Received: 30 October 2020 | Revised: 13 April 2021 | Accepted: 27 April 2021

DOI: 10.1002/1348-9585.12233

ORIGINAL ARTICLE

Journal of Occupational Health Open Access WILEY

# Occupation, work-related stress, and personal characteristics among suicide deaths with occupation-related compensation claims in Korea

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## Abstract

**Objectives:** This study compared differences in age-standardized suicide mortality rates, personal characteristics (demographics, employment conditions, and details of suicide), and work-related stress by gender and occupation among workers who had committed suicide in Korea.

**Methods:** Data comprised 413 suicide death claims lodged with the Industrial Accident Compensation Insurance (IACI) from 2010 to 2018, which were coded. We calculated age-standardized suicide mortality rates by gender and occupation. The chi-square test, Fisher's exact test, and *t*-test were conducted to examine gender differences. Frequency and percentage distribution by gender and occupation were calculated using descriptive statistics.

**Results:** Regardless of gender, age-standardized suicide mortality rate was highest among "Managers." Women who died by suicide were significantly younger and more likely to be unmarried, live alone, and have fewer years of continuous employment than men. "Managers," "Professionals and Related Workers," and "Clerks" experienced similar work-related stresses, including "Difficult work to achieve," "Fail to achieve allocation workload," and "Change of job contents or workload." "Skilled Agricultural, Forestry and Fishery Workers," "Craft and Related Trades Workers," and "Equipment, Machine Operating and Assembling Workers" had higher work-related stress related to "Severe disease/injury" or "Causing a serious accident" compared with other workers.

**Conclusions:** Work-related stress related to suicide deaths differed by gender and occupation. The gender gap of labor market participation in Korea may affect gender differences in terms of demographics and employment conditions among workers who died by suicide. Our study suggests that gender- and occupation-specific strategies and policies to reduce work-related stress can prevent suicide among workers.

KEYWORDS

gender gap, interpersonal conflict, psychiatric treatment, responsibility, suicide rate

## 1 | INTRODUCTION

Suicide is the primary cause of death for working populations in some countries,[1,2] especially Korea.[3] According to data from Statistics Korea, over the past decade, more than 40% of the suicide deaths among those aged 15-64 years were by those who were employed.[4] Unemployment was a significant predictor of suicide and was the most common adverse life event experienced within 1 year of death by people who died by suicide,[5,6] but it is not yet clear which work-related stresses influence death by suicide. Several studies examined work-related stresses preceding suicide, and identified conditions related to working hours, physical conditions, monotonous work, high responsibility, high strain due to contact with clients, low psychological demand, and low control.[6-12] However, most studies did not differentiate between occupations, or conducted the study only on specific occupations. Suicide rates have been reported differently by occupation.[13,14] Differences in work-related stresses can affect suicide rates by occupation.

In a Japanese study on attempted suicide,[15] men were more likely to be affected by financial or work-related problems, while women were more likely to be affected by relationship problems. The authors suggested that gender differences in stresses indicate the gender gap in the Japanese labor market. Korea also has the highest gender gap in the labor market among OECD countries. Meaning, men and women in Korea have very stark inequalities in wage, employment rate, and management positions.[16] Korean men and women who died by suicide might experience different employment conditions and work-related stresses. Therefore, comparing gender and occupation differences in terms of employment conditions and work-related stress is important because it can clarify the labor market characteristics affecting workers who died by suicide.

Several countries, including Korea and Japan, provide compensation for suicide deaths that have been recognized as occupational diseases through Industrial Accident Compensation Insurance (IACI). IACI data allow researchers to identify information on the relationship between occupation and suicide. When the Application Form for Compensation from the Bereaved is submitted to the Korea Workers' Compensation & Welfare Service (COMWEL), the COMWEL interviews the bereaved, employers, and colleagues and examines the police report, medical reports, and related evidence to confirm the role of work-related stress. In this process, all possible information about work-related stress experienced by the worker prior to their suicide is collected. Work-related stresses are stressful events occurring in the 6 months preceding suicide, and which could have triggered or played a major role in the previous mental condition of the person who committed suicide. After the revision of investigation guidelines pertaining to mental health and suicide in 2016, easing the standard for the causal relationship between work-related stress and suicide, the total approval rate for compensation of suicide in Korea has increased significantly from 35.2% in 2014 to 80.0% in 2018. Thus, it is necessary to analyze all claimed suicide deaths in IACI, including unapproved cases, to better understand suicide among workers.

