





Risks of Completed Suicide of Community Individuals with ICD-10 Disorders Across Age Groups: A Nationwide Population-Based Nested Case-Control Study in South Korea

Eun Jin Na^{1,2*}, Hyewon Lee^{3,4*}, Woojae Myung⁴, Maurizio Fava⁵, David Mischoulon⁵, Jong-Woo Paik⁶, Jin Pyo Hong², Kwan Woo Choi⁷, Ho Kim^{3,8} , and Hong Jin Jeon^{1,2,9} 

¹Korea Psychological Autopsy Center (KPAC), Seoul, Republic of Korea

²Department of Psychiatry, Depression Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

³Institute of Health and Environment, Seoul National University, Seoul, Republic of Korea

⁴Department of Neuropsychiatry, Seoul National University Bundang Hospital, Seongnam, Republic of Korea

⁵Depression Clinical and Research Program, Massachusetts General Hospital, Harvard Medical School, Boston, USA

⁶Department of Psychiatry, Kyung Hee University College of Medicine, Seoul, Republic of Korea

⁷Department of Psychiatry, Anam Hospital, Korea University College of Medicine and School of Medicine, Seoul, Republic of Korea

⁸Department of Public Health Science Graduate School of Public Health, Seoul National University, Seoul, Republic of Korea

⁹Department of Health Sciences & Technology, Department of Medical Device Management & Research, and Department of Clinical Research Design & Evaluation, Samsung Advanced Institute for Health Sciences & Technology (SAIHST), Sungkyunkwan University, Seoul, Republic of Korea

Objective Suicide is the leading cause of death in 10–39-year-olds in South Korea, and the second highest rate among the OECD countries. However, few studies have investigated the particularity of completed suicide in South Korea.

Methods Study subjects consisted of 2,838 suicide cases and 56,758 age and sex matched living controls from a national representative sample of 1,025,340 South Koreans. They were obtained from the Korean National Health Insurance Service-National Sample Cohort (NHIS-NSC) with follow-up up to 12 years. We obtained information on primary diagnosis of any ICD-10 disorder along with suicide cases during their lifetime.

Results Among ICD-10 disorders, depression was the most common disorder (19.10%, n=542), found in victims of completed suicides except for common medical disorders such as hypertensive crisis, respiratory tract infection or arthropathies. After adjusting for sex, age, economic status, disability, and disorders, schizophrenia showed the strongest association with suicide (AOR: 28.56, 95% CI: 19.58–41.66) among all ICD-10 disorders, followed by psoriasis, multiple body injury, epilepsy, sleep disorder, depression, and bipolar disorder. For age groups, ≤19 years was associated with anxiety disorder (AOR=80.65, 95% CI: 13.33–487.93), 20–34 years with epilepsy (AOR=134.92, 95% CI: 33.69–540.37), both 35–49 years (AOR=108.57, 95% CI: 37.17–317.09) and 50–65 years (AOR=189.41 95% CI: 26.59–1349.31), with schizophrenia, and >65 years (AOR=44.7, 95% CI: 8.93–223.63) with psoriasis.

Conclusion Psychiatric and physical disorders carried greatly increased risks and numbers of suicides in South Korea. Schizophrenia was the strongest risk factor, especially 35–65 years, and depression was the most common in suicide victims among ICD-10 disorders in South Korea.

Psychiatry Investig 2019;16(4):314-324

Key Words Suicide, Schizophrenia, Depressions, Health insurance, Multiple body injury.

Received: November 17, 2018 Revised: December 22, 2018 Accepted: February 19, 2019

 **Correspondence:** Hong Jin Jeon, MD, PhD

Department of Psychiatry, Depression Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81 Irwon-ro, Gangnam-gu, Seoul 06351, Republic of Korea

Tel: +82-2-3410-3586, Fax: +82-2-3410-0050, E-mail: jeonhj@skku.edu

 **Correspondence:** Ho Kim, PhD

Department of Public Health Science Graduate School of Public Health, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea

Tel: +82-2-880-2701, Fax: +82-2-762-2888, E-mail: hokim@snu.ac.kr

*These authors contributed equally to this work.

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Suicide is a significant cause of death in many countries. The number of suicide deaths worldwide in 2015 was estimated to be 788,000 and the annual global age-standardized suicide rate was 10.7 per 100,000 population.¹ The estimated total suicide mortality in South Korea was 24.3 per 100,000 in 2017,² which was 2.3 times higher than the global rate. South Korea had the second highest suicide mortality rate among OECD countries after Lithuania in 2017.³ Suicide was the leading cause of death in individuals between 10 and 39 years, with individuals in their eighties having the highest suicide rate at 70.0 per 100,000 in 2017 among all age groups.⁴ The Korean government has created policies to reduce suicide rates such as prohibition of paraquat in 2011,⁵ regulation of media reports about suicide to reduce copycat suicides of celebrities,⁶ and legislation of “Suicide Prevention and Life Respect Culture” Act in 2011. After legislation, suicide rate was decreased from 31.7 per 100,000 in 2011 to 28.1 per 100,000 in 2012. However, high suicide rates in South Korea have continued.

In an important review paper on risk factors for suicide, Hawton and Kees ven Herringen⁷ have reported distal and proximal factors. They stressed that both psychiatric and physical disorders were proximal risk factors for suicide. They were particularly associated with poor physical health, disabilities, and pain.⁸ Many previous studies have also suggested that suicide is related to physical disorders and psychiatric disorders.⁹⁻¹¹ Previous research has shown an association between suicide and chronic physical disorders such as asthma, allergy, type I diabetes mellitus, epilepsy, coronary heart disease, stroke, and cancer.^{8,9,12-17} However, few previous studies have examined the relative strength of association between psychiatric/physical disorders and completed suicide using a nationwide representative sample.

We hypothesized that there would be large differences in the relative strength of associations of each psychiatric/physical disorder and suicide after adjusting for sex, age, economic status, and disability. To investigate how specific physical and psychiatric disorders contributed to suicide in Korea and associations of suicide with gender and five age groups, we used a representative sample of one million South Koreans from National Health Insurance data known as the National Health Insurance Service-National Sample Cohort (NHIS-NSC) collected during 2002–2013.¹⁸ All 52 million population of South Korea were entered into the national health insurance service and followed by the national registry. Using the NHIS-NSC cohort, we were able to compare differences in odds ratios associated with specific physical and psychiatric disorders.

