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# Incidence of Traumatic Brain Injury by Severity Among Work-Related Injured Workers From 2010 to 2019

## *An Analysis of Workers' Compensation Insurance Data in Korea*

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**Objective:** This study aimed to investigate the status of work-related traumatic brain injury (wrTBI) in Korea between 2010 and 2019. **Methods:** This study used Korea Workers' Compensation Insurance data, and the sample comprised workers who claimed compensation for wrTBI from 2010 to 2019. The annual incidence of wrTBI was calculated as the rate per 100,000 workers. Time trends over the 10-year period were assessed using Poisson regression. **Results:** The mean incidence of wrTBI was 28.4/100,000. Regarding the incidence rate of wrTBI by severity, mild TBI and moderate-to-severe TBI were 12.9/100,000 and 15.5/100,000, respectively. The incidence of mild TBI among workers was higher in 2010, but moderate-to-severe TBI was higher after 2011. **Conclusions:** Our findings highlight the need for providing information on mild TBI to workers as part of occupational safety and health education.

**Keywords:** traumatic brain injury, incidence, worker's compensation, epidemiology, occupational injuries

Traumatic brain injury (TBI) is an acute brain injury resulting from an external physical force to the head leading to short- or long-term physical and psychological problems.<sup>1,2</sup> Each year, approximately 69 million new cases of TBI are reported worldwide,<sup>3,4</sup> and almost 37% of all injury-related deaths in Europe are caused by TBI.<sup>5</sup> In 2017, approximately 248,000 cases of TBI were reported in Korea, among which the mortality rate among those older than 80 years was 120.6 per 100,000.<sup>6</sup> According to the World Health Organization, TBI has remained a significant public health problem and a leading cause of mortality and disability worldwide as of 2020.<sup>7-9</sup>

In the United States and Europe, work-related TBI (wrTBI) accounts for less than 10% of all TBIs, but it still warrants much

### Learning Objectives

- To identify differences in the risk factors of work related TBI.
- To identify the important implications for industrial accident prevention strategies and appropriate rehabilitation systems for work related TBI.
- To ascertain the severity and understand the burden and trend of work related TBI by injury severity during a decade (2010–2019) using data from the Korea Workers' Compensation Insurance claims.

concern.<sup>10-13</sup> WrTBI is one of the most disabling occupational injuries and can change the injured workers' lives due to subsequent job loss and sustained disability. It may also lead to significant economic burden in terms of medical expenses and wage losses.<sup>8,10,14,15</sup> According to the literature published in 2019, it was reported that the incidence of wrTBI is on the rise despite the decline in work-related injuries.<sup>16</sup> This finding suggests that efforts to prevent wrTBI are insufficient and that there is a need for increased awareness of wrTBI.<sup>3</sup>

Clinical features of TBIs are classified according to the severity (ie, mild, moderate, and severe).<sup>17</sup> Moderate-to-severe TBI can be life-threatening and cause permanent physical or mental disability, making it difficult to return to work.<sup>8,18</sup> Meanwhile, mild TBI, which comprises the majority of TBIs (70%–90%),<sup>19</sup> is often overlooked because it is not fatal and does not cause severe disability. In most patients with mild TBI, acute symptoms (eg, headache, dizziness, cognitive difficulty) resolve in days to weeks after the injury; however, a subgroup of them may develop persistent neuropsychiatric symptoms up to 3 months after the injury, called post-concussion syndrome.<sup>20</sup> Patients with post-concussion syndrome can experience difficulties in daily living and in returning to work.<sup>3,8,18,21</sup> However, individuals with mild TBIs are often difficult to identify and are therefore left untreated. Thus, the actual burden of wrTBI may be much higher.<sup>7,8,22,23</sup>

Therefore, identifying differences in the risk factors and severity of wrTBI may have important implications for industrial accident prevention strategies and appropriate rehabilitation systems.<sup>9</sup> However, although there have been some studies regarding the incidence and mortality of TBI in Korea, to the best of our knowledge, there has been no published report on the epidemiology of wrTBI.<sup>6,24</sup>

This study aimed to investigate the status of wrTBI with a focus on its severity in Korea and discuss the burden and trend of wrTBI by injury severity during a decade (2010–2019) using data from the Korea Workers' Compensation Insurance (WCI) claims—a large-scale source of administrative data.