To the best of our knowledge, no study has compared differences in personal characteristics and work-related stresses in IACI-claimed suicide deaths by gender and occupation. A Japanese study using IACI data dealt only with compensation suicide and did not analyze women's suicide deaths.[17] In our previous study of compensation cases in

**TABLE 1** Age-standardized suicide mortality rates (per 10 00 000) of Industrial Accident Compensation Insurance (IACI) in Korea, 2010-2018

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| Occupation | N[a] | ASM | 95% CI | N[a] | ASM | 95% CI |
| Managers | 119 | 29.5 | 17.7-41.3 | 2 | 13.8 | 0.0-38.1 |
| Professionals and related workers | 47 | 1.4 | 1.0-1.9 | 14 | 0.4 | 0.2-0.6 |
| Clerks | 46 | 1.4 | 1.0-1.8 | 16 | 0.7 | 0.2-1.1 |
| Service workers | 11 | 1.4 | 0.5-2.3 | 1 | 0.1 | 0.0-0.1 |
| Sales workers | 21 | 2.2 | 1.2-3.3 | 3 | 0.2 | 0.0-0.4 |
| Skilled agricultural, forestry and fishery workers | 2 | 3.5 | 0.0-8.3 | 0 | — | |
| Craft and related trades workers | 49 | 2.8 | 1.4-4.1 | 0 | — | |
| Equipment, machine operating and assembling workers | 45 | 1.9 | 1.3-2.5 | 5 | 0.8 | 0.1-1.6 |
| Elementary workers | 30 | 1.6 | 1.1-2.2 | 2 | 0.3 | 0.0-0.7 |

Abbreviations: ASM, age-standardized suicide mortality rate; CI, Confidence Interval.

[a]Suicide number.

**TABLE 2** Comparison of personal characteristics (demographics, employment conditions, and details of suicide) by gender

| | Total (N = 413, 100%) | | Men (N = 370, 89.6%) | | Women (N = 43, 10.4%) | | *p*-value [a] |
|---|---|---|---|---|---|---|---|
| Death age, year, mean (SD) | 43.3 | (9.7) | 44.3 | (9.3) | 35.2 | (9.8) | <0.001*** |
| Death age groups, year, N (%) | | | | | | | <0.001*** |
| <30 | 37 | (9.0) | 22 | (6.0) | 15 | (34.9) | |
| 30-39 | 97 | (23.5) | 84 | (22.7) | 13 | (30.2) | |
| 40-49 | 168 | (40.7) | 157 | (42.4) | 11 | (25.6) | |
| 50-59 | 95 | (23.0) | 91 | (24.6) | 4 | (9.3) | |
| ≥60 | 16 | (3.9) | 16 | (4.3) | 0 | (0.0) | |
| Marital status, N (%) | | | | | | | <0.001*** |
| Single (never married) | 80 | (19.4) | 55 | (14.9) | 25 | (58.1) | |
| Married | 314 | (76.0) | 300 | (81.1) | 14 | (32.6) | |
| Divorced/widowed | 19 | (4.6) | 15 | (4.1) | 4 | (9.3) | |
| Living condition, N (%) | | | | | | | 0.002**[b] |
| Living alone | 43 | (10.4) | 32 | (8.7) | 11 | (25.6) | |
| Not living alone | 370 | (89.6) | 338 | (91.4) | 32 | (74.4) | |
| Occupation, N (%) | | | | | | | <0.001***[b] |
| Managers | 121 | (29.3) | 119 | (32.2) | 2 | (4.7) | |
| Professionals and related workers | 61 | (14.8) | 47 | (12.7) | 14 | (32.6) | |
| Clerks | 62 | (15.0) | 46 | (12.4) | 16 | (37.2) | |
| Service workers | 12 | (2.9) | 11 | (3.0) | 1 | (2.3) | |
| Sales workers | 24 | (5.8) | 21 | (5.7) | 3 | (7.0) | |
| Skilled agricultural, forestry and fishery workers | 2 | (0.5) | 2 | (0.5) | 0 | (0.0) | |
| Craft and related trades workers | 49 | (11.9) | 49 | (13.2) | 0 | (0.0) | |
| Equipment, machine operating and assembling workers | 50 | (12.1) | 45 | (12.2) | 5 | (11.6) | |
| Elementary workers | 32 | (7.8) | 30 | (8.1) | 2 | (4.7) | |
| Years of continuous employment, year, mean (SD) | 10.3 | (9.1) | 11.0 | (9.3) | 4.7 | (5.5) | <0.001*** |
| Employment contract, N (%) | | | | | | | 0.232 |
| Regular | 360 | (87.2) | 325 | (87.8) | 35 | (81.4) | |
| Irregular | 53 | (12.8) | 45 | (12.2) | 8 | (18.6) | |
| Method of suicide, N (%) | | | | | | | 0.056 |
| Hanging | 222 | (53.8) | 204 | (55.1) | 18 | (41.9) | |
| Jumping from height | 106 | (25.7) | 89 | (24.1) | 17 | (39.5) | |
| Other | 81 | (19.6) | 75 | (20.3) | 6 | (14.0) | |
| Missing | 4 | (1.0) | 2 | (0.5) | 2 | (4.7) | |
| Location of suicide, N (%) | | | | | | | <0.001*** |
| Own residence | 186 | (45.0) | 154 | (41.6) | 32 | (74.4) | |
| Workplace | 87 | (21.1) | 81 | (21.9) | 6 | (14.0) | |
| Other | 138 | (33.4) | 133 | (35.9) | 5 | (11.6) | |
| Missing | 2 | (0.5) | 2 | (0.5) | 0 | (0) | |
| Records of psychiatric treatment, N (%) | | | | | | | 0.011* |
| Yes | 222 | (53.8) | 191 | (51.6) | 31 | (72.1) | |

