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Factors Influencing Suicidal Ideation among Korean Workers

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Purpose: This study aimed to identify factors influencing suicidal ideation among workers using data from the 2021 Korea National Health and Nutrition Examination Survey (KNHANES VIII-3), providing foundational data for workplace suicide prevention programs.
Methods: This descriptive correlational study analyzed data from 2,287 employed workers using hierarchical logistic regression to examine relationships between general characteristics, health behaviors, physical and mental health, and suicidal ideation.
Results: The prevalence of suicidal ideation among workers was 3.6%. The primary influencing factors were lower educational level (≤ middle school; OR=3.33), depression (OR=10.77), generalized anxiety disorder (OR=4.63), mild anxiety (OR=2.51), and stress (OR=1.82). Mental health variables significantly increased explanatory power from 8% to 37%.
Conclusion: These findings highlight the critical role of mental health, particularly depression and anxiety, in predicting suicidal ideation among workers. Workplace mental health management programs should include comprehensive mental health assessments and early intervention strategies addressing not only severe conditions but also mild anxiety symptoms.

Keywords: Depression; Generalized anxiety disorder; Mental health; Suicidal ideation; Occupational groups

Introduction

Background

Suicide is a serious social problem resulting from a complex interaction among individuals' economic, physical, and psychological factors [1]. In 2021, the suicide rate in Korea was 26 deaths per 100,000 population, a 1.2% increase compared to the previous year, and the average number of suicides per day was 36.6 [2]. In particular, as the socioeconomic crisis has recently worsened since the COVID-19 pandemic, the proportion of mental factors among the main factors contributing to suicide has been increasing rapidly, further emphasizing the need for mental health management [2]. Above all, the deterioration of mental health has become conspicuously evident among workers, who are engaged in core economic activities, and thus, the management of workers' mental health has emerged as a social issue that needs to be addressed urgently [3].

According to a recent survey by the Korea Occupational Safety and Health Agency, the number of the cases of mental disorders recognized as industrial accidents among workers has increased more than fourfold from 126 cases in 2017 to 513 cases in 2021, and about 20% of these cases were found to be directly related to suicide [4]. Data from the Korea Workers' Compensation and Welfare Service also shows that the approval rate of applications for recognition of a mental disorder as an industrial accident has risen sharply from 23.6% in 2010 to 71.5% in 2021, indicating the seriousness of workers' mental health problems [5]. This phenomenon means that workers' mental health problems go beyond individual problems, and can lead to the decreased productivity of companies and increased industrial accidents, which can incur increased social costs.

Suicidal behavior generally occurs as a sequential process consisting of suicidal ideation, suicide planning, and suicide attempts, and suicidal ideation is considered the most important precursor

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symptom of actual suicide and thus a key point for interventions for suicide prevention [6]. According to a recent suicide survey, 14.7% of adults have thought about suicide at least once in their lives, and in some people, suicidal ideation tends to lead to concrete suicide plans and actual suicide attempts [7]. In particular, depression has been reported to have the strongest effect on suicidal ideation [8]. Therefore, early detection and interventions from the stage of suicidal ideation are very important for suicide prevention.

Workers are exposed to various psychological risk factors, such as long working hours, job stress, job insecurity, and emotional labor, while performing their work, so they may be at higher risk of suicidal ideation than the general population [9,10]. In addition, stress levels and suicide risk levels may vary depending on the type of occupation, so it is necessary to clearly identify the differences between occupations and thereby apply customized workplace suicide prevention strategies for each job type [3,5,9]. In particular, irregular workers tend to show higher mental stress and be at higher risk for suicide due to job insecurity, and rapid changes in the working environment, such as an increase in telecommuting and lack of social interaction since the COVID-19 pandemic, are accelerating the deterioration of mental health [11].

Major individual factors affecting suicidal ideation have been reported to include age, gender, education level, and household type [7]. In particular, single-person households that experience an economic burden and social isolation have been found to be more vulnerable to suicide risk [12]. In addition, among the health behaviors of workers, drinking has been shown to increase impulsivity and thus the likelihood of suicide attempts [12], and smoking has been found to be associated with an increased risk for suicidal ideation [13]. Moreover, shorter sleep duration has been reported to increase the risk of suicidal ideation, suggesting that lifestyle management is also important in suicide prevention [14].

Psychological factors account for 39.8% of all the causes of suicide, and the rates of people experiencing depression and anxiety in the general population have increased significantly since COVID-19 [2,15]. Accordingly, the Korea National Health and Nutrition Examination Survey introduced Generalized Anxiety Disorder-7 (GAD-7), a self-reported screening tool for generalized anxiety disorder, in order to more accurately assess the mental health status of adults [16]. Generalized anxiety disorder is a condition characterized by excessive and persistent anxiety and worry, and is accompanied by various symptoms such as fatigue, decreased concentration, and sleep disturbances [17]. Therefore, in order to prevent suicide among workers, it is most important to apply a practical strategy that includes the comprehensive assessment of mental conditions such as depression, anxiety, and stress.

