,912 (19.3%)
60's	8 (6.0%)	15 (11.0%)	7 (6.5%)	13 (12.0%)	7 (8.0%)	50 (8.7%)	1,263 (12.8%)
80's	9 (6.8%)	7 (5.1%)	5 (4.6%)	4 (3.7%)	2 (2.3%)	27 (4.7%)	1,291 (13.0%)
80's	2 (1.5%)	1 (0.7%)	8 (7.4%)	1 (0.9%)	5 (5.7%)	17 (3.0%)	559 (5.7%)
Over 90's	1 (0.8%)	2 (1.5%)	0 (0.0%)	2 (1.9%)	1 (1.1%)	6 (1.0%)	113 (1.1%)
Unknown	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (0.1%)
Total	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)
Marital status							
Married	39 (29.3%)	34 (25.0%)	32 (29.6%)	30 (27.8%)	27 (31.0%)	162 (28.3%)	3,749 (37.9%)
Unmarried	48 (36.1%)	56 (41.2%)	47 (43.5%)	49 (45.4%)	38 (43.7%)	238 (41.6%)	3,234 (32.7%)
Separated	3 (2.3%)	6 (4.4%)	1 (0.9%)	0 (0.0%)	1 (1.1%)	11 (1.9%)	335 (3.4%)
Divorced	16 (12.0%)	18 (13.2%)	16 (14.8%)	11 (10.2%)	5 (5.7%)	66 (11.5%)	1,283 (13.0%)
Widowed	5 (3.8%)	8 (5.9%)	6 (5.6%)	4 (3.7%)	3 (3.4%)	26 (4.5%)	621 (6.3%)
Unknown	22 (16.5%)	14 (10.3%)	6 (5.6%)	14 (13.0%)	13 (14.9%)	69 (12.1%)	671 (6.8%)
Total	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)
Living alone	48 (36.1%)	46 (33.8%)	37 (34.3%)	33 (30.6%)	22 (25.3%)	186 (32.5%)	2,754 (27.8%)
Employment status							
Employed	51 (38.3%)	49 (36.0%)	38 (35.2%)	34 (31.5%)	29 (33.3%)	201 (35.1%)	2,225 (22.5%)
Self-employed	11 (8.3%)	12 (8.8%)	9 (8.3%)	13 (12.0%)	10 (11.5%)	55 (9.6%)	956 (9.7%)
Housewife	8 (6.0%)	8 (5.9%)	10 (9.3%)	7 (6.5%)	4 (4.6%)	37 (6.5%)	505 (5.1%)
Student	4 (3.0%)	8 (5.9%)	6 (5.6%)	7 (6.5%)	5 (5.7%)	30 (5.2%)	433 (4.4%)
Unemployed	26 (19.5%)	34 (25.0%)	19 (17.6%)	27 (25.0%)	17 (19.5%)	123 (21.5%)	1,676 (16.9%)
Economic inactive	23 (17.3%)	17 (12.5%)	13 (12.0%)	10 (9.3%)	13 (14.9%)	76 (13.3%)	3,414 (34.5%)
Military service	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	25 (0.3%)
others	2 (1.5%)	0 (0.0%)	2 (1.9%)	0 (0.0%)	2 (2.3%)	6 (1.0%)	66 (0.7%)
Unknown	8 (6.0%)	8 (5.9%)	11 (10.2%)	10 (9.3%)	7 (8.0%)	44 (7.7%)	593 (6.0%)
Total	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)

those seen in Seoul. For example, there was more jumping and gas poisoning compared to the most common method of hanging in District A. These results can help to set different policies and directions to prevent suicide by region.

Characteristics of suicide victims by regional group

There are many ways to prevent suicide. According to Zalsman’s short communication,⁴ suicide prevention requires evidence-based strategies, and Zalsman’s 10-year systematic re-

view³⁰ said that a single strategy is insufficient and a cooperative strategy is needed. Therefore, to show the characteristics of suicide victims based on evidence, we implemented three strategies for various approaches. We also took three approaches to provide characteristics of suicide victims for locally customized suicide prevention projects. First, we focused on areas where both suicide rates and absolute number of suicides were high. Second, we tried to identify characteristics of each region that might have been distinct from other regions. Third, this study

