# Characteristics of workers' compensation claim applications for COVID-19 infections in South Korea

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**Abstract: This study aimed to identify the major industries and jobs with the highest proportion of workers' compensation (WC) claims for COVID-19, characterize COVID-19 WC claims in terms of their demographic properties and disease severity, and identify factors influencing the approval of COVID-19 WC claims as occupational disease. A total of 488 workers who submitted COVID-19-related claims to the Korea Workers' Compensation and Welfare Service (KWCWS) from January 2020 to July 2021 were analyzed. A Fisher's exact test was employed to associate the severity of COVID-19 infection with demographic properties. The highest proportion of all COVID-19 WC claims compensated as occupational disease (N=462) were submitted by healthcare workers (HCW=233, 50%), while only 9% (N=41) of the total originated from manufacturing industries. The 5% (N=26) of the COVID-19 WC claims accepted were evaluated as severe (N=15) and acute respiratory distress syndrome (N=9). A total of 71% (N=329) of the COVID-19 patients compensated (N=462) were from workplaces with infection clusters. A total of 26 WC cases were rejected for various reasons, including unclear infection routes, infection at private gatherings (including within families), no diagnosis, and more. Given our findings, we suggest an official system should be established to detect and compensate more job-associated infectious diseases like COVID-19.**

**Key words:** COVID-19, COVID-19 workers' compensation, Healthcare workers, Industrial Accident Compensation Insurance Acts, Infectious disease

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## Introduction

Healthcare workers (HCWs) who treat patients can be directly infected by these infected patients[1]. First responders, a group that often transports patients, can also be infected while working. However, HCWs who treat patients other than in hospitals can still be infected by coworkers infected outside. For example, medical staff and other workers in nursing homes can be infected as they commute. Hospitalized patients pose relatively low risks of virus transmission because they are tested before admission[1]. Workplaces with environments vulnerable to viral infection can also be a source of potential mass transmission. In the current prolonged COVID-19 pandemic, many workers are claiming COVID-19 infections and COVID-19-related diseases as occupational diseases. Unlike occupational disease caused by exposure to hazardous agents generated in the workplace, it can be difficult to associate COVID-19 infections with occupation, job, and work environment.

Most countries, including South Korea, have not systematically collected any occupational data on COVID-19-induced illnesses and deaths classified by type of industry or occupation, even though daily statistics on the incidence and death rate have been officially reported[1]. This makes it challenging to identify the occupational factors involved in the spread of the virus. By analyzing the occupational characteristics found in statistics of workers' compensation claims for COVID-19 infection-related disease (hereafter COVID-19 WC), a wide range of occupations exposed to infection or disease due to the work activities involved can be identified. Few studies have reported on COVID-19 WC claims, including on such aspects as the excess risk of WC claim cases[2], the temporal trend in WC applications[3], and the work and health status of WC cases[4].

We aimed to identify the major industries and occupations with the highest proportion of COVID-19 WC claims; characterize COVID-19 WC in terms of demographic properties, seasons during the pandemic, and the level of disease severity; and identify factors influencing the approval of COVID-19 WC claims as occupational disease.

## Subjects and Methods

### Study population and data collection

A total of 488 workers who presumed their COVID-19 infections to be an occupational disease and submitted claims to the Korea Workers' Compensation and Welfare Service (KW-CWS) from January 2020 to July 2021 were studied. The Accident Reports (AR) that they are required to submit to KW-CWS (hereafter AR) were obtained from KWCWS, along with individual COVID-19 epidemiologic results provided by the health center affiliated with the local province. The primary information included in the ARs such as the demographic characteristics of the workers, types of industry and job performed, type of WC, and clinical results on the diseases claimed were used for this study. In addition, the number of other conventional occupational diseases compensated as industrial accidents and the number of COVID-19 infections from the general population in South Korea (52 million) are indicated together. The numbers of workers who were registered under the Industrial Accident Compensation Insurance Act (IACI) as of June 2020 and June 2021 were 25.915 million and 26.697 million, respectively.

