The Relationship between Smoking Status and Suicidal Behavior in Korean Adults: The 4th Korea National Health and Nutrition Examination Survey (2007–2009)

So-Eun Kim, Ji-Hyun Shim, Hyung Noh, Hwan-Sik Hwang*, Hoon-Ki Park

Department of Family Medicine, Hanyang University College of Medicine, Seoul, Korea

**Background:** This study was performed to evaluate the relationship between smoking status and suicidal ideations or suicide attempts in Korean adults.

**Methods:** The study used data from the 4th Korea National Health and Nutrition Examination Survey, and involved 17,065 participants. We used multiple logistic regression analysis to evaluate the relationship between smoking status and suicidal behavior. The results were adjusted for covariates including depression and physical disease.

**Results:** After adjusting for covariates, current smokers (odds ratio [OR], 1.66; 95% confidence interval [CI], 1.34 to 2.05) and former smokers (OR, 1.39; 95% CI, 1.13 to 1.72) proved more likely to have suicidal ideations than non-smokers. Among women, current smokers (OR, 2.00; 95% CI, 1.47 to 2.72) and former smokers (OR, 1.48; 95% CI, 1.11 to 1.99) were more likely to have suicidal ideations than non-smokers. However, among the men there was no significant relationship between smoking status and suicidal ideations. Among all the participants who had had suicidal ideations, there was a significant relationship between current smoking and suicide attempts (OR, 1.80; 95% CI, 1.05 to 3.07). There was also a relationship between current smoking and suicide attempts among women (OR, 2.40; 95% CI, 1.31 to 4.37), but no significant relationship among men.

**Conclusion:** There is a relationship between smoking status and suicidal ideations and suicide attempts in the general population of Korea. This relationship is particularly clear in women, and is independent of comorbid chronic disease and depression. Current smokers and former smokers are more likely to have suicidal ideations than non-smokers; current smokers are also more likely to have attempted suicide.

**Keywords:** Smoking; Suicidal Ideation; Attempted Suicide

**INTRODUCTION**

The mortality rate of Korean adults over the age of 20 is 31.2 per 100,000 according to Statistics Korea, 2010. This is double the mortality rate in Organization for Economic Cooperation and Development nations and 2.4 times the figure ten years previously. Actual suicide can generally be predicted from the wish to die, suicidal ideations and previous suicide attempts. Understanding the risks posed by suicide-related behavior is therefore important in preventing suicide.
A history of psychiatric disorders and particular demographic characteristics (female, young age, unemployment, and single status) have been presumed to be risk factors for suicide completion and suicide-related outcomes.

Smoking is one of many factors that influence suicide and suicide attempts. Several studies have found a positive association between smoking and suicide attempts and others have found an association between smoking and suicide completion. However, it is not clear whether the relationship between smoking and suicide attempts is causal or correlational.

Smoking is positively related to almost all psychiatric disorders and psychiatric diseases are well-known risk factors for suicide attempts and suicidal ideations. However, some analyses of the relationship between smoking and suicidal behavior have not taken into account the effect of mental disorders; in studies that included controls for psychiatric disorders, the relationship between suicidal behavior and smoking was not significant. Moreover, many of these studies involved only teenagers; there are few studies of the adult population. In this study, we sought to examine the relationship between smoking status and suicidal behavior (suicidal ideations and suicide attempts) in the Korean adult population.

METHODS

1. Study Population

Data for the study population came from the 4th Korea National Health and Nutrition Examination Survey (KNHANES). The survey contained data on 31,705 individuals, and we approached 24,871 of these to take part in our survey. We excluded people who did not respond to our approach (1,290 people), people who answered “I don’t know” to the question about whether they wished to die (51 people), and everyone under the age of 18 (6,465 people). After these exclusions, 17,065 subjects were included in the study, which was approved by the ethics committee of a university hospital in Seoul.

The Ministry of Health and Welfare of Korea set up the KNHANES to examine the general health and nutritional status of Koreans. The 4th KNHANES was conducted from July 2007 to December 2009. It used a stratified multistage sampling design for the South Korean population in multiple geographic areas, of multiple ages and both genders. Weighting the samples could therefore give a meaningful representation of the entire population.

2. Data Collection

Suicidal ideations were assessed by asking the question: “Have you wished to die at any time during the past year?” For those who answered “yes”, a further question was asked: “During the past year, have you actually attempted suicide?” From the answers to the first question, we divided people into two groups: ‘suicidal ideations’ and ‘no suicidal ideations’. From the answer to the second question, the ‘suicidal ideations’ group was further divided into: suicidal ideations without suicide attempts and suicidal ideations with suicide attempts.

We compared various characteristics (age, sex, height, weight, body mass index, total cholesterol, triglyceride, hemoglobin, quality of life measured by visual analog scale of Euroqol 5 dimension, alcohol intake, education level, and total pack years) of the ‘suicidal ideations’ group with those of the ‘no suicidal ideations’ group. We then compared the characteristics of the ‘suicidal ideations’ group with those of its two sub-groups.

Household income and education level were classified into four groups, alcohol intake was presented by frequency of drinking days a week (none, ≤ 1, 2–3, and ≥ 4), and we used self-reporting to categorize the smokers into three groups: current smokers, former smokers, and non-smokers. Former smoker was defined as someone who selected the question “I do not smoke now. But I smoked in the past.” Stress perception levels were divided into “much” and “little” by self-reporting. Depressive mood for more than two weeks and psychiatric counseling during the past year were also assessed by self-reporting. Comorbid chronic diseases were classified into cardiovascular diseases (hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, and angina pectoris), musculoskeletal diseases (arthritis and rheumatoid arthritis), respiratory diseases (tuberculosis, asthma, and chronic obstructive pulmonary disease), endocrine diseases (diabetes mellitus and thyroid disease), and gastrointestinal diseases (peptic ulcer, liver cirrhosis, hepatitis type B, and hepatitis type C) by lifetime prevalence.