Table 3. Locations, methods and causes of suicide victims in District A

	District A					Seoul	
	2013	2014	2015	2016	2017	Total of district A	Total of Seoul
Number	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)
Find location							
Home	90 (67.7%)	87 (64.0%)	67 (62.0%)	69 (63.9%)	41 (47.1%)	354 (61.9%)	5,860 (59.2%)
Public place	25 (18.8%)	27 (19.9%)	24 (22.2%)	22 (20.4%)	23 (26.4%)	121 (21.2%)	2,731 (27.6%)
School/work place	5 (3.8%)	9 (6.6%)	2 (1.9%)	4 (3.7%)	7 (8.0%)	27 (4.7%)	286 (2.9%)
Accommodations	5 (3.8%)	8 (5.9%)	9 (8.3%)	1 (0.9%)	7 (8.0%)	30 (5.2%)	414 (4.2%)
Suburbs/hill	1 (0.8%)	0 (0.0%)	1 (0.9%)	3 (2.8%)	0 (0.0%)	5 (0.9%)	276 (2.8%)
Hospital	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	1 (0.2%)	100 (1.0%)
Relatives’ home	0 (0.0%)	2 (1.5%)	1 (0.9%)	2 (1.9%)	3 (3.4%)	8 (1.4%)	90 (0.9%)
Acquaintances’ home	5 (3.8%)	2 (1.5%)	4 (3.7%)	4 (3.7%)	1 (1.1%)	16 (2.8%)	73 (0.7%)
Others	2 (1.5%)	1 (0.7%)	0 (0.0%)	2 (1.9%)	5 (5.7%)	10 (1.7%)	63 (0.6%)
Total	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)
Method of suicide							
Hanging	74 (55.6%)	83 (61.0%)	65 (60.2%)	67 (62.0%)	45 (51.7%)	334 (58.4%)	5,620 (56.8%)
Gas poisoning	18 (13.5%)	14 (10.3%)	14 (13.0%)	6 (5.6%)	10 (11.5%)	62 (10.8%)	1,105 (11.2%)
Pesticide poisoning	2 (1.5%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	1 (1.1%)	4 (0.7%)	172 (1.7%)
Jumping	28 (21.1%)	26 (19.1%)	27 (25.0%)	25 (23.1%)	24 (27.6%)	130 (22.7%)	1,977 (20.0%)
Drug poisoning	7 (5.3%)	4 (2.9%)	1 (0.9%)	4 (3.7%)	1 (1.1%)	17 (3.0%)	220 (2.2%)
Drowning	1 (0.8%)	3 (2.2%)	0 (0.0%)	2 (1.9%)	4 (4.6%)	10 (1.7%)	424 (4.3%)
Self-harm	2 (1.5%)	3 (2.2%)	1 (0.9%)	3 (2.8%)	2 (2.3%)	11 (1.9%)	204 (2.1%)
Others	1 (0.8%)	2 (1.5%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	4 (0.7%)	161 (1.6%)
Unknown	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (0.1%)
Total	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)
Main cause (problem)							
Occupational	9 (6.8%)	10 (7.4%)	6 (5.6%)	11 (10.2%)	12 (13.8%)	48 (8.4%)	513 (5.2%)
Economic	30 (22.6%)	35 (25.7%)	21 (19.4%)	21 (19.4%)	25 (28.7%)	132 (23.1%)	1,922 (19.4%)
Family-related	10 (7.5%)	5 (3.7%)	10 (9.3%)	5 (4.6%)	3 (3.4%)	33 (5.8%)	871 (8.8%)
Interpersonal	10 (7.5%)	8 (5.9%)	7 (6.5%)	4 (3.7%)	3 (3.4%)	32 (5.6%)	463 (4.7%)
Physical health	10 (7.5%)	9 (6.6%)	12 (11.1%)	10 (9.3%)	7 (8.0%)	48 (8.4%)	1,687 (17.1%)
Mental health	59 (44.4%)	65 (47.8%)	41 (38.0%)	52 (48.1%)	32 (36.8%)	249 (43.5%)	3,910 (39.5%)
Others	2 (1.5%)	1 (0.7%)	3 (2.8%)	1 (0.9%)	3 (3.4%)	10 (1.7%)	134 (1.4%)
Unknown	3 (2.3%)	3 (2.2%)	8 (7.4%)	4 (3.7%)	2 (2.3%)	20 (3.5%)	393 (4.0%)
Total	133 (100%)	136 (100%)	108 (100%)	108 (100%)	87 (100%)	572 (100%)	9,893 (100%)

analyzed characteristics of suicide victims in local residents that more closely reflected the characteristics of the region.