### Workers' compensation for COVID-19

COVID-19-related cases claimed were classified into five categories: asymptomatic, upper respiratory infection, pneumonia, acute respiratory distress syndrome (ARDS), and undiagnosed cases that cannot be clinically diagnosed as a disease. The severity of the diagnosis of the claimed cases was categorized into three levels as follows: asymptomatic and upper respiratory infection were categorized as mild; pneumonia as intermediate; and acute respiratory distress syndrome and death as severe. We checked if COVID-19 WC cases had positive laboratory results from a polymerase chain reaction (PCR) test and If the COVID-19 related diseases were diagnosed with medical doctors.

### Data analysis

Demographic and occupational properties and COVID-19 WC were categorized and analyzed according to the objectives of this study. Descriptive statistics were used to describe the COVID-19 WC cases submitted and compensated. A Fisher's exact test was employed to associate the severity levels of COVID-19 infection disease compensated with demographic characteristics, including sex and age. Logistic regression was employed to identify demographic, environmental, and occupational factors associated with the approval of COVID-19 infection as an occupational disease. Odds ratios (ORs) were estimated with 95% confidence intervals (CIs). Type of industry and job combined was categorized into three groups: manufacturing industry and other jobs other than HCW, service industry and other jobs other than HCW, and service industry and HCW. The presence of infection clusters within work-
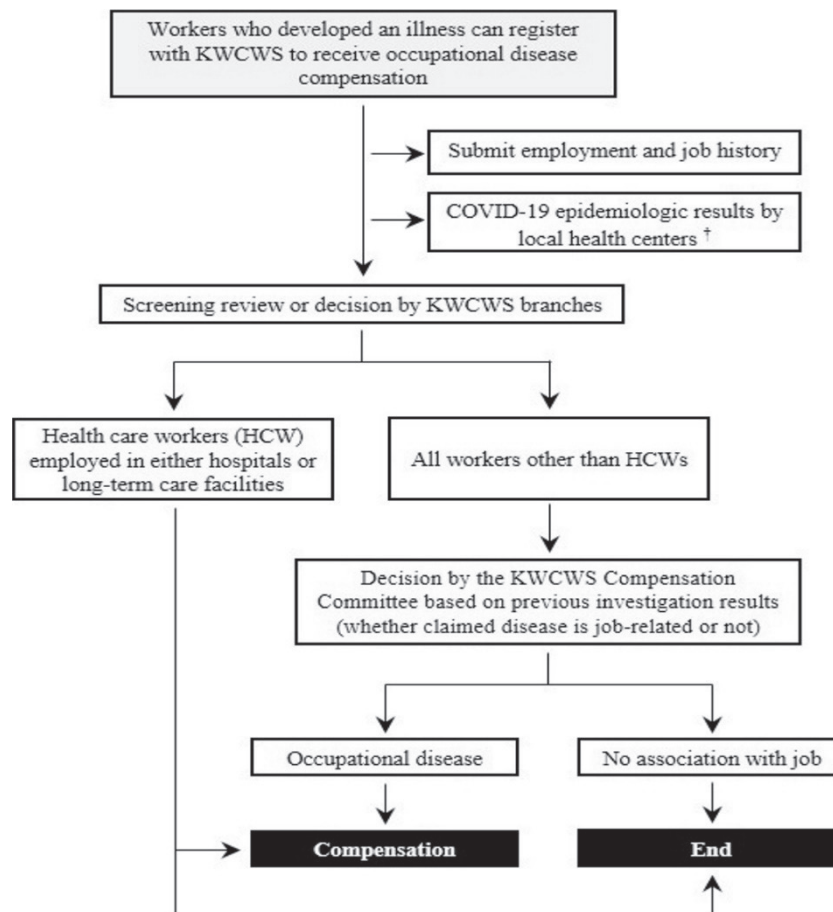
**Fig. 1. Workflow for evaluating a COVID-19 workers' compensation claim as an occupational disease (KWCWS=Korea Worker's Compensation and Welfare Service)**
**[†] COVID-19 epidemiological evaluation results including PCR analysis by health authorities.**

places with approval of the infection as occupational disease was categorized into yes or no, and season was classified as summer and fall or winter and spring. All analyses were conducted with R statistical software version 4.1.0 (The R Foundation, Vienna, Austria). The study protocol was approved by the Institutional Review Boards of Samsung Medical University (IRB No. 2021-09-036).