However, with respect to research on workplace suicide, so far, there have been few studies to comprehensively analyze general characteristics, health behaviors, and mental health status in a stepwise manner, and a number of previous studies were focused on specific variables rather than comprehensively considering various types of factors, so many previous studies had limitations in taking a comprehensive approach to the problem of workplace suicide. To overcome these limitations, this study conducted a comprehensive analysis of the personal and occupational characteristics, health behaviors, and mental health status factors of workers in order to systematically elucidate their effects on suicidal ideation by using representative data from the Korea National Health and Nutrition Examination Survey.

The influencing factors identified through this analysis can be utilized as useful and practical basic data for policy-making decisions and for establishing strategies to promote mental health and prevent suicide among workers in the future. In addition, the research results will hopefully contribute to the development of customized mental health management programs that take into account occupational types and working environments.

Aims and objectives

This study aimed to identify factors influencing suicidal ideation among workers in Korea by using data from the 3rd year of the 8th National Health and Nutrition Survey (2021) in order to provide basic data for the development of workplace suicide prevention programs in the future. The specific objectives of this study are as follows:

1) To analyze differences in suicidal ideation according to general characteristics among workers (personal factors, occupation factors);
2) to analyze differences in suicidal ideation according to health behaviors among workers;
3) to analyze differences in suicidal ideation according to health status factors (physical health, mental health) among workers;
4) to systematically identify the factors affecting suicidal ideation among workers.

Methods

Study design

This study is a descriptive correlation study to analyze differences in suicidal ideation according to general characteristics, health be-

haviors, and health status, and investigate the effects of the variables on suicidal ideation among workers in Korea by using data from the 3rd year of the 8th Korea National Health and Nutrition Examination Survey (2021) (KNHANES VIII-3).

Participants and data collection

The participants of this study were 2,328 paid workers selected among a total of 7,090 participants in the 3rd year of the 8th Korea National Health and Nutrition Examination Survey (2021 KNHANES). More specifically, 2,328 paid workers who responded to the question "Which of the following is your job?" by answering that "I work for some other person or a company as an employee and receive compensation for the work that I do" were first selected from the participants of the 2021 KNHANES. Then, of the 2,328 paid workers, 41 people who answered "I don't know" or did not respond to the questions about the main research variables were excluded after processing missing values, and the data of 2,287 people were finally included in the analysis.

This study used the raw data from the 3rd year of the 8th Korea National Health and Nutrition Examination Survey (KNHANES) (2021) [16] after receiving approval for the use of the data after registering the 'statistical data use agreement' with the Korea Disease Control and Prevention Agency. The KNHANES data are government-designated statistics from Statistics Korea (Approval No. 117002), and a representative sample of Korean residents aged 1 year or older was extracted by using the most recent data of the Population and Housing Census at the time of sample design as the sampling frame. The participants were selected by a stratified sampling method, and the population was stratified by city/province, dong (neighborhood)/eup (village)/myeon (township), and housing type, and the residential area ratio, age of the household head, and single-person household ratio were used as internal stratification criteria. The KNHANES data were collected through a household survey about household members, a health survey, physical examinations, and a nutrition survey.

Measures

General characteristics

1. Personal factors

The personal factors of the participants considered in this study were gender, age, Region (residential area), education level, and household type. Gender was divided into male and female, and age was classified into three age groups: young adults aged 16-39 years, middle-aged people aged 40-64 years, and elderly people aged 65 years or older. Region was divided into urban and rural areas, and education level was divided into middle school or lower, high school, and college or higher. Household type was divided into single-person household and multi-person household for analysis.

2. Occupation factors

Among occupational characteristics, occupation, employment type, weekly working hours, and working type were analyzed. Based on the classification codes of the major group of the standard occupational classification system, occupations were reclassified into office workers (managers, experts, related workers, and office workers), service workers (service and sales workers), and labor workers (skilled workers and technicians in agriculture, forestry, and fisheries, and workers who operate and assemble equipment or machinery, and simple laborers). Military personnel were excluded from the analysis due to the special nature and limitations of their working environment. Employment type was analyzed by dividing it into permanent and temporary workers, and weekly working hours were categorized into less than 20 hours, 20 to 39 hours, 40 to 52 hours, and more than 52 hours. Working type was classified into day work and night or shift work.

Health behaviors

The health behaviors analyzed in this study were smoking, drinking, practice of strength exercise, sleep duration, and health examination. Smoking status was classified into 'Yes (smoker)' if the respondent is a current smoker, and 'No (non-smoker)' if the respondent has quit smoking or is a non-smoker. Drinking status was classified into 'Yes (drinker)' if the respondent has drunken one glass or more of alcohol per month in the past year, and 'No (non-drinker)' if the respondent drinks less than one glass of alcohol per month or has never drunken alcohol in all his or her life. The practice of strength exercise was classified into 'Yes (practiced)' if the respondent performs it three or more times a week, and 'No (not practiced)' if he or she does not. Sleep duration was divided into less than 6 hours and 6 hours or more, based on the average sleep duration during the weekdays excluding weekends. The presence of health examination was classified as 'Yes' if the respondent has received it within the last two years, and 'No' if the respondent has not.