The suicide rate and the number of suicide victims

The suicide rate and the number of suicides are closely related. However, the suicide rate per 100,000 people and the number of suicide deaths may always not match. The suicide rate per 100,000 people is necessary for assessing a change or comparing suicide rates between regions, and the number of suicide victims is important to more actively select places in a region where suicide prevention is necessary. The number of suicides and suicide rates help local suicide prevention practitioners to be more effective in preventing suicide (Figure 2).

Centralized index

We sought to identify the characteristics of suicide victims in the region through five factors, including the locations, methods, and main causes of suicide, life cycle, and solitary life. Our examination was designed to help prevent suicide locally by determining the characteristics of local suicide victims. Therefore, we developed and applied the Centralized Index (CI) to compare regional characteristics in more detail. The CI is constructed as an indicator of the relative centralization tendency of the target value among five particular factors such as the Gini coefficient and entropy coefficient. This allowed us to analyze the relative level of the region of the re-

sults of the variables. According to Table 3, suicide is middle-aged men with mental health problems often commit suicide by hanging themselves in their homes. However, when CI is applied, there are cases where the different characteristics are shown for each district in the region.

Figure 3 illustrates the characteristics of a particular district in the region. Suicide victims in District A were mainly young women, and most were solitary people who lived alone. In the case of suicide victims in this district, the suicide prevention target can be narrowed because the characteristics differ from those of the norm. A clear understanding of characteristics of suicide victims in the region will thus lead to a more effective reduction of suicide rates.

Characteristics of suicide victims as regional residents

All suicides do not happen where people live. Some victims end their lives in their homes, and others travel far away to commit suicide. If you examine the characteristics of a suicide victim in a particular district, the victim may not be a resident of the district. To prevent localized suicides, it is important to distinguish the characteristics of suicide victims between those who live in the district and those who have committed suicide in other districts. Figure 4 provides a reflection of the characteristics of both suicide victims living in the district and those who do not. This result can explain the characteristics of people who come in from outside and commit suicide in the dis-