METHODS

A nationwide population-based cohort and study population

This study was performed by the Korea Psychological Autopsy Center (KPAC), an affiliate of the Korean Ministry of Health and Welfare operated by the Sungkyunkwan University Research and Business Foundation, and School of Public Health, Seoul National University in collaboration with Health Insurance Review & Assessment Service (HIRA) and Statistics Korea. As the Korean health insurance system is a universal health insurance system provided by the government, every citizen is obligatorily inducted into the Korean National Health Insurance in their lifetime without exception. Their medical records are handled by the HIRA and the National Health Insurance Service (NHIS).

A nested case-control study design was constructed using the National Health Insurance Service-National Sample Cohort (NHIS-NSC) which consisted of representative 1,025,340 individuals (2.21%) sampled from a total of 46,405,433 eligible citizens of South Korea. As the universal insurance provider in South Korea, the NHIS developed National Health Insurance Database (NHID) based on claims data containing all citizens' information on demographics such as sex, age [in 5-year units], economic status, disability, and healthcare utilization [date of hospital visits/admissions, primary and accessory diagnosis, type of medical department, and drugs/treatments administered]. The NHIS-NSC was established based on the 2002 NHID. The NHIS-NSC was randomly selected using systematic stratified random sampling according to sex, age (18 age groups), and economic status from eligible population in the 2002 NHID. The cohort was followed until 2013 (up to 12 years).

The income variable in the NHIS-NSC cohort was based on the insurance premium of insured employees/insured self-employed individuals. The NHIS imposes a premium according to income levels (0 for medical aid beneficiaries and an insurance premium decile for the insured). To adjust for economic status, we recategorized the income variable as having 4 categories which consisted of level 1 (beneficiaries: lowest income), level 2 (1st to 4th deciles), level 3 (5th to 7th deciles), and level 4 (8th to 10th deciles: highest income).

The NHIS was authorized to link the NHIS-NSC with the Death Statistics Database based on data of the Korean Statistical Information Service (KOSIS). The KOSIS defines “suicide” status of each dead person through two kinds of statistics. One is cause of death statistics resulting from the integration of national statistics and the other is intentional self-harm among all cases of unnatural death investigations by the National Police Agency which include their Coroner's findings from the

National Forensic Service. We obtained linked data and included all individuals who died by suicide from such data. Suicide cases were identified from causes of death codes which had ICD-10 (International Classification of Disease, 10th version) codes X60-X84 (Intentional self-harm). Using this definition, we identified 2,838 suicide cases (0.27%) from all ages during 2002–2013 from the NHIS-NSC. Each suicide case was matched by gender, age [in 5-year unit], and date of death to 20 controls who were alive until 2013 from representative subsamples in NHIS-NSC. This control section method was based on a previous study,^{8,9,12-17} which assessed the relationship between suicide and physical disorders. The selection of large numbers of controls enabled maximizing the power for accurate effect estimation for low prevalence disorders. Consequently, 2,838 suicide cases and 56,758 sex- and age- matched living controls were included in the present study. This study was approved by the Institutional Review Board (IRB) of Seoul National University (No. E1711/003-014). Informed consent was waived by IRB because we obtained encrypted data for privacy.

Psychiatric and physical disorders as potential risk factors

Information on primary diagnosis was retrieved from claims of NHIS-NSC for both suicide cases and corresponding controls until the date of death. To comprehensively evaluate the effect of psychiatric and physical disorders on the risk of suicide, we examined all diseases associated with suicide cases during their lifetime among all ICD-10 disorders. As shown in Table 1, a total of 39 disorders were included in the analysis, including 9 psychiatric disorders (dementia, alcohol use disorder, schizophrenia, bipolar disorder, depression, anxiety disorder, adjustment disorder, somatoform disorder, and sleep disorder) and 30 physical disorders (cancer, benign tumor, iron deficiency anemia, disorder of thyroid gland, diabetes mellitus, other nutritional deficiencies, epilepsy, migraine, vascular disease, cataract, glaucoma, visual disturbances and blindness, hearing loss, hypertensive disease, ischemic heart disease, cerebrovascular disease, acute upper respiratory infection, influenza and pneumonia, chronic lower respiratory disease, noninfective enteritis and colitis, other diseases of intestines, alcoholic liver disease, atopic dermatitis, psoriasis, arthropathies, renal failure, urolithiasis, multiple body injury, effects of foreign body, and burns and corrosions).

Statistical analysis

For descriptive analysis, we calculated the absolute number of suicide cases and the rate of suicide per disorder in the total study population (for which cases and controls were combined) and in subgroups stratified by sex and age (<19 years,

Table 1. ICD-10 disorders associated with 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
Physical disorders	
Cancer	C00-D09
Benign tumor	D10-48
Iron deficiency anemia	D50
Disorder of 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
Multiple body injury	T00-07
Effects of foreign body	T15-19
Burns and corrosions	T20-32

ICD-10: International Classification of Diseases, Tenth Revision

20–34 years, 35–49 years, 50–65 years, and >65 years). To determine whether the risk of suicide was increased with selected psychiatric and physical disorders, odds ratios (ORs) and two-tailed 95% confidence intervals (CIs) were estimated by 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 group. All statistical analyses were performed with SAS version 9.4 (SAS Institute, Cary, NC, USA).

RESULTS

Demographic profiles of suicide subjects and non-suicide subjects

Table 2 shows demographic characteristics (sex, age, economic status and disability) and clinical characteristics of the NHIS-NSC cohort by suicide cases and non-suicide controls from 2002–2013. Of 1,025,340 representative samples of Koreans, 2,838 (0.28%) died by suicide during 12 years. Schizophrenia (RR=14.70), sleep disorder (RR=11.93), depression (RR=9.27), bipolar disorder (RR=9.03), and anxiety disorder (RR=6.92) had significantly high relative ratio (RR) of completed suicide compared to non-suicide controls among psychiatric disorders. Among physical disorders which included cases of suicide, multiple body injury (RR=7.33) showed the highest relative ratio. As shown in Table 2, psychiatric disorder had higher effect on suicide than physical disorder in view of illness in South Korea.

Relation between suicide and psychiatric/physical disorders

Table 3 shows odds ratios and adjusted odds ratios (AOR) of all ICD-10 disorders associated with suicide cases during their lifetime after adjusting for sex, age, economic status, disability, and all covariates listed. Among all ICD-10 disorders, schizophrenia showed the strongest association with suicide cases (OR=17.44, 95% CI: 14.06–21.63). Its association with suicide cases was much stronger after adjusting for all covariates listed (AOR=28.56, 95% CI: 19.58–41.66). AOR of schizophrenia for suicide cases was the highest, followed by psoriasis, multiple body injury, epilepsy, sleep disorder, depression, and bipolar disorder. AOR of schizophrenia was as much as two times higher than the AOR of psoriasis, the second highest disorder that showed strong association with suicide cases.