(Continues)

**TABLE 2** (Continued)

| | Total (N = 413, 100%) | | Men (N = 370, 89.6%) | | Women (N = 43, 10.4%) | | *p*-value [a] |
|---|---|---|---|---|---|---|---|
| Principal diagnosis of mental disorders, N (%) | | | | | | | 0.007**[b] |
| F20-F29 Schizophrenia, schizotypal and delusional disorders | 10 | (4.5) | 8 | (4.2) | 2 | (6.5) | |
| F30-F39 Mood [affective] disorders | 125 | (56.3) | 100 | (52.4) | 25 | (80.7) | |
| F40-F48 Neurotic, stress-related and somatoform disorders | 69 | (31.1) | 65 | (34.0) | 4 | (12.9) | |
| Other | 18 | (8.1) | 18 | (9.4) | 0 | (0.0) | |

[a]Statistical significance for difference by gender: ***$P < .001$; **$P < .01$; *$P < .05$.

[b]Fisher's exact test.

2016-2017,[18] interpersonal conflicts, including conflicts with supervisors and harassment, were the most common work-related stresses, but there was no classification by occupation and gender.

The current study aimed to examine age-standardized suicide mortality rate and work-related stresses by gender and occupation using all data in IACI-claimed suicide deaths in Korea from 2010 to 2018. Further, we compared personal characteristics by gender. Our findings could improve current understandings of suicide trends and inform the development of effective suicide prevention strategies for workers.

## 2 | METHODS

### 2.1 | Data and coding

Data used in this study comes from the suicide death claims in IACI, collected by the COMWEL. We accessed all suicide deaths claims to the IACI from 2010 to 2018. According to Article 2 of the Enforcement Decree of the IACI in Korea, the following businesses or workers are excluded from IACI: public officials or workers who are compensated by other laws; private households with employed persons; and agriculture, forestry, and fishery businesses with fewer than five full-time workers. Moreover, workers such as those with special employment types who did not voluntarily apply for IACI due to the burden of half premiums were not included in data, as were IACI-enrolled cases where the bereaved did not claim for compensation of suicide.

Variables were extracted using the following data included in each case: Application Form for Compensation from the Bereaved; investigation report from COMWEL; Decision Statement from the Committee on Occupational Disease Judgement (CODJ); the police report; death certification; charts of medical records; opinion of physician; interviews/letters from family members, employers, colleagues, close friends, or related persons (witness, and *so on*); and suicide notes (including diary, email, text message, and so on). The definition of occupation for this study was taken from the 7th version of the Korea Standard Classification of Occupations (KSCO), except for the Armed Forces, which are not covered by IACI.[19]

To code work-related stresses, we categorized 36 kinds of stress into five major categories using the 2011 Recognition Criteria for Occupational Mental Disorders in Japan.[20] The following are the major categories: (a) Accident/Disaster (which included two work-related stresses), (b) Failure/Responsibility (12 work-related stresses), (c) Quantity/Quality (five work-related stresses), (d) Role/Position (nine work-related stresses), and (e) Interpersonal Conflict (including sexual harassment) (eight work-related stresses). Each work-related stress included in the five major categories can be found in Table 3.

To establish interrater agreement and the standard of coding, two authors coded the same 30 pilot cases independently, referring to previous suicide studies that coded data.[21,22] All the other cases were coded by the first authors for consistency and reviewed by another author who coded pilot cases to check for accuracy of coding data. If there was a difference in argument between the bereaved and employer regarding work-related stresses, we followed the opinions of the decision statement from the CODJ. Nevertheless, if it was difficult to decide, we coded it as missing data. The corresponding author supervised all data. This study was approved by the Research Ethics Board at Hanyang University in Korea (HYI-16-029).

### 2.2 | Statistical analysis

We directly calculated age-standardized suicide mortality rate and 95% confidence intervals (CI) per 1 000 000 for IACI data by gender and occupation using microdata of Statistics Korea for the Economically Active Population Survey (2008-2018), and the Korea 2015 mid-year standard population. Suicide deaths claimed in the period 2010-2018 occurred between 2008 and 2018. The chi-square test (or Fisher's exact test) for categorical variables and *t*-test for continuous variables (death age, years of continuous employment) were conducted to compare personal characteristics (demographics,

**TABLE 3** Frequency and percentage distribution of suicide deaths for 36 work-related stresses, by gender and occupation