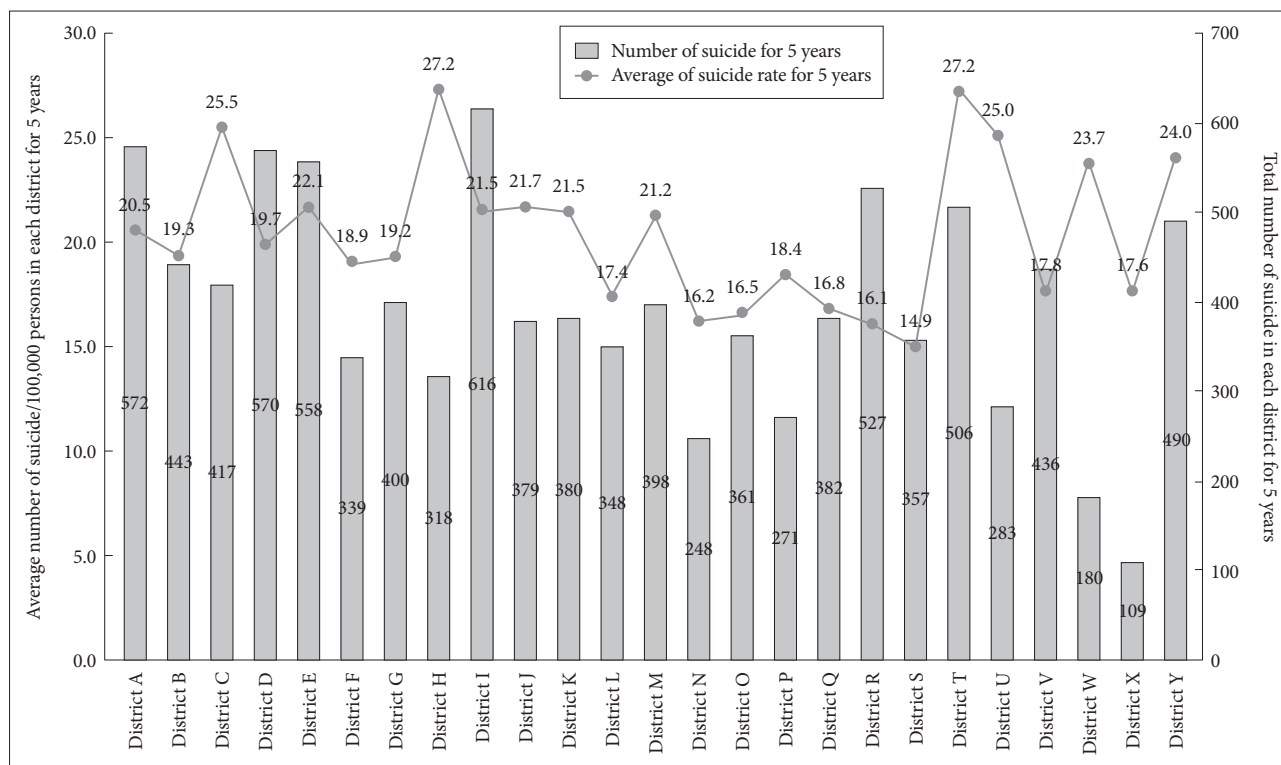


Figure 2. The suicide rate and the number of suicide victims in the region.

trict, which can help to prevent this type of suicide.

Relation between suicide and age group

Table 4 shows age-specific differences between psychiatric/physical disorders (Supplementary Table 1 in the online-only Data Supplement) and suicide of all suicide victims in Seoul

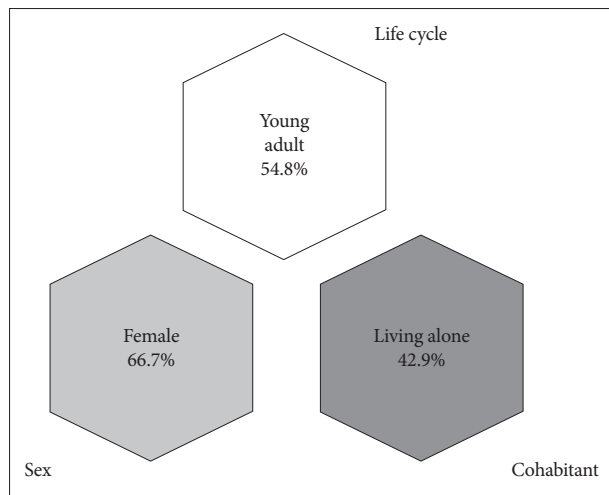


Figure 3. Centralized Index in the region.

over five years. We performed a nested case-control study to see the differences in the disorders associated with suicide between suicide victims and the general population in Seoul.

After adjusting for sex, economic status, disability, and all covariates listed in each age group, there were marked differences in the OR associated with suicide according to each age group. In the age group less than 19 years old, depression [adjusted OR (aOR)=4.38, 95% CI: 2.67–7.28] showed the strongest association with suicide. Schizophrenia showed the highest association with suicide in three age groups: 20–34 years (aOR=7.46, 95.05% CI: 5.86–9.51), 35–49 years (aOR=6.13, 95% CI: 5.05–7.45) and 50–65 years (aOR=3.86, 95% CI: 3.1–4.8). For the age group of more than 65 years, alcohol use disorder (aOR=2.34, 95% CI: 1.82–2.99) showed the strongest association with suicide. As shown in Table 4, schizophrenia showed high associations with risk of suicide for age groups of 20–34, 35–49, and 50–65 years.

These results indicate that associations of psychiatric/physical disorders with suicide are different among age groups in South Korea. Therefore, the Seoul Metropolitan Government has become more aware of what to watch for in order to prevent suicide in each age group.

