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Medical Care Expenditure in Suicides From Non-illness-related Causes

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Objectives: Several epidemiological studies on medical care utilization prior to suicide have considered the motivation of suicide, but focused on the influence of physical illnesses. Medical care expenditure in suicide completers with non-illness-related causes has not been investigated.

Methods: Suicides motivated by non-illness-related factors were identified using the investigator's note from the National Police Agency, which was then linked to the Health Insurance Review and Assessment data. We investigated the medical care expenditures of cases one year prior to committing suicide and conducted a case-control study using conditional logistic regression analysis after adjusting for age, gender, area of residence, and socioeconomic status.

Results: Among the 4515 suicides motivated by non-illness-related causes, medical care expenditures increased in only the last 3 months prior to suicide in the adolescent group. In the younger group, the proportion of total medical expenditure for external injuries was higher than that in the older groups. Conditional logistic regression analysis showed significant associations with being a suicide completer and having a rural residence, low socioeconomic status, and high medical care expenditure. After stratification into the four age groups, a significant positive association with medical care expenditures and being a suicide completer was found in the adolescent and young adult groups, but no significant results were found in the elderly groups for both men and women.

Conclusions: Younger adults who committed suicide motivated by non-illness-related causes had a higher proportion of external injuries and more medical care expenditures than their controls did. This reinforces the notion that suicide prevention strategies for young people with suicidal risk factors are needed.

Key words: Suicide, Health expenditures, Social behavior disorders

INTRODUCTION

Suicide is one of the leading causes of death in the world and regarded as one of the most serious public health and critical social issues in the Republic of Korea (ROK). The incidence of suicide deaths has increased very rapidly and steadily in recent years in the ROK; suicide was the fourth most frequent cause of death, reaching 31.2 per 100 000 inhabitants in 2010 [1]. In 2011, the ROK had an age-standardized suicide rate of 33.3 per 100 000 individuals, which was the highest rate among all of

the Organization for Economic Cooperation and Development countries [2].

To develop effective suicide prevention strategies, it would be helpful to explore the point of service through the investigation of medical care utilization prior to suicide. In Western countries, many previous studies showed that individuals prior to suicide have more medical care utilization, particularly in the primary care setting [3,4]. In the ROK, a previous study showed that medical expenditures during one year prior to death in suicide completers were remarkably higher than those among age- and gender-matched controls [5]. However, suicide can be motivated by not only chronic illnesses which might reflect medical expenditures but also non-illness-related causes [6,7]. Nonetheless, a few studies on medical care utilization prior to suicide have considered the patient's motivation to commit suicide. Focusing on suicide completers motivated by physical illnesses, a previous study suggested that medical expenditures significantly increased during the last three months before death [8], but suicide completers motivated by non-illness-related causes have not been investigated so far.

The motivations of suicidal behaviors have been well documented, and include not only chronic physical or mental illnesses but also financial problems, the recent loss of a spouse, social isolation, or loneliness [9,10]. Previous studies have shown that there are age-related differences in risk factors preceding suicide [11]. Many studies on elderly suicide committers found that most elderly people who commit suicide suffer from both physical illnesses and depressive disorders associated with a physical disability prior to suicide [12,13]. Furthermore, several epidemiological studies have suggested that most of the suicides had contact with utilization of health care services more frequently motivated by chronic physical illnesses [8]. However, among adolescents and young adults more suicides are preceded by social problems and psychiatric disorders including depression, schizophrenia, and alcohol abuse than that among the elderly are [14]. Therefore, different strategies for suicide prevention are necessary for different age groups.

Although numerous studies on suicides from physical or mental illnesses have been performed, few studies have investigated the association between suicides from non-illness-related causes and medical care utilization. Considering that the suicide rates among the elderly in the ROK have been increasing [15], analysis of elderly suicides motivated by non-illness-related causes including economic problems or family troubles will contribute to effective suicide prevention strategies. In the present study, we investigated the difference in medical care expenditure between those who committed suicide from non-illness-related causes and their age- and gender-matched controls using national representative data.