Relationship between suicide and sex differences

Table 4 shows sex differences between psychiatric/physical disorders and suicide. There were marked differences in adjusted odds ratio (AOR) for suicide between sex in both psychiatric and physical disorders. In males, schizophrenia showed the strongest association with suicide cases among all ICD-10 disorders after adjusting for age, economic status, disability, and all covariates listed. However, no male patient with schizophrenia was found in non-suicidal control. Psoriasis (AOR=27.83, 95% CI: 11.53–67.19) and bipolar disorder (AOR=24.83, 95% CI: 11.26–54.84) also showed stronger association with suicide cases than other ICD-10 disorders in males. In females, schizophrenia (AOR=22.17, 95% CI: 11.97–41.05) showed the second highest association with suicide cases. Multiple body injury had the highest association with suicide cases (AOR=33.67, 95% CI: 9.28–122.19) among all ICD-10 disorders. Epilepsy (AOR=19.76, 95% CI: 6.59–59.25) and sleep disorder (AOR=15.19, 95% CI: 10.01–23.04) also showed stronger associations with suicide cases than other ICD-10 disorders in females. Those results indicated that psychiatric and physical disorders related suicide were different according to sex. Females showed much higher suicide rates among individuals with schizophrenia than males (7.63% vs. 5.03%).

Relationship between suicide and age group

Table 5 shows age differences between psychiatric/physical disorders and suicide. After adjusting for sex, economic status, disability, and all covariates listed in each age group, there were marked differences in OR associated with suicide according to each age group. In the age group of less than 19 years old, anxiety disorder (AOR=80.65, 95% CI: 13.33–487.93) showed the strongest association with suicide. Schizophrenia showed the highest association with suicide both in the age group of 35–49 years (AOR=108.57, 95% CI: 37.17–317.09) and the age group of 50–65 years (AOR=189.41, 95% CI: 26.59–1349.31). For the age group of 20–34 years, schizophrenia had the second highest association with suicide (AOR=56.74, 95% CI: 26.13–123.22) after epilepsy (AOR=134.92, 95% CI: 33.69–540.37). For the age group of more than 65 years, psoriasis (AOR=44.70, 95% CI: 8.93–223.63) showed the strongest association with suicide while alcoholic liver disease (AOR=21.29, 95% CI: 3.83–118.39) had the second strongest association. As shown in Table 5, schizophrenia showed high associations with the risk of suicide in for age groups of 20–34, 35–49, and 50–65 years. On the contrary, for age group of more than 65 years or less than 19 years, there was no significant association between schizophrenia and suicide. Those results indicated that associations of psychiatric/physical disorders with suicide were different among age groups in South Korea.

Table 2. Demographic and clinical characteristics of the NHIS-NSC cohort by suicide cases and age- and sex-matched non-suicidal living controls from 2002 to 2013 (N=1,025,340)

Variables	Total	Suicide cases	Non-suicidal controls	Relative ratio
	N=59,596 (N, %)	N=2,838 (N, %)	N=56,758 (N, %)	
Sex				
Male	40067 (67.23)	1908 (67.23)	38159 (67.23)	1.00
Female	19529 (32.77)	930 (32.77)	18599 (32.77)	1.00
Age				
<19	4242 (7.12)	202 (7.12)	4040 (7.12)	1.00
20–34	12789 (21.46)	609 (21.46)	12180 (21.46)	1.00
35–49	16527 (27.73)	787 (27.73)	15740 (27.73)	1.00
50–64	13755 (23.08)	655 (23.08)	13100 (23.08)	1.00
>65	12283 (20.61)	585 (20.61)	11698 (20.61)	1.00
Economic status*				
Income level 1	32594 (54.69)	172 (6.06)	32422 (57.12)	0.11
Income level 2	8806 (14.78)	977 (34.43)	7829 (13.79)	2.50
Income level 3	10131 (17.00)	804 (28.33)	9327 (16.43)	1.72
Income level 4	8065 (13.53)	885 (31.18)	7180 (12.65)	2.46
Disability				
No	50120 (84.10)	2627 (92.57)	47493 (83.68)	1.11
Moderate	4842 (8.12)	67 (2.36)	4775 (8.41)	0.28
Severe	4634 (7.78)	144 (5.07)	4490 (7.91)	0.64
Psychiatric disorders				
Schizophrenia	393 (0.66)	167 (5.88)	226 (0.40)	14.70
Dementia	858 (1.44)	80 (2.82)	778 (1.37)	2.06
Alcohol use disorder	788 (1.32)	130 (4.58)	658 (1.16)	3.95
Bipolar disorder	280 (0.47)	87 (3.07)	193 (0.34)	9.03
Depression	1710 (2.87)	542 (19.10)	1168 (2.06)	9.27
Anxiety disorder	1276 (2.14)	328 (11.56)	948 (1.67)	6.92
Adjustment disorder	419 (0.70)	79 (2.78)	340 (0.60)	4.63
Somatoform disorder	425 (0.71)	100 (3.52)	325 (0.57)	6.18
Sleep disorder	960 (1.61)	359 (12.65)	601 (1.06)	11.93
Physical disorders				
Cancer	1868 (3.13)	189 (6.66)	1679 (2.96)	2.25
Benign tumor	3509 (5.89)	338 (11.91)	3171 (5.59)	2.13
Iron deficiency anemia	835 (1.40)	66 (2.33)	769 (1.35)	1.73
Disorder of thyroid gland	1268 (2.13)	134 (4.72)	1134 (2.00)	2.36
Diabetes mellitus	4416 (7.41)	453 (15.96)	3963 (6.98)	2.29
Other nutritional deficiencies	198 (0.33)	28 (0.99)	170 (0.30)	3.30
Epilepsy	363 (0.61)	51 (1.80)	312 (0.55)	3.27
Migraine	1333 (2.24)	143 (5.04)	1190 (2.10)	2.40
Vascular disease	529 (0.89)	77 (2.71)	452 (0.80)	3.39
Cataract	2152 (3.61)	362 (12.76)	1790 (3.15)	4.05
Glaucoma	1248 (2.09)	120 (4.23)	1128 (1.99)	2.13
Visual disturbances and blindness	233 (0.39)	17 (0.60)	216 (0.38)	1.58