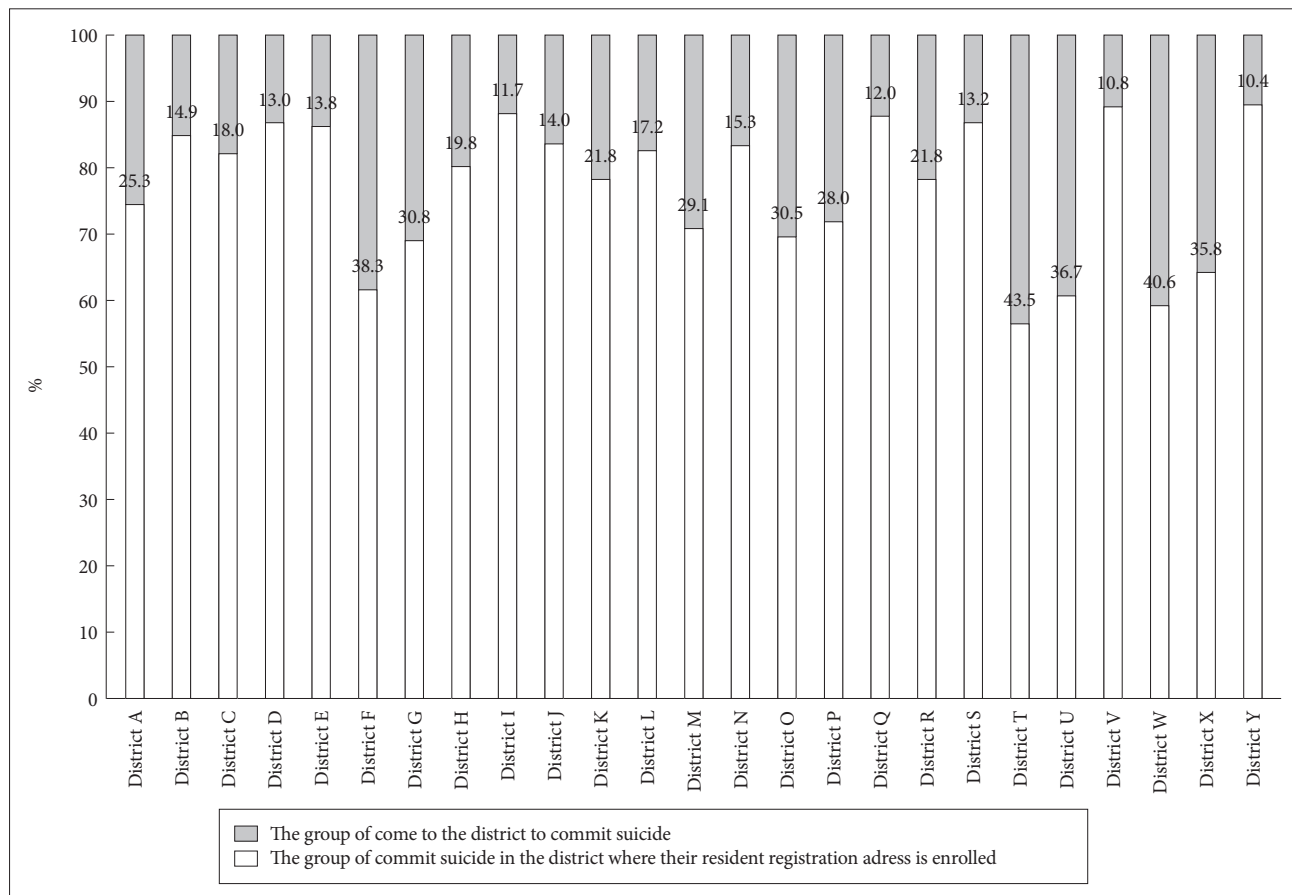


Figure 4. Characteristics of suicide victims as regional residents.

Table 4. Age differences in risks of suicide by each ICD-10 disorder in the police investigation report from 2013 to 2017