METHODS

Study Population

Data of 8413 suicides in the ROK in 2004, identified by the investigator's notes including the post-mortem examination findings and motivation for suicide were provided by the National Police Agency. Two physicians (KT Moon and JY Park) reviewed the investigator's notes, records of the suicides and any family obtained by inquiry for the 8413 total suicides and reported that 6381 (75.8%) of these suicides were motivated by non-illness-related causes such as economic reasons, intrapersonal relations, divorce, family troubles, unemployment, parents scolding, and a death in the family as well as other unknown reasons [16]. Among the 6381 suicides, 4515 were finally confirmed as suicide cases after linking our database with that of the Death Statistics Database of the Korean National Statistical Office [17].

To achieve good comparability between our cases and controls and compare the medical expenditures between suicide completers and the general population without bias, nine controls from the same source population of the cases were frequency-matched with each suicide completer by gender and age group (10-19, 20-39, 40-59, and ≥60 years of age). In total, 40 635 controls who were registered as health insurance subscribers, dependents of health insurance subscribers, or medical aid beneficiaries were randomly selected from all Koreans. This study was approved by the institutional review board of Yonsei University Health System (approval number 4-2011-0273), Seoul, ROK.

Medical Care Utilization

Information on medical care utilization during one year prior to suicide was obtained by linking to the data from the Health Insurance Review and Assessment from January 1, 2003 to December 31, 2004. For the controls, medical care utilization was used over a period spanning July 1, 2003 to June 30, 2004. The Health Insurance Review and Assessment data contains a diagnosis codes (according to the International Classification of Diseases 10th revision [ICD-10]), the date of diagnosis, medical expenditures, and health insurance premium rates for each case and control. All medical care expenditures for all medical care

visits were summed for each study subject. Then, the medical care expenditure during one year prior to death in suicide completers and the relevant period in the controls were calculated. The ICD-10 disease diagnosis codes for external injuries (S00-S99), the respiratory system (J00-J99), the gastrointestinal system (K00-K93), mental disorders (F00-F99) and others were used to categorize the total medical expenditures of each case.

Statistical Analysis

Demographic variables such as age, gender, area of residence, and socioeconomic status were considered to be confounders related to medical care utilization [18]. The study population was categorized into four age groups: 10 to 19, 20 to 39, 40 to 59, and ≥60 years of age. The area of residence was classified as metropolitan/urban or rural. The Korea National Health Insurance premium rate, which is based on family income and immovable property for all Koreans, was used to categorize each subject's socioeconomic status as either low (the lowest quintile of medical aid beneficiaries) or mid-high (the remaining four quintiles). Medical care expenditures during one year prior to suicide were divided into two groups as low (lower than the median value based on the study population's distribution) or high (higher than the median value based on the study population's distribution).

Comparisons of age, gender, area of residence, and socioeconomic status between suicide completers from non-illness-related causes and their matched controls were conducted using chi-squared tests. Initially, we compared medical care utilization and total medical care expenditures stratified by disease category among only the suicide completers from non-illness-related causes. Thereafter, we conducted a case-control study using bivariate conditional logistic regression analyses to estimate crude odds ratios (OR) and 95% confidence intervals (CI). Subsequent multivariate analyses were performed to calculate adjusted ORs for committing suicide after adjusting for area of residence, socioeconomic status, and medical care expenditure after stratifying according to age and gender. All analyses were performed with SAS version 9.3 (SAS Institute, Cary, NC, USA) and randomly generated identification numbers were used to protect the identity of all of the subjects.