Table 2. Demographic and clinical characteristics of the NHIS-NSC cohort by suicide cases and age- and sex-matched non-suicidal living controls from 2002 to 2013 (N=1,025,340) (continued)

Variables	Total	Suicide cases	Non-suicidal controls	Relative ratio
	N=59,596 (N, %)	N=2,838 (N, %)	N=56,758 (N, %)	
Hearing loss	1718 (2.88)	124 (4.37)	1594 (2.81)	1.56
Hypertensive disease	8508 (14.28)	759 (26.74)	7749 (13.65)	1.96
Ischemic heart disease	1305 (2.19)	196 (6.91)	1109 (1.95)	3.54
Cerebrovascular disease	2141 (3.59)	294 (10.36)	1847 (3.25)	3.19
Acute upper respiratory infection	24322 (40.81)	1860 (65.54)	22462 (39.58)	1.66
Influenza and pneumonia	3327 (5.58)	380 (13.39)	2947 (5.19)	2.58
Chronic lower respiratory disease	8748 (14.68)	810 (28.54)	7938 (13.99)	2.04
Noninfective enteritis and colitis	4629 (7.77)	481 (16.95)	4148 (7.31)	2.32
Other diseases of intestines	7448 (12.50)	762 (26.85)	6686 (11.78)	2.28
Alcoholic liver disease	736 (1.23)	158 (5.57)	578 (1.02)	5.46
Atopic dermatitis	553 (0.93)	95 (3.35)	458 (0.81)	4.14
Psoriasis	230 (0.39)	37 (1.30)	193 (0.34)	3.82
Arthropathies	10535 (17.68)	1055 (37.17)	9480 (16.70)	2.23
Renal failure	477 (0.80)	47 (1.66)	430 (0.76)	2.18
Urolithiasis	749 (1.26)	86 (3.03)	663 (1.17)	2.59
Multiple body injury	187 (0.31)	50 (1.76)	137 (0.24)	7.33
Effects of foreign body	3290 (5.52)	246 (8.67)	3044 (5.36)	1.62
Burns and corrosions	949 (1.59)	150 (5.29)	799 (1.41)	3.75

Categorical variables are presented as frequencies and percentages, and continuous variables are presented as means and standard deviations. *level 1: 0 for beneficiaries (lowest income); level 2: 1st to 4th deciles; level 3: 5th to 7th deciles; and level 4: 8th to 10th deciles (highest income). NHIS-NSC: National Health Insurance Service–National Sample Cohort

DISCUSSION

To the best of our knowledge, this is the first study to compare odds ratios of suicide in all psychiatric and physical disorders across age groups from a large national representative cohort. The main findings from this study were: 1) suicide was strongly associated with medical disorders, especially schizophrenia in psychiatric disorders compared to non-suicide control; 2) sex had a significant effect on the relationship (odds ratio) between suicide risk and medical disorders; 3) the associations between suicide risk and medical disorders showed large differences across age groups.

Our results are consistent with previous studies showing that psychiatric disorders had the strongest association with suicide.^{9–11} They were present in about 90% of completed suicides led by depression and schizophrenia.^{9,19,20} Suicide is also associated with poor physical health such as epilepsy,^{16,21,22} cancer,^{23–25} and pain-related illnesses.⁷

Although the present study also showed associations between psychiatric/physical disorders and completed suicide, the unique finding of the present study was that schizophrenia had the highest odds ratios for completed suicide among psychiatric and physical disorders in South Korea. Up to date,

meta-analysis results of suicide risk in schizophrenia have changed. According to earlier literatures,^{26–28} the prevalence of suicide in patients affected by schizophrenia was approximately 10–13%. However, recent studies²⁹ showed that average lifetime suicide rate in schizophrenia was about 4.9%. Therefore, the main finding that suicide rate was 5.03% in males and 7.63% in females in the present was meaningful in that such rates were above average of 4.9%.

Another finding of this study was that suicide rates showed great differences across sex and age groups. For sex, males were associated with depressions, bipolar disorders, and psoriasis while females were associated with schizophrenia, sleep disorder, epilepsy, and alcoholic liver disease. The middle age group (35–65 years) was more strongly associated with psychiatric disorders such as schizophrenia, depressions, anxiety disorders, alcohol use disorders, and sleep disorders whereas the younger age group (20–34 years) was not only associated with psychiatric disorders, but also strongly with physical disorders such as epilepsy and cancer. The elderly group (>65 years) was associated with psoriasis and alcoholic liver disease while children and adolescent age group (<19 years) was associated with anxiety disorders. These findings suggest there are psychiatric comorbidities in patients with physical disorders in

Table 3. Risk of suicide by each ICD-10 disorder associated with suicide cases had during their lifetime compared to age- and sex-matched non-suicidal living controls in the NHIS-NSC cohort from 2002 to 2013 (N=1,025,340)

