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Original Article

Safety Climate and Occupational Stress According to Occupational Accidents Experience and Employment Type in Shipbuilding Industry of Korea

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ABSTRACT

Background: Safety climate and occupational stress are related with occupational accident. The present study tried to identify the differences in safety climate and occupational stress according to occupational accidents experience and employment type (e.g., direct workers and subcontract workers).
Methods: In this study, we conducted a survey using safety climate scale and Korean Occupational Stress Scale and classified the participants into four groups: direct workers working for accident-free departments, direct workers working for accident departments, subcontract workers working for accident-free departments, and subcontract workers working for accident departments for 2 years within the same workplace in the shipbuilding industry.
Results: The direct workers and subcontract workers showed diverse results in subscales of safety climate and occupational stress. This result is supported by existing studies; however, further study is necessary for more supporting evidence and elaborative methodological approach.
Conclusion: The necessity of management for safety climate and psychosocial factor such as occupational stress for both direct workers and subcontract workers as a whole is suggested by this study.

1. Introduction

Safety-related occupational accidents are responsible for a considerable proportion of annual deaths and disabilities, and lead to enormous suffering in the affected individual workers and their families. Such accidents are also highly costly to employers [1]. The 2016 Annual Report published by the Korean Ministry of Employment and Labor reported an occupational accident rate of about 0.5% in 2015, during which 90,129 out of a total of 17,968,931 workers requested medical leave lasting 4 days or longer [2]. Although this accident rate was a slight decrease from 2014 (0.53%), the estimated economic loss from these accidents increased from KRW (Korean won) 19,632,795 million to KRW 20,395,540 million, which suggests an urgent need for improved safety management.

Psychology researchers have long been investigating accident proneness [1], with many studies demonstrating a link between occupational accidents and factors associated with safety behaviors, such as occupational stress, conscientiousness, cognitive failures, emotional stability, and safety-related internal/external control [3]. Zohar [4] defined safety climate as a basic psychological perception that employees share about how safe their work environment is. According to Zohar, safety climate comprises the following eight factors: the importance placed on safety training programs, the management's safety attitude, the impact of safety behaviors on promotion, the degree of risk present in the workplace, the effect of the work pace on safety, the safety manager's status, the impact of safety behaviors on social status, and the safety committee's status. Griffin and Neal [5] also defined safety

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climate as a kind of organizational climate that an individual experiences within the organization. According to Griffin and Neal's definition, safety climate comprises the following five factors: management's values, communication, safety practices, education/training, and safety equipment.

Safety climate is often mentioned as an indicator of safety-related outcomes. Payne et al [6] argued that whenever researchers have identified safety climate as a leading indicator of safety outcomes, it is because they have related a prior measure of safety climate to a later measure of safety outcomes, and inversely they have identified safety climate as a lagging indicator because the previous measure of safety outcome can affect the current safety climate [6]. In other words, safety climate reflects the way the workplace safety policies are currently implemented and executed, and because it can have a direct impact on workers' safety behaviors, it can be used to predict future accidents. Furthermore, safety climate also reflects past safety-related behaviors, their personal consequences, and workers' perceptions of past accidents within the organization. For this reason, many studies compared workers personally affected by workplace accidents with workers unaffected by them within the same period. For example, Brown and Holmes [7] found that workers who had experienced workplace accidents exhibited a significantly lower level of safety concerns and behaviors than did workers who had not, which suggests that safety climate is a lagging indicator.

A similar Korean study was conducted by Kim and Park [8], who defined safety climate as a web of perceptions based on individual workers' personal assessments of workplace safety characteristics, and tested Griffin and Neal's safety [5] climate model in Korea. Yi et al [9] tried to find the components of safety climate using a survey of 210 Korean shipbuilding industry workers. They identified the following components: managerial safety interventions, effectiveness of safety communication, safety education, assessment of physical work environment and potential hazards, colleagues' social support of safety climate, supervisors' supportive environment of safety climate, work pressure, workers' level of involvement, safety competence, and safety rules and procedures. These early safety climate studies focused on the specific organizational level, as the researchers believed that this was sufficient to represent the safety climate of the organization as a whole [10]. More recently, however, a different view has emerged, arguing that subgroups of workers must be distinguished within an organization according to their in-group homogeneity [11].