## MATERIALS AND METHODS

### Data Source

This study used Korea WCI data. In Korea, the Industrial Accident Insurance Act was introduced in 1964, and WCI coverage was expanded to all businesses or workplaces that employ workers, with some exceptions. When an industrial accident occurs, the respective employer is supposed to report it to the Korea Ministry of Employment and Labor. Compensation

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is then provided to concerned workers with work-related injuries by the Korea Workers' Compensation and Welfare Service (KCOMWEL). The KCOMWEL manages the WCI data, which include information on workplaces at the time of industrial accidents, injuries, medical care, and compensations. Therefore, we obtained the anonymized data from 2010 to 2019 from the KCOMWEL for this study.

### Study Population

The population of this study consisted of workers who claimed compensation for wrTBI from January 1, 2010, to December 31, 2019. Patients with the following TBI diagnostic codes as main or sub-diagnoses were extracted by using the eighth Korean Standard Classification of Diseases based on the International Classification of Diseases, 10<sup>th</sup> revision: concussion (S06.0), cranial fracture

(S02.0, S02.1, S02.7, S02.8, S02.9, S07.1, and T90.2), and intracranial injury (S06.1–S06.9 and T90.5). The subjects of this study were defined and selected by priority in the order of intracranial injury, cranial fracture, and concussion among the three TBI diagnostic categories. The diagnoses and priorities according to the diagnostic codes are shown in Supplementary Table 1, <http://links.lww.com/JOM/B190>. In this study, concussion was classified under mild TBI, whereas cranial fracture and intracranial injury were considered moderate-to-severe TBIs.<sup>6,25–27</sup> Finally, a total of 48,166 patients were included in this study.

### Variables

The variables used in this study included the demographic characteristics, work-related injury characteristics, claim duration, and

**TABLE 1.** Preinjury Demographic Characteristics of Claimants With Work-Related Traumatic Brain Injury Stratified by Severity in Korea From 2010 to 2019