| | | Men | | | | | | | | | | Women[a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MN | PR | CL | SR | SL | SK | CR | EQ | EL | T | MN | PR | CL | SR | SL | EQ | EL | T |
| **Work-related stress** | **N** | **119** | **47** | **46** | **11** | **21** | **2** | **49** | **45** | **30** | **370** | **2** | **14** | **16** | **1** | **3** | **5** | **2** | **43** |
| Accident/disaster | | | | | | | | | | | | | | | | | | | |
| Severe disease/injury | N | 3 | 1 | 1 | 1 | 1 | 2 | 15 | 8 | 4 | 36 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 3 |
| | (%) | (2.5) | (2.1) | (2.2) | (9.1) | (4.8) | (100) | (30.6) | (17.8) | (13.3) | (9.7) | (0.0) | (0.0) | (0.0) | (100) | (33.3) | (20.0) | (0.0) | (7.0) |
| Experiencing or witnessing a severe accident or fire | N | 4 | 0 | 1 | 0 | 0 | 0 | 3 | 3 | 1 | 12 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | (%) | (3.4) | (0.0) | (2.2) | (0.0) | (0.0) | (0.0) | (6.1) | (6.7) | (3.3) | (3.2) | (0.0) | (0.0) | (0.0) | (0.0) | (33.3) | (0.0) | (0.0) | (2.3) |
| Failure/responsibility | | | | | | | | | | | | | | | | | | | |
| Causing a serious accident | N | 4 | 2 | 2 | 1 | 0 | 0 | 2 | 10 | 1 | 22 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 |
| | (%) | (3.4) | (4.3) | (4.3) | (9.1) | (0.0) | (0.0) | (4.1) | (22.2) | (3.3) | (5.9) | (0.0) | (7.1) | (0.0) | (0.0) | (33.3) | (0.0) | (0.0) | (4.7) |
| Crucial mistake in work | N | 20 | 5 | 4 | 1 | 5 | 0 | 6 | 4 | 0 | 45 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| | (%) | (16.8) | (10.6) | (8.7) | (9.1) | (23.8) | (0.0) | (12.2) | (8.9) | (0.0) | (12.2) | (50.0) | (7.1) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (4.7) |
| Responsibility for accident/incident | N | 40 | 12 | 10 | 3 | 6 | 0 | 6 | 7 | 1 | 85 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 4 |
| | (%) | (33.6) | (25.5) | (21.7) | (27.3) | (28.6) | (0.0) | (12.2) | (15.6) | (3.3) | (23.0) | (0.0) | (7.1) | (12.5) | (0.0) | (0.0) | (20.0) | (0.0) | (9.3) |
| Financial responsibility | N | 30 | 9 | 6 | 1 | 6 | 0 | 8 | 7 | 0 | 67 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| | (%) | (25.2) | (19.1) | (13.0) | (9.1) | (28.6) | (0.0) | (16.3) | (15.6) | (0.0) | (18.1) | (0.0) | (7.1) | (0.0) | (0.0) | (0.0) | (20.0) | (0.0) | (4.7) |
| Forcing illegal behavior | N | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 7 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| | (%) | (2.5) | (4.3) | (2.2) | (0.0) | (0.0) | (0.0) | (0.0) | (2.2) | (0.0) | (1.9) | (0.0) | (0.0) | (6.3) | (0.0) | (0.0) | (0.0) | (0.0) | (2.3) |
| Difficult work to achieve | N | 52 | 24 | 22 | 3 | 13 | 0 | 14 | 5 | 2 | 135 | 1 | 5 | 4 | 0 | 0 | 1 | 0 | 11 |
| | (%) | (43.7) | (51.1) | (47.8) | (27.3) | (61.9) | (0.0) | (28.6) | (11.1) | (6.7) | (36.5) | (50.0) | (35.7) | (25.0) | (0.0) | (0.0) | (20.0) | (0.0) | (25.6) |
| Fail to achieve allocation workload | N | 42 | 15 | 15 | 1 | 12 | 0 | 11 | 2 | 2 | 100 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 5 |
| | (%) | (35.3) | (31.9) | (32.6) | (9.1) | (57.1) | (0.0) | (22.4) | (4.4) | (6.7) | (27.0) | (50.0) | (14.3) | (6.3) | (0.0) | (0.0) | (20.0) | (0.0) | (11.6) |
| In charge of new business or company reconstruction | N | 27 | 10 | 5 | 0 | 3 | 0 | 1 | 0 | 0 | 46 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| | (%) | (22.7) | (21.3) | (10.9) | (0.0) | (14.3) | (0.0) | (2.0) | (0.0) | (0.0) | (12.4) | (0.0) | (7.1) | (12.5) | (0.0) | (0.0) | (0.0) | (0.0) | (7.0) |
| Unreasonable demands from client | N | 23 | 14 | 8 | 0 | 4 | 0 | 2 | 3 | 2 | 56 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| | (%) | (19.3) | (29.8) | (17.4) | (0.0) | (19.0) | (0.0) | (4.1) | (6.7) | (6.7) | (15.1) | (0.0) | (7.1) | (6.3) | (0.0) | (0.0) | (0.0) | (0.0) | (4.7) |
| Complaints from client | N | 37 | 17 | 9 | 0 | 6 | 0 | 4 | 7 | 2 | 82 | 0 | 3 | 4 | 0 | 0 | 0 | 0 | 7 |
| | (%) | (31.1) | (36.2) | (19.6) | (0.0) | (28.6) | (0.0) | (8.2) | (15.6) | (6.7) | (22.2) | (0.0) | (21.4) | (25.0) | (0.0) | (0.0) | (0.0) | (0.0) | (16.3) |
| Be forced to present at a large presentation or formal meeting | N | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | (%) | (0.8) | (4.3) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.8) | (0.0) | (7.1) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (2.3) |