Disorders	Suicide cases N=2,838 (N, %)	Non-suicidal controls N=56,758 (N, %)	Odds ratio (95% CI)	Adjusted odds ratio ^a (95% CI)
Schizophrenia	167 (5.88)	226 (0.40)	17.44 (14.06–21.63)***	28.56 (19.58–41.66)**
Psoriasis	37 (1.30)	193 (0.34)	3.85 (2.70–5.47)***	15.45 (8.14–29.29)**
Multiple body injury	50 (1.76)	137 (0.24)	7.38 (5.33–10.22)***	10.51 (6.44–17.14)**
Epilepsy	51 (1.80)	312 (0.55)	3.33 (2.47–4.50)***	10.41 (6.33–17.11)**
Sleep disorder	359 (12.65)	601 (1.06)	15.34 (13.25–17.75)***	4.75 (3.85–5.87)**
Depression	542 (19.10)	1168 (2.06)	13.67 (12.12–15.43)***	4.59 (3.83–5.50)**
Bipolar disorder	87 (3.07)	193 (0.34)	9.18 (7.11–11.86)***	3.84 (2.30–6.42)**
Atopic dermatitis	95 (3.35)	458 (0.81)	4.34 (3.46–5.45)***	3.12 (2.31–4.20)**
Visual disturbances and blindness	17 (0.60)	216 (0.38)	1.58 (0.96–2.58)	2.87 (1.52–5.43)*
Anxiety disorder	328 (11.56)	948 (1.67)	7.97 (6.97–9.12)***	2.40 (1.94–2.95)**
Alcoholic liver disease	158 (5.57)	578 (1.02)	5.62 (4.70–6.72)***	2.39 (1.88–3.04)**
Somatoform disorder	100 (3.52)	325 (0.57)	6.25 (4.99–7.83)***	2.16 (1.56–3.01)**
Cerebrovascular disease	294 (10.36)	1847 (3.25)	3.97 (3.45–4.57)***	2.09 (1.70–2.57)**
Cataract	362 (12.76)	1790 (3.15)	6.5 (5.63–7.50)***	1.93 (1.58–2.35)**
Alcohol use disorder	130 (4.58)	658 (1.16)	4.19 (3.44–5.09)***	1.78 (1.33–2.40)**
Ischemic heart disease	196 (6.91)	1109 (1.95)	3.74 (3.19–4.37)***	1.75 (1.39–2.21)**
Urolithiasis	86 (3.03)	663 (1.17)	2.68 (2.13–3.38)***	1.74 (1.32–2.30)**
Burns and corrosions	150 (5.29)	799 (1.41)	3.98 (3.32–4.76)***	1.70 (1.33–2.18)**
Arthropathies	1055 (37.17)	9480 (16.70)	3.47 (3.18–3.78)***	1.42 (1.27–1.59)**
Other diseases of intestines	762 (26.85)	6686 (11.78)	3.08 (2.80–3.38)***	1.26 (1.12–1.42)**
Disorder of thyroid gland	134 (4.72)	1134 (2.00)	2.7 (2.22–3.28)***	1.25 (0.94–1.65)
Renal failure	47 (1.66)	430 (0.76)	2.3 (1.68–3.15)***	1.22 (0.72–2.05)
Chronic lower respiratory disease	810 (28.54)	7938 (13.99)	2.76 (2.52–3.02)***	1.19 (1.05–1.33)
Diabetes mellitus	453 (15.96)	3963 (6.98)	2.92 (2.60–3.28)***	1.15 (0.97–1.35)
Cancer	189 (6.66)	1679 (2.96)	2.49 (2.12–2.93)***	1.09 (0.87–1.35)
Influenza and pneumonia	380 (13.39)	2947 (5.19)	2.98 (2.65–3.36)***	1.04 (0.88–1.22)
Migraine	143 (5.04)	1190 (2.10)	2.58 (2.15–3.10)***	1.00 (0.77–1.29)
Benign tumor	338 (11.91)	3171 (5.59)	2.38 (2.10–2.69)***	0.97 (0.83–1.15)
Noninfective enteritis and colitis	481 (16.95)	4148 (7.31)	2.71 (2.44–3.02)***	0.93 (0.81–1.08)
Glaucoma	120 (4.23)	1128 (1.99)	2.20 (1.81–2.67)***	0.88 (0.69–1.14)
Effects of foreign body	246 (8.67)	3044 (5.36)	1.72 (1.49–1.98)***	0.87 (0.74–1.04)
Hypertensive disease	759 (26.74)	7749 (13.65)	2.75 (2.50–3.03)***	0.86 (0.75–0.98)
Other nutritional deficiencies	28 (0.99)	170 (0.30)	3.31 (2.22–4.94)***	0.80 (0.45–1.44)
Adjustment disorder	79 (2.78)	340 (0.60)	4.74 (3.70–6.07)***	0.75 (0.51–1.09)
Hearing loss	124 (4.37)	1594 (2.81)	1.59 (1.32–1.93)***	0.62 (0.49–0.79)**
Acute upper respiratory infection	1860 (65.54)	22462 (39.58)	3.70 (3.39–4.04)***	0.60 (0.53–0.67)**
Dementia	80 (2.82)	778 (1.37)	2.33 (1.81–3.02)***	0.36 (0.24–0.54)**
Iron deficiency anemia	66 (2.33)	769 (1.35)	1.78 (1.37–2.32)***	0.31 (0.21–0.45)**
Vascular disease	77 (2.71)	452 (0.80)	3.53 (2.76–4.52)***	0.09 (0.06–0.13)**

Significance levels: * <0.05 , ** <0.01 , *** <0.001 . Statistical significance for aORs was calculated after Holm-Bonferroni correction for all covariates included. ^aModel adjusted for age, income level, disability, and all covariates listed. ICD-10: International Classification of Diseases, Tenth Revision, NHIS-NSC: National Health Insurance Service-National Sample Cohort, CI: confidential interval

Table 4. Gender differences in risks of suicide by each ICD-10 disorder in the NHIS-NSC cohort from 2002 to 2013 (N=1,025,340)

Disorders	Male			Female		
	Suicide cases N=1,908	Non-suicidal controls N=38,159	aORs (95% CI) ^a	Suicide cases N=930	Non-suicidal controls N=18,599	aORs (95% CI) ^a
Schizophrenia	96 (5.03)	0 (0)	— ^b	71 (7.63)	226 (1.22)	22.17 (11.97–41.05)**
Psoriasis	26 (1.36)	108 (0.28)	27.83 (11.53–67.19)**	11 (1.18)	85 (0.46)	8.84 (3.13–25.01)**
Multiple body injury	38 (1.99)	117 (0.31)	7.99 (4.48–14.24)**	12 (1.29)	20 (0.11)	33.67 (9.28–122.19)**
Epilepsy	36 (1.89)	214 (0.56)	6.19 (3.27–11.71)**	15 (1.61)	98 (0.53)	19.76 (6.59–59.25)**
Sleep disorder	202 (10.59)	371 (0.97)	1.96 (1.45–2.65)**	157 (16.88)	230 (1.24)	15.19 (10.01–23.04)**
Depression	275 (14.41)	341 (0.89)	10.32 (7.53–14.13)**	267 (28.71)	827 (4.45)	3.92 (3.03–5.08)**
Bipolar disorder	46 (2.41)	110 (0.29)	24.85 (11.26–54.84)**	41 (4.41)	83 (0.45)	3.45 (1.45–8.17)
Atopic dermatitis	53 (2.78)	195 (0.51)	4.98 (3.11–7.96)**	42 (4.52)	263 (1.41)	2.12 (1.35–3.34)*
Visual disturbances and blindness	12 (0.63)	83 (0.22)	5.01 (2.07–12.12)**	5 (0.54)	133 (0.72)	1.57 (0.53–4.68)
Anxiety disorder	161 (8.44)	472 (1.24)	1.9 (1.39–2.61)**	167 (17.96)	476 (2.56)	3.07 (2.22–4.24)**
Alcoholic liver disease	138 (7.23)	522 (1.37)	1.94 (1.48–2.54)**	21 (2.26)	37 (0.2)	10.68 (4.04–28.21)**
Somatoform disorder	56 (2.94)	173 (0.45)	2.23 (1.36–3.68)*	44 (4.73)	152 (0.82)	2.55 (1.4–4.65)
Cerebrovascular disease	200 (10.48)	1274 (3.34)	1.23 (0.93–1.63)	94 (10.11)	573 (3.08)	3.91 (2.57–5.94)**
Cataract	226 (11.84)	854 (2.24)	2.41 (1.84–3.16)**	136 (14.62)	936 (5.03)	1.85 (1.31–2.61)*
Alcohol use disorder	109 (5.71)	621 (1.63)	1.27 (0.89–1.83)	21 (2.26)	37 (0.2)	5.11 (2.09–12.5)**
Ischemic heart disease	133 (6.97)	606 (1.59)	2.63 (1.86–3.72)**	63 (6.77)	503 (2.7)	1.72 (1.15–2.59)
Urolithiasis	55 (2.88)	476 (1.25)	1.02 (0.71–1.45)	31 (3.33)	187 (1.01)	2.16 (1.29–3.62)
Burns and corrosions	81 (4.25)	403 (1.06)	1.46 (1.03–2.07)	69 (7.42)	396 (2.13)	2.07 (1.36–3.15)*
Arthropathies	639 (33.49)	5485 (14.37)	1.53 (1.32–1.77)**	416 (44.73)	3995 (21.48)	1.31 (1.07–1.61)
Other diseases of intestines	463 (24.27)	3592 (9.41)	1.62 (1.37–1.92)**	299 (32.15)	3094 (16.64)	0.95 (0.77–1.17)