3. Statistical Analysis

The analysis used weighted values of the stratified samples
from the KNHANES. The characteristics of the study subjects were compared using a Student t-test. Household income, education, stress perception, depressive mood for more than two weeks, psychological counseling, comorbid diseases, suicide attempts, suicidal ideations, and smoking status were compared using Pearson’s chi-square test. Student t-test and the chi-square test were used to compare variables between groups. Adjusted odds ratio (OR) and 95% confidence intervals (CIs) were calculated by multiple logistic regression analysis to assess the relationship between suicidal ideations and smoking status in all the study subjects, as well as to evaluate the relationship between suicide attempts and smoking status in the ‘suicidal ideations’ group. A P-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS ver. 18.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

1. Baseline Characteristics of Study Subjects

Table 1 shows the descriptive statistics of all the study subjects, by gender. A total of 17,065 subjects (weighted 37,170,000) were included; mean age was 43.7 years for men and 45.8 years for women. Of the men in the study, 18.9% were non-smokers, 33.8% were former smokers, and 47.4% were current smokers. The respective figures for the women were 86.4%, 6.9%, and 6.8%. The total number of pack years was 18.2 for men and 1.0 for women.

Ten point five percent of men and 21.7% of women answered “yes” to the question “Have you wished to die at any time during the past year?” Zero point six percent of men and 1.3% of women answered “yes” to the question “During the past year, have you actually attempted suicide?” Suicidal ideations and suicide attempts were therefore both twice as high in women as in men. Depression, which is a high risk factor for suicide and suicidal behavior, occurred in 4.9% of men and 17.4% of women.

2. Comparison of Characteristics between the Suicidal Ideations Group and Other Groups in Female Subjects

The mean age of the ‘suicidal ideations’ group and 44.6 years in the ‘no suicidal ideations’ group. In the ‘suicidal ideations’ group, 22.2% had experienced depression compared with 2.9% in the ‘no suicidal ideations’ group. Of those with suicidal ideations, 6.1% had attempted suicide (Table 2).

3. Comparison of Characteristics between the Suicidal Ideations Group and Other Groups in Male Subjects

The mean age was 47.5 years in the ‘suicidal ideations’ group and 43.3 years in the ‘no suicidal ideations’ group. In the ‘suicidal ideations’ group, 12.9% were non-smokers, 31.9% were former smokers, and 55.2% were current smokers; in the ‘no suicidal ideations’ group, 19.6% were non-smokers, 34.0% were former smokers and 46.5% were current smokers. In the ‘suicidal ideations’ group, 22.2% had experienced depression compared with 2.9% in the ‘no suicidal ideations’ group. Of those with suicidal ideations, 6.1% had attempted suicide (Table 3).

4. Comparison between People Who Attempted Suicide and Those with Suicidal Ideations in Female Subjects

The mean age of people who had attempted suicide was 48.6 years and the mean age of those with suicidal ideations but who had not attempted suicide was 50.3 years. In the ‘suicide attempt’ group, 62.7% were non-smokers, 11.4% were former smokers and 25.9% were current smokers. In the group who had not attempted suicide these figures were 81.0%, 8.2%, 10.8%, respectively. Comorbid depressive disorder was more prevalent in the suicide attempt group (53.5%) than in those who had suicidal ideations but had not attempted suicide (34.4%), and this difference was statistically significant (Table 4).

5. Comparison between People Who Attempted Suicide and Those with Suicidal Ideations in Male Subjects

The mean age of people who had attempted suicide was 50.1 years and the mean age of those with suicidal ideations but who had not attempted suicide was 47.3 years. In the ‘suicide attempt’ group, 13.8% were non-smokers, 29.9% were former smokers and 56.3% were current smokers. In the group who had not attempted
Table 1. Baseline characteristics of study subjects