Health status

1. Physical health

Physical health was examined by assessing subjective health status and the number of comorbid chronic diseases. Subjective health status was measured using the question about one's usual health

status, and it was reclassified into 'good' ('very good' and 'good') and 'poor' ('fair' and 'poor'). The number of comorbid chronic diseases was reclassified into three or more diseases, two diseases, one disease, and none, based on the number of the chronic diseases that the respondent was diagnosed with among the following diseases: myocardial infarction, stroke, angina pectoris, hypertension, diabetes, dyslipidemia, renal failure, thyroid disease, osteoarthritis, arthritis, osteoporosis, rheumatoid arthritis, asthma, pulmonary tuberculosis, sinusitis, otitis media, allergic rhinitis, atopic dermatitis, cataracts, glaucoma, hepatitis B, hepatitis C, liver cirrhosis, and obesity. In addition, according to the definition and classification of obesity by the World Health Organization (WHO), a body mass index of 30kg/m^2 or more was classified as 'obesity' [18].

2. Mental health

Among the mental health factors, stress, depression, and generalized anxiety disorder were measured. With respect to stress, to assess stress levels in daily life, 'Quite a bit stressed' and 'Very much stressed' were reclassified as 'Yes (Feel stressed)' and 'A little stressed' and 'Hardly stressed' were reclassified as 'No (Not feel stressed).' The experience of depression was measured using the question asking whether or not the respondent has felt sad or hopeless to such a degree that the feelings of sadness or hopelessness interfered with his or her daily life for at least two weeks continuously in the past year, and the experience of depression was categorized into 'Yes' and 'No'. Generalized anxiety disorder was measured using the Generalized Anxiety Disorder-7 (GAD-7), a self-report screening tool for generalized anxiety disorder, which uses the question that asks participants how often their problems have interfered with their daily life in the past 2 weeks. This scale consists of 7 items in total, and the total scores can range from 0 to 21 points. A higher total score indicates a higher level of generalized anxiety disorder. More specifically, based on the total scores, 0 to 4 points are classified as normal, 5 to 9 points as mild anxiety, 10 to 14 points as moderate anxiety, and 15 to 21 points as severe anxiety. In general, a total score of 10 points or higher is diagnosed as generalized anxiety disorder [17]. Therefore, in this study, a total score of 0 to 4 points was classified as 'normal', 5 to 9 points as 'mild anxiety', and 10 points or higher as 'generalized anxiety disorder', based on the diagnostic tool for generalized anxiety disorder.

3. Suicidal ideation

Suicidal ideation was measured using the question about whether the respondent has ever considered suicide seriously in the past year. If the respondent answered 'yes', suicidal ideation was categorized as 'Yes (the presence of suicidal ideation)', and if the respondent answered 'no', it was categorized as 'No (the absence of suicidal ideation).'

Data analysis

Data analysis was conducted using SPSS/WIN 29.0, and the significance level of all statistical tests was set at $p < 0.05$. First, to analyze differences in suicidal ideation according to the general characteristics, health behaviors, and health status of the participants, the frequencies and percentages were calculated, and Chi-squared tests were performed to determine the significance of differences in suicidal ideation. Second, in order to identify significant factors affecting suicidal ideation among the participants, a hierarchical logistic regression analysis was performed by entering independent variables in a stepwise manner. Only the variables that were found to be significant variables in a univariable analysis were extracted, and then suicidal ideation was used as the dependent variable, and the following three types of regression models were derived. The order of entering variables was determined based on previous studies. Invariant factors such as personal and occupational characteristics were first entered, and health behavior variables and health status variables, which are variables relatively likely to change, were additionally entered in a stepwise manner in order to clearly identify the relative influence between variables. In Model 1, only general characteristic variables, including personal and occupational factors of the participants, were entered. In Model 2, health behavior variables were additionally entered along with the variables analyzed in Model 1. Lastly, in Model 3, general characteristics, health behaviors, and health status variables including physical health and mental health variables were all entered. Multicollinearity in regression analysis was examined using tolerance and variance inflation factor (VIF) in linear regression analysis. The goodness-of-fit of the regression model was assessed by Hosmer-Lemeshow goodness-of-fit test, and the explanatory power of the regression model was evaluated using Nagelkerke's coefficient of determination, R^2.

Ethical considerations

This study used data from the 3rd year (2021) of the 8th Korea National Health and Nutrition Examination Survey conducted by the Korea Disease Control and Prevention Agency. The survey was conducted after obtaining written informed consent from the participants, and since the raw data does not contain personally identifiable information that allow identification of individuals, this study received an exemption determination from the Institutional Review Board of Kyungpook National University, which is

the affiliated institution of the researcher (IRB No. KNU-2024-0146)