Disorders	aORs ^a (95% CI)				
	<19 years	20–34 years	35–49 years	50–65 years	>65 years
Psychiatric disorders					
Dementia	0.58 (0.1–3.33)	2.11 (1.29–3.45)	0.88 (0.58–1.34)	0.72 (0.54–0.97)	0.88 (0.78–1)
Alcohol use disorder	^b -	2.73 (1.85–4.04)****	3.95 (3.12–5.01)****	3.1 (2.56–3.75)****	2.34 (1.82–2.99)****
Schizophrenia	13.53 (4–45.81)**	7.46 (5.86–9.51)****	6.13 (5.05–7.45)****	3.86 (3.1–4.8)****	1.41 (1.06–1.86)
Bipolar disorder	13.19 (3.09–56.35)*	3.15 (2.35–4.22)****	2.5 (1.9–3.28)****	3.11 (2.35–4.12)****	2.17 (1.61–2.92)****
Depression	4.38 (2.67–7.18)****	3.8 (3.3–4.37)****	3.63 (3.2–4.12)****	3.57 (3.16–4.03)****	2.7 (2.43–3)****
Anxiety disorder	3.15 (1.67–5.95)*	1.73 (1.45–2.07)****	1.64 (1.41–1.91)****	1.55 (1.35–1.78)****	1.52 (1.37–1.7)****
Adjustment disorder	2.21 (1.13–4.31)	1.26 (1.01–1.58)	1.44 (1.16–1.79)*	1.68 (1.36–2.06)****	1.25 (1–1.55)
Somatoform disorder	1.63 (0.56–4.77)	1.16 (0.86–1.56)	1.29 (1.03–1.63)	1.43 (1.18–1.74)**	1.17 (1.01–1.36)
Sleep disorder	2.59 (1.04–6.47)	3.2 (2.71–3.77)****	3.22 (2.83–3.66)****	2.75 (2.44–3.09)****	2.18 (1.97–2.4)****
Personality disorder	2.43 (0.38–15.54)	1.92 (1.27–2.9)	0.85 (0.51–1.44)	1.14 (0.58–2.23)	0.75 (0.31–1.81)
Mental retardation	0.78 (0.15–4.09)	0.67 (0.33–1.34)	0.53 (0.21–1.32)	0.5 (0.22–1.11)	0.75 (0.38–1.5)
Developmental disorder	1.12 (0.39–3.26)	0.75 (0.33–1.73)	1.33 (0.45–3.95)	1.84 (0.51–6.61)	1.12 (0.4–3.14)
Childhood/adolescence disorder	1.17 (0.73–1.87)	0.91 (0.67–1.25)	0.72 (0.34–1.55)	0.4 (0.13–1.26)	1.3 (0.65–2.63)
Physical disorders					
Cancer	0.86 (0.44–1.69)	1.02 (0.86–1.21)	1.04 (0.91–1.17)	1.1 (0.99–1.23)	1.39 (1.27–1.52)****
Benign tumor	1.13 (0.69–1.85)	0.87 (0.75–1)	0.79 (0.71–0.89)**	0.81 (0.73–0.89)**	0.78 (0.71–0.85)****
Iron deficiency anemia	0.82 (0.36–1.85)	0.9 (0.69–1.17)	1.13 (0.92–1.38)	1.32 (1.07–1.63)	1.26 (1.07–1.49)
Disorder of the thyroid gland	0.86 (0.54–1.38)	1.05 (0.9–1.23)	0.76 (0.66–0.87)**	0.72 (0.63–0.83)***	0.86 (0.76–0.96)
Diabetes mellitus	^b -	0.88 (0.61–1.26)	1.25 (1.07–1.47)	1.33 (1.2–1.48)****	1 (0.91–1.09)
Other nutritional deficiencies	2.64 (0.31–22.26)	0.78 (0.5–1.23)	1.14 (0.81–1.61)	0.84 (0.61–1.15)	1.04 (0.84–1.3)
Epilepsy	0.15 (0.03–0.86)	1.06 (0.72–1.56)	1.94 (1.41–2.68)**	0.87 (0.61–1.22)	1 (0.78–1.29)
Migraine	0.89 (0.44–1.77)	0.96 (0.79–1.16)	0.85 (0.72–1.01)	0.76 (0.65–0.9)*	1.03 (0.91–1.17)
Vascular disease	2.06 (0.14–31.05)	1.79 (0.81–3.92)	1.3 (0.84–2.03)	0.93 (0.7–1.25)	0.98 (0.84–1.16)
Cataract	0.64 (0.12–3.33)	1.05 (0.63–1.76)	1 (0.73–1.37)	1.02 (0.88–1.17)	0.99 (0.9–1.09)
Glaucoma	0.7 (0.24–2.05)	0.8 (0.63–1.02)	0.75 (0.62–0.91)	0.88 (0.76–1.01)	0.9 (0.81–1.01)
Visual disturbances and blindness	0.39 (0.15–1)	0.86 (0.59–1.26)	0.95 (0.62–1.43)	0.9 (0.65–1.26)	1.04 (0.82–1.33)
Hearing loss	0.75 (0.31–1.85)	1.08 (0.86–1.34)	0.77 (0.62–0.95)	0.9 (0.76–1.07)	1.07 (0.96–1.19)
Hypertensive disease	1.09 (0.24–4.97)	0.66 (0.47–0.92)	0.87 (0.76–1)	0.99 (0.9–1.09)	1.08 (0.98–1.2)
Ischemic heart disease	2.73 (0.49–15.09)	0.61 (0.37–1.02)	0.77 (0.6–1)	0.85 (0.73–0.98)	0.89 (0.81–0.99)
Cerebrovascular disease	^b -	1.83 (1.08–3.1)	1.66 (1.27–2.18)**	1.28 (1.1–1.49)	1.23 (1.11–1.36)**
Acute upper respiratory infection	0.69 (0.19–2.53)	0.81 (0.68–0.97)	0.71 (0.63–0.81)****	0.74 (0.66–0.84)****	1.02 (0.87–1.21)
Influenza and pneumonia	0.94 (0.69–1.29)	0.88 (0.79–0.98)	0.91 (0.83–1)	0.99 (0.9–1.08)	0.98 (0.89–1.09)
Chronic lower respiratory disease	1.38 (1–1.91)	0.9 (0.81–1.01)	0.87 (0.79–0.95)	0.86 (0.78–0.95)	1.05 (0.96–1.16)
Noninfective enteritis and colitis	0.87 (0.63–1.19)	0.9 (0.81–1.01)	0.85 (0.76–0.95)	1.1 (0.98–1.23)	1.15 (1.04–1.26)
Other disease of intestine	1.19 (0.87–1.63)	0.89 (0.8–0.99)	0.82 (0.75–0.91)**	0.75 (0.68–0.83)****	1.02 (0.93–1.13)
Alcoholic liver disease	^b -	1.78 (1.22–2.61)	1.53 (1.26–1.86)**	1.31 (1.12–1.54)*	0.96 (0.78–1.17)