Characteristic	Total (n = 48,166)		Mild (n = 21,842)		Moderate-to-Severe (n = 26,324)		P*
Age at injury, yrs							
Mean (SD)	50.6	13.1	49.9	13.2	51.2	13.1	<0.001
Median (IQR)	52	43–60	52	42–59	53	44–60	
Age group, n (%)							<0.001
<30	4063	8.4	2047	9.4	2016	7.7	
30–39	5266	10.9	2489	11.4	2777	10.6	
40–49	10,262	21.3	4690	21.5	5572	21.2	
50–59	16,031	33.3	7388	33.8	8643	32.8	
≥60	12,544	26.0	5228	23.9	7316	27.8	
Sex, n (%)							<0.001
Male	41,588	86.3	17,328	79.3	24,260	92.2	
Female	6578	13.7	4514	20.7	2064	7.8	
Work-related injury type, n (%)							<0.001
Injury	46,222	96.0	20,840	95.4	25,382	96.4	
Commuting injury	1944	4.0	1002	4.6	942	3.6	
Occupation, n (%)							<0.001
Managers	3606	7.5	1393	6.4	2213	8.4	
Professionals/related workers	2407	5.0	1224	5.6	1183	4.5	
Clerks	1298	2.7	663	3.0	635	2.4	
Service workers	2189	4.5	1374	6.3	815	3.1	
Sales workers	469	1.0	266	1.2	203	0.8	
Skilled agricultural, forestry/fishery workers	944	2.0	478	2.2	466	1.8	
Craft/related trades workers	11,865	24.6	4837	22.2	7028	26.7	
Equipment/machine operating/assembling workers	4679	9.7	2168	9.9	2511	9.5	
Elementary workers	20,709	43.0	9439	43.2	11,270	42.8	
Industry, n (%)							<0.001
Agriculture/forestry/fishing	1384	2.9	729	3.3	655	2.5	
Mining/quarrying	172	0.4	68	0.3	104	0.4	
Manufacturing	9467	19.7	3665	16.8	5802	22.0	
Electricity/gas/steam/air conditioning supply	41	0.1	11	0.1	30	0.1	
Water supply/sewage/waste management/materials recovery	10	0.0	3	0.0	7	0.0	
Construction	19,120	39.7	7977	36.5	11,143	42.3	
Wholesale/retail trade	2	0.0	0	0.0	2	0.0	
Transportation/storage	3029	6.3	1644	7.5	1385	5.3	
Accommodation/food service activities	3584	7.5	1872	8.6	1712	6.5	
Information/communication	218	0.5	104	0.5	114	0.4	
Financial/insurance activities	209	0.4	113	0.5	96	0.4	
Real estate activities	104	0.2	49	0.2	55	0.2	
Professional/scientific/technical activities	285	0.6	125	0.6	160	0.6	
Business facilities management/business support services/rental and leasing activities	5003	10.4	2361	10.8	2642	10.0	
Public administration/defense/compulsory social security	636	1.3	405	1.9	231	0.9	
Education	374	0.8	255	1.2	119	0.5	
Human health/social work activities	1155	2.4	798	3.7	357	1.4	
Arts/sports/recreation related services	520	1.1	262	1.2	258	1.0	
Membership organizations/repair/other personal services	2661	5.5	1310	6.0	1351	5.1	
Activities of households as employers/undifferentiated goods- and services-producing activities of households for own use	172	0.4	78	0.4	94	0.4	
Activities of extraterritorial organizations/bodies	20	0.0	13	0.1	7	0.0	

\*P value from chi-squared test (categorical variables) or t test (continuous variable).

claim cost of the injured workers. Ages were classified into <30, 30–39, 40–49, 50–59, and ≥60 years.

Work-related injury types were classified into injury, disease, and commuting injury. Occupations were classified according to the seventh Korean Standard Classification of Occupations based on the International Standard Classification of Occupations. Industries were classified according to the 10<sup>th</sup> Korean Standard Industrial Classification based on the International Standard Industrial Classification.

Time lost from work was estimated for workers receiving the cost of income replacement. The duration of work disability was defined as the number of days treated for a work-related injury. The total cost per claim refers to the total cost paid to a worker for an industrial accident. The cost of medical and similar services refers to medical care benefits and medical service fees, medication costs, medical care expenses, and nursing expenses. The cost of income replacement refers to the amount paid to workers with a work-related injury while they are unable to work due to medical treatment.

### Statistical Analyses

The mean, standard deviation (SD), median, and interquartile range (IQR) of continuous variables for the subjects and the severity classification were calculated using the *t* test. The frequency distribution of the categorical variables for comparison by severity was determined using the chi-squared test.

The annual incidence of wrTBI was calculated as the rate per 100,000 workers by dividing the number of workers diagnosed with TBI by the total number of workers. Time trends over the 10-year period were assessed using Poisson regression. In addition, the incidence rate of wrTBI as stratified by the industry classification was calculated as the mean incidence rate over the past decade. Risk ratios (RRs) and 95% confidence intervals (CIs) for moderate-to-severe TBI compared with mild TBI were calculated. The statistical analyses were performed using SAS statistical package version 9.4 (SAS Institute, Cary, NC).

## RESULTS

From 2010 to 2019, a total of 48,166 workers claimed compensation for wrTBI, including 21,842 (45.3%) for mild TBI and 26,324 (54.7%) for moderate-to-severe TBI (Supplementary Table 2, <http://links.lww.com/JOM/B190>). This table accounted for approximately 5% of all claims during this study period. The mean incidence of wrTBI was 28.4/100,000. In terms of the incidence rate of wrTBI by

severity, mild TBI and moderate-to-severe TBI were 12.9/100,000 and 15.5/100,000, respectively (RR, 1.21; 95% CI, 1.19–1.22).