Results

Differences in suicidal ideation according to general characteristics

Table 1 shows the analysis results of differences in suicidal ideation according to the general characteristics of the participants. 3.6% of the total participants responded that they had suicidal ideation, and there was a statistically significant difference in suicidal ideation according to age, education level, and household type, but gender and region did not show a significant effect on suicidal ideation. Regarding age, the prevalence of suicidal ideation was highest among the young adult group aged 16-39 at 4.8%, followed by the elderly group aged 65 and older (4.2%) and the middle-aged group aged 40-64 (2.6%) (p = .032). In terms of education level, the group with the education level of middle school or higher showed the highest prevalence of suicidal ideation at 6.9%, and lower education level was associated with a

Table 1. Suicidal Ideation by General Characteristics of Participants (N=2,287)

Variables	Total	% of suicidal ideation	Suicidal ideation		χ^2	p
	N (%)		Yes n (%)	No n (%)		
Personal factors						
Gender						
Male	1,098 (48.0)	2.8	31 (37.8)	1,068 (48.4)	3.55	.060
Female	1,189 (52.0)	4.3	51 (62.2)	1,138 (51.6)		
Age (range: 16–80)						
16–39	728 (31.8)	4.8	35 (42.7)	693 (31.4)	6.89	.032
40–64	1,156 (50.5)	2.6	30 (36.6)	1,126 (51.1)		
≥ 65	403 (17.6)	4.2	17 (20.7)	386 (17.5)		
Region						
Urban	2,205 (75.6)	3.3	62 (75.6)	1,814 (82.3)	2.38	.123
Rural	411 (18.0)	4.9	20 (24.4)	391 (17.7)		
Education level						
≤ Middle school	420 (18.4)	6.9	29 (35.4)	391 (17.7)	16.91	< .001
High school	781 (34.1)	3.2	25 (30.5)	756 (34.3)		
≥ College	1,086 (47.5)	2.6	28 (34.1)	1,058 (48.0)		
Household type						
Single	355 (15.5)	5.6	20 (24.4)	335 (15.2)	5.10	.024
Multi	1,932 (84.5)	3.2	62 (75.6)	1,870 (84.8)		
Occupation factors						
Occupation						
Clerks	1,034 (45.2)	3.1	32 (39.0)	1,002 (45.4)	1.32	.518
Service workers	424 (18.5)	4.0	17 (20.7)	407 (18.5)		
Production workers	829 (36.2)	4.0	33 (40.2)	796 (36.1)		
Employment type						
Permanent	1,097 (48.0)	2.4	26 (31.7)	1,071 (48.6)	9.01	.003
Temporary	1,190 (52.0)	4.7	56 (68.3)	1,134 (51.4)		
Weekly working hours						
< 20	415 (18.1)	4.6	19 (4.6)	396 (95.4)	12.23	.007
20–39	546 (23.9)	4.4				
41–52	1,124 (49.1)	2.3				
> 52	202 (8.8)	6.4				
Working type						
Day work	1,947 (85.1)	3.6	71 (86.6)	1,876 (85.1)	0.14	.707
Shift or night work	340 (14.9)	3.2	11 (13.4)	329 (14.9)		

higher prevalence rate of suicidal ideation ($p < .001$). As to household type, the prevalence of suicidal ideation was higher in single-person households (5.6%) than in multi-person households (3.2%) ($p < .001$).

With respect to differences in suicidal ideation according to the occupational factors of the participants, occupation and working type did not have a significant effect on suicidal ideation, but there were statistically significant differences in suicidal ideation according to employment type and weekly working hours. Regarding employment type, the prevalence of suicidal ideation was higher in temporary workers at 4.7% than permanent workers (2.4%). In terms of weekly working hours, the prevalence of suicidal ideation was highest in the group working for more than 52 hours per week at 6.4%, followed by the group working for less than 20 hours per week (4.6%), the group working for 20-39 hours per week (4.4%), and the group working for 41-52 hours per week (2.3%). The group working for 41-52 hours per week showed the lowest prevalence of suicidal ideation ($p = .007$).

Differences in suicidal ideation according to health behaviors

Health behaviors were variables concerning the lifestyle habits of the participants. Analysis results of differences in suicidal ideation according to health behaviors are shown in Table 2. Among the health behavior variables, only smoking was significantly linked to suicidal ideation ($p = .004$), and the prevalence of suicidal ideation was significantly higher in smokers (6.0%) than non-smokers (3.1%). However, there were no statistically significant differences in suicidal ideation according to drinking, strength exercise, sleep duration, or health examination.

Differences in suicidal ideation according to health status

Differences in suicidal ideation according to health status among workers are shown in Table 3. Among the variables related to physical health, only subjective health status showed a statistically significant effect on suicidal ideation ($p < .001$). The prevalence of suicidal ideation was significantly higher in the group with poor subjective health status (4.8%) than the group with good subjective health status (1.6%). However, there was no significant difference in the prevalence of suicidal ideation according to the number of chronic diseases ($p = .568$). The prevalence of suicidal ideation was 2.9% in both the group with no chronic diseases and the group with one chronic disease, 4.2% in the group with two chronic diseases, and 4.1% in the group with three or more chronic diseases.