RESULTS

Table 1 shows the demographic characteristics of the cases and controls. Among the total population of 45 150 subjects,

Table 1. Demographic characteristics of case and control group

Variable	Total (n=45 150)	Case (n=4515)	Control (n=40 635)	*p*-value
Age (y, mean ± SD)	49.3 ± 15.9	46.1 ± 16.4	49.7 ± 15.8	<0.001
Gender				
Men	33 760 (74.8)	3376 (74.8)	30 384 (74.8)	1.00
Women	11 390 (25.2)	1139 (25.2)	10 251 (25.2)	
Area of residence				
City, rural	24 587 (54.5)	2740 (60.7)	21 847 (53.8)	<0.001
Metropolitan city	20 563 (45.5)	1775 (39.3)	18 788 (46.2)	
Socioeconomic status				
Low	10 499 (23.3)	1467 (32.5)	9032 (22.2)	<0.001
Mid-high	34 651 (76.7)	3048 (67.5)	31 603 (77.8)	
Medical care expenditure (1000 Korean won, median [IQR])	98.9 (291.8)	119.4 (538.0)	97.2 (276.6)	
Low	19.0 (50.8)	11.3 (44.2)	19.9 (51.4)	<0.001
High	310.8 (556.8)	486.6 (1068.0)	299.2 (505.8)	

Values are expressed as number (%) unless otherwise indicated.
IQR, interquartile range.

4515 (10.0%) and 40 635 (90.0%) participants comprised the suicide completers and control group, respectively. By design, suicide completers and controls were matched with respect to age (suicides; mean, 46.1; standard deviation [SD], 16.4; controls; mean, 49.7; SD, 15.8) and gender. Cases and controls significantly differed in their area of residence ($p<0.001$) and socioeconomic status ($p<0.001$). The median values (interquartile range) of medical care expenditures (in 1000 Korean won) during one year prior to suicide were 119.4 (538.0) for the cases and 97.2 (276.6) for the controls.

Figure 1 presents the patterns in medical care expenditure during one year prior to suicide individually by gender and age group. Among both men and women, the medical care expenditure increased in only last three months prior to committing suicide among those in aged between 10 to 19 years, while a gradual increase over the one-year period was noted in the other age groups. Table 2 shows the medical care utilization and total medical care expenditures of the cases who utilized medical care within one year prior to committing suicide stratified by disease diagnosis. The percentage of cases and expenditures for external injuries were higher in the adolescent and young adult groups than that among the older age groups in both men and women. Among men, the proportion of medical care expenditure for external injuries was especially higher in the adolescent (53.5% vs. 15.9%) and young adult groups
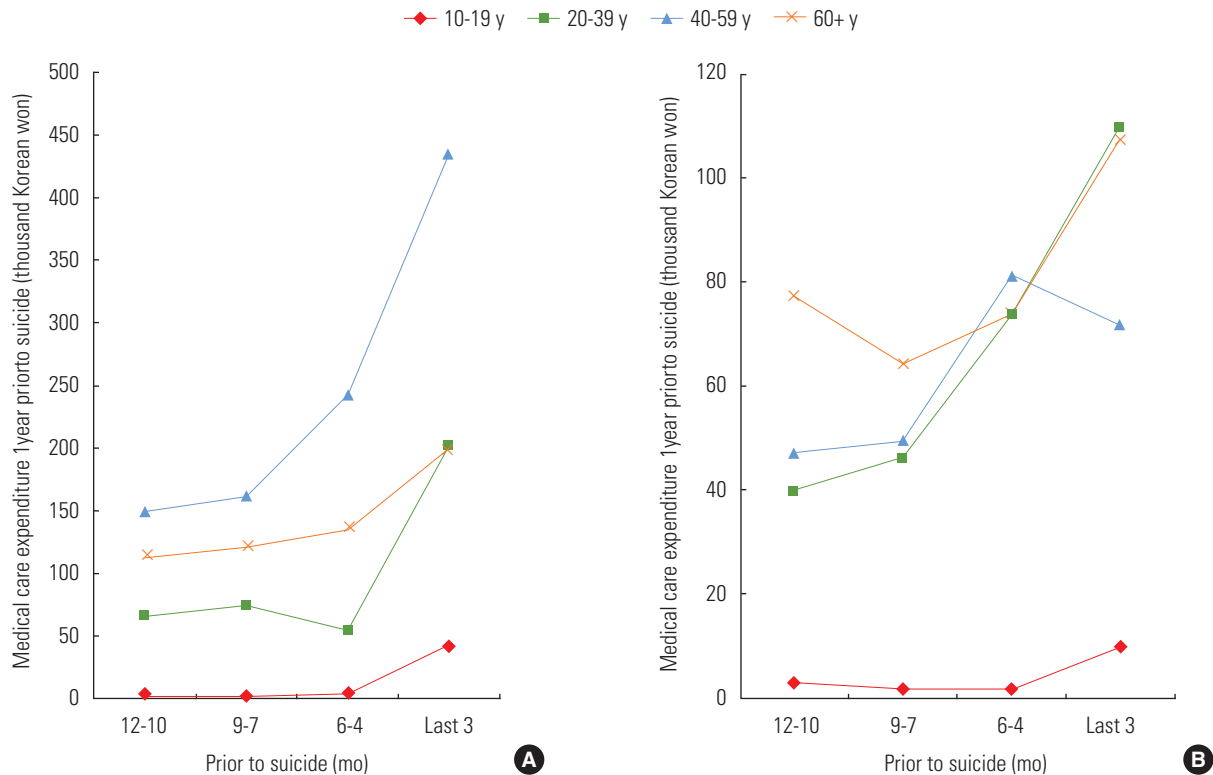
Figure 1. Individual medical care expenditure during period of 1 year prior to suicide stratified according to age and gender. (A) Men and (B) women.

