Association between personality traits and suicidality by age groups in a nationally representative Korean sample

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Abstract
Suicide is a leading health issue, which substantially contributes to the causes of death worldwide. Personality traits are some of the major risk factors for suicidality. We sought to identify the relationships between personality traits and suicidality by age group. The Big-Five Inventory-10 traits were measured in community-dwelling individuals in a nationally representative sample in the Republic of Korea. Because personality traits are long-standing patterns throughout one’s lifetime, suicidality was measured based on lifetime history, rather than in a recent period. To comprehensively examine independent influences of personality traits on suicidality, psychiatric comorbidity and sociodemographic data were adjusted for.

A total of 6022 subjects (3714 females and 2308 males) were included. Agreeableness (odds ratio [OR] [95% confidence intervals (CI)]=0.79 [0.64–0.98]) was negatively associated with suicidal ideation, whereas neuroticism (1.27 [1.05–1.54]) and openness (1.36 [1.11–1.67]) were positively associated with suicidal ideation among young adults. Openness (1.25 [1.10–1.43]) had a positive association, and conscientiousness (0.86 [0.75–0.98]) had a negative association with suicidal ideation among the middle-aged group. Neuroticism is the only influencing factor for suicidal attempts among the young adult (1.88 [1.24–2.86]) and older (1.65 [1.24–2.20]) groups.

Given the differential associations between personality traits and suicidality by age groups, future studies are needed to comprehensively identify possible roles in personality in suicide by age.

Abbreviations: BFI-10 = Big-Five Inventory-10, CI = confidence intervals, DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4\textsuperscript{th} Edition, OR = odds ratio.

Keywords: neuroticism, openness, personality, risk factors, suicide

1. Introduction
Suicide is a leading health problem, which substantially contribute to the causes of death worldwide. It is estimated that suicide will contribute 2% or more to the global burden of disease by 2020.\textsuperscript{[11]} In 2017, the suicide rate in the Republic of Korea was 25.6 per 100,000, which is the highest among the Organization for Economic Co-operation and Development countries in the past 10 years.\textsuperscript{[2,3]} Given the substantial socioeconomic and public health burden of suicide,\textsuperscript{[4]} identifying and modifying contributing factors and protective factors for suicide is crucial for prevention strategies.

There are various contributing and protective factors for suicide,\textsuperscript{[5,6]} and personality traits are some of the critical variables. A lot of studies have investigated personality trait associations with suicide.\textsuperscript{[7,8]}

Although personality plays an important role in the suicide and suicide-related behavioral problems such as suicide attempt,\textsuperscript{[9]} however, previous studies have several limitations. First, many studies have investigated associations between personality traits and suicidal risk within a specific subgroup, such as depressed patients,\textsuperscript{[9]} or a specific age group.\textsuperscript{[10,11]} Recently, the Ministry of Health and Welfare of Korea reported that suicidal risk factors, means of suicide, psychiatric symptoms associated with suicide, and communicating patterns of suicidal ideation differ by age group.\textsuperscript{[12]} Secondly, few studies have adjusted for possible effects of comorbid psychiatric disorders on suicidality. Because anxiety disorders,\textsuperscript{[13]} nicotine dependence,\textsuperscript{[14]} and alcohol use disorder\textsuperscript{[15]} are all associated with suicidal risk, lifetime history of psychiatric conditions should be adjusted for in the analysis.

Among various theories of personality, the big five-factor personality model, which was suggested by McCrae and Costa,\textsuperscript{[16]} has been widely investigated in numerous areas in
the field of psychiatry, including suicide.\textsuperscript{[17,18]} The five-factor model conceptualizes personality as a hierarchical organization that consists of extraversion, agreeableness, conscientiousness, neuroticism, and openness. The validity of the five-factor personality model was also cross-culturally confirmed, suggesting that the results could be widely applied and generalized.\textsuperscript{[19]} A recent study reported that five-factor-based personality has an important role in the development of suicidality.\textsuperscript{[20]} Another recent study reported that higher neuroticism with lower extraversion raised suicide risk among Taiwanese soldiers.\textsuperscript{[21]}

The pattern of personality traits differs by age, and the associations between personality traits and suicidality would be characteristic of specific age groups.

This study mainly aims at answering the question that whether age groups have any different personality traits between individuals with and without suicidal attempts in the community-dwelling population.

