



Analyzing psychological conditions of field-workers in the construction industry

Soram Lim ^a, Seokho Chi ^{a,b}, Joon Deuk Lee ^c, Hoon-Jin Lee ^c and Hyunjung Choi^d

^aDepartment of Civil and Environment Engineering, Seoul National University, Seoul, Korea; ^bThe Institute of Construction and Environmental Engineering (ICEE), Seoul National University, Seoul, Korea; ^cDepartment of Psychology, Seoul National University, Seoul, Korea; ^dTrauma Healing Center HumanHeart, Seoul, Korea

ABSTRACT

The Korean construction industry has experienced poor labor productivity and high accident rates. Previous studies have reported that workers' mental health can cause negative impacts on work performance; thus, enhancing workers' psychological conditions would help achieve more productive and safer workplaces. This research aimed to understand the level of psychological conditions of construction field-workers using four categories: (1) stress (occupational stress and stress-coping style), (2) personal temperament, (3) emotional disturbance (depression and trait anxiety), and (4) drinking habits. This research used validated questionnaires commonly used in the field of clinical psychology, surveyed 430 respondents from road, bridge, tunnel, subway, and apartment construction sites in Korea, and analyzed the overall psychological tendency of construction workers with the collaboration of professional clinical psychologists using the Z-test, analysis of variance (ANOVA), and cross-tabulation. The research also investigated how the mental conditions differed according to different working conditions, such as demographic information, employment status, work types, work experience, and wage conditions. The results indicated that construction workers suffer from a high level of stress and showed high inclination for problem-focused coping: impulsive, cautious, and dependent on other people. Two out of five construction workers suffer from depression and experience trait anxiety. More seriously, three out of five workers show alcohol-use problems that require clinical attention. This study also revealed the particular psychological problems that occur under different working conditions. The findings can be used to promote the awareness of the importance of construction workers' mental well-being and to help in setting targets for improvement.

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Introduction

Since 2010, construction labor productivity per hour in Korea has been lower than the average of all industries' (Figure 1), with the labor productivity in all industries in Korea being ranked 28th out of 34 Organization for Economic Cooperation and Development (OECD) countries in 2012 [1]. Additionally, the accident rate in the Korean construction industry has been continuously increasing during the same period, while it has been decreasing in other industries (Figure 2). The fatality per ten thousand construction workers in Korea was 1.78 in 2012, which was much higher than that in the United States (U.S.) (0.35), Japan (0.20), and the United Kingdom (U.K.) (0.04) [2].

According to the World Health Organization (WHO) [3], mental health problems such as stress, personality disorder, depression and anxiety, and alcohol abuse can affect the ability of individual workers to perform work safely and can cause low productivity. In the construction industry, many

studies have pointed out that the construction workers' mental health is one of the critical factors influencing safety and productivity [4–6]. Occupational stress (e.g. heavy workload, job insecurity), organizational stress (e.g. inefficient communication, interpersonal conflicts, lack of rewards), and working environment-related stress (e.g. inappropriate personal protective equipment, noise, severe weather conditions) can reduce workplace safety and productivity [7–9]. Siu et al. [10] and Haslam et al. [11] investigated and revealed that depression and anxiety were highly related to long-term productivity and safety losses by causing motivation, satisfaction, and emotional problems in workers. Alcohol abuse was also identified as a critical factor that increased misjudgment and high-risk behaviors in workers [12,13].

Although the research findings of the previous studies promoted an awareness of the importance of workers' mental well-being in the construction industry, there has been a lack of studies assessing

CONTACT Seokho Chi  shchi@snu.ac.kr  Department of Civil and Environment Engineering, Seoul National University, 1 Gwanak-Ro, Gwanak-Ku, Seoul 08826, Korea

Present affiliation of Joon Deuk Lee is Department of Counseling Psychology, Hanyang Cyber University, Seoul, Korea and Hyunjung Choi is Chungbuk National University, Cheongju, Korea.

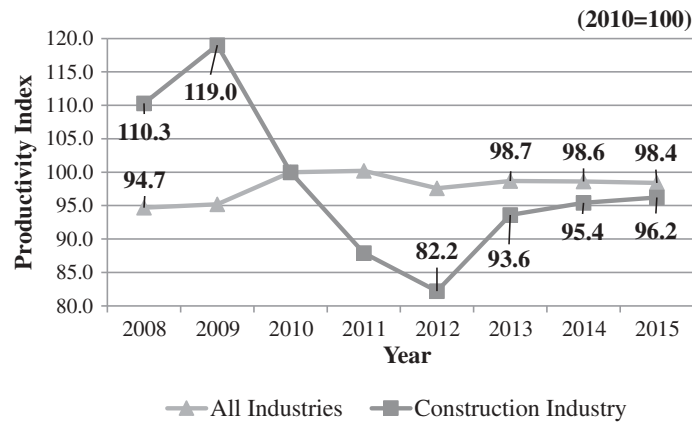


Figure 1. Labor productivity per hour index (2008–2015) [1].

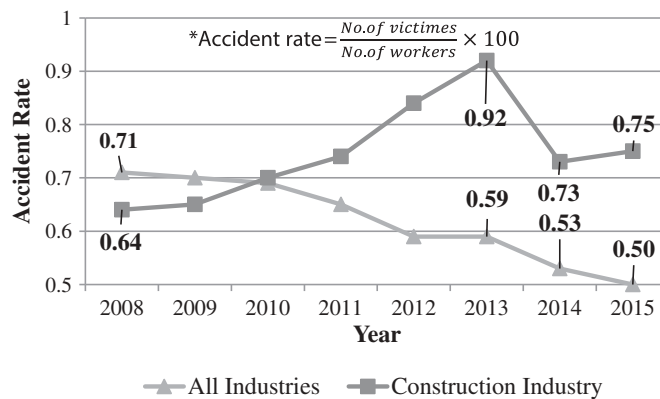


Figure 2. Accident rate in the Korean construction industry (2008–2015) [2].

the mental health conditions of construction workers from the perspective of a professional clinical psychologist. The previous studies in construction mostly used questionnaires self-developed by construction researchers for data collection that were not verified by clinical psychology [7,9,14–19]; thus, reliable measurement and investigation of psychological conditions were limited. Instead of self-developed questionnaires, clinical psychologists commonly use validated questionnaires to assess mental health problems, including stress, personal temperament, emotional disturbance, and drinking habits. Moreover, there is a need to explore how psychological tendencies might be affected by different working conditions of the construction workers (e.g. demographic information, employment status, work types, working experiences, and wage conditions). For instance, job insecurity or the hierarchy between general contractors and subcontractors could lead to the unique mental conditions of workers.

The primary objective of this study is to investigate the psychological conditions of construction workers and analyze the relationship between these psychological conditions and working conditions. Specific research objectives are as follows:

- (1) Understand the level of psychological conditions of construction field-workers in Korea, as measured through: (1) stress (occupational stress and stress-coping style), (2) personal temperament, (3) emotional disturbance (depression and trait anxiety), and (4) drinking habits (alcohol abuse).
- (2) Explain psychological differences in a range of different working conditions, including demographic information, employment status, work types, work experiences, and wage conditions.

Literature review

Relationship between mental health and productivity/safety

Construction workers' mental health is one of the critical factors to productivity and safety losses [4–6]. Previous studies identified that occupational stresses are among the mental health challenges that cause serious productivity and safety problems (Table 1). Goldenhar [14] developed a stress-injury causation model that explained that organizational stresses due to the job demands and lack of supervisor support and training directly or indirectly increased the occurrences

Table 1. Literature review summary on the relationship between mental health and productivity/safety.