Table 2. Medical care utilization and total medical care expenditure by disease group stratified according to age and gender

	Adolescent (10-19 y)		Young adult (20-39 y)		Middle adult (40-59 y)		Elderly (60+ y)	
	n	Medical care expenditure	n	Medical care expenditure	n	Medical care expenditure	n	Medical care expenditure
Men								
External injuries	74 (16.0)	33.8 (53.5)	479 (13.3)	98.6 (20.7)	753 (8.5)	103.4 (10.0)	401 (4.7)	37.9 (6.7)
Respiratory system	109 (23.5)	1.8 (2.9)	548 (15.2)	17.1 (3.6)	983 (11.2)	25.3 (2.4)	1091 (12.7)	44.7 (7.8)
GI system	30 (6.5)	2.9 (4.6)	414 (11.6)	44.1 (9.3)	1116 (12.6)	86.1 (8.4)	976 (11.4)	51.8 (9.1)
Mental disorder	54 (11.7)	4.9 (7.8)	778 (21.6)	144.7 (30.4)	1012 (11.5)	192.3 (18.6)	478 (5.5)	54.1 (9.5)
Others	196 (42.3)	19.7 (31.2)	1377 (38.3)	171.4 (36.0)	4965 (56.2)	626.8 (60.6)	5638 (65.7)	381.2 (66.9)
Women								
External injuries	29 (8.0)	5.6 (15.9)	197 (6.3)	29.8 (10.3)	156 (5.1)	13.1 (5.2)	193 (4.3)	26.4 (7.8)
Respiratory system	103 (28.5)	1.4 (4.1)	612 (19.9)	18.3 (6.3)	420 (13.8)	7.5 (3.0)	388 (8.7)	12.2 (3.6)
GI system	38 (10.7)	1.5 (4.5)	291 (9.4)	15.3 (5.3)	251 (8.3)	46.0 (18.2)	359 (8.0)	18.5 (5.4)
Mental disorder	50 (13.8)	15.5 (43.6)	501 (6.3)	97.0 (33.5)	447 (14.7)	61.3 (24.3)	278 (6.2)	23.0 (6.7)
Others	141 (39.0)	11.3 (31.9)	1482 (48.1)	129.3 (44.6)	1763 (58.1)	124.5 (49.3)	3267 (72.8)	261.3 (76.5)

Unit: million Korean won.
GI, gastrointestinal.

(20.7% vs. 10.3%). In the older age groups, the proportion of external injuries was much lower than that among the young age group with little difference between these findings in men and women.