Table 4. Age differences in risks of suicide by each ICD-10 disorder in the police investigation report from 2013 to 2017 (continued)

Disorders	aORs ^a (95% CI)				
	<19 years	20–34 years	35–49 years	50–65 years	>65 years
Atopic dermatitis	1.09 (0.78–1.51)	0.91 (0.79–1.06)	0.89 (0.75–1.05)	0.95 (0.79–1.14)	0.84 (0.72–0.98)
Psoriasis	0.85 (0.19–3.86)	1 (0.7–1.43)	1 (0.76–1.33)	1.17 (0.91–1.51)	1.19 (0.95–1.48)
Arthropathies	0.97 (0.68–1.38)	0.74 (0.66–0.82)****	0.97 (0.89–1.07)	0.95 (0.86–1.04)	0.88 (0.79–0.99)
Renal failure	^b -	2.18 (0.99–4.78)	1.68 (1–2.83)	2.02 (1.51–2.69)****	1.03 (0.85–1.25)
Urolithiasis	1.08 (0.13–9.32)	1.23 (0.91–1.68)	0.76 (0.62–0.94)	0.87 (0.72–1.04)	0.82 (0.68–0.99)
Congenital disease	0.6 (0.25–1.45)	1.05 (0.79–1.4)	0.71 (0.47–1.1)	0.96 (0.66–1.39)	0.88 (0.64–1.22)
Congenital malformation of the circulatory system	2.59 (0.26–25.72)	0.41 (0.15–1.16)	2.88 (1.17–7.11)	0.56 (0.16–2.04)	0.85 (0.33–2.15)
Multiple body injury	1.73 (0.89–3.34)	1.57 (1.21–2.04)*	1.26 (0.96–1.66)	1.49 (1.14–1.96)	1.1 (0.86–1.42)
Effects of foreign body	0.76 (0.47–1.23)	0.84 (0.71–1)	0.96 (0.84–1.09)	0.89 (0.8–1)	1.06 (0.95–1.18)
Burns and corrosions	1.06 (0.64–1.75)	1.31 (1.12–1.54)*	1.04 (0.89–1.23)	1.16 (1–1.36)	1.23 (1.06–1.43)

Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$. ^aModel adjusted for income level, disability, and all covariates listed, statistical significance for aORs was calculated after Holm-Bonferroni correction for all covariates included, ^baOR incalculable due to no case of each disorder in the control group. NHIS-NSC: National Health Insurance Service–National Sample Cohort, aORs: adjusted odds ratios, CI: confidential interval

DISCUSSION

There are many reports^{1,31–37} that have studied and analyzed the causes of suicide in different countries. However, to the best of our knowledge, this is the first study to examine almost all suicide victims nationwide in South Korea, and it is the first paper to study the disease characteristics of suicide victims in more depth by matching national data from the NHID. The main findings of this study are as follows: 1) from 2013 to 2017, nearly all of the nation's suicide victims have been studied, 2) in addition to the location and method of suicides, the association with certain diseases was also studied, and 3) suicide victims from each district may have different characteristics, and therefore different approaches are needed to prevent suicide.

The most specific finding of this study is that the characteristics of people who died by regional suicide are different. There have been many articles^{11,38–49} that reported risk factors of suicide. As mentioned in these papers, numerous factors contribute to suicide. Social, cultural, psychological, and other medical factors are organically related to committing suicide. Based on these common risk factors, a policy to prevent suicide in a community can be implemented. However, if the policy is implemented to reflect the characteristics of suicide victims in each region, it could shorten the time that it takes to reduce the suicide rate. Our study was comprised of two parts to investigate the characteristics of suicide victims: 1) a pilot study and 2) an article that examined the link between suicide victims and diseases in the 1,000,000 sample cohort in the NHID. Through these two parts, this study developed and implemented suicide research methods.