As mentioned previously, occupational stress is an important contributing factor to workplace accidents. For instance, Clarke [12] has argued that psychological distress has a strong impact on safety outcomes, such as accidents and injuries. Siu et al [13] further reasoned that occupational stress is not ensconced within Western culture; rather, it appears to be a universal problem, including in Asia. Numerous other studies have strongly supported the links of workers' safety outcomes with occupational stress and safety behaviors [14].

According to Kim et al [15], the factors influencing workplace accidents can be divided into environmental and psychological factors, the latter of which are primarily associated with workers' stress. Kim and Ahn [16] argued that stress tends to be accompanied by negative psychological responses such as anxiety and depression, as well as negative physiological responses such as hypertension, cardiovascular acceleration, headache, and diminished awareness. According to researchers, these responses can lead to human errors, which subsequently increase the risk of workplace accidents. Therefore, minimizing workers' stress can be a way of reducing workplace safety accidents.

As for Korean research in terms of safety climate and occupational stress, Lee et al [17] examined the effects of safety culture on safety behaviors and accident rates among train operators. Lee [1] similarly conducted a study of railroad workers to examine the effects of failure in perception, conscientiousness, occupational stress, faith in safety control, and emotional stability on workers' safety behaviors and workplace accidents. However, again, most existing studies have focused on a single subgroup within the organization; few studies have examined safety climate and occupational stress among different subgroups such as direct workers and subcontracted workers.

Nonstandard forms of work such as subcontracting have emerged out of economic priority and uncertainties in the production market owing to changing technologies and regulations. This pressure has, unfortunately, encouraged subcontracted workers, owner-operators, and workers at small-scale workplaces to prioritize economic outcomes over running health and safety programs, regular health and safety risk assessment, safety education/training, and adequate supervision [18,19]. The unstable nature of subcontracted workers' employment further increases their exposure to stress and degenerative disease, as well as job-specific hazards [19]. Furthermore, subcontracted workers tend to have lower wages and inferior employment conditions to direct workers. Korea's shipbuilding industry, despite its key role in the Korea economy, has been particularly beleaguered because of weakening demand in recent years. The industry's plight has forced the consideration of employment restructuring for direct workers. The fact that the industry now employs a large number of subcontractors, coupled with the fact that there remains a considerable wage and benefit gap between direct workers and subcontracted workers, has been attracting a great deal of attention in the Korean society [20]. According to a study by Kim [21], direct workers accounted for only 38.8% (57,785 workers) of the 149,030 workers employed in Korea's shipbuilding industry, with the remaining 61.2% (91,245 workers) being subcontracted workers.

In line with the current direction of safety climate and occupational stress research, the present study aims to identify the differences in safety climate and psychosocial factors such as occupational stress between direct workers and subcontracted workers at the same workplace. The study participants include individuals working for Korea's shipbuilding industry, which is the largest employer of subcontracted workers in Korea. Furthermore, we organized participants into subgroups based on their experience of workplace accidents and employment types (direct/subcontract).

2. Materials and methods

2.1. Participants and data collection

The participants included individuals employed or subcontracted by Korean shipbuilding companies with a minimum of 10,000 workers as of April 2016. A total of 284 study participants were ultimately selected from the pool, including 60 direct workers (21.1%) working for 2-year accident-free departments, 92 direct workers (32.2%) working for departments with a history of accidents within the same period, 59 subcontracted workers (20.7%) working for 2-year accident-free departments, and 73 subcontracted workers (25.7%) working for departments with a history of accidents in the same period. Table 1 shows the demographic data pertaining to the participants' sex and age including group. All participating individuals and departments were selected via random sampling. The survey questionnaires were hand-delivered to the workplace managers by the researcher, which were subsequently distributed to the participants to complete over a 2- to 3-day period (to accommodate the demands of their shift schedules). Upon completion, questionnaires were retrieved by the researcher.