Table 1 shows the preindustrial accident demographic characteristics of workers with wrTBI. The mean age at the time of the work-related injury was 50.6 years, and the mean age with moderate-to-severe TBI was 1.3 years older than those with mild TBI ( $P < 0.001$ ). WrTBI most commonly occurred in those aged 50–59 years, with more than half of the cases occurring in those aged ≥50 years ( $P < 0.001$ ). Males and injury in terms of work-related injury type accounted for the majority of wrTBI cases ( $P < 0.001$  and  $P < 0.001$ , respectively). In terms of occupation, wrTBI was most common in elementary workers (43.0%) and craft/related trades workers (24.6%). As for industries, wrTBI most commonly occurred in construction (39.7%), followed by manufacturing (19.7%) and business facilities management/business support services/rental and leasing activities (10.4%).

Figure 1 shows the wrTBI trend over 10 years. The incidence of workers with mild TBI decreased until 2016 and then increased in 2017 ( $P \leq 0.001$ ). The incidence of moderate-to-severe TBI among workers continued to decrease from 17.6/100,000 (95% CI, 16.9–18.2) in 2010 to 14.5/100,000 (95% CI, 13.9–15.0) in 2019 ( $P = 0.001$ ). The incidence of mild TBI among workers was higher in 2010, but moderate-to-severe TBI was higher after 2011.

Table 2 shows the incidence of wrTBI among all workers by industry. The incidence of wrTBI among all workers was the highest in construction (112.9/100,000), and lowest in wholesale/retail trade (0.0/100,000). The incidence rates of mild TBI and moderate-to-severe TBI were highest in construction, followed by manufacturing and business facilities management/business support services/rental and leasing activities. The industry with the highest incidence of moderate-to-severe TBI compared with mild TBI was electricity/gas/steam/air conditioning supply (RR, 2.73; 95% CI, 1.59–4.67), whereas the industry with the lowest rate of wrTBI was the human health/social work activities industry (RR, 0.45; 95% CI, 0.41–0.49).

Table 3 shows the characteristics of compensation claims for wrTBI. Of all workers with wrTBI, 86.4% experienced time lost from work, with a higher proportion among those with mild TBI than those with moderate-to-severe TBI ( $P < 0.001$ ). The total duration of compensated medical care was 262.2 days, but it was longer for those with moderate-to-severe TBI at 358.2 days ( $P < 0.001$ ). The total cost per claim, medical and like services, and income replacement for moderate-to-severe TBI workers were nearly four times higher

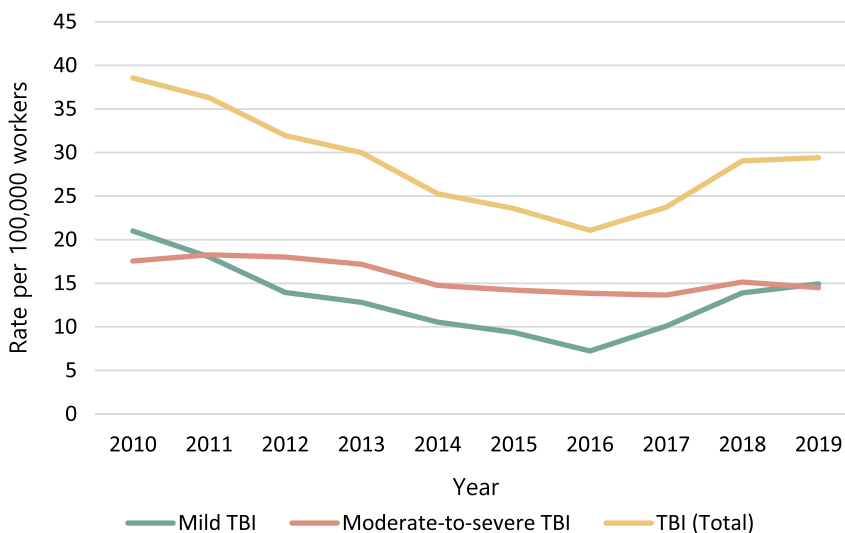


FIGURE 1. Incidence of work-related traumatic brain injury in all workers in Korea from 2010 to 2019.