## Results

*The workflow for compensating COVID-19 infection*

The procedures for recognized or compensated as an occupational disease has been reported elsewhere[5]. These procedures were partially revised for COVID-19 WC claims. A submitted AR is first reviewed by the committee on COVID-19 compensation of KWCWS branches across South Korea, based on COVID-19 related epidemiological results provided by a health center under the local provin-

cial authority. This step was newly added only for compensation of COVID-19 WC claims. COVID-19 cases submitted by healthcare workers such as nurses, physicians, and caregivers (HCW=199) were all evaluated by the KWCWS branch if both positive infection results by PCR and clinical diagnosis were confirmed (Fig. 1). HCW includes physicians, nurses, several types of healthcare assistants, social workers, etc. employed in either hospitals or long-term care facilities. COVID-19 WC claims from workers other than HCW were all transferred to one of the Occupation Associated Disease Decision Committees (OADDC) operated in the six regions of the KWCWS to determine whether COVID-19 WC were compensated or not. This committee consists of seven members, including a chair, two physicians who are specialists on the disease claimed, two occupational medicine specialists, an industrial hygienist, and a lawyer or labor attorney. It makes its decisions through a majority vote based on investigation results, including the

**Table 1. Demographic characteristics of people who submitted claims for workers' compensation for COVID-19**

| Classification | | Number | Proportion (%) |
|---|---|---|---|
| Sex | Male | 204 | 41.8 |
| | Female | 284 | 58.2 |
| Age | 10–29 | 44 | 9.0 |
| | 30–39 | 79 | 16.2 |
| | 40–49 | 101 | 20.7 |
| | 50–59 | 138 | 28.3 |
| | 60–69 | 108 | 22.1 |
| | Over 70 | 18 | 3.7 |
| Region | Gyeonggi-do | 131 | 26.8 |
| | Seoul | 130 | 26.6 |
| | Busan | 70 | 14.3 |
| | Gyeongsangbuk-do | 46 | 9.4 |
| | Daegu | 33 | 6.8 |
| | Gyeongsangnam-do | 20 | 4.1 |
| | Chungcheongbuk-do | 16 | 3.3 |
| | Incheon | 12 | 2.5 |
| | Chungcheongnam-do | 10 | 2.0 |
| | Gwangju | 6 | 1.2 |
| | Gangwon | 4 | 0.8 |
| | Jeollabuk-do | 4 | 0.8 |
| | Daejeon | 2 | 0.4 |
| | Sejong | 1 | 0.2 |
| | Ulsan | 1 | 0.2 |
| | Jeollanam-do | 1 | 0.2 |
| | Jeju-do | 1 | 0.2 |
| Compensated as occupational diseases | Yes | 462 | 94.7 |
| | No | 26 | 5.3 |
| Total | | 488 | 100 |

AR. First, one of the two physician committee members reports if the disease claimed is COVID-19-infection-related. The two occupational physician evaluates work-relatedness, including work environment. All vote independently with comments on whether the diseases claimed are associated with occupation or not based on comments made by the two physicians, focusing on the following: the employee tested positive for or was diagnosed with COVID-19 by a physician within 14 days after a day that the employee performed labor or services at the place of employment.

*The properties of COVID-19 WC*

Two hundred sixty-one COVID-19 WC cases were submitted to KWCWS from Seoul (N=130) and Gyeonggi Province (N=131) (where over half of the South Korean population (N=52 million) resides), accounting for 54% of the total. Fifty-five percent of WC claims were found to be distributed in the 50 and older age group (Table 1). The approval rate of COVID-19 WC cases compensated as an occupational disease was 80%. For the month diagnosed, COVID-19 WC cases were found to peak in December 2020 (N=105), accounting for 22% of all claims. Overall, 70% of WC cases (N= 348) were diagnosed during the cold weather (spanning the months from November to March). The number of COVID-19 WC cases by month is quite small compared with those of other occupational disease cases accepted and among COVID-19 infection cases from the general population (Table 2). The majority of all COVID-19 related WC claims submitted and accepted were from HCW (54%) employed in hospital treating COVID-19 infected patients, followed by long-term care facilities. The types of industry and jobs with COVID-19 disease claims were found to be diverse (Table 3). The severity of COVID-19 cases compensated as occupational disease were evaluated to be mild (N=364), intermediate (N=74), and severe (including 15 deaths) (N=24) (Table 4). Psychological diseases claimed by five mild and two severe infection patients were accepted as occupational disease.