In the conditional logistic regression model that adjusted for area of residence, socioeconomic status, and total medical care expenditure after gender stratification (Table 3), having a rural residence (vs. metropolitan; OR, 1.297; 95% CI, 1.218 to 1.382),

Table 3. Gender stratified analyses of odds ratios for suicide according to suicidal risk factors (conditional logistic regression analysis)

Variables	Total		Men		Women	
	Crude OR	Adjusted OR[1]	Crude OR	Adjusted OR[1]	Crude OR	Adjusted OR[1]
Area of residence						
Metropolitan	1.00		1.00		1.00	
Urban or rural	1.33 (1.25, 1.41)	1.30 (1.22, 1.38)	1.31 (1.21, 1.40)	1.28 (1.19, 1.38)	1.39 (1.23, 1.58)	1.35 (1.19, 1.53)
Socioeconomic status						
Mid-high	1.00		1.00		1.00	
Low	1.65 (1.58, 1.80)	1.67 (1.56, 1.78)	1.77 (1.64, 1.91)	1.76 (1.63, 1.90)	1.46 (1.28, 1.67)	1.43 (1.26, 1.63)
Medical expenditure (1000 Korean won)						
Low	1.00		1.00		1.00	
High	1.17 (1.10, 1.25)	1.16 (1.09, 1.24)	1.11 (1.03, 1.19)	1.10 (1.03, 1.18)	1.43 (1.26, 1.63)	1.41 (1.24, 1.61)

OR, odds ratio.

[1]Adjusted for residence, socioeconomic status, and medical expenditure.

low socioeconomic status (vs. mid-high; OR, 1.666; 95% CI, 1.558 to 1.780) and high medical care expenditure (vs. low; OR, 1.165; 95% CI, 1.095 to 1.239) was significantly associated with being a suicide completer. In both men and women, medical care expenditure was also significantly associated with being a suicide completer (men; OR, 1.102; 95% CI, 1.026 to 1.183; women; OR, 1.413; 95% CI, 1.242 to 1.607), but no gender differences were found.

After stratification into the four age groups, multivariate logistic regression analyses were also performed. Among adolescent and young adult men, having a high medical care expenditures was significantly associated with being a suicide completer (adolescent; OR, 3.191; 95% CI, 2.088 to 4.879; young adult; OR, 1.458; 95% CI, 1.274 to 1.669), but no significant results were found among those in the 40 to 59 or ≥60 years old age group (Table 4). There are little differences between crude odds ratios and adjusted odds ratios. The results among women also described in Table 4 showed little gender differences in significance of odds ratios with increasing total medical care expenditure.

DISCUSSION

We investigated the total medical care expenditures and medical care utilization among suicide completers with non-illness-related causes individually and overall. The individual medical care expenditure increased in only the last three months prior to suicide in the adolescent group, while expenditure increased gradually over the one-year period in the older age groups. In addition, the proportion of medical care expenditures for external injuries was much higher among adolescents and young adults (25.8%) than that among older adults was (9.1%). This might reflect an acute stressful life event or psychopathology influencing young adults to attempt suicide. Previous studies have shown that alcohol use disorders are the most common cause of suicide and are highly comorbid with other mental disorders such as bipolar disorder or personality disorder in younger populations [19,20]. In addition, several studies also have reported associations between antisocial behavior (including conduct disorder, oppositional defiant disorder, and antisocial personality disorder) and increased suicide risk among younger populations [21,22]. Together with our results, these findings suggest that the treatment and management of alcohol use disorder or other sudden mental disorders among young people are of great important to prevent external injuries or other physical illnesses. Because young people with external injuries are more likely to have contact with primary care medical providers rather than mental health professionals [23], primary care physicians and pediatricians may be critical players in suicide prevention programs. Moreover, primary care physicians should consider adolescent and young adults with comorbid mental disorders as potential suicide cases and perform effective prevention strategies.