(Continues)

**TABLE 3** (Continued)

| | | Men | | | | | | | | | | Women[a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MN | PR | CL | SR | SL | SK | CR | EQ | EL | T | MN | PR | CL | SR | SL | EQ | EL | T |
| **Work-related stress** | **N** | **119** | **47** | **46** | **11** | **21** | **2** | **49** | **45** | **30** | **370** | **2** | **14** | **16** | **1** | **3** | **5** | **2** | **43** |
| Substitute for supervisor | N | 5 | 3 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 12 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| | (%) | (4.2) | (6.4) | (4.3) | (0.0) | (0.0) | (0.0) | (2.0) | (2.2) | (0.0) | (3.2) | (0.0) | (0.0) | (6.3) | (0.0) | (0.0) | (0.0) | (0.0) | (2.3) |
| Quantity/quality | | | | | | | | | | | | | | | | | | | |
| Change of job contents or workload | N | 40 | 19 | 24 | 4 | 4 | 0 | 11 | 5 | 4 | 111 | 0 | 5 | 7 | 1 | 1 | 2 | 0 | 16 |
| | (%) | (33.6) | (40.4) | (52.2) | (36.4) | (19.0) | (0.0) | (22.4) | (11.1) | (13.3) | (30.0) | (0.0) | (35.7) | (43.8) | (100) | (33.3) | (40.0) | (0.0) | (37.2) |
| Long working hour | N | 7 | 5 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (%) | (5.9) | (10.6) | (4.3) | (9.1) | (0.0) | (0.0) | (2.0) | (2.2) | (3.3) | (4.9) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| Continuous work for more than 2 weeks | N | 6 | 4 | 1 | 2 | 2 | 0 | 4 | 0 | 0 | 19 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | (%) | (5.0) | (8.5) | (2.2) | (18.2) | (9.5) | (0.0) | (8.2) | (0.0) | (0.0) | (5.1) | (0.0) | (7.1) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (2.3) |
| Change in work arrangements of shift | N | 10 | 5 | 8 | 1 | 4 | 0 | 7 | 5 | 2 | 42 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 3 |
| | (%) | (8.4) | (10.6) | (17.4) | (9.1) | (19.0) | (0.0) | (14.3) | (11.1) | (6.7) | (11.4) | (0.0) | (0.0) | (12.5) | (0.0) | (33.3) | (0.0) | (0.0) | (7.0) |
| Change of pace or activity | N | 19 | 8 | 12 | 2 | 4 | 0 | 10 | 7 | 2 | 64 | 0 | 0 | 3 | 0 | 1 | 1 | 0 | 5 |
| | (%) | (16.0) | (17.0) | (26.1) | (18.2) | (19.0) | (0.0) | (20.4) | (15.6) | (6.7) | (17.3) | (0.0) | (0.0) | (18.8) | (0.0) | (33.3) | (20.0) | (0.0) | (11.6) |
| Role/position | | | | | | | | | | | | | | | | | | | |
| Retirement pressure | N | 14 | 4 | 2 | 2 | 2 | 0 | 3 | 7 | 2 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (%) | (11.8) | (8.5) | (4.3) | (18.2) | (9.5) | (0.0) | (6.1) | (15.6) | (6.7) | (9.7) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| Relocation | N | 21 | 6 | 14 | 2 | 6 | 0 | 6 | 10 | 1 | 66 | 0 | 1 | 5 | 0 | 1 | 1 | 0 | 8 |
| | (%) | (17.6) | (12.8) | (30.4) | (18.2) | (28.6) | (0.0) | (12.2) | (22.2) | (3.3) | (17.8) | (0.0) | (7.1) | (31.3) | (0.0) | (33.3) | (20.0) | (0.0) | (18.6) |
| Transfer | N | 14 | 6 | 2 | 0 | 2 | 0 | 5 | 0 | 0 | 29 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| | (%) | (11.8) | (12.8) | (4.3) | (0.0) | (9.5) | (0.0) | (10.2) | (0.0) | (0.0) | (7.8) | (0.0) | (0.0) | (6.3) | (0.0) | (0.0) | (0.0) | (0.0) | (2.3) |
| Solo work | N | 8 | 5 | 3 | 0 | 1 | 0 | 3 | 2 | 1 | 23 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 4 |
| | (%) | (6.7) | (10.6) | (6.5) | (0.0) | (4.8) | (0.0) | (6.1) | (4.4) | (3.3) | (6.2) | (0.0) | (7.1) | (12.5) | (0.0) | (0.0) | (20.0) | (0.0) | (9.3) |
| Discrimination (Irregular worker) | N | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (%) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (2.0) | (4.4) | (6.7) | (1.4) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| Own promotion | N | 22 | 5 | 4 | 3 | 3 | 0 | 0 | 1 | 1 | 39 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| | (%) | (18.5) | (10.6) | (8.7) | (27.3) | (14.3) | (0.0) | (0.0) | (2.2) | (3.3) | (10.5) | (0.0) | (7.1) | (6.3) | (0.0) | (0.0) | (0.0) | (0.0) | (4.7) |
| Reduction of colleagues | N | 16 | 3 | 4 | 1 | 2 | 0 | 3 | 0 | 2 | 31 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| | (%) | (13.4) | (6.4) | (8.7) | (9.1) | (9.5) | (0.0) | (6.1) | (0.0) | (6.7) | (8.4) | (0.0) | (0.0) | (12.5) | (0.0) | (0.0) | (0.0) | (0.0) | (4.7) |