**Table 2. Number of workers submitting COVID-19 compensation claims from January 2020 to July 2021**

| Year | Month | COVID-19 WC claims based on the date submitted (compensated proportion, %) | COVID-19 WC claims based on the date diagnosed | The number and rate of other occupational diseases compensated [†] | The COIVD-19 incidence rate for the general population per one million [‡] |
|---|---|---|---|---|---|
| 2020 | January | 0 | 0 | 744 (65.0) | 0.3 |
| | February | 0 | 18 | 751 (62.0) | 61.2 |
| | March | 1 (100) | 60 | 842 (62.9) | 133.7 |
| | April | 15 (93.3) | 10 | 874 (64.2) | 19.1 |
| | May | 43 (98) | 19 | 753 (63.6) | 5.9 |
| | June | 13 (100) | 4 | 799 (61.5) | 26.0 |
| | July | 10 (100) | 3 | 821 (65.1) | 29.4 |
| | August | 9 (89) | 31 | 694 (65.8) | 110.0 |
| | September | 32 (94) | 22 | 709 (60.7) | 75.4 |
| | October | 25 (88) | 16 | 610 (61.4) | 52.7 |
| | November | 18 (100) | 16 | 755 (63.8) | 150.0 |
| | December | 21 (95) | 105 | 733 (59.8) | 517.4 |
| 2021 | January | 61 (95) | 71 | 713 (61.8) | 340.8 |
| | February | 39 (90) | 33 | 746 (66.8) | 223.7 |
| | March | 46 (96) | 35 | 922 (65.1) | 261.7 |
| | April | 57 (98) | 12 | 924 (62.1) | 369.2 |
| | May | 52 (94) | 23 | 815 (62.9) | 357.5 |
| | June | 40 (90) | 2 | 845 (64.1) | 324.2 |
| | July | 6 (100) | 1 | 908 (65.7) | 807.0 |
| | Total | 488 | 481 [§] | - | 3,868.7 |

[†] The number of workers registered under the Industrial Accident Compensation Insurance Act (IACI) as of June 2020 and June 2021 were 3.168 and 2.917 million, respectively.

[‡] Based on 51,269,185 people (total population).

[§] Including seven WC cases with no information on the date diagnosed.

Twenty-three patients aged over 50 were found to be severe, accounting for 88% among severe compensated cases (N=26) (Table 5). All claiming workers employed in workplaces with two more WC clusters were found to be compensated. Age and the rate of compensation were found to both be significantly associated with infection severity ($p<0.0001$). Seventy-one percent of the cases compensated as occupational disease (N=329) were submitted from workplaces with more than two clusters (Table 6). A total of 26 WC cases were rejected due to one of several reasons, including unclear infection route (N=12), infection at a private gathering (N=7), no diagnosis, and more (Table 7). A logistic analysis revealed that the presence of an infection cluster and HCW employed in the service industry were found to be significantly associated with the increased approval rate of COVID-19 as occupational disease. Specifically, the odds ratio (OR) of approval among WC workers employed in workplaces with infection cluster cases increased about four-fold or more compared with WC claims in workplaces without virus cluster cases (Table 8).

## Discussion

This study analyzed a total of 488 COVID-19 WC cases submitted to KWCWS during the pandemic period ranging from January 2020 to July 2021. Demographic and occupational factors among WC cases, claim trend by month, type and severity of COVID-19 related disease, and infection clusters were mainly described and examined. We found several key features in terms of the type of job, industry, and claimed diseases.

Firstly, the highest proportion of COVID-19 WC was among HCW, including workers employed in long-term care facilities (54%). The service industry, including hospitals, elder care facilities, social welfare facilities, and offices, accounted for the most WC cases, while the manufacturing industry (including construction) showed only 41 (Table 3). Most COVID-19 WC cases were from facilities or jobs treating virus-infected patients or caring for medically vulnerable groups. The OR of approval from HCW