Table 1
Characteristics of participants

Characteristic		Frequency ($n = 284$)	Percent
Sex	Male	278	97.9
	Female	6	2.1
Age (y)	21–29	22	7.75
	30–39	109	38.38
	40–49	73	25.70
	50–59	68	23.94
	Over 60	7	2.46
	Missing value	5	1.8
Group	Direct worker of free AD	60	21.1
	Direct worker of AD	92	32.3
	Subcontracted worker of free AD	59	20.7
	Subcontracted worker of AD	73	25.7

AD, accident department; free AD, free accident department.

2.2. Measurements

To measure safety climate, we used the scale used in Kim and Park's study [8]. This scale is based on Griffin and Neal's scale [5], which measures safety knowledge, safety motivation, compliance behavior, participation behavior, management's values, communication, education and training, and safety regulations and systems. Furthermore, the items concerning participants' direct supervisors in this scale were adapted from those found in Zohar's scale [22]. Each item was rated on a 5-point scale, with higher scores indicating more robust safety climate. In Kim and Park's study [8], the internal consistency of the scale was represented by the relatively high Cronbach's alpha coefficients of 0.87–0.95, whereas in the present study, the Cronbach's alpha coefficients ranged from 0.82 to 0.91.

The Korean Occupational Stress Scale (KOSS), which was developed by Jang et al [23], was used to assess the overall stress level that an individual worker experiences at work. The scale comprises 43 items in eight subfactors: physical environment, job demand, job autonomy, relational conflict, job insecurity, organizational system, unfair compensation, and workplace culture. Each item is rated on a 4-point scale, with a higher score indicating a greater number of stressors and thus greater occupational stress. In the present study, Cronbach's alpha for the internal consistency was 0.66–0.85. Job autonomy was only excluded from the final analysis because of its low Cronbach's alpha coefficients (0.22).

2.3. Data analysis

To analyze the safety climate and occupational stress among shipbuilding industry workers working in the same workplace according to their employment type and experience of workplace accidents, we performed a two-way analysis of variance (ANOVA) while following the general linear modeling procedure. For the analysis, the independent variables were employment type (direct workers vs. subcontracted workers) and recent experience of accidents (2-year accident-free departments vs. departments with a history of accidents within same period), whereas the dependent variables were safety climate and KOSS scores. All data analyses were performed with SPSS Statistics 22 version by IBM.

3. Results

3.1. Safety climate

Table 2 shows the mean scores, standard deviations, and two-way ANOVA results for the nine safety climate subscales according to employment type and recent accident experience. The results are as follows. Significant interactions between employment type and accident experience were found for the subscales of management values ($F = 5.039$, $p < 0.05$), direct supervisor ($F = 4.379$, $p < 0.05$), communication ($F = 4.101$, $p < 0.05$), education and training ($F = 8.652$, $p < 0.01$), practicing safety ($F = 20.118$, $p < 0.001$), compliance behavior ($F = 12.6$, $p < 0.001$), and

Table 2
Mean scores, standard deviations, and two-way ANOVA results for safety climate subscales according to employment type and accident experience