| Characteristic                        | Male (n = 7,222) | Female (n = 9,843) | P-value* |
|---------------------------------------|------------------|--------------------|----------|
| Age (y)                               | 43.7 ± 0.3       | 45.8 ± 0.3         | <0.001   |
| VAS of EQ5D                           | 78.7 ± 0.8       | 75.1 ± 0.6         | <0.001   |
| Height (cm)                           | 170.3 ± 0.1      | 157.0 ± 0.1        | <0.001   |
| Weight (kg)                           | 69.9 ± 0.2       | 57.1 ± 0.1         | <0.001   |
| Body mass index (kg/m²)               | 24.1 ± 0.1       | 23.2 ± 0.1         | <0.001   |
| Fasting glucose                       | 97.7 ± 0.4       | 95.0 ± 0.3         | <0.001   |
| Total cholesterol                     | 185.8 ± 0.6      | 187.1 ± 0.6        | 0.080    |
| Triglycerides                         | 155.0 ± 1.8      | 114.0 ± 1.1        | <0.001   |
| Hemoglobin                            | 15.3 ± 0.0       | 12.9 ± 0.0         | <0.001   |
| Pack years (total)                    | 18.2 ± 0.3       | 1.0 ± 0.1          | <0.001   |
| Smoking status                         |                  |                    | <0.001   |
| Non-smoker                            | 1,314 (18.9)     | 8,645 (86.4)       |          |
| Former smoker                         | 2,728 (33.8)     | 590 (6.9)          |          |
| Current smoker                        | 3,179 (47.4)     | 607 (6.8)          |          |
| Alcohol (d/wk)                         |                  |                    | <0.001   |
| None                                  | 857 (9.9)        | 1,737 (20.5)       |          |
| ≤1                                    | 3,156 (51.2)     | 5,054 (67.3)       |          |
| 2–3                                   | 1,704 (25.9)     | 663 (9.3)          |          |
| ≥4                                    | 1,079 (13.0)     | 221 (2.8)          |          |
| Education                             |                  |                    | <0.001   |
| Elementary school or lower            | 1,489 (13.5)     | 3,523 (27.2)       |          |
| Middle school                         | 906 (10.4)       | 1,016 (10.5)       |          |
| High school                           | 2,599 (41.6)     | 3,129 (37.1)       |          |
| College or higher                     | 2,208 (34.5)     | 2,159 (25.3)       |          |
| Income                                |                  |                    | 0.48     |
| Low                                   | 1,769 (24.5)     | 2,381 (24.0)       |          |
| Low to moderate                       | 1,731 (24.1)     | 2,408 (25.2)       |          |
| Moderate to high                      | 1,768 (25.6)     | 2,403 (25.4)       |          |
| High                                  | 1,782 (25.9)     | 2,396 (25.3)       |          |
| Stress perception                     | 1,639 (26.6)     | 3,015 (31.3)       | <0.001   |
| Depressive mood (over two weeks)      | 775 (9.6)        | 1,941 (18.8)       | <0.001   |
| Suicidal ideations (over one year)    | 877 (10.5)       | 2,287 (21.7)       | <0.001   |
| Attempted suicide                     | 63 (0.6)         | 134 (1.3)          | <0.001   |
| Psychological counseling              | 105 (1.5)        | 262 (2.5)          | <0.001   |
| Comorbidity                           |                  |                    |          |
| Cardiovascular disease                | 1,898 (20.7)     | 2,511 (21.0)       | 0.63     |
| Musculoskeletal disease               | 2,022 (22.5)     | 4,814 (40.8)       | <0.001   |
| Respiratory disease                   | 940 (10.9)       | 942 (8.9)          | 0.001    |
| Endocrine disease                     | 687 (7.5)        | 1,215 (10.7)       | <0.001   |
| Cancer                                | 178 (1.5)        | 325 (2.8)          | <0.001   |
| Gastrointestinal disease              | 697 (8.7)        | 684 (6.3)          | <0.001   |
| Depression                            | 436 (4.9)        | 1,853 (17.4)       | <0.001   |

Values are presented as mean ± SE or number (%). The numbers of subjects were not weighted, but the percentages of subjects were weighted. VAS of EQ5D: visual analog scale of Euroqol 5 dimension.

*By Student t-test or Pearson's chi-square test. †Hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris. ‡Arthritis, rheumatoid arthritis. §Tuberculosis, asthma, chronic obstructive pulmonary disease. ¶Diabetes mellitus, thyroid disease. ¤Peptic ulcer, liver cirrhosis, hepatitis type B, hepatitis type C.
### Table 2. Comparison of characteristics between the suicidal ideations group and other groups in female subjects

| Characteristic                  | No suicidal ideations (n = 7,556) | Suicidal ideations (n = 2,287) | P-value* |
|---------------------------------|-----------------------------------|-------------------------------|----------|
| Age (y)                         | 44.6 ± 0.3                        | 50.4 ± 0.6                    | <0.001   |
| VAS of EQ5D                     | 77.4 ± 0.7                        | 66.7 ± 1.1                    | <0.001   |
| Height (cm)                     | 157.2 ± 0.1                       | 155.5 ± 0.2                   | <0.001   |
| Weight (kg)                     | 57.1 ± 0.1                        | 57.3 ± 0.3                    | 0.584    |
| Body mass index (kg/m²)         | 23.1 ± 0.1                        | 23.7 ± 0.1                    | <0.001   |
| Fasting glucose                 | 94.2 ± 0.3                        | 97.5 ± 0.8                    | <0.001   |
| Total cholesterol               | 186.0 ± 0.6                       | 191.0 ± 1.1                   | <0.001   |
| Triglycerides                   | 110.7 ± 1.1                       | 124.7 ± 2.3                   | <0.001   |
| Hemoglobin                      | 12.9 ± 0.0                        | 12.9 ± 0.0                    | 0.131    |
| Pack years (total)              | 0.8 ± 0.1                         | 1.7 ± 0.1                     | <0.001   |
| Smoking status                  |                                   |                               | <0.001   |
| Non-smoker                      | 6,775 (88.1)                      | 1,870 (80.0)                  |          |
| Former smoker                   | 402 (6.5)                         | 188 (8.4)                     |          |
| Current smoker                  | 378 (5.4)                         | 229 (11.6)                    |          |
| Alcohol (d/wk)                  | None                              | 1,281 (19.9)                  | <0.001   |
|                                 | ≤1                                 | 4,046 (69.2)                  |          |
|                                 | 2–3                                | 508 (8.7)                     |          |
|                                 | ≥4                                 | 134 (2.2)                     |          |
| Education                       | Elementary school or lower         | 2,360 (23.2)                  | <0.001   |
|                                 | Middle school                      | 783 (10.2)                    |          |
|                                 | High school                        | 2,552 (38.8)                  |          |
|                                 | College or higher                  | 1,851 (27.9)                  |          |
| Income                          | Low                                | 1,694 (22.1)                  | <0.001   |
|                                 | Low to moderate                    | 1,827 (24.8)                  |          |
|                                 | Moderate to high                   | 1,867 (26.0)                  |          |
|                                 | High                               | 1,994 (27.1)                  |          |
| Stress                          | 1,712 (23.7)                      | 1,303 (58.9)                  | <0.001   |
| Depressive mood (over two weeks)| 795 (10.0)                        | 1,146 (50.7)                  | <0.001   |
| Suicidal attempts               | -                                  | 134 (5.9)                     | <0.001   |
| Psychological counseling        | 114 (1.4)                         | 148 (6.7)                     | <0.001   |
| Comorbidity                     | Cardiovascular disease<sup>1</sup> | 1,766 (19.1)                  | <0.001   |
|                                 | Musculoskeletal disease<sup>1</sup>| 3,401 (37.4)                  | <0.001   |
|                                 | Respiratory disease<sup>1</sup>    | 670 (8.1)                     | <0.001   |
|                                 | Endocrine disease<sup>1</sup>      | 853 (9.8)                     | <0.001   |
|                                 | Cancer                             | 230 (2.6)                     | 0.022    |
|                                 | Gastrointestinal disease<sup>1</sup>| 486 (6.0)                   | 0.049    |
|                                 | Depression                         | 1,013 (12.4)                  | <0.001   |