**Table 3.  Occupational characteristics of people who submitted workers' compensation claims for COVID-19**

| Classification | | Compensated | | Not compensated | |
|---|---|---|---|---|---|
| | | Number | Proportion (%) | Number | Proportion (%) |
| Type of industry | Other | 342 | 94.0 | 22 | 6.0 |
| | Professional, health, education, leisure-related services [†] | 252 | 95.8 | 11 | 4.2 |
| | General building management, sanitation and similar service business [†] | 38 | 92.7 | 3 | 7.3 |
| | Wholesale, retail, food and lodging businesses [†] | 22 | 84.6 | 4 | 15.4 |
| | Business of the State and Local Governments [†] | 14 | 100.0 | 0 | 0.0 |
| | Various other business [†] | 8 | 88.9 | 1 | 11.1 |
| | Overseas dispatch business [†] | 7 | 70.0 | 3 | 30.0 |
| | Real estate and rental business [†] | 1 | 100.0 | 0 | 0.0 |
| | Manufacturing industry [‡] | 28 | 93.3 | 2 | 6.7 |
| | Construction industry [‡] | 13 | 86.7 | 2 | 13.3 |
| | Finance and insurance [‡] | 8 | 100.0 | 0 | 0.0 |
| Type of job | Nurse [§] | 111 | 98.2 | 2 | 1.8 |
| | Caregiver [§] | 79 | 95.2 | 4 | 4.8 |
| | Unloading and loading (port) | 42 | 100.0 | 0 | 0.0 |
| | Street cleaner | 26 | 100.0 | 0 | 0.0 |
| | Health administration in hospital [§] | 24 | 100.0 | 0 | 0.0 |
| | Driving and delivery | 22 | 100.0 | 0 | 0.0 |
| | Flight attendant or overseas work | 21 | 87.5 | 3 | 12.5 |
| | Manufacturing industry | 20 | 90.9 | 2 | 9.1 |
| | Call center consultant | 16 | 100.0 | 0 | 0.0 |
| | Officer | 16 | 94.1 | 1 | 5.9 |
| | Construction | 13 | 86.7 | 2 | 13.3 |
| | Cook | 12 | 80.0 | 3 | 20.0 |
| | Social worker [§] | 10 | 90.9 | 1 | 9.1 |
| | Service industry | 10 | 76.9 | 3 | 23.1 |
| | Physician [§] | 9 | 100.0 | 0 | 0.0 |
| | Insurance agent | 7 | 100.0 | 0 | 0.0 |
| | Ship repair | 5 | 100.0 | 0 | 0.0 |
| | Sales professional | 5 | 83.3 | 1 | 16.7 |
| | Building management | 3 | 60.0 | 2 | 40.0 |
| | Communication equipment maintenance | 3 | 75.0 | 1 | 25.0 |
| | Funeral director | 2 | 100.0 | 0 | 0.0 |
| | Railroad technician | 2 | 100.0 | 0 | 0.0 |
| | Marketing | 2 | 100.0 | 0 | 0.0 |
| | Education | 1 | 50.0 | 1 | 50.0 |
| | Broadcasting | 1 | 100.0 | 0 | 0.0 |
| Total | | 462 | 94.7 | 26 | 5.3 |

[†] The third digit of industry type as classified by the Korean Workers' Compensation Insurance Act.

[‡] The first digit of industry type as classified by Korean Workers' Compensation Insurance Act.

[§] Healthcare workers employed in either hospitals or long-term care facilities.

employed in the service industry was found to increase roughly seven-fold or more compared with WC claim cases employed in the manufacturing industry (Table 8). Regardless of type of industry or job, WC workers employed in the same workplace as infection cluster cases were found to be significantly associated with the increased approval rate of COVID-19 as occupational disease after adjusting all predictors compared with WC claims in a workplace without a virus cluster case (Table 8).

Our results are similar to COVID-19 claims results in other countries, including HCW's contributions to occupational claims applications in Italy[3, 6] and a spike in claims in areas such as aged care and the medical and allied pro-

fessions in Australia[4]. Thirty-eight percent of COVID-19 claims submitted in California during the 2020 COVID-19 epidemic period were related to healthcare industry employment, whereas about 10% of employed persons in California work in this industry. Not surprisingly, studies regarding WC claims and COVID-19 infection have shown that HCW are at greater risk of contracting COVID-19 through their work[2, 7–9]. In general, HCWs who treat patients infected in hospitals are associated with an increased risk of developing COVID-19 infections and submitting a workers' compensation claim[2].