2. Materials and methods

2.1. Subjects and procedures

We used data from the Korean Epidemiologic Catchment Area Study, which was conducted between March 25 2011 and December 23 2011.\textsuperscript{[22]} The Korean Epidemiologic Catchment Area Study was based on a stratified multistage probability sample of the non-institutionalized Korean population 18 to 74 years old. Based on the administrative divisions of Korea, six primary sampling units were selected. Subsequently, twelve secondary sampling units were selected from within a primary sampling unit. Then, three to five tertiary sampling units were extracted. Census units were randomly assigned within the tertiary sampling units by probability proportional to the population size. Every household in each sampling unit was regarded as a target of this survey. Finally, 6022 individuals participated from a total of 246 sampling units.

All subjects received comprehensive explanation about the purpose and methods of the study, and gave informed consent prior to participation. The Institutional Review Board of the Seoul National University College of Medicine approved this study.

A total of 78 interviewers were employed for this study. The training of the interviewers was conducted according to the World Health Organization guidelines.\textsuperscript{[23]} All interviewers received a 5-day, 8-hour per day training program. The training mainly consisted of mock interviews and live interviews by role-playing, which aimed to improve interview skills. During the training, inter-rater reliability was checked and all interviewers received feedback from each other.

3. Assessments

3.1. Personality traits

Personality traits were assessed with the Big-Five Inventory-10 (BFI-10).\textsuperscript{[24]} Since, McCrae and Costa (1987) developed a 240-item questionnaire for five-factor model personality traits,\textsuperscript{[16]} subsequent researchers have developed shorter versions based on the model.\textsuperscript{[25]} The Big-Five-based approach for personality is widely used in various social scientific field, such as criminology,\textsuperscript{[26]} work-related stress such as burn-out syndrome,\textsuperscript{[27]} and empathy.\textsuperscript{[28]}

The BFI-10 is an abbreviated version of the 44-item version of the Big-Five Inventory (BFI-44)\textsuperscript{[23]}; The BFI-10 is scored on a five-point scale ranging from 1 (disagree strongly) to 5 (agree strongly), with a higher score indicating a higher level of each personality factor. The BFI-10 measures five personality dimensions, including extraversion, agreeableness, conscientiousness, neuroticism, and openness. Extraversion includes seeking interaction with other people, being energetic and active, and joyfulness. The questionnaires start with following instructions: “How well do the following statements describe your personality?” All answers start with “I see myself as someone who . . . ” Questions for extraversion are “ . . . is reserved” and “ . . . is outgoing, sociable.” The former question is reverse-scored. Agreeableness consists of comfortable and harmonious interpersonal relationships. Questions for agreeableness are “ . . . is generally trusting” and “tends to find fault with others.” The latter is reverse-scored. Conscientiousness consists of self-discipline and following social rules. Questions for conscientiousness are “ . . . tends to be lazy” and “does a thorough job.” The former is reverse-scored. Neuroticism consists of emotional distress, dysphoria, and uncontrolled feelings. Questions for neuroticism are “ . . . is relaxed, handles stress well” and “gets nervous easily.” The former is reverse-scored. Lastly, openness consists of seeking novel stimuli, intellectual exploration, and being imaginative. Questions for openness are “ . . . has few artistic interests” and “has an active imagination.” The former is reverse-scored.

The reliability and validity of the BFI-10 are found to be good.\textsuperscript{[24]} Due to the balanced number of questionnaires and variety of measuring factors, the BFI-10 has been still used widely at the moment.\textsuperscript{[29–32]}

3.2. Comorbid psychiatric disorders

The lifetime history of psychiatric disorders was assessed with the Korean version of the Composite International Diagnostic Interview.\textsuperscript{[23,33]} The Korean version of the Composite International Diagnostic Interview is a structured diagnostic interview designed to diagnose psychiatric disorders according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV).\textsuperscript{[34]} The Korean version of the Composite International Diagnostic Interview, which showed modest concordance with the Structured Clinical Interview for the DSM-IV,\textsuperscript{[13]} has been used for a previous Korean Epidemiologic Catchment Area study.\textsuperscript{[35]}

3.3. Suicidality

Because personality traits are long-standing patterns throughout one’s lifetime, suicidality was measured based on lifetime history, rather than in a recent period. Respondents’ lifetime histories of suicidal ideation and suicide attempts were assessed with a modified Suicide Prevention Multisite Intervention Study on Suicidal Behaviors (SUPRE-MISS)\textsuperscript{[36]} questionnaire. Among the items, suicidal ideation and attempts were measured. The suicidal ideation question was “Have you ever seriously thought about committing suicide?” Suicidal attempt was measured by the following question: “Have you ever attempted suicide?” We further used the following questions to differentiate suicidal attempts from suicidal gestures or self-harming behaviors: (a) I made a serious attempt to kill myself, and it was only by luck that I failed. (b) I tried to kill myself, but I knew the method was not foolproof. (c) My attempt was a cry for help. I did not want to die. According to previous studies,\textsuperscript{[37,38]} we defined only (a) and (b) as a suicide attempt.
3.4. Statistical analysis