Values are presented as mean ± SE or number (%). The numbers of subjects were not weighted, but the percentages of subjects were weighted. VAS of EQ5D: visual analog scale of Euroqol 5 dimension.

<sup>*</sup>By Student t-test or Pearson’s chi-square test. <sup>†</sup>Hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris. <sup>‡</sup>Arthritis, rheumatoid arthritis. <sup>§</sup>Tuberculosis, asthma, chronic obstructive pulmonary disease. <sup>∥</sup>Diabetes mellitus, thyroid disease. <sup>¶</sup>Peptic ulcer, liver cirrhosis, hepatitis type B, hepatitis type C.
Table 3. Comparison of characteristics between the suicidal ideations group and other groups in male subjects

| Characteristic                      | No suicidal ideations (n = 6,345) | Suicidal ideations (n = 877) | P-value* |
|-------------------------------------|-----------------------------------|-----------------------------|----------|
| Age (y)                             | 43.3 ± 0.3                        | 47.5 ± 0.7                  | <0.001   |
| VAS of EQ5D                         | 79.3 ± 0.8                        | 73.0 ± 2.5                  | 0.015    |
| Height (cm)                         | 170.3 ± 0.1                       | 169.2 ± 0.3                 | <0.001   |
| Weight (kg)                         | 70.1 ± 0.2                        | 67.9 ± 0.6                  | <0.001   |
| Body mass index (kg/m^2)            | 24.1 ± 0.0                        | 23.7 ± 0.2                  | 0.004    |
| Fasting glucose                     | 97.7 ± 0.4                        | 98.1 ± 0.8                  | 0.580    |
| Total cholesterol                   | 186.0 ± 0.6                       | 184.0 ± 1.6                 | 0.220    |
| Triglycerides                       | 154.4 ± 1.8                       | 160.2 ± 4.8                 | 0.240    |
| Hemoglobin                          | 15.3 ± 0.0                        | 15.1 ± 0.1                  | 0.015    |
| Pack years (total)                  | 17.5 ± 0.3                        | 23.6 ± 1.0                  | <0.001   |
| Smoking status                      |                                   |                             | <0.001   |
| Non-smoker                          | 1,184 (19.6)                      | 130 (12.9)                  |          |
| Former smoker                       | 2,407 (34.0)                      | 321 (31.9)                  |          |
| Current smoker                      | 2,753 (46.5)                      | 426 (55.2)                  |          |
| Alcohol (d/wk)                      |                                   |                             | <0.001   |
| None                                | 698 (9.3)                         | 159 (15.1)                  |          |
| ≤1                                  | 2,846 (52.2)                      | 310 (43.0)                  |          |
| 2–3                                 | 1,537 (26.3)                      | 167 (22.3)                  |          |
| ≥4                                  | 895 (12.2)                        | 184 (19.7)                  |          |
| Education                           |                                   |                             | <0.001   |
| Elementary school or lower          | 1,163 (12.0)                      | 326 (27.1)                  |          |
| Middle school                       | 792 (10.2)                        | 114 (12.1)                  |          |
| High school                         | 2,341 (42.2)                      | 258 (36.4)                  |          |
| College or higher                   | 2,037 (35.7)                      | 171 (24.4)                  |          |
| Income                              |                                   |                             | <0.001   |
| Low                                 | 1,462 (23.2)                      | 307 (35.1)                  |          |
| Low to moderate                     | 1,513 (23.8)                      | 218 (26.7)                  |          |
| Moderate to high                    | 1,580 (26.0)                      | 188 (21.9)                  |          |
| High                                | 1,643 (27.0)                      | 139 (16.3)                  |          |
| Stress                              | 1,375 (23.2)                      | 464 (55.2)                  | <0.001   |
| Depressive mood (over two weeks)    | 401 (5.8)                         | 374 (42.2)                  | <0.001   |
| Suicidal attempts                   | -                                 | 63 (6.1)                    | <0.001   |
| Psychological counseling            | 57 (0.9)                          | 48 (6.3)                    | <0.001   |
| Comorbidity                         |                                   |                             |          |
| Cardiovascular disease†             | 1,632 (20.1)                      | 266 (25.8)                  | <0.001   |
| Musculoskeletal disease†            | 1,653 (21.0)                      | 369 (34.9)                  | <0.001   |
| Respiratory disease§                | 769 (10.3)                        | 171 (16.3)                  | <0.001   |
| Endocrine disease§                  | 573 (7.1)                         | 114 (10.4)                  | 0.002    |
| Cancer                              | 144 (1.4)                         | 34 (2.3)                    | 0.036    |
| Gastrointestinal disease¶           | 586 (8.3)                         | 111 (12.3)                  | 0.003    |
| Depression                          | 230 (2.9)                         | 206 (22.2)                  | <0.001   |