Secondly, most jobs including HCWs mentioned in COVID-19 WC claims are found to be not typically consid-

**Table 4.  Characteristics of disease among people who submitted workers' compensation claims for COVID-19**

| | Classification | Compensated | | Not compensated | | *p*-value [*] |
|---|---|---|---|---|---|---|
| | | Number | Proportion (%) | Number | Proportion (%) | |
| Route of transmission or infection | Workplace | 219 | 96.5 | 8 | 3.5 | |
| | Medical institution, including hospitals and elderly facilities | 218 | 98.6 | 3 | 1.4 | |
| | Overseas | 18 | 85.7 | 3 | 14.3 | |
| | Family | 0 | 0.0 | 4 | 100.0 | *p*<0.001 |
| | Unknown | 6 | 54.5 | 5 | 45.5 | |
| | Other | 1 | 33.3 | 2 | 66.7 | |
| | Undiagnosed | 0 | 0.0 | 1 | 100.0 | |
| Respiratory site infected or type of disease | Asymptomatic | 30 | 6.5 | 2 | 7.7 | |
| | Upper respiratory tract | 334 | 72.3 | 14 | 53.8 | |
| | Pneumonia [†] | 74 | 16.0 | 8 | 30.8 | *p*=0.177 |
| | Acute respiratory distress syndrome (ARDS) [‡] | 9 | 1.9 | 0 | 0.0 | |
| | Death | 15 | 3.2 | 2 | 7.7 | |
| The level of infection severity | Mild | 364 | 96.0 | 15 | 4.0 | |
| | Intermediate | 74 | 90.2 | 8 | 9.8 | *p*<0.001 |
| | Severe [§] | 24 | 92.3 | 2 | 7.7 | |
| | Undiagnosed | 0 | 0.0 | 1 | 100.0 | |
| | Total | 462 | 94.7 | 26 | 5.3 | - |

[†] Including five patients with further psychological disease, [‡] including two patients with further psychological disease, [§] including 15 death and nine ARDS, [*] Fischer exact test.

**Table 5.  Associations with the levels of COVID-19 infection severity**

| Classification | | The level of severity (compensated proportion, %) | | | *p*-value[*] |
|---|---|---|---|---|---|
| | | Mild | Intermediate | Severe | |
| Sex | Male | 148 (72.5) | 35 (17.2) | 21 (10.3) [†] | *p*<0.001 |
| | Female | 231 (81.3) | 47 (16.5) | 5 (1.8) | |
| Age | <50 | 192 (85.7) | 29 (12.9) | 3 (1.3) | |
| | 50–60 | 174 (70.7) | 53 (21.5) | 18 (7.3) | *p*<0.001 |
| | >70 | 13 (72.2) | 0 (0.0) | 5 (27.8) | |
| Compensated as occupational disease | Yes | 364 (78.8) | 74 (16.0) | 24 (5.2) | *p*<0.001 |
| | No | 15 (57.6) | 8 (30.8) | 2 (7.7) | |

[†] One patient undiagnosed was excluded. [*]Fisher exact test.

ered high-risk in terms of traditional industrial accidents. Most COVID-19 WC cases were reported to come from the service industry where no or a small number of industrial accidents are normally compensated, accounting for 9% (N=41) among all infected cases (Table 3). The cause of respiratory disease involved in COVID-19 WC claims are infectious agents, which is very different from traditional acute or chronic disease due to chemical or non-infectious hazardous agents generally generated in the workplace. In general, over 50% of occupational diseases compensated were reported to occur in manufacturing industries in 2019[10] (third column in Table 2). The types of diseases involved in COVID-19 WC claims are different from traditional acute or chronic diseases caused by hazardous agents generated in the workplace or industry[6]. This result presented a challenge to the government and to employers at they attempted to find a mechanism to pay for the medical care and lost time associated with a disease acquired during employment but not at a specific work task[2]. Many countries, including South Korea, exclude coverage for routine community-acquired chronic illnesses like cancer that result from repeated exposure to harmful materials and environments, or for transmitted diseases like viral upper respiratory infections such as common colds or seasonal influenza since they usually cannot be directly tied to the workplace.