Psychological categories	Goldenhar et al. [14]	Campbell [8]	Leung et al. [4]	Abbe et al. [7]	Leung et al. [9]	Bowen et al. [20]	Blackhall and Littlemore [6]	Seo et al. [21]	Siu et al. [10]	Haslam et al. [11]	Boschman et al. [24]	Li and Bai [13]	Biggs and Williamson [12]	Larson et al. [25]
Occupational Stress	*			*			*	*	*	*		*	*	*
Personal Temperament														
Depression	*		*											
Anxiety	*		*											
Drinking Habit					*	*					*			

of near misses and injuries. Campbell [8], Leung et al. [4], and Abbe et al. [7] similarly revealed that a group of stressors, including environmental factors (e.g. noise, inadequate ventilation), organizational factors (e.g. communication problems, interpersonal conflicts), and job-related factors (e.g. heavy workload, lack of participation in decision making, insufficient job control), was highly correlated to safety and productivity performance. Leung et al. [9] and Bowen et al. [20] determined organizational stressors such as unfair rewards, inappropriate safety equipment uses, lack of goal settings, and unsafe physical working environments as the accident drivers. Such occupational stresses not only deteriorate the work performance of individual workers but also hinder cooperative work as a group, which leads to safety and productivity problems on the site [6,21].

Second, personal temperament (i.e. natural predisposition), such as overconfidence, intolerance, and aggression, can control risk-taking behaviors of the workers, causing them to act either safely or unsafely [22]. Leung et al. [4] identified that construction workers with a behavior pattern characterized to be aggressive, impatient, and incapable of relaxing are more vulnerable to stress while causing at-risk behaviors. Seo et al. [21] also revealed that five personal characteristics, called “Big Five (first named by Goldberg [23]),” including neuroticism, extraversion, openness, agreeableness, and conscientiousness, influenced self-perceived fatigue and safety culture on construction sites.

Next, emotional disturbances, such as depression and anxiety, have crucial impacts on productivity and safety [10,11,24]. Siu et al. [10] determined that psychological distress, including depression and anxiety, had a positive correlation with the number of accidents and occupational injuries. Haslam et al. [11] also explained that the depression and anxiety of workers might affect lack of concentration, emotional distress, reduced motivation, and difficulties with decision making and thus emphasized that the workers’ emotional disturbance should be relieved to improve workplace productivity and safety. Depression was even identified as the most serious mental health problem among bricklayers and field supervisors [24].

Last, alcohol misuse can increase the risk of fatalities [13]. According to Biggs and Williamson [12], 59% of Australian construction workers studied suffered from alcohol-related problems, which deteriorated safety cognition and individual safety behaviors. Larson et al. [25] also showed that the construction industry consistently ranked high in heavy alcohol use and the workers in the small-sized companies tended to consume more alcohol than in the large-sized companies.

Although the previous studies discussed above successfully investigated and revealed that the mental health of construction workers was one of the critical factors determining workplace productivity and safety performance, there is a lack of studies

Table 3. Overview of the developed questionnaire.

Psychological categories	Stress	Personal temperament	Emotional disturbance	Drinking habit
Selected psychologies (Measurement)	Occupational stress (KOSS-SF) Stress-coping style (WCC)	Temperament (TCI-RS)	Depression (CES-D-20) Trait anxiety (STAI-T)	Alcohol-use disorder (AUDIT-K)
Number of questions	56 (24 + 32)	81	40 (20 + 20)	10
Analysis method	Compare with other case study (z-Test)		Compare with cutoff scale	
Statistical method	ANOVA		Cross-tabulation	

KOSS-SF: Korean Occupational Stress Scale Short Form

WCC: Ways of Coping Checklist

TCI-RS: Temperament and Character Inventory Revised Short Version

CES-D: Center for Epidemiologic Studies Depression Scale

STAI-T: State-Trait Anxiety Index, Trait Version

AUDIT-K: Alcohol Use Disorder Identification Test in Korea.

Research methodology

The research methodology is summarized in Figure 3. Based on a literature review, the research determined that four categories of psychological conditions (i.e. stress, personal temperament, emotional disturbance, and drinking habit) can influence workers' productivity and safety. The detailed overview of the questionnaire is summarized in Table 3. The research used six different types of questionnaires in Korean that were developed by professional clinical psychologists, verified by previous psychological studies, and commonly used in the field of clinical psychology [31–36] in order to measure psychological conditions of construction workers in the four identified categories. The questionnaires also included introductory questions that ask demographic and job characteristics of the respondents. Next, the authors surveyed target

respondents from five different types of construction projects (i.e. roads, tunnels, bridges, subways, and apartments) and analyzed data to not only identify the level of psychological conditions of construction workers but also investigate differences based on different working conditions.

Survey setup

To set target respondents, purposive sampling, which is a type of non-probability sampling strategy [37], was used since the target respondents of this research were clearly defined as construction field-workers who worked at road, tunnel, bridge, subway, and apartment sites. To attain reliable statistical results, it was important to preset the site conditions. As such, the road construction sites did not include tunnel or bridge sections. The tunnel sites represented ongoing tunnel

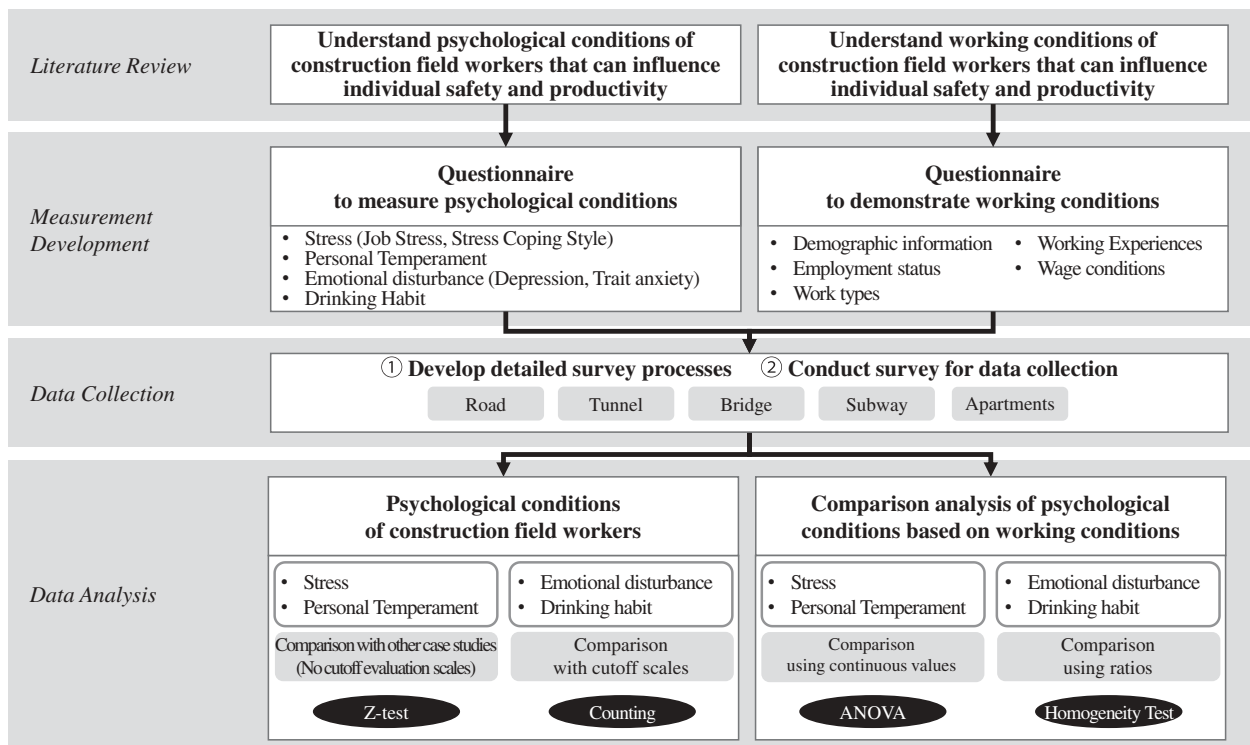


Figure 3. Research methodology.

boring stages. For the bridge construction sites, the length of the bridge needed to be over 1 km. The subway sites met over 1 km underground in length and included more than one station. For the apartment sites, it was determined that each apartment complex needed to accommodate more than 600 households and respondents needed to be working on the main construction stage after earthmoving but before interior and exterior finishes. Additionally, the target construction sites were mainly located in Seoul Metropolitan City, Incheon Metropolitan City, and Gyeonggi Province to minimize geographical effects.