Sociodemographic variables, personality traits, and suicidality were compared across three age groups: young adults (18–34), middle-aged (35–54), and older (55–74). Dichotomous variables were analyzed with chi square analysis whereas continuous variables were compared using analyses of variance. Bonferroni correction was applied to the post-hoc analysis of the analyses of variance. Multivariate logistic regression analyses were used to examine the associations between personality traits and lifetime suicidality. Education ≤12 years vs >12 years), cohabitation (living alone vs living together), employment (unemployed vs employed), a history of diagnosis of mood disorders, anxiety disorders, nicotine use disorders, and alcohol use disorders were included as covariates. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated based on these multiple logistic regression models in each group. Because the objective of this study was to investigate risk factors for suicidality, we used unweighted data for the statistical analysis. All statistical analyses were performed using SPSS software, version 16.0 (SPSS Inc., Chicago, IL).

4. Results

4.1. Sociodemographic variables, personality traits, and suicidality data

Sociodemographic data of the three groups are presented in Table 1.

Among the total sample, the mean (SD) age is 47.88 (15.38) years. The number of females was 3714 (61.7%). The female ratio of the young adult group was 778 (57.7), which is lower than middle aged and old-aged groups. The education level showed increasing tendency as the age groups goes older. The proportion of living alone was the lowest in the middle-aged group than younger and older groups.

The number of psychiatric conditions was 351 (5.8%) for nicotine use disorders, 647 (10.7%) for alcohol use disorders, 481 (8.0%) for mood disorders, and 549 (9.1%) for anxiety disorders among the total sample.

Mean (SD) scores on each of the personality trait were 3.07 (1.04) for extraversion, 3.39 (0.83) for agreeableness, 3.60 (0.98) for conscientiousness, 2.78 (0.92) for neuroticism, and 3.25 (0.89) for openness. There were significant differences in the five personality traits among the three age groups. In the post-hoc analysis, the young adult group had significantly higher scores on extraversion than did the middle-aged (P < .0001) and older (P < .0001) groups, respectively. There were no significant differences between the middle-aged and older groups (P=.111).

For agreeableness and conscientiousness, young adults had significantly lower scores than did the middle-aged group (P < .0001) and the older group (P < .0001), and the middle-aged group had significantly lower scores than did the older group (P < .0001). For neuroticism, the young adult group had significantly higher scores than did the middle-aged (P = .041) and older (P = .017) groups, and there were no significant differences between the young adults and the older groups or between the middle-aged and older groups (P = 1.000). For openness, young adults had significantly higher scores than did the middle-aged group (P < .0001) and older group (P < .0001), and the middle-aged group had significantly higher scores than did the older group (P < .0001).

The mean frequency (%) of lifetime suicidal ideation and suicidal attempts is 937 (15.6%) and 156 (2.6%), respectively. There were no significant differences in suicidal ideation or suicidal attempts between the three groups.

4.2. Associations between personality traits and lifetime suicidal ideation by age group

Associations between personality traits and lifetime suicidal ideation adjusted for sociodemographic variables and major psychiatric disorders are presented in Table 2.

Extraversion and agreeableness were negatively associated with suicidal ideation, whereas neuroticism and openness were positively associated with suicidal ideation among young adults. Openness and neuroticism had positive associations with suicidal ideation in the middle-aged group and the older age group, respectively.

### Table 1

| Sociodemographic variables, personality traits, and suicidality among three age groups. |
|-----------------------------------------------|---|---|---|---|---|
| Gender, Female | 18–34 (n = 1349) | 35–54 (n = 2479) | 54–74 (n = 2194) | P value | χ² or F |
| Education, ≤12 years | 776 (57.7) | 1567 (63.2) | 1369 (62.4) | .002 | 12.102 |
| Living alone | 597 (29.4) | 1513 (61.0) | 1951 (88.9) | .0001 | 1302.60 |
| Personality trait | | | | | |
| Extraversion | 3.18 (1.01) | 3.03 (1.02) | 2.97 (1.07) | <.0001 | 17.98 |
| Agreeableness | 3.26 (0.78) | 3.41 (0.83) | 3.60 (0.85) | <.0001 | 74.32 |
| Conscientiousness | 3.28 (0.86) | 3.67 (0.85) | 3.90 (0.85) | <.0001 | 216.35 |
| Neuroticism | 2.85 (0.90) | 2.77 (0.92) | 2.76 (0.96) | .014 | 4.257 |
| Openness | 3.41 (0.87) | 3.23 (0.89) | 3.09 (0.87) | <.0001 | 57.53 |
| Suicide | Ideation | 213 (15.9) | 417 (16.0) | 321 (14.7) | .128 | 4.108 |
| Attempts | 55 (4.1) | 74 (3.0) | 72 (3.3) | .198 | 3.236 |
| Psychiatric disorders | | | | | |
| Nicotine use disorders | 84 (6.2) | 155 (6.3) | 112 (5.1) | .193 | 3.295 |
| Alcohol use disorders | 205 (15.2) | 294 (11.9) | 148 (6.7) | <.0001 | 67.697 |
| Mood disorders | 103 (7.6) | 196 (7.9) | 182 (8.3) | .551 | 0.759 |
| Anxiety disorders | 146 (10.8) | 211 (8.5) | 192 (8.8) | .047 | 6.134 |