Thirdly, seven COVID-19 patients, including two pneumonia patients, were compensated for psychological symptoms and disease (Table 4). They were diagnosed with post-traumatic stress disorder (PTSD) (N=1) and adjustment disorders (N=6), including anxiety, nervousness, loneliness, insomnia, depression, stress, and secondarily caused by the viral infection. In general, psychological diseases due to COVID-19 infection were diagnosed based on

**Table 6.  Number of workers submitting and workplaces with COVID-19 clusters**

| Number of workers submitting | Number of workplaces with infection claim [†] | Number of workers compensated (compensated proportion, %) |
|---|---|---|
| 32 | 1 | 32 (100) |
| 26 | 1 | 26 (100) |
| 17 | 1 | 17 (100) |
| 16 | 2 | 32 (100) |
| 15 | 1 | 14 (93) [‡] |
| 14 | 1 | 14 (100) |
| 12 | 1 | 12 (100) |
| 10 | 1 | 10 (100) |
| 9 | 2 | 18 (100) |
| 8 | 2 | 16 (100) |
| 7 | 2 | 14 (100) |
| 6 | 4 | 23 (96) |
| 5 | 6 | 29 (97) |
| 4 | 6 | 23 (96) |
| 3 | 7 | 19 (91) |
| 2 | 17 | 30 (88) |
| 1 | 149 [§] | 133 (89) |
| Total | 185 | 462 (97) |

[†] The number of workplaces with more than two WC claims.

[‡] One case was rejected due to being past the 14-dayvirus incubation period.

[§] Workplaces with individual one case, thus no cluster

**Table 7.  Reasons for COVID-19 claim rejection**

| Reasons | Number | Proportion (%) |
|---|---|---|
| Unknown work-related infection route | 12 | 46.2 |
| Known private infection route which was not related to work | 7 | 26.9 |
| Work-related infection route, but not applicable for worker's compensation | 4 | 15.4 |
| Beyond the 14-day virus incubation period | 2 | 7.7 |
| No diagnosis | 1 | 3.8 |
| Total | 26 | 100 |

the frustration and anger caused by extended quarantine isolation, fear of infection and mortality, boredom, lack of daily necessities, inadequate information, financial loss, and stigma[11–13], even though the exact causes were not identified due to a lack of information. Nonetheless, this study provides an opportunity to recognize the presence of psychological diseases caused by COVID-19 and to examine them in terms of type of causes and prevalence as occupational disease. Surveillance systems should be established to further evaluate various health problems, including psychiatric diseases, for the compensated COVID-19 WC cases.

Fourthly, the numbers of COVID-19 WC cases (N=488) are assumed to be quite few, considering both the overall proportion of workers in the general population (52%, N=27.088 million as of June 2021) and the total number of people infected (Table 2). This result is far lower than the proportion of occupationally infected cases registered in Italy, which accounted for 19.4% (N=43,399) of total cases in May 2020[6] and 9.7% (N=65,804) for the period of March-October 2020[3]. Since the virus can be contracted from other people anywhere and a direct attribution is often difficult, classifying COVID-19 as an occupational illness can be controversial. The scope and approach for evaluating the association of infectious disease with occupation or job should be reflected in WC regulations. There have been no national statistics on the number infected among workers registered under IACI (N= between 2.917 and 3.168 million). In addition, there have been no revisions to the Industrial Accident Compensation Act or the Enforcement