For reliable analyses, we calculated the minimum number of required respondents using G*Power, launched by Heinrich-Heine-Universität Düsseldorf [38]: 304 respondents were required to achieve a significance level of 0.05 and an effect size (f^2) of 0.08 for an F-test. The researchers conducted surveys from April 2014 to June 2014 and collected a total of 430 responses: 59, 73, 51, 64, and 183 from road, tunnel, bridge, subway, and apartment construction sites, respectively. For reliable data collection, the researchers hired a professional survey company and the investigator of the company surveyed each respondent face to face by asking questions one by one and filling in the answers. Among the total 430 responses, we analyzed 59, 62, 44, 62, and 169 responses (total 396 responses) by filtering out samples that had missing values [39]. Around 87.9% of the respondents were from Seoul Metropolitan City, Incheon Metropolitan City, and Gyeonggi Province in Korea, and the remainder were from Gangwon, South Chungcheong, North Jeolla, and South Jeolla Provinces. Based on empirical statistics, the minimum sample size of each group, such as the number of workers who earned over US\$2,500, is recommended to be larger than 13 to be compared in one-way analysis of variance (ANOVA) and satisfy the homoscedasticity hypothesis [40].

Research measurements

The questionnaires' reliability was first checked using Cronbach's alpha as a coefficient of internal consistency (Table 4). When the value is higher than 0.6, it is considered an appropriate threshold for exploratory studies [41]. All questions were scored using a Likert scale from zero or one (not at all) to four or five (very much). Appendix A shows the examples of the survey questionnaire and their measurement scales. Some questions were intentionally scored inversely to check the consistency of responses. The descriptions of each subcategory and subscale of the psychological conditions are summarized in Table 4 [31, 42–46]. The questionnaire was also reviewed by the Institutional Review Board (IRB, Approval No.E1403/001–005) since it dealt with construction individuals' psychological information.

Psychological conditions

Stress: KOSS-SF and WCC. The Korean Occupational Stress Scale Short Form (KOSS-SF), developed by the Occupational Safety and Health Research Institute in Korea [32], was used to investigate the level of occupational stress. It includes seven subscales: job demand, insufficient job control, interpersonal conflict, job insecurity, organizational system, lack of reward, and occupational climate. A larger score means a higher stress (24 questions, total score: 100).

Additionally, the research selected the Ways of Coping Checklist (WCC) to understand stress-coping styles, which refers to personal sensitivity under stressful situations. According to Lazarus and Folkman [47] and Folkman et al. [4], "coping" is defined as cognitive and behavioral efforts to manage internal or external mental challenges; individuals feel differently about the level of stress under the same conditions. The WCC was developed by Folkman and Lazarus [48] to measure individuals' coping styles. Cho [34] transformed this tool to comprise 32 questions to fit into the Korean context based on the factor loading method. It contains four different kinds of coping styles: problem-focused coping, seeking social support coping, emotion-focused coping, and wishful thinking coping styles. The first two styles are considered active coping styles, whereas the latter two are passive coping styles. When someone has a strong problem-focused coping style, the person might try hard to challenge their stressful situations. Conversely, having a seeking social support style means that a person wants to talk to others to solve their problems. Individuals with an emotion-focused coping style try to isolate themselves from stressful emotions, and those with wishful thinking coping styles use imagination without effort or hope for miracles [43].

Personal temperament: TCI-RS. Temperament is defined as the emotional reactions by neurobiological responses to external conditions [49]. It varies under the influence of genetics and is not easily changed during a person's life [44,50]. This research adopted the Temperament and Character Inventory Revised Short version (TCI-RS) developed by Goth et al. [51], which was transformed to the Korean context by Min et al. [31]. The TCI-RS consists of four main subscales (81 questions): novelty seeking, harm avoidance, reward dependence, and persistence.

A person high in novelty seeking is impulsive, quick tempered, exploratory, and curious. They might suffer difficulties in performing structured tasks or following rules. Conversely, someone high in harm avoidance is cautious, apprehensive, pessimistic, and fearful, and would prepare for danger carefully. With high reward dependence, a person tends to be sympathetic, moody, open, and dependent. This person can easily form relationships with others and understands their emotions. If

Table 4. Descriptions and internal consistencies of psychological categories.

Categories	Subcategories	Subscales	Description	Internal consistency (Cronbach's alpha)	
Stress	Job Stress	Job demand	Time pressure, increasing workload, insufficient rest, and multiple functioning	0.69	
		Insufficient job control	Noncreative work, skill underutilization, little or no decision making, and low level of control	0.62	
		Interpersonal conflict	Inadequate supervisor, coworker support, and emotional support	0.69	
		Job insecurity	Uncertainty and undesirable changes of job status	0.59	
		Organization system	Unfair organizational policy and support, inter-department conflict, and limitation of communication	0.67	
		Lack of reward	Unfair treatment and future ambiguity, and interruption of opportunity	0.67	
		Occupational climate	Authoritarian culture, inconsistency of job order, and gender discrimination	0.66	
		Stress-coping style	Problem-focused	Might try hard to change their stressful situation	0.89
	Seeking social support		Want to talk to others to clarify their problems	0.75	
		Emotion-focused	Try to isolate themselves from stressful emotions	0.61	
	Wishful thinking	Imagine the end of their stressful situation without efforts or hope for a miracle	0.66		
Personal temperament	-	Novelty seeking	Impulsive, quick tempered, exploratory, and curious → Suffer hardships performing a simple and structured task or following rules	0.84	
	-	Harm avoidance	Cautious, apprehensive, pessimistic, and fearful → Prepare for danger carefully	0.84	
	-	Reward dependence	Sympathetic, moody, open, and dependent → Easily form relationships with other people and understand emotions in others	0.77	
	-	Persistence	Industrious, ambitious, overachieving, and flawless → Once start doing a job, see it through to the end; also have a tendency to stick to their successful experiences	0.85	
Emotional disturbance	Depression	-	How often a person experiences a loss of appetite, irritation, fear, happiness, sadness, and other symptoms	0.88	
	Trait anxiety	-	A disposition to perceiving one's circumstance as a threat on a day-to-day basis, including tiredness, worry, and discomfort	0.89	
Drinking habit	-	Alcohol abuse	Drinking frequency, quantity, alcohol-dependence symptoms, and alcohol-related troubles	0.90	

individuals are high in persistence, they are likely to be industrious, ambitious, overachieving, and flawless. There is a good possibility that these individuals will finish their job. Such people also have a tendency to stick to successful experiences [31,44–46].

Emotional disturbance: CES-D and STAI-T. The Center for Epidemiologic Studies Depression Scale (CES-D), first developed by Radloff [52], has been widely used to measure depression. It explains how a respondent experiences loss of appetite, irritation, fear, happiness, sadness, and other symptoms related to depression. This research adopted the Korean version of the CES-D (20 questions), transformed and verified by Chon and Rhee [35].

Additionally, the research used the State Trait Anxiety Index (STAI-T, or STAI-II, comprising 20 questions) developed by Kim and Shin [36], which is a transformed version of STAI that was originally developed by Spielberger et al. [53]. Trait anxiety explains tiredness, worry, or discomfort that is a disposition to perceive one's day-to-day situation as a mental threat.