Values are presented as mean ± SE or number (%). The numbers of subjects were not weighted, but the percentages of subjects were weighted. VAS of EQ5D: visual analog scale of Euroqol 5 dimension.

*By Student t-test or Pearson’s chi-square test. †Hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris. ‡Arthritis, rheumatoid arthritis. §Tuberculosis, asthma, chronic obstructive pulmonary disease. ¶Diabetes mellitus, thyroid disease. ¶Peptic ulcer, liver cirrhosis, hepatitis type B, hepatitis type C.
| Characteristic                      | Suicidal ideations only (n = 2,124) | Attempted suicide (n = 134) | P-value† |
|------------------------------------|-------------------------------------|----------------------------|----------|
| Age (y)                            | 50.3 ± 0.6                          | 48.6 ± 1.7                 | 0.367    |
| VAS of EQ5D                        | 67.1 ± 1.0                          | 54.4 ± 2.6                 | <0.001   |
| Height (cm)                        | 155.6 ± 0.2                         | 155.9 ± 0.8                | 0.709    |
| Weight (kg)                        | 57.2 ± 0.3                          | 59.0 ± 1.3                 | 0.154    |
| Body mass index (kg/m²)            | 23.6 ± 0.1                          | 24.2 ± 0.4                 | 0.199    |
| Fasting glucose                    | 97.4 ± 0.8                          | 98.7 ± 2.8                 | 0.650    |
| Total cholesterol                  | 190.9 ± 1.1                         | 187.1 ± 6.1                | 0.545    |
| Triglycerides                      | 123.8 ± 2.4                         | 130.2 ± 10.7               | 0.564    |
| Hemoglobin                         | 12.9 ± 0.0                          | 13.2 ± 0.1                 | 0.027    |
| Pack years (total)                 | 1.6 ± 0.1                           | 4.1 ± 0.8                  | 0.003    |
| Smoking status                     |                                     |                            | <0.001   |
| Non-smoker                         | 1,756 (81.0)                        | 90 (62.7)                  |          |
| Former smoker                      | 170 (8.2)                           | 16 (11.4)                  |          |
| Current smoker                     | 198 (10.8)                          | 28 (25.9)                  |          |
| Alcohol (d/wk)                     |                                     |                            | 0.035    |
| None                               | 423 (23.2)                          | 31 (23.0)                  |          |
| ≤1                                 | 942 (61.3)                          | 54 (51.7)                  |          |
| 2–3                                | 138 (10.5)                          | 13 (15.3)                  |          |
| ≥4                                 | 73 (5.0)                            | 12 (10.1)                  |          |
| Education                          |                                     |                            | 0.012    |
| Elementary school or lower         | 1,067 (40.7)                        | 80 (49.0)                  |          |
| Middle school                      | 215 (11.4)                          | 12 (9.5)                   |          |
| High school                        | 539 (31.2)                          | 33 (35.1)                  |          |
| College or higher                  | 298 (16.6)                          | 9 (6.5)                    |          |
| Income                             |                                     |                            | 0.019    |
| Low                                | 617 (29.8)                          | 59 (49.1)                  |          |
| Low to moderate                    | 545 (27.0)                          | 31 (25.2)                  |          |
| Moderate to high                   | 506 (24.1)                          | 25 (15.1)                  |          |
| High                               | 382 (19.1)                          | 14 (10.6)                  |          |
| Stress                             | 1,176 (57.3)                        | 107 (82.2)                 | 0.001    |
| Depressive mood (over two weeks)   | 1,026 (49.2)                        | 104 (76.0)                 | <0.001   |
| Psychological counseling           | 116 (5.6)                           | 29 (23.5)                  | <0.001   |
| Comorbidity                        |                                     |                            |          |
| Cardiovascular disease             | 700 (28.5)                          | 37 (21.1)                  | 0.226    |
| Musculoskeletal disease            | 1,312 (53.3)                        | 85 (54.6)                  | 0.932    |
| Respiratory disease                | 249 (11.4)                          | 18 (11.0)                  | 0.106    |
| Endocrine disease                  | 334 (13.9)                          | 23 (17.2)                  | 0.611    |
| Cancer                             | 90 (3.9)                            | 4 (1.0)                    | 0.122    |
| Gastrointestinal disease           | 182 (7.3)                           | 14 (8.6)                   | 0.847    |
| Depression                         | 753 (34.4)                          | 79 (53.5)                  | 0.003    |

Values are presented as mean ± SE or number (%). The numbers of subjects were not weighted, but the percentages of subjects were weighted.

VAS of EQ5D: visual analog scale of Euroqol 5 dimension.