**Table 8.  Analysis of factors influencing the approval of COVID-19 infection as occupational disease**

| Demographic and occupational variables | COVID cases compensated (N=462) | | COVID cases not compensated (N=26) | | Crude OR | 95% CI | Adjusted OR[†] | 95% CI |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | | | | |
| Sex | | | | | | | | |
| Male | 191 | 93.6 | 13 | 6.4 | 1 (reference) | | 1 (reference) | |
| Female | 271 | 95.4 | 13 | 4.6 | 1.42 | (0.64, 3.16) | 1.06 | (0.43, 2.59) |
| Age | | | | | | | | |
| ≤30s | 120 | 97.6 | 3 | 2.4 | 1 (reference) | | 1 (reference) | |
| 40s | 97 | 96 | 4 | 4 | 0.61 | (0.12, 2.81) | 0.61 | (0.12, 2.81) |
| 50s | 128 | 92.8 | 10 | 7.2 | 0.32 | (0.07, 1.08) | 0.36 | (0.08. 1.25) |
| ≥60s | 117 | 92.9 | 9 | 7.1 | 0.33 | (0.07, 1.12) | 0.47 | (0.10, 1.65) |
| Season infected [‡] | | | | | | | | |
| Summer & fall | 388 | 94.9 | 21 | 5.1 | 1 (reference) | | 1 (reference) | |
| Spring & winter | 74 | 93.7 | 5 | 6.3 | 0.80 | (0.32, 2.46) | 0.97 | (0.37, 2.99) |
| Type of industry and job | | | | | | | | |
| Manufacturing and other jobs other than HCW | 33 | 89.2 | 4 | 10.8 | 1 (reference) | | 1 (reference) | |
| Service and other jobs than HCW | 309 | 93.9 | 20 | 6.1 | 1.87 | (0.52, 5.32) | 1.49 | (0.39, 4.76) |
| Service and HCW | 120 | 98.4 | 2 | 1.6 | 7.27 | (1.36, 54.13) | 4.86 | (0.78, 40.02) |
| Presence of infection cluster [§] | | | | | | | | |
| Yes | 330 | 97.1 | 10 | 2.9 | 1 (reference) | | 1 (reference) | |
| No | 132 | 89.2 | 16 | 10.8 | 0.25 | (0.11, 0.56) | 0.28 | (0.12, 0.62) |

*Abbreviation:* OR, odds ratio; CI, confidence interval; HCW, healthcare workers including physicians and nurses.

[†] Adjusted for all predictors.

[‡] Spring and winter: from November to May; Summer and fall: from June to October.

[§] Workplaces with ≥= 2 patients were defined as a cluster.

Decree under the Act. We assumed that a large number of infected workers, including HCW, have not submitted claims because of various factors such as mild disease, difficulty of reporting, fear of losing their job, an obscure transmission history, various types of psychological stress related to infection and the shutdown of the workplace or work activities, lack of knowledge of disease, WC claim policy, and more. Further work should be conducted to establish a surveillance system to compensate more job-related infectious diseases with epidemic and pandemic status like COVID-19.

Finally, the COVID-19 pandemic is changing the understanding of high-risk occupations. The nation-level statistics regarding infection biohazard-caused diseases classified by occupational factors should be provided, making it possible to compare high-infection-risk occupations among countries[1]. It has been reported that most countries have not systematically collected occupational data on COVID-19-induced illnesses and deaths classified by type of industry or occupation, even though daily statistics on the incidence and death rate among COVID-19 cases have been officially reported[1]. This result is often in the form of internal reference materials within a country, but it would prove beneficial to other countries if major factors causing infectious diseases such as COVID-19 are discussed.

This study has a limitation in representing the risk of COVID-19 among industries and jobs. These WC results are only from workers who actively submitted WC claims. Thus, workers who have registered with a WC compensation program could be highly self-selective. There has been no national system to collect and analyze the number of COVID-19 infection cases according to various types of industry and job, making it difficult to evaluate the impact on mobility of the working population during the COVID-19 pandemic period. We have another limitation in estimating the incidence or prevalence of COIVD-19 infection among workers registered with IACI by job or industry because we were unable to identify the number of actual infected workers among actual workers who were employed in a specific industry or occupation during pandemic periods. Workforces registered with IACI are categorized by number of workers employed, type of industry, year registered, and demographic characteristics, indicating that there are no national statistics classified by job or occupation. We assumed that our result might be the tip of the iceberg in terms of the actual COVID-19 related WC cases. Nevertheless, this study contributes to the classification of COVID-19 WC claims based on occupational factors, and type of disease and the evaluation of COVID-19 infection risk by type of industry and job.

## Conclusion

Most of the COVID-19 WC cases were from several jobs

involving caring for or treating COVID-19 patients, other patients, and service industries. A national surveillance system for infectious diseases like COVID-19 with epidemic or pandemic status should be established not only to develop compensation procedures and actions, but to detect and follow up on health problems in COVID-19 WC cases.

## Conflict of Interest

All authors have no conflicts of interest to declare.

## Author Contributions

D.U. and S. Y conceived the ideas; J.J. and M.W collected the data; J.H., W.C. and J.H. analyzed the data; D.U. and S.Y. led the writing; D.U., J.H. and J.J. drafted the work or revised it critically for important intellectual content; W.C., D.H. and S.J. contributed to data acquisition, analysis and interpretation of results; and D.U., S.Y., M.W. and J.J led the overall process of the work.

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