**TABLE 2.** Incidence Rate of Work-Related Traumatic Brain Injury by Industry Sector and Severity Among All Workers in Korea From 2010 to 2019

Industry Sector	All Workers (rate per 100,000)*			
	Total	Mild	Moderate-to-Severe	RR (95% CI) <sup>†</sup>
Agriculture/forestry/fishing	8.2	4.3	3.9	0.90 (0.83–0.97)
Mining/quarrying	1.0	0.4	0.6	1.53 (1.23–1.91)
Manufacturing	55.9	21.6	34.3	1.58 (1.54–1.63)
Electricity/gas/steam/air conditioning supply	0.2	0.1	0.2	2.73 (1.59–4.67)
Water supply/sewage/waste management/materials recovery	0.1	0.0	0.0	2.33 (0.83–6.54)
Construction	112.9	47.1	65.8	1.40 (1.37–1.43)
Wholesale/retail trade	0.0	0.0	0.0	NA
Transportation/storage	17.9	9.7	8.2	0.84 (0.80–0.89)
Accommodation/food service activities	21.2	11.1	10.1	0.91 (0.87–0.96)
Information/communication	1.3	0.6	0.7	1.10 (0.91–1.32)
Financial/insurance activities	1.2	0.7	0.6	0.85 (0.70–1.03)
Real estate activities	0.6	0.3	0.3	1.12 (0.85–1.47)
Professional/scientific/technical activities	1.7	0.7	0.9	1.28 (1.08–1.51)
Business facilities management/business support services/rental and leasing activities	29.5	13.9	15.6	1.12 (1.08–1.16)
Public administration/defense/compulsory social security	3.8	2.4	1.4	0.57 (0.51–0.64)
Education	2.2	1.5	0.7	0.47 (0.40–0.55)
Human health/social work activities	6.8	4.7	2.1	0.45 (0.41–0.49)
Arts/sports/recreation related services	3.1	1.5	1.5	0.98 (0.87–1.11)
Membership organizations/repair/other personal services	15.7	7.7	8.0	1.03 (0.98–1.09)
Activities of households as employers/undifferentiated goods- and services-producing activities of households for own use	1.0	0.5	0.6	1.21 (0.97–1.49)
Activities of extraterritorial organizations/bodies	0.1	0.1	0.0	0.54 (0.27–1.06)
Total	28.4	12.9	15.5	1.21 (1.19–1.22)

\*Rates are presented as an average over the 10-year period.

<sup>†</sup>Moderate-to-severe TBI to mild TBI risk ratio.

NA, not applicable; RR, risk ratio.

than for workers with mild TBI. In addition, the mean mortality rate of wrTBI was 2.8/100,000, which was mostly associated with moderate-to-severe TBI.

### DISCUSSION

This is the first epidemiologic study of wrTBI in Korea to consider the severity of the TBI in its analysis. From Korea WCI data spanning 10 years (2010–2019), we estimated the incidence rate of wrTBI by severity and industry sector and reported differences by severity in terms of demographic and claims characteristics.