All the mental health variables showed a statistically significant relationship with suicidal ideation ($p < .001$). The prevalence of suicidal ideation was significantly higher in the group with stress (8.8%) than the group without stress (1.6%). In addition, the prevalence of suicidal ideation was significantly higher in the group with the experience of depression (24.2%) than the group without the experience of depression (1.2%). Regarding the level

Table 2. Suicidal Ideation by Health Behavior of Participants (N=2,287)

Variables	Total	% of suicidal ideation	Suicidal ideation		χ^2	p
			Yes	No		
	n (%)		n (%)			
Total	2,287 (100.0)	3.6	82 (3.6)	2,205 (96.4)		
Smoking						
Yes	399 (17.4)	6.0	24 (29.3)	375 (17.0)	8.25	.004
No	1,888 (82.6)	3.1	58 (70.7)	1,830 (83.0)		
Drinking						
Yes	1,269 (55.5)	3.7	48 (57.3)	1,222 (55.4)	0.12	.734
No	1,018 (44.5)	3.4	35 (42.7)	983 (44.6)		
Strength exercise						
Yes	408 (17.8)	2.5	10 (12.2)	398 (18.0)	1.85	.174
No	1,879 (82.2)	3.8	72 (87.8)	1,807 (82.0)		
Sleep duration						
> 6hr	477 (20.9)	4.4	21 (25.6)	456 (20.7)	1.16	.281
≤ 6hr	1,810 (79.1)	3.4	61 (74.4)	1,749 (79.3)		
Health examination						
Yes	1762 (77.0)	3.2	56 (68.3)	1,706 (77.4)	3.68	.055
No	26 (23.0)	5.0	26 (31.7)	499 (22.6)		

Table 3. Suicidal Ideation by Health Status of Participants (N=2,287)

Variables	Total	% of suicidal ideation	Suicidal ideation		χ^2	p
			Yes	No		
	n (%)		n (%)			
Total	2,287 (100)	3.6	82 (3.6)	2,205 (96.4)		
Physical health						
Subjective health status						
Good	868 (38.0)	1.6	14 (17.1)	854 (38.7)	15.75	< .001
Poor	1,419 (62.0)	4.8	68 (82.9)	1,351 (61.3)		
Chronic disease						
None	865 (37.8)	2.9	25 (30.5)	840 (38.1)	2.02	.568
1	622 (27.2)	3.9	24 (29.3)	598 (27.1)		
2	408 (17.8)	4.2	17 (20.7)	391 (17.7)		
≥ 3	392 (17.1)	4.1	16 (19.5)	376 (17.1)		
Mental health						
Stress						
Yes	623 (27.2)	8.8	55 (67.1)	568 (25.8)	68.08	< .001
No	1,664 (72.8)	1.6	27 (32.9)	1,637 (74.2)		
Depression mood						
Yes	236 (10.3)	24.2	57 (69.5)	179 (8.1)	322.01	< .001
No	2,051 (89.7)	1.2	25 (30.5)	2,026 (91.9)		
Generalized anxiety disorder						
Generalized anxiety disorder	95 (4.2)	26.3	25 (30.5)	70 (3.2)	193.12	< .001
Mild anxiety	249 (10.9)	10.0	25 (30.5)	224 (10.2)		
Normal	1,943 (85.0)	1.6	32 (39.0)	1,911 (86.7)		

of anxiety, the prevalence of suicidal ideation was 1.6% in the normal group, 10.0% in the mild anxiety group, and 26.3% in the generalized anxiety disorder group, showing that the prevalence of suicidal ideation increased with the increase of the level of anxiety.

In short, the above analysis results showed that subjective health status and mental health factors were significantly associated with suicidal ideation.

Factors affecting suicidal ideation among workers

The factors associated with suicidal ideation among the participants were divided into general characteristics, health behaviors, and health status characteristics, and a hierarchical logistic regression analysis was performed to identify influencing factors for suicidal ideation. The results of hierarchical logistic regression analysis are shown in Table 4. Only the variables that were found to be significant ($p < 0.05$) in the univariate analysis were entered into each regression model in a stepwise manner.

As a result of checking the multicollinearity of all regression models, the tolerance value was 0.51~0.97, which satisfied the criterion of the acceptable range of 0.1 or more, and the variance inflation factor (VIF) was 1.04~1.97, which was less than the threshold value of 10, indicating that there was no multicollinearity problem. In addition, the results of the Hosmer-Lemeshow goodness-of-fit test showed that all models were statistically valid.

In Model 1, among general characteristics, the variables that showed a significant relationship with suicidal ideation in the univariate analysis were entered. In other words, age, education level, household type, employment type, and weekly working hours were entered in Model 1. As a result, the young adult group aged 16~39 was found to have 2.48 times higher risk of suicidal ideation than in the middle-aged group aged 40~64 (OR = 2.48, 95% CI = 1.45~4.26). In terms of education level, the risk of suicidal ideation was 4.05 times higher in workers with the education level of middle school or lower than those with the education level of college or higher (OR = 4.05, 95% CI = 1.96~8.34). Regarding weekly working hours, workers who worked for more than 52 hours per week had a 2.52 times higher risk of suicidal ideation than those who worked for 40 to 52 hours per week (OR = 2.52, 95% CI = 1.24~5.15). The explanatory power of Model 1 was 7%, based on Nagelkerke R^2.