Drinking habit: AUDIT-K. The WHO developed the Alcohol Use Disorder Identification Test (AUDIT), and we used AUDIT-K, a version transformed by Kim [33], for the Korean context. AUDIT has been widely employed to identify the alcohol abuse level of various occupations such as police officers [54], mining workers [55], and workers in emergency departments [56]. Additionally, Biggs and Williamson [12] applied and validated it for construction field-workers. AUDIT-K helps determine a person with problematic alcohol use, which has a high probability of developing into alcoholism. AUDIT-K can measure drinking frequency and quantity, alcohol-dependence symptoms, and alcohol-related troubles.

Construction field-workers' working conditions.

Working conditions are important for the systematic analyses of psychological conditions in different circumstances. In particular, this covered: (1) demographic information, (2) employment status, (3) work types, (4) working experiences, and (5) wage conditions. Construction trades included in the work types followed the category of Construction Association of Korea [57].

Data analysis methods

The authors analyzed the collected data to understand construction field-workers' level of psychological conditions (the first research objective) by either comparing relative to other case studies or using evaluation scales. Second, to explain psychological differences in a range of different working conditions (the second objective), ANOVA and homogeneity tests were used for statistical analyses.

Comparisons with other case studies

The measurements to understand occupational stress, stress-coping style, and temperament do not have evaluation scales; they are relative values. It means that there is no lowest and highest score range, and it is difficult to say whether the calculated average score is bad, normal, or good. Thus, the research team compared the construction workers' mental conditions with those experienced by other industry workers (e.g. harsh working conditions: firefighters; normal working conditions: general office workers and Korean adult males).

Firefighting is considered a high-strain job because it entails both physical danger and psychological stress originated by exposures to noxious chemicals, tense environments, and 24-hour shifts [58,59]. According to CareerCast [60], firefighters were ranked as having the most stressful job in 2015, and thus comparison with firefighters' stress level supports comparison to the stress level of construction workers. The firefighters' stress data were provided by Jo [61], who studied distress of 456 firefighters in Korea using KOSS-SF, the same questionnaire used in this research.

The score of stress-coping styles does not signify good or bad, and different people have different coping styles to overcome stressful situations [62]. The comparison between the general population who works indoors and construction field-workers who conversely do more physical outdoor works is thus expected to explain the similarities regardless of job characteristics and dissimilarities according to different working atmospheres. The research compared construction workers' stress-coping styles with those of general office workers as analyzed by Kang [63], who used WCC, the same questionnaire used this study. Since the total score used by Kang was 120, the score was converted into a scale totaling 100 for comparison purposes. More specifically, the subtotals of problem-focused, seeking social support, emotional-focused, and hopeful thinking copings were 60, 20, 32, and 16, respectively, in this study; however, Kang used 30 for each subtotal. Therefore, the score was converted using Equation 1 [32].

$$\text{Converted Score} = \frac{(\text{Obtained Score} - \text{No. of questions})}{(\text{The total score} - \text{No. of questions})} \times 100$$

This research also analyzed the construction workers' personal temperament by comparing it with that of

980 normal Korean male adults measured by TCI-RS, the same questionnaire used in this study [31], since the target population (construction workers) consisted mostly of males (98.2%) in this study.

The averages of the construction field-workers' data were compared with those of other industries' data using a Z-test by considering the sample size. The test statistic, at a 0.05 significance level equation that was used, is as follows:

$$z = \frac{\bar{x}_1 - \bar{x}_2 - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad 2)$$

Here, \bar{x} is the average stress level, subscription 1 is construction workers (target data), subscription 2 is respondents in the other cases, s is standard deviation of the data, and n is the number of the target population.

The critical point of this one-tailed test at the 0.05 significance level was 1.645. A z-value larger than 1.645 means that the construction workers suffer more than people in the comparison groups; however, if the z-value is smaller than -1.645, the workers in the comparison target tend to suffer more in the given psychological conditions than do the construction workers.

Comparisons with cutoff scales

Since the inventories of depression, trait anxiety, and alcohol abuse provide absolute cutoff scales for evaluation, the results were compared with the provided threshold scores to screen people who experience psychological problems. The cutoff scales of depression are 0–15 (normal), 16–20 (mild), 21–24 (moderate), and over 25 (severe). The cutoff scales of trait anxiety are 0–53 (normal), 54–58 (mild), 59–63 (moderate), and over 64 (severe). The mild, moderate, and severe conditions are regarded as abnormal conditions. The cutoff scales of alcohol abuse are 0–7 (normal), 8–15 (drinking problem), 16–19 (alcohol abuse), and over 20 (alcohol dependence).

ANOVA and homogeneity test

An F-test in ANOVA was used to compare psychological scores with different working conditions because ANOVA is effective for discrete independent variables (i.e. working conditions) and continuous dependent variables (i.e. occupational stress, stress-coping style, and temperament). A prior assumption for ANOVA is equal variance of the comparison target; thus, the results that did not satisfy this assumption were eliminated even if the p -values were significant.

On the other hand, for the depression, trait anxiety, and alcohol abuse groups, the number of respondents was divided into classes according to different severities of symptoms. Therefore, the chi-square test was used with a significance level of 0.05 for homogeneity using

cross-tabulation since both independent (i.e. working conditions) and dependent (i.e. depression, trait anxiety, and alcohol abuse) variables are discrete. Rejecting the hypothesis of homogeneity means that working conditions show a different distribution of disorder. This research also used Fisher's exact test when expected responses of less than five were more than 20% of the total category group cells [64].

Results and discussions

Data distribution

The information on working conditions of the collected data is illustrated in Figure 4. The majority of the respondents were male (98.2%), over 50 years old (50.8%), and married (68.9%). Regarding the educational background, 58.3% of the respondents completed high school. The type of employment included full-time (11.6%), contract (23%), and daily (64.6%) workers. The ratio of general contractors:subcontractors was 15.9:84.1%, and work positions included 31.8% foremen, 52% craftspeople, and 16.2% assistants. The respondents also included a range of different types of workers (e.g. 32.1% carpenters, 14.4% iron workers). The majority of workers fell into the 10–20 years (30.3%) and over 20 years (34.8%) working experience categories. Respondents' working experience on their

present work site varied: 3–6 months (20.2%), 6–12 months (25.8%), and over 1 year (24.2%). Most workers were paid monthly (70.7%) and earned over 2,500,000 Korean won (US\$2,500) per month.

Psychological conditions of construction field-workers

Stress

As shown in Figure 5, using ANOVA ($F = 31.57$, $p = 0.00$) to compare the stress levels of construction workers with different subscales, stress from insufficient job control (49.3) was relatively higher than that of other stress factors, and stresses from interpersonal conflict (37.6) and occupational climate (37.6) were comparatively low. Construction work is normally repetitive, and workers must follow scheduled work routines assigned by supervisors; the job and daily routine are therefore rule-oriented. These conditions may cause high stress due to insufficient job control. However, due to such conditions, construction workers may tend to accept and adapt themselves to less-controllable environments. The construction tasks are also divided by specialties with different business mind-sets: temporary task-based teams, but with the same project goals. This could be the reason for the relatively low stress levels due to occupational climate