Subscale	Direct workers			Subcontracted workers			*F*
	Group (n)	M	SD	Group (n)	M	SD	
Management value	Accident (92)	4.062	0.884	Accident (73)	4.288	0.763	AE = 0.043
	Free accident (60)	4.296	0.693	Free accident (59)	4.093	0.767	ET = 0.015
							AE × ET = 5.039*
Direct supervisor	Accident (92)	4.242	0.658	Accident (73)	4.320	0.698	AE = 0.603
	Free accident (60)	4.458	0.453	Free accident (59)	4.220	0.631	ET = 1.127
							AE × ET = 4.379*
Communication	Accident (92)	4.042	0.647	Accident (73)	4.252	0.660	AE = 0.003
	Free accident (60)	4.200	0.635	Free accident (59)	4.102	0.564	ET = 0.540
							AE × ET = 4.101*
Education and training	Accident (92)	3.687	0.759	Accident (73)	4.006	0.776	AE = 1.417
	Free accident (60)	4.050	0.664	Free accident (59)	3.852	0.684	ET = 0.472
							AE × ET = 8.652**
Practicing safety	Accident (92)	3.710	0.923	Accident (73)	4.192	0.837	AE = 0.030
	Free accident (60)	4.139	0.679	Free accident (59)	3.729	0.777	ET = 0.130
							AE × ET = 20.118***
Safety knowledge	Accident (92)	4.141	0.639	Accident (73)	4.274	0.676	AE = 0.185
	Free accident (60)	4.283	0.606	Free accident (59)	4.198	0.597	ET = 0.095
							AE × ET = 2.039
Safety motivation	Accident (92)	4.650	0.529	Accident (73)	4.664	0.470	AE = 0.108
	Free accident (60)	4.678	0.433	Free accident (59)	4.598	0.487	ET = 0.311
							AE × ET = 0.659
Compliance behavior	Accident (92)	4.169	0.691	Accident (73)	4.461	0.538	AE = 1.198
	Free accident (60)	4.496	0.471	Free accident (59)	4.288	0.563	ET = 0.364
							AE × ET = 12.6***
Participation behavior	Accident (92)	4.116	0.670	Accident (73)	4.264	0.663	AE = 0.277
	Free accident (60)	4.258	0.609	Free accident (59)	4.038	0.668	ET = 0.210
							AE × ET = 5.42*

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
AE, accident experience; ANOVA, analysis of variance; ET, employment type; M, mean; SD, standard deviation.

participation behavior ($F = 5.42$, $p < 0.05$). Specifically, among direct workers, those working for 2-year accident-free departments tended to have a more positive safety climate than individuals working in accident departments. In fact, this group of direct workers had the highest mean scores for management values, direct supervisor, education and training, and compliance behaviors subscales of the safety climate instrument than did any other subcontracted workers.

Among subcontracted workers, however, those working in accident departments showed rather high scores for the management values, direct supervisor, communication, education and training, safety practices, compliance behavior, and participation behavior subscales. Furthermore, this group of subcontracted workers showed a much more positive perception of safety climate in terms of the communication, safety practices, and participation behavior subscales than did the group of direct workers working for 2-year accident-free departments.

3.2. Occupational stress

Table 3 shows the mean scores, standard deviations, and two-way ANOVA results for the seven KOSS subscales according to employment type and accident experience. The results are as follows. Significant interactions between employment type and accident experience were observed for the subscales of physical environment ($F = 30.663$, $p < 0.001$) and job demand ($F = 7.495$, $p < 0.01$). The direct workers working in accident departments tended to have higher occupational stress in terms of the subscales of physical environment and job demand. Among the subcontracted workers, however, those working for 2-year accident-free departments had a relatively high level of occupational stress.

In terms of job insecurity, we observed significant group differences according to their accident experience ($F = 4.3$, $p < 0.05$) and employment type ($F = 10.762$, $p < 0.01$). More specifically, participants working in accident departments showed relatively high job insecurity, whereas direct workers tended to have higher job insecurity than did their subcontracted counterparts.

In terms of the organizational system subscale, significant group differences were observed according to employment type ($F = 6.709$, $p < 0.05$) and interaction effects ($F = 5.433$, $p < 0.05$). Overall, direct workers tended to have higher occupational stress associated with organizational system. By contrast, subcontracted workers working for 2-year accident-free departments tended to show greater occupational stress associated with organizational systems than did their counterparts working for accident departments.

Finally, in terms of organizational culture, significant group differences were observed according to accident experience ($F = 4.532$, $p < 0.05$), with participants working in accident departments showing a higher level of occupational stress related to the organizational culture than participants working for 2-year accident-free departments. No statistically significant differences pertaining to relational conflict or unfair compensation were observed.

4. Discussion

The current study examined direct workers and subcontracted workers working for the same shipbuilding workplace. These participants were also distinguished according to employment type and recent accident experience within the past 2 years. The aim of the study was to examine the group differences in safety climate and occupational stress. The results are summarized as follows.