In Model 2, smoking status, which was a significant variable among health behaviors, was additionally entered along with the

Table 4. Factors Affecting to Suicidal Ideation among Participants (*N*=2,287)

Variables		Model 1	Model 2	Model 3
		OR (95% CI)	OR (95% CI)	OR (95% CI)
General characteristics				
Personal factors				
Age				
16–39	(ref:40–64)	2.48 (1.45~4.26)***	2.40(1.40~4.12)**	1.44(0.78~2.64)
≥ 65	(ref:40–64)	0.55 (0.26~1.15)	0.61(0.29~1.28)	0.66(0.28~1.58)
Educational level				
≤ Middle school	(ref : ≥ College)	4.05 (1.96~8.34)***	3.76 (1.82~7.75)***	3.33 (1.46~7.56)**
High school	(ref: ≥ College)	1.19 (0.67~2.11)	1.09 (0.61~1.95)	1.33 (0.69~2.56)
Household				
Single	(ref:Multiple)	1.53 (0.89~2.62)	1.48 (0.87~2.54)	1.30 (0.70~2.41)
Occupational factors				
Employment type		1.41 (0.78~2.52)	1.41 (0.80~2.51)	1.24 (0.65~2.36)
Temporary	(ref:Permanent)	1.41 (0.78~2.52)	1.41 (0.80~2.51)	1.24 (0.65~2.36)
Weekly working hours				
< 20	(ref:40–52)	1.41 (0.68~2.89)	1.49 (0.72~3.07)	1.22 (0.53~2.85)
20-39	(ref:40–52)	1.656 (0.91~3.04)	1.71 (0.93~3.14)	1.60 (0.81~3.15)
> 52	(ref:40–52)	2.52 (1.24~5.15)*	2.38 (1.16~4.88)*	2.10 (0.90~4.91)
Health behavior				
Smoking				
Yes	(ref:No)		1.93 (1.15~3.22)*	1.81 (0.99~3.32)
Health status				
Physical health				
Subjective health status				
Poor	(ref:Good)			1.44 (0.75~2.75)
Mental health				
Stress				
Yes	(ref:No)			1.82 (1.01~3.29)*
Depression mood				
Yes	(ref:No)			10.77 (6.13~18.94)***
General anxiety disorder				
Mild anxiety	(ref:Normal)			2.51 (1.32~4.77)**
General anxiety disorder	(ref:Normal)			4.63 (2.25~9.53)***
Hosmer-Lemeshow		χ^2 = 11.33, df = 8, p = .184	χ^2 = 7.16 df = 8, p = .520	χ^2 = 6.05 df = 8, p = .642
Nagelkerke R^2		.07	.08	.37

*p<.05, **p<.01, ***p<.001.
Model 1 OR (95% CI) represents the results of logistic regression analysis for general characteristics, Model 2 includes the results incorporating both general characteristics and health behaviors, and Model 3 presents the results that include all independent variables.

variables of Model 1. Smokers were found to have a 1.93 times higher risk of suicidal ideation than non-smokers (OR = 1.93, 95% CI = 1.15~3.22). Younger age, lower education level, and weekly working hours of > 52 hours, which were significant in Model 1, were also significant in Model 2. The explanatory power of Model 2 was slightly increased to 8%.

In Model 3, which was the final regression model, subjective health status, stress, depression, and generalized anxiety disorder were entered in addition to the variables included in Model 2, and the explanatory power was increased significantly to 37%. Finally, the variables significantly affecting suicidal ideation were depression, generalized anxiety disorder, lower education level, mild anxiety, and stress. Specifically, workers with the experience of depression had a 10.77 times higher risk of suicidal ideation, compared to the normal group (OR = 10.77, 95% CI = 6.13~18.94), and workers with generalized anxiety disorder had a 4.63 times

higher risk of suicidal ideation than the normal group (OR = 4.63, 95% CI = 2.25~9.53). In addition, the risk of suicidal ideation was 3.33 times higher in workers with a lower education level of middle school or lower than those with the education level of college or higher (OR = 3.33, 95% CI = 1.46~7.56). Also, the risk of suicidal ideation was 2.51 times higher in the mild anxiety group than the normal group (OR = 2.51, 95% CI = 1.32~4.77), and the group with stress was found to have a 1.82 times higher risk of suicidal ideation, compared to the group without stress (OR = 1.82, 95% CI = 1.01~3.29). Meanwhile, after mental health factors were additionally entered into the regression model, the statistically significant effects of younger age (ages 16-39) and weekly working hours of > 52 hours on suicidal ideation disappeared, suggesting that age and weekly working hours indirectly influenced suicidal ideation through mental health problems.

In conclusion, the strongest influencing factor for suicidal ideation among workers was depression, followed by generalized anxiety disorder, lower education level, mild anxiety, and stress, and these results clearly showed that the management of workers' mental health is crucial in preventing workplace suicide.