We also compared medical care expenditures between suicides motivated by non-illness-related causes and age- and gender-matched controls and found little differences in medical care expenditures between genders. Medical care expenditures were significantly higher among suicide completers with non-illness-related causes compared to their matched controls among adolescents and young adults. This finding is consistent

Table 4. Age stratified analyses of odds ratios for suicide according to suicidal risk factors among men and women (conditional logistic regression analysis)

Variables	Adolescent (10-19 y)		Young adult (20-39 y)		Middle adult (40-59 y)		Elderly (60+ y)	
	Crude OR	Adjusted OR[1]	Crude OR	Adjusted OR[1]	Crude OR	Adjusted OR[1]	Crude OR	Adjusted OR[1]
Men								
Area of residence								
Metropolitan	1.00		1.00		1.00		1.00	
Urban or rural	1.30 (0.86, 1.97)	1.31 (0.86, 2.00)	1.29 (1.13, 1.47)	1.27 (1.11, 1.45)	1.45 (1.30, 1.61)	1.43 (1.29, 1.60)	1.05 (0.90, 1.24)	1.04 (0.88, 1.22)
Socioeconomic status								
Mid-high	1.00		1.00		1.00		1.00	
Low	0.77 (0.47, 1.27)	0.79 (0.48, 1.31)	2.25 (1.96, 2.58)	2.27 (1.98, 2.61)	1.74 (1.55, 1.96)	1.73 (1.54, 1.94)	1.49 (1.25, 1.76)	1.48 (1.25, 1.76)
Total medical expenditure (1000 Korean won)								
Low	1.00		1.00		1.00		1.00	
High	3.23 (2.12, 4.93)	3.19 (2.09, 4.88)	1.419 (1.24, 1.62)	1.458 (1.27, 1.67)	0.94 (0.85, 1.05)	0.94 (0.84, 1.04)	1.02 (0.86, 1.22)	1.04 (0.87, 1.24)
Women								
Area of residence								
Metropolitan	1.00		1.00		1.00		1.00	
Urban or rural	1.36 (0.83, 2.24)	1.28 (0.78, 2.12)	1.32 (1.08, 1.61)	1.25 (1.02, 1.54)	1.75 (1.39, 2.20)	1.73 (1.38, 2.18)	1.14 (0.88, 1.47)	1.14 (0.88, 1.48)
Socioeconomic status								
Mid-high	1.00		1.00		1.00		1.00	
Low	1.12 (0.63, 1.97)	1.06 (0.60, 1.87)	1.74 (1.42, 2.16)	1.77 (1.42, 2.20)	1.76 (1.40, 2.22)	1.75 (1.38, 2.20)	0.99 (0.76, 1.29)	0.98 (0.75, 1.27)
Total medical expenditure (1000 Korean won)								
Low	1.00		1.00		1.00		1.00	
High	2.12 (1.28, 3.50)	2.07 (1.25, 3.43)	1.90 (1.54, 2.32)	1.92 (1.56, 2.35)	1.03 (0.81, 1.29)	1.03 (0.82, 1.30)	1.32 (0.98, 1.77)	1.32 (0.99, 1.78)

OR, odds ratio.

[1]Adjusted for residence, socioeconomic status, and medical expenditure.

with those of previous studies [23,24]. However, we found no significant difference in the medical care expenditures between suicide completers with non-illness-related causes and their matched controls among the middle-aged and the elderly age groups. This age difference might be related to differences in the motivation behind committing suicide; nonetheless, it provides clues toward the proper development of age-specific strategies for suicide prevention.

We found that suicides from non-illness-related causes were significantly and positively associated with medical care expenditures in the adolescent (10 to 19 years) and young adult (20 to 39 years) groups for both men and women. Although adolescents and young adults are often at an elevated level of risk of suicide because of stresses during puberty or loss of control over self-destructive impulses [25], most young people who are at risk of committing suicide may not utilize suicide prevention programs [5,23]. Because young adults tend to visit primary care physicians much more frequently than they visit mental health specialists [24,26], primary care physicians and pediatri-

cians may have a significant and important role in suicide prevention programs, as mentioned above. Consistent with previous studies [27,28], our findings suggest that young adults from rural areas with lower socioeconomic status are more likely to commit suicide. Park et al. [16] reported that, in the ROK, the most common motivation for committing suicide in young people was psychiatric disorders. Because psychiatric hospital resources vary across different areas of the ROK, youth from rural areas might be disproportionately less able to access these health resources than their age-matched urban-dwelling counterparts are, thus are more likely to attempt and commit suicide [29]. For effective suicide prevention among young adult, those with psychiatric disorders should be considered at a high risk for suicide, and community-based strategies are required [23].