First, the direct workers working for 2-year accident-free departments showed a more robust safety climate in terms of the subscales of management value, direct supervisor, communication, education and training, safety practices, compliance behavior, and participation behavior than did their counterparts working in accident departments. However, a reverse trend was observed among subcontracted workers, with those working in accident departments showing a higher level of safety climate than did their counterparts working in the 2-year accident-free departments. In terms of the overall safety climate score, the direct workers working for 2-year accident-free departments had the highest safety climate in terms of the subscales of management values, direct supervisor, education and training, and compliance behavior. For the subscales of communication, safety practices, and participation behaviors, the subcontracted workers working in accident departments showed the highest scores.

As reported by Payne et al [6], the fact that direct workers working in accident departments showed a less robust safety

Table 3
Mean scores, standard deviations, and two-way ANOVA results for KOSS subscales according to employment type and accident experience

Subscale	Direct workers			Subcontracted workers			*F*
	Group (*n*)	M	SD	Group (*n*)	M	SD	
Physical environment	Accident (92) Free accident (60)	2.663 2.206	0.666 0.456	Accident (73) Free accident (59)	2.368 2.672	0.624 0.427	AE = 1.231 ET = 1.549 AE × ET = 30.663***
Job demand	Accident (92) Free accident (60)	2.550 2.329	0.463 0.449	Accident (73) Free accident (59)	2.331 2.422	0.509 0.461	AE = 1.323 ET = 1.230 AE × ET = 7.495**
Relational conflict	Accident (92) Free accident (60)	1.819 1.888	0.427 0.394	Accident (73) Free accident (59)	1.863 1.908	0.500 0.377	AE = 1.198 ET = 0.389 AE × ET = 0.051
Job insecurity	Accident (92) Free accident (60)	2.749 2.674	0.371 0.407	Accident (73) Free accident (59)	2.611 2.469	0.522 0.430	AE = 4.3* ET = 10.762** AE × ET = 0.402
Organizational system	Accident (92) Free accident (60)	2.374 2.220	0.529 0.351	Accident (73) Free accident (59)	2.097 2.206	0.499 0.421	AE = 0.156 ET = 6.709* AE × ET = 5.433*
Unfair compensation	Accident (92) Free accident (60)	2.190 2.103	0.429 0.447	Accident (73) Free accident (59)	2.189 2.311	0.495 0.517	AE = 0.091 ET = 3.364 AE × ET = 3.387
Workplace culture	Accident (92) Free accident (60)	1.875 1.850	0.538 0.494	Accident (73) Free accident (59)	1.887 1.653	0.505 0.462	AE = 4.532* ET = 2.316 AE × ET = 2.954

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
AE, accident experience; ANOVA, analysis of variance; ET, employment type; M, mean; SD, standard deviation.

climate than those working for accident-free departments is likely representative of the former group's perception and experience of workplace accidents as a lagging indicator of safety climate. The results for the subcontracted workers working in accident departments, by contrast, deviate from those of existing studies of safety indicators. This outcome might be attributed to the relationship between employers and subcontractors. When an employer and a subcontractor sign a contract in South Korea, the employer tends to exert a great deal of control over the health and safety terms for the subcontractor. For example, following a workplace accident, employers might pressure subcontractors to participate in safety education programs or to put in place reinforced health and safety measures designed to prevent accident recurrences. This contract culture might have contributed to more positive perception of safety climate among subcontractors working in accident departments. Further support for this inference comes from the fact that subcontracted workers working in these departments scored the highest in participation behavior, safety practices, and communication.

Second, in terms of occupational stress, direct workers working in accident departments had high mean scores in the subscales of physical environment, job demand, job insecurity, organizational system, and workplace culture. Similarly, subcontracted workers working for 2-year accident-free departments had high mean scores in physical environment, job demand, organizational system, and workplace culture. And the former group also had the highest scores for occupational stress associated with job insecurity and the organizational system of all subgroups. Furthermore, overall, occupational stress associated with the organizational system was greater among direct workers than among subcontracted workers, whereas occupational stress stemming from workplace culture was higher among both direct workers and subcontracted workers working in accident departments compared to those working in accident-free departments.