(Continues)

**TABLE 3** (Continued)

| | | Men | | | | | | | | | | Women[a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MN | PR | CL | SR | SL | SK | CR | EQ | EL | T | MN | PR | CL | SR | SL | EQ | EL | T |
| **Work-related stress** | **N** | **119** | **47** | **46** | **11** | **21** | **2** | **49** | **45** | **30** | **370** | **2** | **14** | **16** | **1** | **3** | **5** | **2** | **43** |
| Early retirement offer | N | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | (%) | (3.4) | (6.4) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (1.9) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (20.0) | (0.0) | (2.3) |
| Contract expire (Irregular workers) | N | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 3 | 10 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | (%) | (1.7) | (2.1) | (2.2) | (0.0) | (0.0) | (0.0) | (2.0) | (4.4) | (10.0) | (2.7) | (0.0) | (7.1) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (2.3) |
| Interpersonal conflict | | | | | | | | | | | | | | | | | | | |
| Workplace harassment, mobbing, violence | N | 5 | 2 | 1 | 1 | 1 | 0 | 0 | 3 | 1 | 14 | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 6 |
| | (%) | (4.2) | (4.3) | (2.2) | (9.1) | (4.8) | (0.0) | (0.0) | (6.7) | (3.3) | (3.8) | (50.0) | (14.3) | (12.5) | (0.0) | (0.0) | (0.0) | (50.0) | (14.0) |
| Conflict with supervisor | N | 50 | 16 | 23 | 6 | 11 | 0 | 14 | 11 | 6 | 137 | 0 | 4 | 4 | 0 | 1 | 1 | 0 | 10 |
| | (%) | (42.0) | (34.0) | (50.0) | (54.5) | (52.4) | (0.0) | (28.6) | (24.4) | (20.0) | (37.0) | (0.0) | (28.6) | (25.0) | (0.0) | (33.3) | (20.0) | (0.0) | (23.3) |
| Conflict with colleague | N | 12 | 5 | 7 | 1 | 4 | 0 | 6 | 3 | 7 | 45 | 1 | 8 | 5 | 0 | 1 | 0 | 1 | 16 |
| | (%) | (10.1) | (10.6) | (15.2) | (9.1) | (19.0) | (0.0) | (12.2) | (6.7) | (23.3) | (12.2) | (50.0) | (57.1) | (31.3) | (0.0) | (33.3) | (0.0) | (50.0) | (37.2) |
| Conflict with subordinates | N | 10 | 3 | 4 | 2 | 4 | 0 | 2 | 2 | 4 | 31 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| | (%) | (8.4) | (6.4) | (8.7) | (18.2) | (19.0) | (0.0) | (4.1) | (4.4) | (13.3) | (8.4) | (0.0) | (7.1) | (6.3) | (0.0) | (0.0) | (0.0) | (0.0) | (4.7) |
| Break up with a close colleague | N | 7 | 5 | 3 | 0 | 0 | 0 | 1 | 2 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (%) | (5.9) | (10.6) | (6.5) | (0.0) | (0.0) | (0.0) | (2.0) | (4.4) | (0.0) | (4.9) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| New supervisor | N | 14 | 5 | 5 | 0 | 1 | 0 | 4 | 1 | 2 | 32 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 4 |
| | (%) | (11.8) | (10.6) | (10.9) | (0.0) | (4.8) | (0.0) | (8.2) | (2.2) | (6.7) | (8.6) | (0.0) | (0.0) | (18.8) | (0.0) | (33.3) | (0.0) | (0.0) | (9.3) |
| Losing promotion | N | 2 | 3 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (%) | (1.7) | (6.4) | (6.5) | (0.0) | (0.0) | (0.0) | (4.1) | (0.0) | (0.0) | (2.7) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| Sexual harassment | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| | (%) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (18.8) | (0.0) | (0.0) | (0.0) | (0.0) | (7.0) |

Abbreviations: CL, Clerks; CR, Craft and Related Trades Workers; EL, Elementary Workers; EQ, Equipment, Machine Operating and Assembling Workers; MN, Managers; PR, Professionals and Related Workers; SK, Skilled Agricultural, Forestry and Fishery Workers; SL, Sales Workers; SR, Service Workers; T, Total.

[a]The case of women in Skilled Agricultural, Forestry and Fishery Workers, and Craft and Related Trades Workers was N = 0.

employment conditions, and details of suicide) between genders at a significance level of $P < .05$. Frequency and percentage distributions for all claimed suicide deaths by gender and occupation were calculated as simple descriptive statistics. All statistics were calculated using SAS software version 9.4 (SAS Institute Inc, Cary, North Carolina, USA).