*Twenty-nine participants from suicidal ideations only group did not answer to the question about attempted suicide. †By Student t-test or Pearson’s chi-square test. ‡Hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris. §Arthritis, rheumatoid arthritis. ¶Diabetes mellitus, thyroid disease. **Peptic ulcer, liver cirrhosis, hepatitis type B, hepatitis type C.
Table 5. Comparison of characteristics between those who attempted suicide and those with suicidal ideations only* in male subjects

| Characteristic                | Suicidal ideations only (n = 805) | Attempted suicide (n = 63) | P-value† |
|------------------------------|-----------------------------------|---------------------------|----------|
| Age (y)                      | 47.3 ± 0.7                        | 50.1 ± 2.2                | 0.233    |
| VAS of EQ5D                   | 72.6 ± 2.5                        | 76.3 ± 11.8               | 0.762    |
| Height (cm)                  | 169.3 ± 0.3                       | 168.2 ± 0.9               | 0.302    |
| Weight (kg)                  | 68.0 ± 0.6                        | 65.9 ± 1.9                | 0.284    |
| Body mass index (kg/m²)      | 23.7 ± 0.2                        | 23.2 ± 0.5                | 0.344    |
| Fasting glucose              | 97.9 ± 0.9                        | 99.8 ± 4.4                | 0.684    |
| Total cholesterol            | 183.9 ± 1.7                       | 189.2 ± 5.7               | 0.362    |
| Triglycerides                | 159.1 ± 4.9                       | 182.8 ± 19.9              | 0.241    |
| Hemoglobin                   | 15.2 ± 0.1                        | 15.1 ± 0.2                | 0.855    |
| Pack years (total)           | 23.1 ± 1.1                        | 27.6 ± 3.5                | 0.218    |
| Smoking status               |                                   |                           | 0.722    |
| Non-smoker                   | 119 (12.8)                        | 10 (13.8)                 |          |
| Former smoker                | 297 (31.8)                        | 20 (29.9)                 |          |
| Current smoker               | 389 (55.4)                        | 33 (56.3)                 |          |
| Alcohol (d/wk)               | 0.103                             |                           |          |
| None                         | 145 (15.0)                        | 11 (12.8)                 |          |
| ≤1                           | 289 (43.8)                        | 17 (29.7)                 |          |
| 2–3                          | 153 (22.5)                        | 14 (22.3)                 |          |
| ≥4                           | 164 (18.7)                        | 19 (35.2)                 |          |
| Education                    | 0.001                             |                           |          |
| Elementary school or lower   | 296 (26.8)                        | 27 (29.3)                 |          |
| Middle school                | 98 (10.7)                         | 14 (31.5)                 |          |
| High school                  | 239 (36.8)                        | 17 (31.7)                 |          |
| College or higher            | 166 (25.7)                        | 4 (7.5)                   |          |
| Income                       | 0.537                             |                           |          |
| Low                          | 277 (34.3)                        | 26 (42.4)                 |          |
| Low to moderate              | 202 (26.9)                        | 14 (25.1)                 |          |
| Moderate to high             | 175 (22.0)                        | 11 (20.0)                 |          |
| High                         | 132 (16.8)                        | 7 (12.5)                  |          |
| Stress                       | 416 (54.1)                        | 40 (65.5)                 | 0.005    |
| Depressive mood (over two weeks) | 320 (40.0)               | 46 (66.9)                 | <0.001   |
| Psychological counseling     | 38 (5.7)                          | 9 (13.8)                  | 0.003    |
| Comorbidty                   |                                   |                           |          |
| Cardiovascular disease†      | 566 (75.2)                        | 41 (64.5)                 | 0.056    |
| Musculoskeletal disease§      | 332 (43.0)                        | 35 (50.2)                 | 0.084    |
| Respiratory disease†         | 151 (15.8)                        | 19 (26.0)                 | 0.049    |
| Endocrine disease¶           | 106 (10.5)                        | 6 (5.7)                   | 0.151    |
| Cancer                       | 29 (2.2)                          | 5 (5.4)                   | 0.240    |
| Gastrointestinal disease**   | 101 (12.2)                        | 8 (11.2)                  | 0.298    |
| Depression                   | 174 (20.3)                        | 29 (48.1)                 | <0.001   |

Values are presented as mean ± SE or number (%). The numbers of subjects were not weighted, but the percentages of subjects were weighted. VAS of EQ5D: visual analog scale of Euroqol 5 dimension.

*Nine participants from suicidal ideations only group did not answer to the question about attempted suicide. †By Student t-test or Pearson's chi-square test. ‡Hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris. §Arthritis, rheumatoid arthritis. †Hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris. †Hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris. "Peptic ulcer, liver cirrhosis, hepatitis type B, hepatitis type C."
Suicide these figures were 12.8%, 31.8%, and 55.4%, respectively. Comorbid depressive disorder was more prevalent in the suicide attempt group (48.1%) than in those who had suicidal ideations but had not attempted suicide (20.3%), and this difference was statistically significant (Table 5).