The high occupational stress associated with physical environment, job demand, job insecurity, organizational system, and workplace culture observed in direct workers working in accident departments appears to support the results of Clarke [12] and Siu et al [13], who suggested a link between occupational stress and workplace accidents. Furthermore, overall, direct workers working for the accident departments showed a more negative perception of safety climate, and a higher level of occupational stress associated with the physical environment and job demand. The higher level of occupational stress associated with job insecurity and the organizational system observed among direct workers might reflect the recent recession plaguing Korea's shipbuilding industry, which has undermined workers' job security, including that of the direct workers, as suggested by Park [20]. Although it is expected that direct workers initially might have had greater faith in the certainty of their continued employment than their subcontracted counterparts, the recent recession might have contributed to the growing job insecurity in this group of workers. In addition, for more than half of the safety climate subscales, direct workers had the highest overall scores, whereas subcontracted workers had the highest mean scores for occupational stress associated with physical environment, workplace culture, and unfair compensation. These findings are in line with the results of Mayhew et al [19] and Park [20], who argued that subcontracted workers face inferior work conditions as well as lower health and safety measures than do direct workers.

The present study distinguishes itself from existing studies by conducting an on-site survey to statistically verify the differences in safety climate and occupational stress according to employment type and accident experience of workers in the same workplace. Although not specifically mentioned in the Results section, we noted an outcome pattern similar to the overall pattern for accident-experienced direct workers ($n = 15$) and their subcontracted counterparts ($n = 15$) who were performing some of the same tasks in the same workgroup. This suggests a need to devise measures for managing the psychosocial factors influencing both direct workers and subcontracted workers in order to improve workplace health and safety as a whole.

Notwithstanding our results, this study has several limitations. First, participant subgroups were created without taking into account the actual employment makeup in the industry (i.e., the ratio of direct workers to subcontracted workers). Considering that subcontracted workers account for a far greater proportion of total industry employment when compared to direct workers, it would be beneficial for future studies to incorporate this fact when creating subgroups.

Second, although the more positive safety climate observed in subcontracted workers working in accident departments might be attributed to how subcontracts are typically concluded in South Korea, it would still be necessary to verify this inference with supporting evidence, such as by referring to actual safety education performance reports or records of prevention measures implemented during the past 2 years for this group of workers.

Third, the job autonomy subscale in the KOSS scale had low reliability in the present study. Although the low reliability might be attributable to the relatively small number of items (three) comprising this subscale, the fact that no existing studies using the same scale have reported this problem suggests that further research would be necessary regarding the use of the KOSS among direct workers and subcontracted workers.

Finally, both direct workers and subcontracted workers showed contrasting results regarding most of the safety climate and occupational stress measures depending on their experience of workplace accidents in the past 2 years. However, for certain occupational stress measures such as physical environment and job demand, subcontracted workers in 2-year accident-free departments showed higher stress, which is difficult to explain with the results of existing studies. Such outcomes are thus likely attributable to a methodological limitation of a simple and one-dimensional survey. For future studies, incorporating participant interviews of each subgroup and performing a more detailed investigation of each subgroup's work conditions, etc., would be needed.

Despite these limitations, the present study's contributions are its examination of group differences in safety climate and occupational stress according to subgroups of employment type and recent accident experience in the department. Additionally, the significant group differences found in the current study suggest that effective management of the psychosocial factors associated with each group's safety climate and occupational stress is crucial to ensuring the health and safety of the workplace as a whole. According to Article 29 of Korea's Occupational Safety and Health Act (health and safety measures pertaining to contract business), employers are responsible for the prevention of occupational accidents among subcontracted workers, and the employer and subcontractor must engage in a joint effort to prevent occupational accidents by putting in place a management–labor consultative body. Kim and Cho [18] reported that workplaces with a high level of trust between management and unions tend to have a lower accident rate, suggesting that union–management relations influence occupational accidents to a degree. Furthermore, beyond the existing environmental and physical measures implemented, there is also a need to develop measures designed to effectively manage the psychosocial factors that influence workplace health and safety, in particular, those factors that influence the relationship between employers and subcontractors.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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