## 3 | RESULTS

### 3.1 | Age-standardized suicide mortality rates of IACI

A total of 413 claimed suicide deaths were identified in IACI data from 2010 to 2018 (Table 1). Age-standardized suicide mortality rate per 1 000 000 was the highest in "Managers," for both men (ASM = 29.5, 95% CI 17.7-41.3) and women (ASM = 13.8, 95% CI 0.0-38.1).

### 3.2 | Gender comparison in IACI-claimed suicide deaths

We compared personal characteristics (demographics, employment conditions, and details of suicide) by gender using a total of 413 claimed suicide deaths in IACI from 2010 to 2018 (Table 2). Of the analyzed suicide deaths, 89.6% (370/413) were men. Women who died by suicide were significantly younger than men (men 44.3 years, women 35.2 years; $P < .001$), and about 35% of those were under 30. Women were more likely to be unmarried (single or divorced/widowed), and living alone than men ($P < .001$ and $P = .002$, respectively). In addition, women had shorter years of continuous employment than did men (men 11.0 years, women 4.7 years; $P < .001$). Women tended to die in their own residence and had records of psychiatric treatment ($P < .001$; $P = .011$, respectively), and 80.7% of their principal diagnoses were mood [affective] disorders. There were no significant differences based on gender in employment contract and method of suicide.

### 3.3 | Frequency and percentage distribution of suicide deaths by gender and occupation for 36 work-related stresses

We identified the frequency and percentage by gender and occupation for each of the 36 work-related stresses in the five categories (Table 3). The highest percentage of men tended to experience "Conflict with supervisor" (37.0%, 137/370), while most women tended to experience "Conflict with colleague" (37.2%, 16/43). Over 30% of male "Managers" experienced work-related stress belonging to Fail/Responsibility, such as "Difficult work to achieve," "Fail to achieve allocation workload," "Responsibility for accident/incident," and "Complaints from client." "Managers," "Professionals and Related Workers," and "Clerks" tended to have similar experiences of work-related stresses such as "Difficult work to achieve," "Fail to achieve allocation workload," and "Change of job contents or workload." Among "Professionals and Related Workers," men experienced "Difficult work to achieve" (51.1%, 24/47) the most, followed by "Change of job contents or workload" (40.4%, 19/47). By contrast, the highest percentage of women experienced "Conflict with colleague" (57.1%, 8/14), followed by "Difficult work to achieve" and "Change of job contents or workload" (both 35.7%, 5/14). Among "Clerks," both men and women experienced "Change of job contents or workload" (52.2%, 24/46 in men; 43.8%, 7/16 in women) and "Relocation" more than other occupations. In men, the percentages of "Severe disease/injury" or "Causing a serious accident" were higher among "Skilled Agricultural, Forestry and Fishery Workers," "Craft and Related Trades Workers," and "Equipment, Machine Operating and Assembling Workers" than in other occupations.

## 4 | DISCUSSION

The present study aimed to examine age-standardized suicide mortality rates and work-related stresses by gender and occupation, using all data from claimed suicide deaths in IACI from 2010 to 2018 in Korea. In addition, we compared demographics, employment conditions, and details of suicide by gender.

We found that work-related stresses preceding suicide differ by occupation, especially white- and blue-collars. Male "Skilled Agricultural, Forestry and Fishery Workers," "Craft and Related Trades Workers," and "Equipment, Machine Operating and Assembling Workers" had high percentages of "Severe disease/injury," or "Causing a serious accident." Blue-collar workers had more occupational injuries than white-collar workers,[23] increasing their risk of suicide.[24]

White-collar workers such as "Managers," "Professionals and Related Workers," and "Clerks" experienced similar work-related stresses, such as "Difficult work to achieve," "Fail to achieve allocation workload," and "Change of job contents or workload." In particular, "Managers" had experienced a variety of work-related stresses related to Fail/Responsibility. Also, the age-standardized suicide mortality rate of "Managers" in both men and women was the highest among occupations. Some studies have suggested that economic crises may affect the high suicide mortality rates among managers in Korea and Japan.[25,26] Changes in working conditions, like downsizing of regular workers, reduction of non-regular workers, and wage cuts due to the 2008

economic crisis in Korea,[27] and the 1990s economic recession in Japan, could increase work-related stress related to the responsibilities of managers.[26] Changes in the labor market caused by the economic crisis may have particularly affected the managers of subcontractors. For example, in the claimed suicide deaths of IACI, there were several "Construction, Electricity, and Production-Related Managers" working as small subcontractors. These site managers mostly experienced work-related burdens such as deadlines for construction, excessive responsibility for damages caused by delays and defects in construction, and conflict with the managing firm. The managing firms provide subcontractors risky and difficult tasks to reduce their own costs and responsibility for work-related accidents and injuries.[28] Subcontractors may place high psychological demands on individual workers and impose excessive responsibility for failure. Work-related stress related to responsibilities caused by subcontracting can adversely affect workers' health[29] and is associated with an increased risk of suicide.[30] In order to prevent suicide deaths by subcontractor managers due to excessive responsibility and failure, the Korean government needs legal and institutional systems that create shared liabilities for labor and employment duties, and obligations between the managing firm and subcontractors.[31]