There were some differences in should be hyphenated demographic characteristics depending on severity, but the overall tendency was similar in both mild and moderate-to-severe groups. Table 1 shows that wrTBI occurred mostly in older workers, males, manual workers, and the construction industry. This result is consistent with the results of previous studies regarding wrTBI.<sup>1,3,8–10,21,28,29</sup> Different tasks at work and employment characteristics according to sex may have contributed to the higher incidence of wrTBI in males.<sup>8,9</sup> For older workers, decreased concentration and falls due to lack of balance and flexibility may have been the main causes of wrTBI.<sup>28</sup> In addition,

**TABLE 3.** Claims Characteristics of Work-Related Traumatic Brain Injury by Severity in Korea From 2010 to 2019

Claims	Total	Mild	Moderate-to-Severe	P*			
All claimants, <i>n</i>	48,166	21,842	26,324				
Time lost from work, <i>n</i> (%)	41,591	86.4	19,502	89.3	22,089	83.9	<0.001
Inpatient hospital stay, <i>n</i> (%)	43,936	91.2	19,182	87.8	24,754	94.0	<0.001
Duration of work disability							
Mean (SD) number of days	262.2	397.4	146.5	190.9	358.2	488.2	<0.001
Median (IQR) number of days	148	53–299	94	43–188	212	81–446	
Claim costs paid (million KRW)							
Mean (SD) total cost per claim	59.26	110.90	21.87	44.20	90.29	136.97	<0.001
Mean (SD) cost of medical and like services	22.17	69.92	6.97	21.95	34.62	90.43	<0.001
Mean (SD) cost of income replacement	14.45	21.15	8.58	12.38	19.32	25.28	<0.001
Time-loss claims, <sup>†</sup> <i>n</i>							
Claim costs paid (million KRW)							
Mean (SD) total cost per claim	60.11	112.63	24.02	45.69	91.97	140.99	<0.001
Mean (SD) cost of medical and like services	25.10	70.28	7.67	23.11	40.48	91.24	<0.001
Mean (SD) cost of income replacement	16.74	21.90	9.61	12.72	23.03	26.00	<0.001
Mortality rate <sup>‡</sup>	2.8	0.0	2.7				

\*P value from chi-squared test (categorical variables) or *t* test (continuous variable).

<sup>†</sup>Analyses restricted to claimants with >0 claim cost paid lost from work.

<sup>‡</sup>Rates are presented as an average over the 10-year period (rate per 100,000).

manual labor may be associated with more frequent exposure to risky work environments.<sup>9</sup>

Our study is one of the few to explore the trend of wrTBI. We identified that the mean incidence of wrTBI was 28.4/100,000 workers per year. It was in Australia where the mean incidence of wrTBI was 19.8/100,000 workers per year,<sup>9</sup> and it was lower in Canada, where it was 33.1/100,000 workers per year.<sup>14</sup> Based on the incidence of Korea TBI reported in Oh et al.'s study,<sup>6</sup> wrTBI is confirmed to comprise approximately 5% of all TBI in Korea. This is consistent with the trends of wrTBI incidence rates in the United States and Europe, where wrTBI accounted for less than 10% of all TBI cases.<sup>10–13</sup> Figure 1 shows that the number of workers with a diagnosis of wrTBI decreased until 2016 but increased in trend in 2017. Similarly, the incidence of mild wrTBI among workers initially decreased, and then increased again from 2017, whereas the incidence of moderate-to-severe TBI among workers continued to decrease for the past 10 years. The trend of industrial accidents announced by the Korea Ministry of Employment and Labor was similar to the results of this study. This is presumably due to the result of policies for improving access to workers' compensation insurance.<sup>30</sup> Since 2018, the employer confirmation system has been abolished, allowing workers to file an industrial accident claim without confirmation from the employer. In addition, the number of work accidents may have increased since injuries incurred during commuting were also approved as work-related injuries.<sup>31</sup> Traffic accidents are the most common cause of work-related mild TBI,<sup>10,21,29,32</sup> and this may be related to the increase in the incidence of mild TBI due to traffic accidents occurring while commuting to and from work.