This method of suicide research examines the demographic characteristics and locations, methods and main causes of nearly all suicides in the past five years, from 2013 to 2017. Besides, as mentioned in the results, the CI shows the local characteristics better, which should be mainly focused on by specific region. This is because the CI explains the degree of bias of each factor among the five aspects of suicidal deaths: locations, methods, and main causes of suicide, life cycle, and solitary life. The results obtained through the CI help to better understand the characteristics of suicide victims in the region and provide a clearer picture of the factors that reduce suicide. Furthermore, by matching the ID number of the suicide victim and NHIS data before death, we can study psychiatric and physical disorders that are highly correlated with suicide. A more in-depth analysis of suicide victims by region can provide a different perspective to the Regional Mental Health Promotion Center. Information on districts where the number of suicides is high and studies of specific factors beyond common suicide factors based on the results will contribute to reducing suicide mortality.

Despite the many advantages of this study, it has several limitations. First, the number of suicide victims in this study does not include all suicides over the five years from 2013 to 2017. Only a very small proportion of suicide victims are missing from the data, such as a person who died of suicide at sea, Koreans who died overseas, and so on. A comparison of the number of suicide victims in the Seoul area after the investigation showed that there was a difference of about five percent between our investigation and the data of the Korea National Statistical Office. Although there are few differences, cooperation with the National Statistical Office will be needed in the

future to better characterize suicide victims in South Korea. Second, the interpretation of economic problems among the analysis of the main cause of suicide death can be somewhat ambiguous. According to the results, the main causes of suicide deaths were mental health problems, physical health problems and economic problems. Because we studied the health data of the suicide victims' ID number, the link between suicide and medical disorders could be studied more clearly based on the NHID. However, it is difficult to pinpoint the relationship between economic problems and suicide because we only know the income distribution of suicide victims in the NHID. To complement these data, it may be necessary to link information about changes in employment status or debt before the death of a suicide victim in the future. Lastly, it is difficult to verify the effects of suicide prevention through our results because this is a retrospective study. Based on the design of this research, if the results permit implementation of the local suicide prevention project our findings may contribute to reducing suicide rates. To assess the efficiency of regional suicide rate change and regional customized suicide prevention policy, the study of suicide victims by region needs to be continued prospectively every year.

In conclusion, suicide prevention policy should be implemented by analyzing the various causes of suicide in each region, and continuing research is needed to verify its effectiveness in the future.

Supplementary Materials

The online-only Data Supplement is available with this article at <https://doi.org/10.30773/pi.2019.07.14>.

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Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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Supplementary Table 1. ICD-10 disorders and suicide cases during their lifetime

Disorders	ICD-10 codes
Psychiatric disorders	
Dementia	F00–09/G30
Alcohol use disorder	F10
Schizophrenia	F20–29
Bipolar disorder	F30–31
Depression	F32–39
Anxiety disorder	F40–41
Adjustment disorder	F43
Somatoform disorder	F45
Sleep disorder	F51/G47
Personality disorder	F60–69
Mental retardation	F70–79
Developmental disorder	F80–89
Childhood and adolescence disorder	F90–98
Physical disorders	
Cancer	C00–D09
Benign tumor	D10–48
Iron deficiency anemia	D50
Disorder of the thyroid gland	E00–07
Diabetes mellitus	E10–14
Other nutritional deficiencies	E50–64
Epilepsy	G40–41
Migraine	G43
Vascular disease	G45–46
Cataract	H25–26
Glaucoma	H40–42
Visual disturbances and blindness	H53–54
Hearing loss	H90–91
Hypertensive disease	I10–15
Ischemic heart disease	I20–25
Cerebrovascular disease	I60–69
Acute upper respiratory infection	J00–06
Influenza and pneumonia	J09–18
Chronic lower respiratory disease	J40–47
Noninfective enteritis and colitis	K50–52
Other diseases of intestines	K55–63
Alcoholic liver disease	K70
Atopic dermatitis	L20
Psoriasis	L40
Arthropathies	M00–25
Renal failure	N17–19
Urolithiasis	N20–23
Congenital disease	Q00–99
Congenital malformation of the circulatory system	Q20–28
Multiple body injury	T00–07
Effects of foreign body	T15–19
Burns and corrosions	T20–32

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