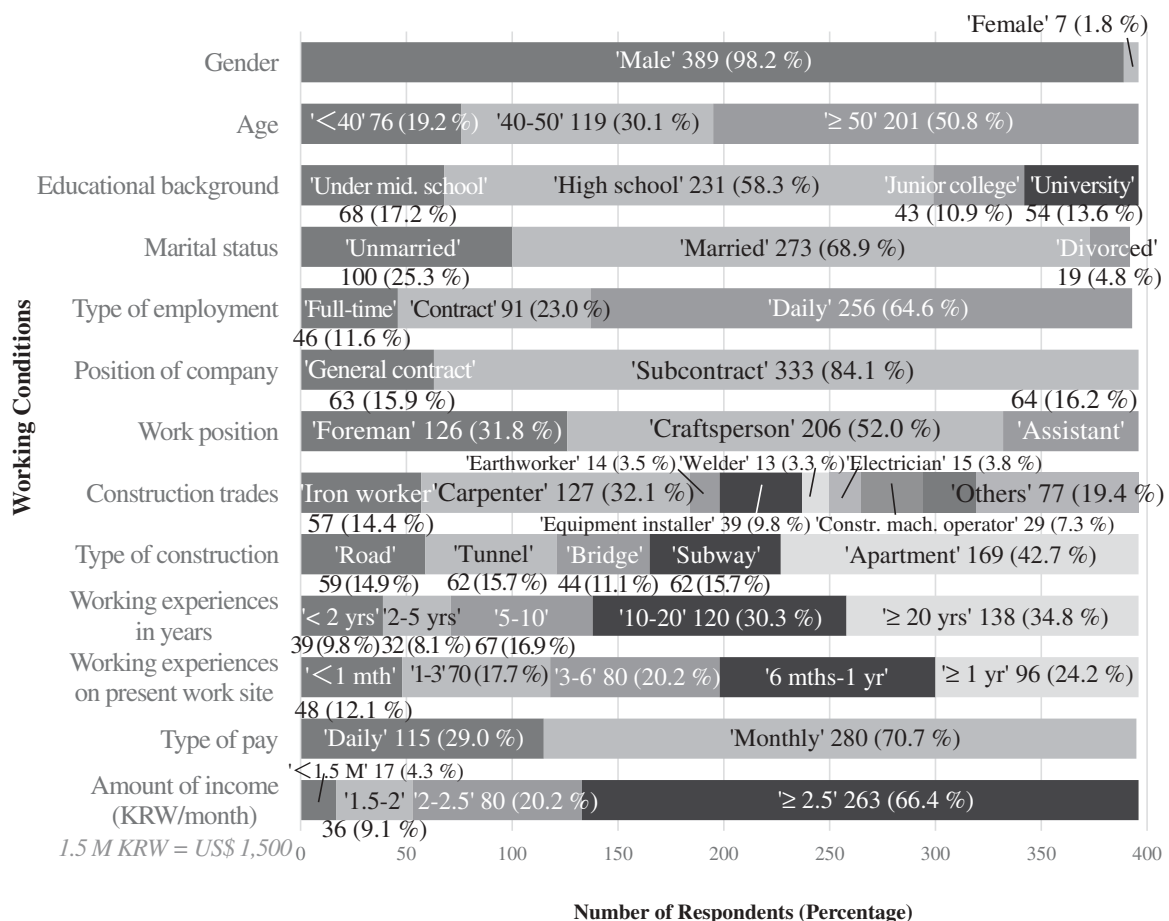


Figure 4. Data distributions.

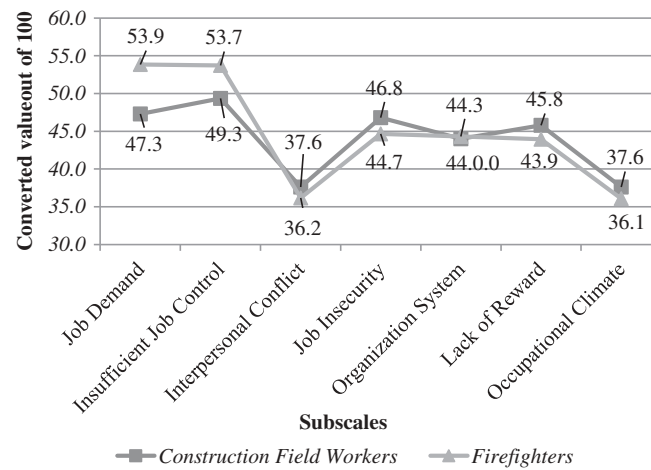


Figure 5. Comparison of job stress between construction field-workers and firefighters.

and interpersonal conflict; construction workers tend to have high social learning behaviors and adapt themselves well to the occupational climate [9].

To understand construction workers' level of occupational stress, we analyzed construction workers' stress levels compared to those of firefighters [20]. As shown in Table 5, the overall stress score of the construction workers showed a similar tendency to that of firefighters when considering that the p -values were not significant. Such similar tendencies indicate that construction workers' stress is as problematic as that of firefighters. Firefighters work under 24-hour shifts and are deployed in emergency situations. For that reason, firefighters usually feel tension, anxiety, and fear but have difficulty in expressing their emotions. In addition, the high probability of receiving severe or fatal injuries during work can increase fatigue [65]. Similarly, construction workers usually start working at daybreak, are exposed to overtime work, and work in physically demanding conditions. They are often pushed to reduce construction schedules and work under urgent as well as a range of risky conditions. Furthermore, the large number of construction accidents can increase tension in construction workers. Such similar working environments might cause similar stress levels for construction workers compared to that of firefighters. Construction workers' stress

caused by job demands and insufficient job control, however, was lower than that of firefighters, with significant p -values. This could be because construction work is normally more controllable in less-dangerous situations than that of firefighting works [61].

When a person seeks an active coping strategy, which consists of problem-focused coping and seeking social support coping styles, they are more likely to be calm and be able to mentally adjust to stressful situations [66]. Construction workers show a more problem-focused coping attitude and seek social support rather than have a passive style; they believe that their situations can be changed (i.e. seeking social support coping) when they plan better and experience more. The construction industry is labor-intensive, and construction work is heavily experience-oriented. Construction workers are also more likely to be risk takers with high work responsibility rather than risk avoiders (i.e. problem-focused coping), and the behavior of such a person is usually more active [43,47]. They are willing to gain more knowledge to overcome problematic situations. Regarding the passive strategies, an emotion-focused coping style was found to be lower in construction workers than the active strategies, but higher than that of the general office worker sample. Under the uncontrollable, changeable, and

Table 5. Comparison of occupational stress scores between construction field-workers and firefighters.

Section	Subscales	Construction field-workers		Firefighters		z	p	
		M	SD	M	SD		C > F ^a	C < F ^b
Occupational stress	Job demand	47.3	17.3	53.9	19.7	-4.83	1.00	0.00*
	Insufficient job control	49.4	15.7	53.7	15.7	-3.83	1.00	0.00*
	Interpersonal conflict	37.6	14.8	36.2	15.7	1.30	0.10	0.90
	Job insecurity	46.8	21.0	44.7	21.6	1.35	0.09	0.91
	Organization system	44.0	14.5	44.3	19.9	-0.24	0.60	0.40
	Lack of reward	45.8	15.7	43.9	18.6	1.47	0.07	0.93
	Occupational climate	37.6	16.2	36.1	20.8	1.11	0.13	0.87
	Average	44.1	10.3	44.7	12.7	-0.73	0.77	0.23

^a Under confidence level = 0.95, significance probability (p -value) < 0.05 means the average of construction field-worker is higher than that of firefighters (C > F).

^b Vice versa (C < F).

* $p < .05$.

Table 6. Comparison of stress-coping styles between construction field-workers and general office workers.

Section	Subscales	Construction field-workers				General office workers				z	p	
		Raw score		Converted score		Raw score		Converted score			C > G ^a	C < G ^b
		M	SD	M	SD	M	SD	M	SD			
Stress-coping style	Problem-focused	45.3	5.5	61.1	11.5	21.2	4.9	63.3	20.4	-1.90	0.97	0.03*
	Seeking social support	13.8	2.0	58.8	13.4	20.4	4.5	59.8	18.5	-0.86	0.81	0.19
	Emotion-focused	9.6	1.7	46.5	14.4	15.9	3.7	41.3	15.4	4.91	0.00*	1.00
	Wishful thinking	16.3	2.6	44.3	12.4	20.3	3.8	59.6	16.0	-15.15	1.00	0.00*

^a Under confidence level = 0.95, significance probability (*p*-value) < 0.05 means the average of construction field-workers is higher than that of general office workers (C > G).

^b Vice versa (C < G).

* *p* < .05

less-predictable outdoor working environments, construction workers want to change the risky conditions and their negative emotional feelings.