The elderly are more likely to have comorbidities with physical illnesses, and previous studies have suggested that the elderly might spend more money on medical services for not only mental health problems but also chronic physical illnesses [30-32]. However, elderly suicide completers with a subjective

health status of apparently healthy might also have underlying diseases [33] or minor/subsyndromal depression [34]. In addition, late-life depression is more prevalent in the ROK than western countries [35], but treatment of depression in the elderly is much less likely to occur in the ROK than in other countries due to a rapid shift toward the nuclear family in the ROK [36]. Collectively, it is possible that the elderly who commit suicide lack the proper means to contact providers for treatment in the critical period preceding their suicide. Moreover, a sudden lack of financial, emotional, and/or social supports might be major risk factors for suicidal behavior [37]. Additionally, economic crises or social isolation can act as barriers to accessing medical care among the elderly. Therefore, management of community-based programs for the socially isolated elderly are needed and the elderly should be encouraged to contact medical care providers.

The main strength of our study is that we used a large, national representative suicide data. Through national record linkage, we conducted the first case-control study, to our knowledge, on the association between suicide motivated by non-illness-related causes and medical care expenditures stratified by age and gender. However, there are several limitations requiring consideration. First, we could not fully evaluate other suicidal risk factors because some medical history information and other demographic variables were not available. In addition, many potential confounding variables including chronic underlying diseases, the prevalence of depression or alcohol abuse, and other socioeconomic factors were not taken into account; therefore, our results should be interpreted cautiously. Nevertheless, the National Police Agency data is the most accessible for suicide records in a limited setting, so it may be used as a basis of further studies by linking additional medical records and/or psychiatric autopsy data. Second, inaccuracies when the National Police Agent suicide data and death statistics data were linked also may have led to bias. Because investigator's notes from the National Police Agency did not cover all suicides, this may have created a discrepancy with the national death statistics. However, all reported deaths are reviewed by the Korean National Statistical Office, if necessary, to ensure the accuracy of the death statistics data. Even if there were some inaccuracies, they would have had little effect on our results because we focused on medical care expenditures during the one-year period prior to suicide completion rather than on specific diseases. Last, the medical expenditures we calculated may not represent underlying medical needs prior to suicide.

Although we collected data on every instance of medical care utilization one year prior to suicide using administrative data, there are still many reasons why appropriate treatment cannot be obtained such as geographic inaccessibility, physical disabilities, or financial constraints. For those with barriers in accessing appropriate primary care, interventions to reduce these barriers and enhance primary care, which is the gatekeeper to accessing mental health services, are needed. In addition, more precise and detailed studies should be performed that consider the effect of undetected illnesses due to medical unmet needs.

In the present study, we investigated the age differences in medical expenditures among suicide completers with non-illness-related causes. In younger adults, we found that suicides from non-illness-related causes were positively associated with high medical care expenditures with a high proportion of expenditures resulting from external injuries. Among the elderly, suicide completion from non-illness-related causes was not associated with medical treatment expenditure. These findings point out the importance of improving health care services at the critical point prior to suicide and reinforce the need to establish suicide prevention strategies among vulnerable populations. Education programs on suicide prevention for physicians including pediatricians should be improved to screen psychiatric disorders in the youth to prevent suicides from non-illness-related causes since youth with psychiatric disorders are considered at high risk for suicide and have high medical expenditure. For the elderly, assessable health care providers, especially general physicians and social support networks are required because the elderly suicides are actually higher prevalent in chronic illnesses they did not have recognized physically or mentally.

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CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

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