6. Relationship between Suicidal Ideations and Smoking Status in All Study Subjects

After adjusting for other covariates among all the study subjects, current smokers (OR, 1.66; 95% CI, 1.34 to 2.05) and former smokers (OR, 1.39; 95% CI, 1.13 to 1.72) were found to be more prone to have suicidal ideations than the non-smoking group. Similar results were seen for women: current smokers

| Table 6. Relationship between suicidal ideations and smoking status among all study subjects |
|--------------------------|-----------------|-----------------|
| Variable                | Adjusted OR* (95% CI) |
|                          | Total            | Male            | Female          |
| Smoking status           |                  |                 |                 |
| Non-smoker              | Reference        | Reference       | Reference       |
| Former smoker           | 1.39 (1.13–1.72) | 1.08 (0.78–1.50) | 1.48 (1.11–1.99) |
| Current smoker          | 1.66 (1.34–2.05) | 1.34 (0.97–1.84) | 2.00 (1.47–2.72) |
| Sex                     |                  |                 |                 |
| Female                  | Reference        |                 |                 |
| Male                    | 0.44 (0.35–0.57) |                 |                 |

OR: odds ratio, CI: confidence interval.

*Adjusted for age, visual analog scale of Euroqol 5 dimension, height, weight, body mass index, fasting glucose, cholesterol, triglyceride, hemoglobin, alcohol intake, education, income, stress, depressive mood over two weeks, psychological counseling for one year, comorbid disease (depression), cardiovascular disease (hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris), musculoskeletal disease (arthritis, rheumatoid arthritis), respiratory diseases (tuberculosis, asthma, chronic obstructive pulmonary disease), endocrine disease (diabetes mellitus, thyroid disease), gastrointestinal disease (peptic ulcer, liver cirrhosis, hepatitis type B, hepatitis type C).

| Table 7. Relationship between attempted suicide and smoking status among people with suicidal ideations |
|--------------------------|-----------------|-----------------|
| Variable                | Adjusted OR* (95% CI) |
|                          | Total            | Male            | Female          |
| Smoking status           |                  |                 |                 |
| Non-smoker              | Reference        | Reference       | Reference       |
| Former smoker           | 1.69 (0.91–3.13) | 0.96 (0.29–3.12) | 1.66 (0.72–3.80) |
| Current smoker          | 1.80 (1.05–3.07) | 0.95 (0.35–2.62) | 2.40 (1.31–4.37) |
| Sex                     |                  |                 |                 |
| Female                  | Reference        |                 |                 |
| Male                    | 0.63 (0.29–1.39) |                 |                 |

OR: odds ratio, CI: confidence interval.

*Adjusted for age, visual analog scale of Euroqol 5 dimension, height, weight, body mass index, fasting glucose, cholesterol, triglyceride, hemoglobin, alcohol intake, education, income, stress, depressive mood over two weeks, psychological counseling for one year, comorbid disease (depression), cardiovascular disease (hypertension, hyperlipidemia, cerebro vascular accident, myocardial infarction, angina pectoris), musculoskeletal disease (arthritis, rheumatoid arthritis), respiratory diseases (tuberculosis, asthma, chronic obstructive pulmonary disease), endocrine disease (diabetes mellitus, thyroid disease), gastrointestinal disease (peptic ulcer, liver cirrhosis, hepatitis type B, hepatitis type C).
women was related to suicidal ideation. A study by Han et al.\(^{10}\) showed a significant relationship between smoking and suicidal behavior in both men and women. Although that study involved adolescents only, it again found a stronger relationship between smoking and suicidal behavior in women than in men.

Differences in the relationship between smoking and suicidal behavior by gender may be related to differences in the prevalence of smoking and smoking behavior in the population. The majority of men (81.2%) were current and former smokers, whereas the majority of women (86.4%) were non-smokers. However, there might be confounding variables among men that render their results not statistically significant. Some workers have described gender differences in smoking behavior: Marqueta et al.\(^{28}\) reported that the factors contributing to stopping smoking differed by gender, and Anda et al.\(^{29}\) reported that women had less success in stopping smoking than men.

Some studies that analyzed interactions between smoking and brain gamma-aminobutyric acid levels\(^{30}\) support the idea that smoking-related behavior depends not only on social effects but also on biological effects such as gender. However, there have been few studies of the biological relationship between smoking and suicidal behavior by gender; further studies are needed.

In many studies that controlled for psychiatric comorbidity, the relationship between smoking and suicidal behavior was not significant. The 4th KNHANES did not obtain information about any comorbid mental disorders apart from depression, which may be a limitation of our study. In some groups (the group as a whole, and the group of women only) we found a significant relationship between smoking status and suicidal behavior, even after controlling for depression and comorbid chronic physical disease. Hence smokers who have shown suicidal behavior may be regarded as a high-risk group, with respect to suicide attempts and, ultimately, suicide completion. This emphasizes the need for careful observation and follow-up to prevent suicide.