As shown in Table 6, construction workers were more likely to use a problem-focused coping style than other strategies. The next preferred coping styles using ANOVA ($F = 169.77$, $p = 0.00$) were seeking social support, emotion-focused coping, and wishful thinking. The general office workers had higher problem-focused coping and wishful thinking styles than construction workers under stressful situations. Seeking social support coping was on a similar level between the two target populations.

Personal temperament

Min et al. [31] suggested that the score range – under 45, 45 to 55, and over 55 years – indicated low, medium, and high temperaments, respectively. Based on this scale, the majority of construction workers showed a low level of novelty seeking (89.4%) and harm avoidance (78.8%), and a considerable number of respondents presented with a low level of reward dependence (58.1%). With regard to persistence, however, almost half of the construction workers (44.2%) indicated low persistence. With regard to personal temperament, a low score indicates that a person is reflective, rigid, loyal, and slow tempered. Such a person tends to follow regulations and act systematically [31]. The low level of novelty seeking found in this study suggests that construction workers have the potential to follow safety rules and work manuals, which are both related to work productivity. When a harm avoidance score is low, a person is confident, carefree, energetic, and daring. Such a person has a tendency to act optimistically in dangerous or changeable working situations. Over-optimism, however, can make a person insensitive to danger [31]. Construction workers who scored low in harm avoidance may respond emotionally well to high-risk situations, being more cautious and apprehensive.

Individuals low in reward dependence are normally susceptible to “rewards” (i.e. feedback from other people in behaviorism), tough-minded, practical, detached, and independent. The low average scores

can indicate that such individuals can not only be insensitive to other people’s changing emotions and independent, but also engage in a low level of emotional exchange with others [31]. The survey results also show the tendency toward low reward dependence. Typical construction projects are undertaken by many daily and part-time workers. In Korea in particular, more than 70% of the work is performed by small and medium-sized companies and the number of part-time workers accounts for approximately 60% of the total construction workers [67]. This may result in a lack of a sense of organizational belonging, leading to low reward dependence. This result can be linked with the survey finding that construction workers emotionally suffer from job insecurity. Finally, the higher the persistence score, the more a person tends to make steady and persistent efforts. This type of person is likely to be industrious, ambitious, over-achieving, and seek perfection [31]; about half of the respondents may pursue these tendencies.

Next, the comparison analysis showed that the average score of the construction field-workers was relatively higher in three subscales – novelty seeking, harm avoidance, and reward dependence – than the general population of adult males in Korea, although the scores were in the low range. The average scores of persistence were similar in the two groups, being at a medium level (Table 7). This comparison indicates that construction workers are more exploratory than reflective, cautious than confident, and sentimental than tough-minded. Both groups show a medium level of persistence. It can be inferred that people who have the personal temperament mentioned above tend to choose the construction industry for their job.

Emotional disturbance

The degree of depression is categorized into four levels using cutoff scores: normal (0–15), mild (16–20), moderate (21–24), and severe (25 or higher) [35,68]. A total of 62.4% of the construction workers were free from depression; however, 37.6% of the total population suffered from depression symptoms. Consistent with clinical practice, the results suggest

Table 7. Comparison of personal temperaments between construction field-workers and Korean adult males.

Section	Subscales	Construction field-workers		Korean adult males		z	p	
		M	SD	M	SD		C > K ^a	C < K ^b
Temperament	Novelty seeking	32.33	9.60	29.59	9.19	4.84	0.00*	1.00
	Harm avoidance	37.38	9.34	33.70	9.99	6.48	0.00*	1.00
	Reward dependence	43.15	7.90	41.95	8.13	2.53	0.01*	0.99
	Persistence	46.08	8.54	46.07	9.73	0.02	0.49	0.51

^a Under confidence level = 0.95, significance probability (*p*-value) < 0.05 means the average of construction field-workers is higher than that of Korean adult males (C > G).

^b Vice versa (C < G).

* *p* < .05

Table 8. Comparison with cutoff scores in depression, trait anxiety, and alcohol abuse.

Sections	Cutoff score		Frequency (%)	Total
Depression	0–15	Normal	247 (62.4%)	396 (100%)
	16–20	Mild	Abnormal 61 (15.4)	
	21–24	Moderate	33 (8.3)	
	25–	Severe	55 (13.9)	
Trait anxiety	0–53	Normal	227 (57.3%)	396 (100%)
	54–58	Mild	Abnormal 77 (19.4)	
	59–63	Moderate	64 (16.2)	
	64–	Severe	28 (7.1)	
Alcohol abuse	0–7	Normal	161 (40.7%)	396 (100%)
	8–15	Problem drinking	Abnormal 152 (38.4)	
	16–19	Alcohol abuse	40 (10.1)	
	20–	Alcohol dependence	43 (10.9)	

that construction workers who have mild depression (15.4%) would benefit from medical help, and, as such, 22.2% of the workers with moderate or severe depression should be diagnosed and treated by psychological specialists (Table 8).

Kim [69] reported the critical points of trait anxiety for adults as 54 (mild), 59 (moderate), and 64 (severe). Using these cutoff scales, the results show that 169 construction workers (42.7%) experienced trait anxiety. Similar to the depression results, 23.3% of the workers were judged as having a moderate or severe condition of trait anxiety and they would benefit from professional treatment.

The fact that construction workers are usually placed in a physically and psychologically demanding condition can cause anxiety and depression [70]. Workers with such mental health issues have a high possibility of causing negative effects with regard to their individual productivity and safety. Depression decreases enthusiasm and makes it difficult for people to adapt themselves to reality or their work environment [71]. A person who has high trait anxiety tends to realize dangers and threats more frequently than does a normal person [72]. Many construction workers suffer from depression and high anxiety, and thus it might be difficult for them to concentrate on their tasks, might be less motivated, and find it difficult to make strategic decisions [11].

Drinking habits

The research adopted the cutoff scales verified by Choi [73], which explained the tendency toward

alcohol abuse in Korea. The survey results explained that Korean construction workers suffer considerably from problematic alcohol usage, which was similarly found by construction research in other countries, including Australia [12] and the United States [13,25]. More than half (59.3%) of the respondents were exposed to alcohol abuse and needed proper treatment. Respondents with problematic drinking conditions (scores 8–15) have a need for medical consultation and advice according to clinical practice recommendations. A total of 10.1% of the workers who had a score of 16–19 fell in the status of alcohol abuse, for which continuous monitoring with consultation is recommended. In addition, 10.9% of the workers scored over 20 points, which indicates a high possibility of alcohol dependence. Problematic alcohol use can lead to absenteeism from work, and workers in this psychological condition are exposed to an accident rate four times greater than that of normal workers [74].

Comparison based on working conditions

To explain the psychological conditions among different working conditions, this research analyzed personal information collected across five categories: (1) demographic information, (2) employment status, (3) work types, (4) work experiences, and (5) wage conditions. The research performed the F-test in ANOVA homogeneity test and post hoc analyses. In

Table 9. Comparisons of psychological conditions based on construction workers' working conditions.