The incidence of moderate-to-severe TBI was higher than that of mild TBI during the observation period except for the first observation year, which is consistent with the results of Brolin et al.'s study.<sup>1</sup> Considering that 70% to 90% of TBI cases are classified as mild TBI, these results are interesting. Mild wrTBI incidence rate is likely underestimated since patients with mild TBI often do not seek medical help.<sup>7,8</sup> Even if a patient needs clinical care, most of them recover within days to weeks after a traumatic incident.<sup>20</sup> However, because it can take a few weeks to receive approval for an industrial accident, considerable cases of mild wrTBI are unlikely to lead to an industrial accident claim. In addition, for mild TBI, the symptoms can be underreported due to the vagueness or workers' lack of awareness of the symptoms.<sup>21,33</sup> Thus, in some cases, mild wrTBI may not even be diagnosed. Therefore, it is necessary to emphasize the symptoms of mild TBI (ie, concussion) during occupational safety and health education sessions conducted for workers in Korea.

This study showed differences by severity in the distribution and proportion of wrTBI by industry. Moderate-to-severe wrTBIs commonly occurred in construction, manufacturing, and business facilities management/business support services/rental and leasing activities associated with manual labor or hazardous working conditions. Mild wrTBIs occurred in financial and insurance activities, public administration/defense/compulsory social security, and service industries. In particular, the incidence of both mild and moderate-to-severe TBI was much higher in the construction industry compared with other industries. Considering that construction workers are at high risk of serious and fatal injuries,<sup>29</sup> and that previous studies have also identified the construction industry as a major contributor to the wrTBI-related industry sector,<sup>10,34</sup> it is necessary to review risk factors and the mechanisms of injuries in this specific industry.<sup>28</sup>

The results of our study showed significant work disability and economic burdens of wrTBI. Injured workers with moderate-to-severe TBI had a longer duration of work disability and higher expense claims than those with mild TBI. However, the proportion of those who experienced time lost from work was higher in subjects with mild TBI than moderate-to-severe TBI. Although acute symptoms after mild TBI improve in days to weeks, approximately 15% of mild TBI patients suffer from persistent neuropsychiatric symptoms (eg, headache,

dizziness, cognitive dysfunction, depression, anxiety), which impact their decision regarding whether to return to work beyond 1 year.<sup>35,36</sup> In Korea, the return-to-work program (functional capacity evaluation, work conditioning, and work hardening) is only provided by the KCOMWEL,<sup>37</sup> and mainly focuses on physical issues. However, the results of this study suggest that, aside from physical problems, neuropsychiatric problems should also be considered when assessing return to work in patients with mild wrTBI.

The strengths of this study are as follows: First, because the WCI data used in this study was nationally representative, our results can be considered as representative of work-related injuries in Korea. Second, to the best of our knowledge, this is the first study to investigate the trend of wrTBI by severity among work-related injury workers in Korea for a duration of 10 years. Third, our study can be seen as wide scale because we were able to provide information on the wrTBI incidence of workers across 21 industries.

However, this study also has several limitations. First, the amount of compensation may not be accurate for injured workers whose compensation claims have not been completed or if compensation for an industrial accident has not been closed. For example, if a worker killed an industrial accident in October 2019 and the resulting compensation was not yet closed, the included compensation amount might only be for 3 months. Second, the age- and sex-standardized incidence of wrTBI could not be calculated because the number of injured workers by age group and sex could not be identified due to restricted access to the statistical data. Third, further studies regarding factors affecting the incidence of wrTBI are needed. Although our study investigated the industry-stratified incidence of wrTBI, further studies that consider gender, mechanism of injury, injured workers' employment status, and workplace size are needed.

## Conclusions

This study provides useful information on the epidemiology of wrTBI concerning its severity during a decade (2010–2019) in Korea. The incidence of wrTBI in Korea decreased until 2016 and then increased in trend from 2017. The incidence of moderate-to-severe TBI was higher than that of mild TBI during the observation period except for the first observation year. Injured workers with moderate-to-severe TBI had a longer duration of work disability and higher expense claims than those with mild TBI. However, the proportion of those who experienced time lost from work was higher in subjects with mild TBI than moderate-to-severe TBI. Our findings highlight the need for providing information to workers on mild TBI in occupational safety and health education and may serve as the basis for further wrTBI research.

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