Significance levels: * <0.05 , ** <0.01 , *** <0.001 . Statistical significance for aORs was calculated after Holm-Bonferroni correction for all covariates included. ^aModel adjusted for age, income level, disability, and all covariates listed, ^baOR incalculable due to no case of each disorder in the control group. ICD-10: International Classification of Diseases, Tenth Revision, NHIS-NSC: National Health Insurance Service-National Sample Cohort, aORs: adjusted odds ratios, CI: confidential interval

both young and old age groups. Previous studies have reported that these physical disorders show risks of comorbid depression and suicide attempt or completed suicide in young age with epilepsy^{16,21,22,30} and cancer³¹ and in old age groups with psoriasis³² and alcohol related problems.³³

According to these three main findings, schizophrenia is the strongest cause of suicide in South Korea. There are several reasons for this. First, treatment and follow-up were poorly managed for schizophrenia in South Korea. Thus, patients with schizophrenia could have high risk of exposure to suicide due to laxity of management. In most countries, depression or bipolar disorder is the highest and strongest cause of suicide based on evidences of many literatures.^{9,19,34} However, our study showed a different result. Second, the diagnosis of psychiatric disorders such as depression was not successful in South Korea. Finally, it might be due to perception of specific psychiatric disorders such as schizophrenia in South Korea. Previous

studies have indicated perceived cognitive dysfunction and stigmatization in the onset of suicidal ideation in people with schizophrenia.³⁵ Significant associations between regional suicide rates and the intention to seek informal help, self-stigma, and shame have been reported in previous studies.³⁶ Therefore, prejudice and misconception might have affected suicide risk in adults with schizophrenia belonging to age groups of 35–49 and 50–65 years in South Korea.

This study was based on the Korean National Health Insurance Service-National Sample Cohort (NHIS-NSC) from 2002 to 2013. It is the largest study examining the relationship between psychiatric/physical disorders and suicide in South Korea. A particular strength of this study was that it compared the risk of suicide in people with different psychiatric and physical disorders within the same total population through case-control research. This allowed comparison of adjusted odds ratios of individuals with and without psychiatric and physi-

Table 5. Age differences in risks of suicide by each ICD-10 disorder in the NHIS-NSC cohort from 2002 to 2013 (N=1,025,340)

Disorders	aORs (95% CI) ^a				
	<19 years	20-34 years	35-49 years	50-65 years	>65 years
Schizophrenia	- ^b	56.74 (26.13-123.22)**	108.57 (37.17-317.09)**	189.41 (26.59-1349.31)**	14.30 (2.44-83.68)
Psoriasis	0.82 (0.06-11.59)	15.02 (2.77-81.41)*	25.95 (8.62-78.15)**	- ^b	44.70 (8.93-223.63)**
Multiple body injury	4.78 (1.27-17.98)	- ^b	- ^b	0.31 (0.08-1.27)	6.59 (0.20-220.64)
Epilepsy	0.62 (0.03-13.37)	134.92 (33.69-540.37)**	0.97 (0.32-2.95)	- ^b	1.36 (0.28-6.71)
Sleep disorder	0.38 (0.06-2.52)	14.03 (7.44-26.45)**	33.55 (15.03-74.86)**	8.14 (4.33-15.28)**	2.03 (1.16-3.55)
Depression	3.15 (0.96-10.39)	6.02 (3.90-9.30)**	10.87 (6.36-18.56)**	28.99 (12.44-67.58)**	3.4 (2.06-5.63)**
Bipolar disorder	- ^b	5.87 (2.08-16.54)*	3.6 (1.19-10.93)	- ^b	0.34 (0.03-3.73)
Atopic dermatitis	5.52 (2.53-12.08)**	1.71 (0.96-3.06)	1.23 (0.37-4.07)	135.79 (23.15-796.58)**	- ^b
Visual disturbances and blindness	0.80 (0.16-4.04)	0.47 (0.11-2.01)	11.04 (1.42-85.66)	39.85 (1.35-1175.95)	- ^b
Anxiety disorder	80.65 (13.33-487.93)**	1.61 (0.98-2.66)	6.34 (3.50-11.45)**	25.72 (10.22-64.76)**	1.34 (0.73-2.46)
Alcoholic liver disease	- ^b	1.45 (0.73-2.85)	1.49 (0.97-2.29)	3.29 (1.55-6.97)	21.29 (3.83-118.39)*
Somatoform disorder	- ^b	4.36 (1.76-10.83)*	0.98 (0.39-2.48)	39.51 (7.92-197.02)**	1.04 (0.46-2.37)
Cerebrovascular disease	- ^b	1.40 (0.48-4.10)	0.32 (0.14-0.70)	19.57 (10.42-36.77)**	0.72 (0.49-1.05)
Cataract	- ^b	8.52 (0.73-99.15)	3.32 (1.46-7.56)	2.93 (1.83-4.71)**	2.69 (1.83-3.94)**
Alcohol use disorder	- ^b	8.23 (3.59-18.87)**	34.29 (17.10-68.75)**	0.71 (0.29-1.72)	0.04 (0.01-0.12)**
Ischemic heart disease	- ^b	0.50 (0.15-1.59)	0.98 (0.46-2.09)	2.94 (1.58-5.48)*	3.35 (1.81-6.23)**
Urolithiasis	3.42 (0.44-26.31)	1.06 (0.58-1.94)	0.88 (0.44-1.74)	12.83 (4.33-38.03)**	- ^b
Burns and corrosions	5.23 (1.79-15.32)**	3.00 (1.81-4.97)**	1.63 (0.88-3.02)	18.99 (5.68-63.51)**	0.60 (0.27-1.31)
Arthropathies	0.21 (0.11-0.39)**	0.96 (0.71-1.30)	0.98 (0.74-1.28)	1.83 (1.33-2.52)**	2.65 (1.91-3.68)**
Other diseases of intestines	1.17 (0.73-1.88)	0.98 (0.73-1.31)	1.30 (0.95-1.78)	1.36 (0.94-1.97)	1.09 (0.73-1.61)