Categories	Demographic information						Employment status	
	Age	Educational background	Marital status	Type of employment	Position of company	Work position		
Stress	<i>p</i> -value	0.00*	0.61	0.07	0.86	0.01*	Foreman > Craftspeople, Assistants	
	Job demand	Under 40 > 40s, Over 50	0.00* Under middle school > High school University > The others					
	<i>p</i> -value	0.03*	0.13	0.00*	0.01*	0.00*	0.00*	0.00*
	Insufficient job control	Over 50 > 40s	0.33	Daily worker > Full-time worker, Contract worker	General contract > Subcontract	0.00*	0.00*	0.00*
	<i>p</i> -value	0.27	0.92	0.29	0.37	0.32	0.32	0.32
	Interpersonal conflict	Similar			Similar			
	<i>p</i> -value	0.62	0.03*	0.09	0.1	0.2	0.2	0.2
	Job insecurity		Married > Unmarried		Similar			
	<i>p</i> -value	0.45	0.22	0.26	0.54	0.03*	0.03*	0.03*
	Organization system	Similar				0.01*	0.01*	0.01*
<i>p</i> -value	0.36	0.6	0.23	0.36	0.01*	0.01*	0.01*	
Lack of reward	Similar							
<i>p</i> -value	0.00*	0.62	0.44	0.05	0.73	0.73	0.73	
Occupational climate	Under 40 > 40s, Over 50	0.00* University > Under middle school Junior college > High school		Similar				
<i>p</i> -value	0.34	0.28	0.29	0.00*	0.21	0.01*	0.01*	
Problem-focused coping	Similar			Contract worker > Daily worker				
<i>p</i> -value	0.84	0.28	0.28	0.01*	0.65	0.04*	0.04*	
Seeking social support coping	Similar			Contract worker > Daily worker				
<i>p</i> -value	0.15	0.58	0.15	0.22	0.39	0.69	0.69	
Emotion-focused coping	Similar							
<i>p</i> -value	0.21	0.53	0.8	0.31	0.38	0.16	0.16	
Wishful thinking coping	Similar							
<i>p</i> -value	0.00*	0.00*	0.33	0.22	0.76	0.54	0.54	
Novelty seeking	Under 40 > 40s, Over 50							
<i>p</i> -value	0.04*	0.82	0.01*	0.97	0.15	0.24	0.24	
Harm avoidance	40s > Over 50		Unmarried > Married, Divorced					
<i>p</i> -value	0.7	0.82	0.42	0.04*	0.44	0.01*	0.01*	
Reward dependence	Similar			Full-time worker > Daily worker				
<i>p</i> -value	0.17	0.86	0.4	0.84	0.67	0.00*	0.00*	
Persistence	Similar							

(Continued)

Table 9. (Continued).

Categories	Demographic information				Employment status			
	Age	Educational background	Marital status	Type of employment	Position of company	Type of pay	Amount of income	Work position
<i>p</i> -value	0.08	0.4	0.74	0.65	0.77	0.87	0.04*	0.83
Depression	Similar				Similar		Violation of Same	
<i>p</i> -value	0.33	0.1	0.58	0.34	0.09		Variance Assumption	
Trait anxiety	Similar							0.05*
<i>p</i> -value	0.02*	0.56	0.87	0.1	0.01*			High abnormal ratio on the order: Assistants > Craftspeople > Foreman
Alcohol-use disorder	High normal ratio in Over 50				High abnormal ratio in General contract			Significant but no trends
Categories	Work types				Wage conditions			
Characteristics	Construction trades	Type of construction	Working experiences in years	Working experiences on pre-sent work site	Type of pay	Amount of income		
Stress	0.06	0.00* Road, Subway, Apartment > Tunnel	0.03* 2-5, 5-10	0.22	0.87	0.04*	Violation of Same	
<i>p</i> -value	0.03*	0.13	> 10-20, Over 20 years	0.01*		0.00*	0.05	
Insufficient job control	Iron worker, Carpenter, Earthworker > Electrician		0.00* Under 2 yrs > The others	3-6 mths > Under 1 mth, 6 mths-1 yr, Over 1 yr	0.11	0.00*	Under 1.5 M, 1.5-2 > Over 2.5 M	
<i>p</i> -value	0.04*	0.19	0.11	0.1	0.39	0.05	2-2.5 > Over 2.5 M	
Interpersonal conflict	Iron worker > Carpenter, Equipment installer, Welder		Similar			0.12		
<i>p</i> -value	0.24	0.01*	0.73	0.06	0.01*	0.12		
Job insecurity		Road, Subway, Apartment > Tunnel	Similar		Daily > Monthly			
<i>p</i> -value	0.59	0.00*	0.03*	0.02*	0.14	0.00*	1.5-2, 2-2.5 > Over 2.5 M	
Organization system		Road, Apartment > Tunnel, Bridge, Subway	Under 2 yrs > 10-20, Over 20 years	3-6 mths, 6 mths-1 yr > Under 1 mth, Over 1 yr		0.01*	1.5-2, 2-2.5 > Over 2.5 M	
<i>p</i> -value	0.1	0.35	0.05	0.21	0.71	0.01*	1.5-2, 2-2.5 > Over 2.5 M	
Lack of reward	Similar		Similar			0.35		
<i>p</i> -value	0.03*	0.00*	0.01*	0.00*	0.13	0.01*	0.35	
Occupational climate	Earthworker, Construction machine driver > Carpenter, Electrician	Road > Apartment > Tunnel	2-5 > 10-20, Over 20 years	Significant but no trends	Similar			
<i>p</i> -value	0.56	0.08	0.08	0.00*	0.32	0.00*	2-2.5, Over 2.5 M > Under 1.5 M, 1.5-2	
Problem-focused coping	Similar		Over 20 years	0.00*		0.01*		
<i>p</i> -value	0.55	0.71	0.96	0.29	0.43	0.01*		

(Continued)

Table 9. (Continued).

Categories	Work types		Working experiences		Wage conditions	
	Construction trades	Type of construction	Working experiences in years	Working experiences on present work site	Type of pay	Amount of income
Personal	Seeking social support coping	Similar	Similar			2–2.5, Over 2.5 M > 1.5–2
	<i>p</i> -value	0.26	0.09	0.64	0.55	0.58
	Emotion-focused coping	Similar	Similar			
	<i>p</i> -value	0.04*	0.11	0.22	0.53	0.2
Personal	Wishful thinking coping	Iron worker, Construction machine driver > Carpenter, Electrician	Similar		Similar	
	temperament	Earthworker > Electrician	0.00*	0.06	0.25	0.99
	Novelty seeking	Road > Apartment > Tunnel	Similar		Similar	
	<i>p</i> -value	0.47	0.81	0.22	0.47	0.14
<i>p</i> -value	Harm avoidance	Road > Bridge	Similar		Similar	
	<i>p</i> -value	0.69	0.69	0.55	0.13	0.03*
	Reward dependence		Similar			
	<i>p</i> -value	0.46	0.21	0.64	0.83	0.25
<i>p</i> -value	Persistence	0.00*	Similar	0.83	0.01*	0.01*
	Depression	High abnormal ratio in Road site	High abnormal ratio in 5–10	High abnormal ratio	High abnormal ratio in Daily workers	High abnormal ratio in Under 1.5 M
	<i>p</i> -value	0.07	High normal ratio in Tunnel and Bridge sites	High normal ratio in Over 20 years	0.17	0.01*
	Trait anxiety	0.4	0.15	0.01*	High abnormal ratio in 3–6 mths	High normal ratio in Over 2.5 M
<i>p</i> -value	Alcohol-use disorder	0.48	0.27	High normal ratio in Under 1 mth and Over 1 yr	0.11	0.02*
	Alcohol-use disorder	Similar	Similar	0.56		High normal ratio in Over 2.5 M

each category, the analysis shows both differences and similarities in psychological conditions. The p -values of each comparison between four psychological categories (y-axis, total 18 subscales) and five categories of working conditions (x-axis, total 12 characteristics except gender) are shown in Table 9. For the significant p -values (smaller than 0.05), specific findings from the post hoc analyses are also explained in the table. For instance, the p -value between the position of company under the employment status category and insufficient job control under the stress category was 0.01, and the results indicate that general contractors tend to be more stressed than subcontractors due to the insufficient job control.

Demographic information

Demographic information comprised gender, age, educational background, and marital status; however, gender was excluded because most of the respondents were male (98.2%). The younger the construction workers were, the more stresses they experienced due to the job demands and occupational climates. The average scores of novelty seeking were high in the younger age group. The construction industry is a highly experience-oriented industry and requires following work procedures. Workers in the younger group who are relatively less experienced but more socialized might face difficulties in completing their workloads and performing structured tasks. On the other hand, workers over 50 years old who are mostly contracted workers were more stressed from insufficient job control, and their alcohol abuse was the highest of any age groups. The respondents who had university degrees felt more stressed due to job demand and occupational climate since management-level workers who generally have university degrees are responsible for controlling projects and meeting on-time project deliverables. The married workers were more stressed by job insecurity. Other psychological conditions (i.e. stress-coping styles and personal temperaments) showed similar tendencies over the demographic groups.