Discussion

This study systematically analyzed factors affecting workers' suicidal ideation using hierarchical logistic regression analysis, focusing on general characteristics, health behaviors, and mental health factors, and this study was conducted using data from the 3rd year of the 8th Korea National Health and Nutrition Examination Survey (2021) (KNHANES VIII-3). The analysis results showed that the suicide rate among workers was 3.6%, which was slightly lower than the suicide rate of all adults in Korea during the same period (4.3%) [2]. This result supports the results of previous studies showing that an economically stable position and a sense of social belonging have a certain protective effect on suicidal ideation [1,19].

The most important result of this study is that mental health factors were found to have a predominantly large effect on suicidal ideation, compared to other variables. More specifically, Model 1, which only included general characteristics, had an explanatory power of 7%, and Model 2, where health behaviors were additionally entered, had an explanatory power of 8%. However, in Model 3, where mental health factors were additionally entered, explanatory power was increased significantly to 37%. These results are consistent with the results of previous studies [9] that clearly showed that mental health is the strongest predictor for suicidal ideation, and they also emphatically show that properly addressing mental health problems should be the key part of policies for the prevention of workplace suicide.

With respect to mental health factors, the experience of depression was found to be the strongest risk factor, increasing the risk of suicidal ideation by 10.77 times compared to the normal group. The strong association between depression and suicide is consistent with the research results reported in a number of studies at home and abroad [8,20]. Depression is a factor that directly promotes extreme thoughts such as suicidal impulses, and is accompanied by various psychological factors such as despair, helplessness, and negative self-evaluation, and depression can act as a direct cause of suicide [20]. In particular, recent studies have reported that a significant number of people even among workers with mild depressive symptoms who do not have obvious depressive symptoms experience suicidal thoughts [21], emphasizing the need to establish an early intervention system that includes not only the high-risk group for depression but also the potential risk group when assessing the mental health of workers. The recently revised guidelines for the management of depression in workers also emphasize suicide prevention activities through cultivating 'gatekeepers' in workplaces, as well as depression management, and this approach can be seen as an appropriate direction reflecting the current situation [22]. Therefore, the mental health assessment system in workplaces should not be limited to the diagnosis of depression, but needs to be expanded to enable early detection of potential risks through comprehensive assessments.

One of the most notable results of this study is that it clearly elucidated the importance of generalized anxiety disorder and mild anxiety states in relation to workers' suicidal ideation. The results of the present study showed that workers with generalized anxiety disorder had a 4.63 times higher risk of suicidal ideation compared to the normal group, and even workers with a mild anxiety state had a 2.51 times higher risk of suicidal ideation, clearly showing the seriousness of anxiety. Previous studies in Korea analyzed only the groups diagnosed with severe generalized anxiety disorder mainly among adolescents and reported the relationship between anxiety disorder and suicidal ideation [23,24]. Thus, it is significant that this study analyzed anxiety symptoms in a group of workers by dividing the level of anxiety into normal, mild anxiety, and generalized anxiety disorder, thereby revealing that even mild anxiety symptoms can be an important predictor of suicide risk. Generalized anxiety disorder is characterized by excessive and persistent worry and anxiety, and is accompanied by various physical and psychological symptoms, such as sleep disturbance, irritability, difficulty with concentration, fatigue, and muscle tension [10]. This chronic state of anxiety continuously causes nega-

tive expectations about the future as well as cognitive distortions, making people vulnerable to stress, and in the long term, chronic anxiety is highly likely to be comorbid with other mental disorders such as depression [24]. In particular, since workers are continuously exposed to various occupational stress factors such as job stress, work burdens, and job insecurity, their anxiety symptoms are likely to worsen, which may eventually act as an important factor that increases the risk of suicidal ideation. The results of this study revealed that anxiety symptoms in workers, especially, even mild anxiety symptoms, which have not received sufficient attention so far, can have a significant impact on suicidal ideation. These results suggest that it is necessary to go one step further from the existing limited mental health management strategies intended to address generalized anxiety disorder, and thus actively manage workers with mild anxiety as well as those with generalized anxiety disorder. Therefore, when the assessment of mental health among workers is performed in workplaces, mild anxiety symptoms as well as generalized anxiety disorder should also be addressed and managed through early assessment and interventions, and workplaces should establish a more systematic and comprehensive mental health management system including counseling, psychological education, and linkage with relevant institutions for treatment. These proactive preventive approaches are expected to ultimately serve as effective preventive measures for suicide among workers and contribute to the creation of a healthy working environment and the improvement of quality of life among workers.

Stress was also found to be a major factor increasing the likelihood of suicidal ideation by 1.82 times compared to the normal group. Stress increases the risk of suicide because it is related to the accumulation of complex factors such as various problems in the workplace, such as work overload, conflicts within the organization, and difficulties in interpersonal relationships, as well as personal and family problems [20,23]. In particular, stress is likely to increase the risk of suicide since it can contribute to depression and anxiety. Therefore, it is necessary to activate the Employee Assistance Program (EAP) for stress management in workplaces and to regularly operate a stress assessment and management system [25]. In addition, it is important to prevent workers from developing chronic stress by managing stress among workers through early interventions in cooperation with mental health welfare centers in the community and specialized institutions.