Results showed women were about 10 years younger at their average age of death and had fewer years of continuous employment than men. These gender differences can be attributed to the gender gap in the Korean labor market. The gender gap in the Korean labor market regarding pay, employment, and management positions is the highest among OECD countries, despite similar education levels.[16] According to the Economically Active Population Survey in 2019,[32] 84.6% of "Managers" among employed persons were men, while only 15.4% were women. The social insurance subscription rate, which indicates a relatively stable job, of female wage and salary earners was approximately 11% lower than that for males.[33]

Further, certain occupations, such as health work, can be more stressful and carry a higher risk of suicide than others.[13] In recent years, the suicide of nurses, classified as "Professionals and Related Workers" in the "human health and social work activities" industry, has become a social problem in Korea. Most of the suicide deaths are known to result from mobbing, bullying, workplace violence, or harassment (so-called "Tae-um"). In the present study, about 70% of women were unmarried, and women were more likely to be living alone than men. Nearly 60% of female "Professionals and Related Workers" experienced "Conflict with colleague," and the percentage of "Conflict with supervisor" was also about 30%. People living alone can be particularly vulnerable to the effect of adverse life events.[34] Our findings suggest that women who died by suicide may have been more affected by negative social relationships at work than men. However, in the current study, the occurrence of "Workplace harassment, mobbing, violence" was low. Because harassment is more subjectively assessed than conflict, it may be difficult for the bereaved to argue for work-related stress.

It should be noted that more than 50% of claimed suicide deaths, including more than 70% of women, included records of psychiatric treatment, in contrast to the finding that most people who died from suicide were not diagnosed with mental illness, and were less likely to be identified as a risk group because they did not visit the hospital, possibly due to stigma and failure.[35] Compared with the low overall rate of psychiatric treatment of people who died from suicide, the high rates of psychiatric treatment for the claimed suicide deaths in IACI make it possible to infer that these deaths had relatively severe mental health issues or obvious work-related stresses. Analyzing the stresses of suicide deaths with relatively severe mental health issues or apparent occupational factors is essential for early detection of suicide signs and timely interventions in workplaces and medical institutions to prevent worker suicide.

This is the first study to compare personal characteristics and work-related stresses by gender and occupation of workers, by using all claimed suicide deaths in the IACI data, which is the only data available to identify the cause of worker suicide in Korea. Despite these strengths, the results should be interpreted in light of the study's limitations. First, this data is not representative of the whole working population who committed suicide in Korea. As this study used only the data for claims made to the IACI, it did not include workers receiving Government Employees Pension, Teachers' Pension, and so on. In addition, many workers were excluded due to not being eligible, not applying, or not claiming for the IACI. Second, IACI data does not precisely fit the psychological autopsy data, but there is a similarity in the information collected and the method. The psychological autopsy method is essential for preventing suicide, but still has methodological issues such as recall bias and information bias.[36] Psychological autopsy in Korea is performed mainly on the bereaved, which may underestimate or miss work-related factors. On the other hand, the COMWEL investigation report included in the IACI is the only data that analyze the work-related factors of worker suicide, in that it carries out a significant in-depth investigation into work-related factors, in addition to personal factors, by obtaining all data about the current status of the workplace and interviews with colleagues and employers. Nevertheless, data from the IACI may also differ from the actual experience of workers who committed suicide, and there may be the same bias in psychological autopsy. Third, except for "Professionals and Related Workers" and "Clerks," a few cases of women in other occupations made it challenging to compare work-related stresses with men due to the difference in sample size. Last, since Korea is one of the countries with the highest suicide rates, we should be careful not to generalize these results to other countries. Nevertheless, this study is very meaningful

in that it examined the causes of suicide of workers covered by IACI, using the data derived after specifically investigating personal characteristics and work-related stresses.

## 5 | CONCLUSIONS

We found that Korean workers who died by suicide had different work-related stress by occupation. Gender differences in suicide deaths may reflect the gender gap in the labor market participation in Korea. Our findings suggest that it is necessary to carefully consider work-related stresses specific to gender and occupation for effective suicide prevention.

### ACKNOWLEDGMENTS

The authors have not declared a specific grant for this research from any funding agency in the public, commercial, or not-for-profit sectors.

### DISCLOSURE

*Approval of the research protocol:* This study was approved by the Research Ethics Board at Hanyang University in Korea (HYI-16-029). *Informed Consent:* N/A. *Registry and the Registration No. of the study/trial:* N/A. *Animal Studies:* N/A. *Conflict of interest:* The authors declare that they no conflict of interest for this article.

### AUTHORS CONTRIBUTIONS

JJ coded and analyzed the data and wrote the manuscript. YK coded data and interpreted the results. JS contributed critical revision for the manuscript. IK supervised data coding and designed and coordinated the manuscript.

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**How to cite this article:** Jang J, Kim Y, Song J, Kim I. Occupation, work-related stress, and personal characteristics among suicide deaths with occupation-related compensation claims in Korea. *J Occup Health*. 2021;63:e12233. https://doi.org/10.1002/1348-9585.12233