Significance levels: * <0.05 , ** <0.01 , *** <0.001 . Statistical significance for aORs was calculated after Holm-Bonferroni correction for all covariates included. ^aModel adjusted for income level, disability, and all covariates listed, ^baOR in calculable due to no case of each disorder in the control group. ICD-10: International Classification of Diseases, Tenth Revision, NHIS-NSC: National Health Insurance Service-National Sample Cohort, aORs: Adjusted Odds Ratios, CI: confidential interval

cal disorders. Results of this investigation also enabled us to report that specific psychiatric/physical disorders could affect suicide risk associated with age (five specific age groups).

This study has several limitations. First, this study was conducted using major diagnoses. We were unable to be aware of dual diagnoses between psychiatric and physical disorders or dual diagnosis between psychiatric disorders such as sleep disorders, depressions, and so on. Sleep disorders might be correlated with depressions. Some serious physical disorders are often accompanied by pain, disability, limited social activity, and worry, leading to many problems with respect to physical, psychological, and social well-being.^{37,38} Second, psychiatric disorders are underestimated when clinicians make a diagnosis. In Asian-culture, community population are likely to conceal their psychiatric problems. As a result, diagnosis of psychiatric disorders is easily underestimated in Korea. Third, it was impossible to differentiate diagnoses resulting from suicide from diagnoses of physical injuries such as ‘effects of foreign body’.

This study showed that suicide was associated with specific psychiatric and physical disorders such as schizophrenia, psoriasis, multiple body injury, epilepsy, sleep disorder, depression, bipolar disorder, and atopic dermatitis. This study also showed that there were considerable differences in the association between psychiatric/physical disorders and suicide risk depending on sex and age (five age groups). To prevent suicide, it is important to have national suicide prevention strategies to address at-risk populations suffering from each psychiatric and physical disorder based on sex and age group. The extremely high odds ratios of suicides in patients with these psychiatric disorders and physical disorders may suggest poor support systems and high stigmatization for such disorder in South Korea. Medical systems should deal with patients’ emotional traumas, low self-esteem, and comorbid psychiatric disorders after diagnosis and provide follow-up for each disorder according to age-specific environments.

Acknowledgments

This study was mainly supported by the Korea Psychological Autopsy Center (KPAC) (Director: Hong Jin Jeon, MD, PhD). The KPAC is operated by the Research & Business Foundation of Sungkyunkwan University on commission of the Korean Ministry of Health and Welfare from Jan 2016. This research was partially supported by the Original Technology Research Program for Brain Science through the National Research Foundation of Korea (NRF) funded by the Ministry of Science and ICT (No. NRF-2016M3C7A1947307; PI HJJ), and the Bio & Medical Technology Development Program of NRF funded by the Korean government, MSIP (No. NRF-2017M3A9F1027323; PI HJJ). Statistical analyses of this study were supported by the Department of Public Health Science Graduate School of Public Health, Seoul National University (Dean: Ho Kim, PhD).

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Hong Jin Jeon. Data curation: Eun Jin Na, Hyewon Lee, Woojae Myung, Hong Jin Jeon. Formal analysis: Hyewon Lee, Ho Kim. Funding acquisition: Hong Jin Jeon. Investigation: Eun Jin Na, Hyewon Lee, Woojae Myung, Kwan Woo Choi, Ho Kim, Hong Jin Jeon. Methodology: Hyewon Lee, Ho Kim. Project administration: Hong Jin Jeon. Resources: Hong Jin Jeon. Software: Hyewon Lee, Ho Kim. Supervision: Maurizio Fava, David Mischoulon, Jong-Woo Paik, Jin pyo Hong, Ho Kim, Hong Jin Jeon. Validation: Hyewon Lee, Ho Kim. Visualization: Hyewon Lee, Ho Kim. Writing—original draft: Eun Jin Na, Hyewon Lee. Writing—review & editing: Eun Jin Na, Hyewon Lee, Woojae Myung, Maurizio Fava, David Mischoulon, Jong-Woo Paik, Jin pyo Hong, Kwan Woo Choi, Ho Kim, Hong Jin Jeon.

ORCID iDs

Hong Jin Jeon	https://orcid.org/0000-0002-6126-542X
Ho Kim	https://orcid.org/0000-0001-7472-3752
Eun Jin Na	https://orcid.org/0000-0002-1111-0446
Hyewon Lee	https://orcid.org/0000-0002-6041-0840