The most notable part of the analysis results of Model 1 and Model 2 is the effects of age, education level, weekly working hours, and smoking. In Model 1, age had a significant effect on suicidal ideation, and in particular, the risk of suicidal ideation was 2.48 times higher in the young adult group aged 16-39 than the middle-aged group aged 40-64. These results are consistent with previous studies [26-28] reporting that the recent unstable employment environment has influenced the increase of the risk of suicide among young people. However, in the final regression model, when mental health variables were entered, the effect of age disappeared, and this is a significant result showing that a high risk of suicide among young people is closely related to mental health problems such as depression, anxiety, and stress. This finding provides supporting evidence for the suggestion that the mental health management of young workers should be considered first in making and implementing suicide prevention policies in the future. Actually, the government is planning to expand mental health screening and counseling for young adults as the priority target group in 2025, which can be viewed as an example of reflecting the results of this study in terms of policies [29]. Education level was also identified as an important factor that independently increases the risk of suicidal ideation. In addition, this study found that workers with lower education level (middle school or lower) had a 3.33 times higher risk of suicidal ideation than workers with the education level of college or higher, and this finding is consistent with previous studies that reporting the association between a low education level and suicide risk [26,30]. Workers with lower education level are more likely to have low access to mental health services because they have structural vulnerabilities such as the lack of social support systems. Therefore, in implementing workplace mental health programs for workers with lower education level, there is a need to explore measures to increase access to counseling support in addition to a customized approach. The analysis results of the final regression model showed that the effects of age and weekly working hours lost statistical significance after mental health variables were entered, and these results suggest that these variables may have an indirect effect on suicidal ideation through mental health problems such as stress, depression, and anxiety [9,10,30]. Therefore, there is a need for implementing a policy that regulates long working hours and considers both the reduction of working hours and the protection of mental health through linkage with a mental health management system.

The fact that the significant effects of age and weekly working hours in Models 1 and 2 disappeared in the final regression model analysis suggests that these variables are more likely to have an indirect effect through mental health factors such as stress, depression, and anxiety rather than directly affecting suicidal ideation [9,10,30]. Therefore, it should be emphasized again that mental health interventions are essentially needed in addition to the regu-

lation of long working hours.

In addition, regarding the fact that except for smoking, health behavior variables, such as drinking, sleep duration, and exercise, did not show a significant correlation with suicidal ideation in this study, these results are thought to show that workers' health behaviors may have an indirect and long-term effect on suicidal ideation through mental health factors such as depression or anxiety rather than directly affecting suicidal ideation in the short term [13,14].

The present study has some limitations. First, this study could not identify the causal relationships between suicidal ideation and influencing factors since it used cross-sectional data. In addition, this research did not consider additional variables such as the specific working environments in workplaces and family factors of workers. Thus, in follow-up studies, it is necessary to use longitudinal data to clarify the causal relationships between variables and conduct an in-depth analysis by including a wider range of variables, including the workplace and family environments.

In conclusion, this study proved that mental health factors such as depression, generalized anxiety disorder, and stress are crucial factors in preventing workplace suicide by using a nationally representative data. In particular, it is considered a significant research outcome that this study expanded the scope of the assessment of anxiety disorders to include mild anxiety symptoms that were overlooked in previous studies, and thus suggested that more detailed and comprehensive suicide prevention strategies are needed. The results of this study can serve as practical and important basic data for the management of workers' mental health and establishing policies for the prevention of workplace suicide.

Conclusions

In this study lower education level and mental health factors, such as depression, stress, generalized anxiety disorder, and mild anxiety, were identified as the main factors affecting suicidal ideation among workers. In particular, the addition of mental health factors greatly increased the explanatory power of the model, clearly confirming the importance of mental health management in preventing workplace suicide. Based on these results, the following suggestions are made.

First, workplaces should establish a regular and comprehensive mental health assessment system that includes depression, stress, generalized anxiety disorder, and even mild anxiety along with an early intervention system for mental health problems. Second, to expand the accessibility of mental health support programs in the workplace, it is necessary to activate personalized counseling services, smoking cessation programs, and stress management programs. Third, regular training on mental health and suicide prevention should be provided to all workers in the workplace to increase workers' awareness of mental health issues and improve their initial response ability. Fourth, although this study did not find any significant differences among occupations, future research should conduct more sophisticated risk assessments for each occupation group to develop customized mental health management programs for each occupation. Lastly, if a follow-up study uses a longitudinal study design and conducts a comprehensive analysis by including workplace factors and socioeconomic environmental factors, it will provide a basis for the development of more sophisticated and effective policies for the management of workers' mental health and prevention of workers' suicide. Such a longitudinal study would also contribute to improving organizational productivity and creating a healthy working environment.

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Conflict of interest

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Authors' contributions

Myeong Hwa Lee contributed to conceptualization, data curation, formal analysis, methodology, project administration, visualization, writing - original draft, review & editing, investigation, resources, software, validation. Eun Suk Choi contributed to conceptualization, methodology, project administration, writing - review & editing and supervision.

Data availability

Please contact the corresponding author for data availability.

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