However, the main limitation of this study was the cross-sectional design, so that only associations rather than causal relationships between smoking and suicidal behavior can be inferred. Also, we did not adjust marriage status, job, religion, or life events which could influence suicidal behavior. Further investigations involving quantitative analysis of smoking and suicidal behavior and long-term follow-up are warranted.
CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Statistics Korea. 2010 Death and cause of death in Korea. Daejeon: Statistics Korea; 2011.
2. Organization for Economic Cooperation and Development. Health at a glance 2011: OECD indicators [Internet]. Paris: Organization for Economic Cooperation and Development; 2011 [cited 2012 Mar 5]. Available from: http://dx.doi.org/10.1787/health_glance-2011-en.
3. Harwood D, Jacoby R. Suicidal behaviour among the elderly. In: Hawton K, van Heeringen K, editors. The international handbook of suicide and attempted suicide. Chichester: Wiley; 2002. p. 275-91.
4. Tidemalm D, Langstrom 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.
5. Harris EC, Barracough B. Suicide as an outcome for mental disorders: a meta-analysis. Br J Psychiatry 1997;170:205-28.
6. Nock MK, Borges G, Bromet EJ, Cha CB, Kessler RC, Lee S. Suicide and suicidal behavior. Epidemiol Rev 2008;30:133-54.
7. Hughes JR. Smoking and suicide: a brief overview. Drug Alcohol Depend 2008;98:169-78.
8. Breslau N, Schultz LR, Johnson EO, Peterson EL, Davis GC. Smoking and the risk of suicidal behavior: a prospective study of a community sample. Arch Gen Psychiatry 2005;62:328-34.
9. Riala K, Taanila A, Hakko H, Rasanen P. Longitudinal smoking habits as risk factors for early-onset and repetitive suicide attempts: the Northern Finland 1966 Birth Cohort study. Ann Epidemiol 2009;19:329-35.
10. Han MA, Kim KS, Ryu SY, Kang MG, Park J. Associations between smoking and alcohol drinking and suicidal behavior in Korean adolescents: Korea Youth Behavioral Risk Factor Surveillance, 2006. Prev Med 2009;49:248-52.
11. Riala K, Alaraisanen A, Taanila A, Hakko H, Timonen M, Rasanen P. Regular daily smoking among 14-year-old adolescents increases the subsequent risk for suicide: the Northern Finland 1966 Birth Cohort Study. J Clin Psychiatry 2007;68:775-80.
12. Iwasaki M, Akechi T, Uchitomi Y, Tsugane S; Japan Public Health Center-based Prospective Study on Cancer and Cardiovascular Disease (JPHC study) Group. Cigarette smoking and completed suicide among middle-aged men: a population-based cohort study in Japan. Ann Epidemiol 2005;15:286-92.
13. Grant BF, Stinson FS, Hasin DS, Dawson DA, Chou SP, Anderson K. Immigration and lifetime prevalence of DSM-IV psychiatric disorders among Mexican Americans and non-Hispanic whites in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. Arch Gen Psychiatry 2004;61:1226-33.
14. Pulay AJ, Stinson FS, Ruan WJ, Smith SM, Pickering RP, Dawson DA, et al. The relationship of DSM-IV personality disorders to nicotine dependence-results from a national survey. Drug Alcohol Depend 2010;108:141-5.
15. Kessler RC, Berglund P, Borges G, Nock M, Wang PS. Trends in suicide ideation, plans, gestures, and attempts in the United States, 1990-1992 to 2001-2003. JAMA 2005;293:2487-95.
16. World Health Organization, Regional Office for the Western Pacific. Fact sheets: tobacco [Internet]. Geneva: World Health Organization [cited 2011 Oct 10]. Available from: http://www.wpro.who.int/mediacentre/factsheets/fs_20050420a/en/index.html.
17. Scott KM, Hwang I, Chiu WT, Kessler RC, Sampson NA, Angermeyer M, et al. Chronic physical conditions and their association with first onset of suicidal behavior in the world mental health surveys. Psychosom Med 2010;72:712-9.
18. Boden JM, Fergusson DM, Horwood LJ. Cigarette smoking and suicidal behaviour: results from a 25-year longitudinal study. Psychol Med 2008;38:433-9.
19. Kessler RC, Berglund PA, Borges G, Castilla-Puentes RC, Glantz MD, Jaeger SA, et al. Smoking and suicidal behaviors in the National Comorbidity Survey: replication. J Nerv Ment Dis 2007;195:369-77.
20. Kessler RC, Borges G, Sampson N, Miller M, Nock MK. The
association between smoking and subsequent suicide-related outcomes in the National Comorbidity Survey panel sample. Mol Psychiatry 2009;14:1132-42.

21. EuroQol Group Executive Office. EQ-5D is a standardised instrument for use as a measure of health outcome [Internet]. Rotterdam: EuroQol Group Executive Office [cited 2011 Jun 12]. Available from: http://www.euroqol.org.

22. Yaworski D, Robinson J, Sareen J, Bolton JM. The relation between nicotine dependence and suicide attempts in the general population. Can J Psychiatry 2011;56:161-70.

23. Benwell ME, Balfour DJ, Anderson JM. Smoking-associated changes in the serotonergic systems of discrete regions of human brain. Psychopharmacology (Berl) 1990;102:68-72.

24. Fowler JS, Logan J, Wang GJ, Volkow ND. Monoamine oxidase and cigarette smoking. Neurotoxicology 2003;24:75-82.

25. Mann JJ. Neurobiology of suicidal behaviour. Nat Rev Neurosci 2003;4:819-28.

26. Choi HA. An analysis on depression and suicide ideation of Korean adults by using Korea National Health and Nutrition Examination Survey (KNHANES) [master’s thesis]. Chuncheon: Kangwon National University; 2011.

27. Kim HK, Ko SH, Chung SH. Suicidal ideation and risk factors among the elderly in Korea. J Korean Acad Public Health Nurs 2010;24:82-92.

28. Marqueta A, Nerin I, Jimenez-Muro A, Gargallo P, Beamonte A. Predictors of outcome of a smoking cessation treatment by gender. Gac Sanit 2013;27:26-31.

29. Anda RF, Williamson DF, Escobedo LG, Mast EE, Giovino GA, Remington PL. Depression and the dynamics of smoking: a national perspective. JAMA 1990;264:1541-5.

30. Esterlis I, McKee SA, Kirk K, Lee D, Bois F, Stiklus SM, et al. Sex-specific differences in GABA(A)-benzodiazepine receptor availability: relationship with sensitivity to pain and tobacco smoking craving. Addict Biol 2013;18:370-8.