All data are presented as frequency (%) or mean (SD).
Among psychiatric comorbidities, nicotine use disorders were commonly associated with suicidal attempts in all three age groups.

Among the personality traits, neuroticism significantly increased the OR for suicidal attempts in young adults and the older age groups, whereas openness was positively associated with suicidal attempts among the middle-aged group. Lifetime history of mood disorder commonly had a positive association with suicidal attempts across the three age groups.

Among psychiatric comorbidities, nicotine use disorders were only associated with suicidal attempts among the young adults group, whereas living alone and unemployed status only had negative associations with suicidal attempts in the older age group. Lifetime history of alcohol use disorder and mood disorder were commonly associated with suicidal attempts in all three age groups.

### 4.3. Associations between personality traits and lifetime suicidal attempts by age group

Associations between personality traits and lifetime suicidal attempts adjusted for sociodemographic variables and major psychiatric disorders are presented in Table 3.

Among the personality traits, neuroticism significantly increased the OR for suicidal attempts in young adults and the older age groups, whereas openness was positively associated with suicidal attempts among the middle-aged group. Lifetime history of mood disorder commonly had a positive association with suicidal attempts across the three age groups.

Among psychiatric comorbidities, nicotine use disorders were only associated with suicidal attempts among the young adults group, whereas living alone and unemployed status only had negative associations with suicidal attempts in the older age group. Lifetime history of alcohol use disorder and mood disorder were commonly associated with suicidal attempts in all three age groups.

### 5. Discussion

In this study, we aimed to investigate different patterns of associations between personality traits and suicide by age groups in a nationally representative sample. There are several interesting findings in our results regarding the associations between personality and suicidality in each group.

For suicidal ideation, personality traits were closely associated with suicidal ideation among the young adults group. Among that group, low agreeableness, high neuroticism, and high openness were associated with increased suicidal ideation. However, among the middle-aged group, low conscientiousness and high openness were associated with suicidal ideation. Among the older age group, only high neuroticism was associated with suicidal ideation. These results suggest that the impact of personality on suicidal ideation is the strongest among young adults, then decreases with age.

Traditionally, individuals with high neuroticism and low extraversion have been considered to attempt and/or commit suicide,[7,39,40] whereas those with high openness have been...
reported to be low-risk for suicide.\[^{20}\] It is unusual to assume one with high neuroticism and low extraversion might have socially withdrawn, depressed, and pessimistic tendency. Despite neuroticism itself can be associated with suicide risk, authors suggested to consider neuroticism not as an single risk factor but contributing factors which raise suicidal risk when combined with other risk factors.\[^{39}\] A recent study also supported the implicated role of neuroticism for suicide.\[^{41}\] However, in another recent study, neuroticism was confirmed again as an independent risk factor for suicide regardless of having mood disorders such as bipolar disorder and depressive disorder.\[^{42}\]

Interestingly, high neuroticism was associated with suicidal attempts in young adults and the older groups, whereas high openness had an association with suicidal attempts among the middle-aged population in our study. On the other hand, the combination of high neuroticism and high openness as shown in the young adults has been consistently reported concerning suicidality and self-injurious behaviors.\[^{9,43,44}\] High neuroticism represents anxious, dysphoric, and depressed traits, and it has been consistently reported to be associated with depression and suicide.\[^{57}\] In addition, a recent study revealed that high neuroticism can contribute to suicide by affecting on the help-seeking behavior.\[^{46}\] Higher openness in suicidal subjects than in controls is a commonly reported finding.\[^{9,43,44}\] In some cases, subjects with high openness may have a curiosity about novel ideas and intellectual stimuli. However, in some cases, high openness might be associated with thinking that is too odd, which often leads to schizotypal content or fantasies.\[^{47}\] Another study has suggested that high openness might be associated with obsessive-compulsive disorder, which suggests that high openness would reflect an association with fantasy.\[^{48}\] A recent systematic review have reported those differences in the personality traits by age groups, particularly focusing on the old age.\[^{49}\]