REFERENCES

1. The World Health Organization. Global Health Observatory (GHO) Data. Geneva: World Health Organization; 2017.
2. The World Health Organization. World Health Statistics: 2017. Geneva: World Health Organization; 2017.
3. The Organisation for Economic Co-operation and Development. The OECD data. Paris, France: Organisation for Economic Cooperation and Development; 2017.
4. Korea TS. Cause of Death Statistics in 2016. Sejong, Daejeon: Vital Statistics Division; 2017.
5. Myung W, Lee GH, Won HH, Fava M, Mischoulon D, Nyer M, et al. Paracetamol prohibition and change in the suicide rate and methods in South Korea. *PLoS One* 2015;10:e0128980.
6. Myung W, Won HH, Fava M, Mischoulon D, Yeung A, Lee D, et al. Celebrity suicides and their differential influence on suicides in the general population: a national population-based study in Korea. *Psychiatry Investig* 2015;12:204-211.
7. Hawton K, van Heeringen K. Suicide. *Lancet* 2009;373:1372-1381.
8. Webb RT, Kontopantelis E, Doran T, Qin P, Creed F, Kapur N. Suicide risk in primary care patients with major physical diseases: a case-control study. *Arch Gen Psychiatry* 2012;69:256-264.
9. Singhal A, Ross J, Seminog O, Hawton K, Goldacre MJ. Risk of self-harm and suicide in people with specific psychiatric and physical disorders: comparisons between disorders using English national record linkage. *J R Soc Med* 2014;107:194-204.
10. Nock MK, Hwang I, Sampson NA, Kessler RC. Mental disorders, comorbidity and suicidal behavior: results from the National Comorbidity Survey Replication. *Mol Psychiatry* 2010;15:868-876.
11. Harris EC, Barraclough B. Suicide as an outcome for mental disorders. A meta-analysis. *Br J Psychiatry* 1997;170:205-228.
12. Qin P, Webb R, Kapur N, Sørensen HT. Hospitalization for physical illness and risk of subsequent suicide: a population study. *J Intern Med* 2013;273:48-58.
13. Kuo CJ, Chen VC, Lee WC, Chen WJ, Ferri CP, Stewart R, et al. Asthma and suicide mortality in young people: a 12-year follow-up study. *Am J Psychiatry* 2010;167:1092-1099.
14. Tseng CH. Mortality and causes of death in a national sample of diabetic patients in Taiwan. *Diabetes Care* 2004;27:1605-1609.
15. Allebeck P, Bolund C, Ringbäck G. Increased suicide rate in cancer patients a cohort study based on the Swedish cancer-environment register. *J Clin Epidemiol* 1989;42:611-616.
16. Christensen J, Vestergaard M, Mortensen PB, Sidenius P, Agerbo E. Epilepsy and risk of suicide: a population-based case-control study. *Lan-*

- et Neurol 2007;6:693-698.
17. Teasdale TW, Engberg AW. Suicide after a stroke: a population study. *J Epidemiol Community Health* 2001;55:863-866.
 18. Lee J, Lee JS, Park SH, Shin SA, Kim K. Cohort Profile: The National Health Insurance Service-National Sample Cohort (NHIS-NSC), South Korea. *Int J Epidemiol* 2017;46:e15.
 19. Tidemalm D, Långström N, Lichtenstein P, Runeson B. Risk of suicide after suicide attempt according to coexisting psychiatric disorder: Swedish cohort study with long term follow-up. *BMJ* 2008;337:a2205.
 20. Cavanagh JT, Carson AJ, Sharpe M, Lawrie SM. Psychological autopsy studies of suicide: a systematic review. *Psychol Med* 2003;33:395-405.
 21. Chen Z, Guo Y, Wang S, Tang Y, Yebo G, Ding M. Suicide risk and associated risk factors in adult patients with epilepsy. *Chin J Neurol* 2014;47:250-253.
 22. Tian N, Cui W, Zack M, Kobau R, Fowler KA, Hesdorffer DC. Suicide among people with epilepsy: a population-based analysis of data from the U.S. National Violent Death Reporting System, 17 states, 2003-2011. *Epilepsy Behav* 2016;61:210-217.
 23. Miller M, Mogun H, Azrael D, Hempstead K, Solomon DH. Cancer and the risk of suicide in older Americans. *J Clin Oncol* 2008;26:4720-4724.
 24. Misono S, Weiss NS, Fann JR, Redman M, Yueh B. Incidence of suicide in persons with cancer. *J Clin Oncol* 2008;26:4731-4738.
 25. Ahn MH, Park S, Lee HB, Ramsey CM, Na R, Kim SO, et al. Suicide in cancer patients within the first year of diagnosis. *Psychooncology* 2015;24:601-607.
 26. Miles CP. Conditions predisposing to suicide: a review. *J Nerv Ment Dis* 1977;164:231-246.
 27. Caldwell CB, Gottesman II. Schizophrenics kill themselves too: a review of risk factors for suicide. *Schizophr Bull* 1990;16:571-589.
 28. Alaräisänen A, Miettunen J, Räsänen P, Fenton W, Koivumaa-Honkanen H-TJ, Isohanni M. Suicide rate in schizophrenia in the Northern Finland 1966 Birth Cohort. *Soc Psychiatry Psychiatr Epidemiol* 2009;44:1107-1110.
 29. Palmer BA, Pankratz VS, Bostwick JM. The lifetime risk of suicide in schizophrenia: a reexamination. *Arch Gen Psychiatry* 2005;62:247-253.
 30. Baker GA. Depression and suicide in adolescents with epilepsy. *Neurology* 2006;66(6 Suppl 3):S5-S12.
 31. Lu D, Fall K, Sparen P, Ye W, Adami HO, Valdimarsdottir U, et al. Suicide and suicide attempt after a cancer diagnosis among young individuals. *Ann Oncol* 2013;24:3112-3117.
 32. Wu JJ, Penfold RB, Primatesa P, Fox TK, Stewart C, Reddy SP, et al. The risk of depression, suicidal ideation and suicide attempt in patients with psoriasis, psoriatic arthritis or ankylosing spondylitis. *J Eur Acad Dermatol Venereol* 2017;31:1168-1175.
 33. Choi KW, Na EJ, Hong JP, Cho MJ, Fava M, Mischoulon D, et al. Alcohol-induced disinhibition is associated with impulsivity, depression, and suicide attempt: a nationwide community sample of Korean adults. *J Affect Disord* 2017;227:323-329.
 34. Lu D, Zhu P, Wu H, Yarla N, Zhu H. Human suicide study, is there an association between suicide and mental illness. *Metabolomics (Los Angel)* 2016;6:186.
 35. Stip E, Caron J, Tousignant M, Lecomte Y. Suicidal ideation and schizophrenia: contribution of appraisal, stigmatization, and cognition. *Can J Psychiatry* 2017;62:726-734.
 36. Reynders A, Kerkhof AJ, Molenberghs G, Van Audenhove C. Stigma, attitudes, and help-seeking intentions for psychological problems in relation to regional suicide rates. *Suicide Life Threat Behav* 2016;46:67-78.
 37. Goodwin RD, Kroenke K, Hoven CW, Spitzer RL. Major depression, physical illness, and suicidal ideation in primary care. *Psychosom Med* 2003;65:501-505.
 38. Hall RC, Popkin MK, Devaul RA, Faillace LA, Stickney SK. Physical illness presenting as psychiatric disease. *Arch Gen Psychiatry* 1978;35:1315-1320.