Low conscientiousness was associated with suicidal ideation among the young adult group. Because conscientiousness represents self-discipline and active coping skills for stressful situations, appropriate conscientiousness leads to adaptation to social rules and personal responsibility. Because individuals with low conscientiousness would be incompetent to cope with stressful event, low conscientiousness could also be associated with suicide. Several previous studies have reported that low conscientiousness was associated with suicide.\[^{50}\] However, maladaptively high conscientiousness could be associated with self-oriented perfectionism,\[^{51}\] which in turn could lead to setting excessively high goals and striving to achieve them.\[^{52}\] Many studies have suggested that perfectionism is closely associated with suicide.\[^{53}\] It is also noteworthy that conscientiousness had a positive association with suicidal attempts in the older age group, although it was not statistically significant (P=.06). We speculate that there would be specific groups or situations in which conscientiousness is positively or inversely associated with suicidality.

In terms of psychiatric comorbidities, alcohol use disorders, mood disorders, and anxiety disorders were associated with suicide ideation and attempts in nearly all age groups. Interestingly, nicotine use disorders had a significant association with suicidal attempts among the young adult group. Our results are in agreement that smoking raises subsequent suicidal risk among young people,\[^{54}\] which emphasizes the importance of not initiating smoking in early adulthood. However, a recent study reported that smoking itself might not be associated suicide idea and attempt.\[^{55}\] The discrepancy of results from ours and that study may be mainly due to the sample characteristics (community-dwelling general population in our study vs patients with depressive disorder in that study) and size (6022 in ours and 269 in that study).

As for sociodemographic risk factors for suicidality, our results have implications for elderly suicide. As shown in our results, living alone was significantly associated with suicidal attempts only in the older age group. Unemployment was associated with suicidal ideation only in the elderly. Suicide in the elderly is substantial in Korea, as suicide rates increase by age. The prevalence of suicide per 100,000 is 19.25 in one’s 20s, 26.94 in one’s 30s, 30.41 in one’s 40s, 35.52 in one’s 50s, 42.45 in one’s 60s, and 83.19 in one’s 70s.\[^{31}\] This age-specific pattern of suicide is distinguished from those of other countries such as the United States, Japan, and European countries.\[^{16}\] Living alone is a well-known risk factor for depression\[^{57}\] and suicide\[^{58}\] in the elderly. Since Havighurst (1961) proposed the activity theory of aging,\[^{59}\] active social participation and connectedness has been one of the key factors for healthy aging in modern society. We speculate that social withdrawal, such as living alone and being unemployed, would leave the elderly more vulnerable for suicide than other age groups.

Our study has several limitations. First, this study was conducted with a cross-sectional design, which could not examine causal relationships between personality traits, sociodemographic factors, and suicidality. Second, because this study was conducted based on a nationally representative sample with a common questionnaire, age-specific factors were not included. For example, unsupervised time had a significant influence on behavioral problems among elementary school students,\[^{60}\] and familial connectedness and physical health are main factors for mental health and suicidality among the elderly.\[^{61}\] Third, we did not include suicidal completers in our analysis. As our results suggest that there might be differences in personality traits between suicidal ideation and attempts, there may also be differences between suicidal attempters and completers. Regarding those differences, a previous study suggested that suicidal completers have lower neuroticism and higher conscientiousness than do suicidal attempters.\[^{62}\] Fourth, because the BFI-10 consists of 10 items, comprehensive evaluation of personality traits was not possible. Fifth, we did not include several variables reported to be associated with suicide attempt.\[^{63,64}\] Lastly, from a fundamental perspective, identifying risk factors for suicide might reach its limit. A recent meta-analysis and systematic review reported that no categorical domains predicted suicide far above change,\[^{46}\] which means that mechanical combination of individual risk factors could not be applied to the real-world suicide prevention strategy. The authors of that study suggested to shift in focus from risk factors to machine learning-based risk algorithms. Although the machine learning based approach has also its weakness,\[^{65}\] machine learning-based, data-driven approach is worth consideration in practically conducting suicide prevention strategy.

6. Conclusion
In conclusion, our results further extended previous notions that personality traits are associated with suicidality. We first revealed age group-stratified associations between personality traits and suicidality. Future studies with longitudinal designs are needed to identify the underlying mechanisms by which personality traits influence suicidality by age groups. 

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