Employment status

Employment types, company positions, and work positions made up employment status. The stress levels were different for those three subcategories. Daily workers suffered higher stress from insufficient job control since their work is normally passive and repetitive. Contract workers showed a high level of seeking social support coping style; they tend to find solutions during work times by talking with coworkers and managers. Full-time workers showed higher reward dependencies since the hierarchy within the organization is strict and their performances should be directly related to promotion. Regarding company types, general contractors displayed a higher stress

score for stress from insufficient job control than did subcontractors and resulted in higher alcohol dependence. Most of the time, general contractors are in a management level on a jobsite, and thus responsible for control and communication with subcontractors. They also play mediator roles among owners, subcontractors, material suppliers, and other stakeholders, which may place them in more stressful conditions in controlling the job and thus lead to alcohol-dependent situations. With regard to work positions, assistants experienced high stress as a result of the insufficient job control; as Boschman et al. [24] identified, a bricklayer is stressed more by lack of job control compared to a supervisor. Assistants also showed a high level of stress from the organization system due to their simple and routine tasks, and the assistants comprised more numbers of individuals who experienced trait anxiety. They worry more about the work and often feel discomfort being with senior workers. The average score of stress originating from job demand was the highest in foremen because they might need to undertake multiple functions as subcontractors in multiple projects and furthermore feel pressurized to complete their work on time. Foremen showed active stress-coping styles and relatively high levels of reward dependency and persistency; they have a tendency to stick to their previous experiences and make new decisions based on their own. Other occupational stresses, passive stress-coping styles, novelty seeking and harm avoidance in personal temperaments, and depression all represented similar tendencies within the employment status groups.

Work types

Work types covered construction trades and construction types. Survey results indicated that iron workers, carpenters, earthmoving workers, and electricians showed severe psychological stress due to insufficient job controllability, interpersonal conflict, and problems on occupational climate. Iron workers experienced more stresses caused by the insufficient job controls and interpersonal conflicts than other trades, whereas electricians, normally working with high voltage and in danger of being electrocuted, suffered more stress originating from negative occupational climates. Earthmoving workers had a higher level of wishful thinking; when they face challenges in heavily equipment-oriented working environments, they may tend to hope for miracles without making efforts to alter their work plans.

Construction type, such as road, subway, apartment, bridge, and tunnel projects, also led to different mental health problems. Workers in road projects, most of who were the daily-paid workers in this survey, experienced the highest level of psychological problems. They displayed high stress scores (under

severe condition) for stresses originating from job demand, job insecurity, organization system, and occupational climate. The subway site workers' stress increased due to the demanding job, job insecurity, and negative occupational climate due to confined working environments. Respondents who worked on apartment sites suffered from stress as a result of job demand, job insecurity, and occupational climate at the medium level, but they felt higher stress in relation to the organization system than other sites' workers. Workers who built bridges on sites experienced a relatively low level of stress. Additionally, the novelty-seeking tendency was high for road site workers but low for tunnel site workers; road site workers also suffered from high depression. Construction workers within the work type categories showed similar tendencies in stress due to a lack of reward, all types of stress-coping styles except wishful thinking, harm avoidance, reward dependence, and persistence in personal temperaments, trait anxiety, and alcohol abuse.

Working experiences

Working experiences were divided into two subcategories: working years and working months on the present work site. Working years included five selection ranges: under 2 years, 2–5 years, 5–10 years, 10–20 years, and over 20 years. Workers who had less than 2 years of experience showed a higher level of stress due to the insufficient job controls and organization systems, similar to the younger age group. The level of stress increased for respondents with a career of 2–5 and 5–10 years due to the job demands and occupational climates. Over 20-year-experience workers were relatively less sensitive to stress, as Abbe et al. [8] reported, with lower stress levels in job demands, organization systems, and occupational climates. The more experienced the construction workers were, the less stressed they were due to the job demands and occupational climates. With regard to depression, however, workers who had over 20 years of experience had the highest score.

The working experiences on the present work site did not show critical differences in psychological conditions. Similar stress tendencies were found in interpersonal conflict, job insecurity, lack of reward, seeking social support coping, emotion-focused coping, wishful thinking coping, all four temperaments, and alcohol abuse.

Wage conditions

It is easily acceptable that daily-paid workers would feel more stressed by job insecurity than would monthly-paid workers. Moreover, the group of daily-paid workers included many depressed workers at a severe level, similar to the fact that road site workers who were stressed more by job insecurity showed a severe

depression level. This suggested that depression was correlated to stress due to job insecurity.

Workers who earned over US\$2,500 (2.5 million Korean won) per month experienced relatively lower stress than the other wage groups due to more satisfied job controllability, less interpersonal conflict, well-structured organizational system, and satisfaction of rewards. The research set two groups according to the monthly income: a lower group (less than \$1,500 and \$1,500–\$2,000) and a higher group (\$2,000–\$2,500 and over \$2,500). The lower group suffered from depression more, whereas the higher group showed a relatively high active stress-coping style and reward dependence as well as low trait anxiety and alcohol abuse.

The wage groups, however, showed similar tendencies in occupational stress from occupational climate, passive stress-coping styles (including emotion-focused and wishful coping styles), novelty seeking, harm avoidance, and persistence of temperaments.

Conclusions and recommendations

The research first analyzed the psychological conditions of construction field-workers in Korea based on the survey of 430 workers. Korean construction workers showed similar levels of stress to firefighters, and they mainly adopted the problem-focused and seeking social support coping styles. The construction workers exhibited a low level of novelty-seeking, harm-avoidance, and reward-dependence personality traits and a medium degree of persistence. Even with this low-level result, these three temperaments were higher than those found in the average Korean adult male populations.

This research revealed that arduous, large-scale, hierarchical, and dynamically changeable working environments can cause workers to experience stress based on the analysis from the perspective of professional clinical psychologists. The experience-based construction industry leads workers to adopt the problem-focused coping strategies. Low novelty-seeking and harm-avoidance strategies may enable these workers to fit themselves into risky situations. Additionally, it is very critical that two out of five construction workers suffer from depression and experience trait anxiety. More seriously, three out of five workers show alcohol-use problems, which would be consistent with recommended clinical attention.

The study also investigated psychological differences in a range of different working conditions. The more experienced the construction workers were, the less stressed they were due to the job demands and occupational climates. Moreover, assistants comprised more number of individuals who experienced trait anxiety. Many of the subcontractors showed severe psychological stresses due to the

insufficient job controllability, interpersonal conflicts, and problems on occupational climate. The group of daily-paid workers included many depressed workers at a severe level. However, workers over 50 years old with a low level of novelty seeking and harm avoidance, as well as full-time workers and foremen with a high level of reward dependence and persistence, have psychological advantages, enabling them to adapt themselves to changeable project environments.

The results of this study can be used to promote productivity and safety improvement plans by mitigating and reducing stress sources and providing appropriate psychological interventions to address emotional disturbances and alcohol abuse. In other words, both industry practitioners and government agencies such as the Ministry of Employment and Labor need to understand the importance of mental well-being of construction workers. Self-checking tools of the psychological conditions of individual construction workers, daily psychological intervention for workers having difficulties, and clinical training and support are emphasized to be developed and distributed to job sites by government agencies since workers' psychological conditions act as front end for better onsite safety and productivity.

This study also suggests an effective training strategy for new workers. New workers may have a high level of stress due to insufficient job control and unfamiliar organizational systems; lack of active stress-coping styles, including problem-focused coping and seeking social support coping; and more depression caused by harsh working conditions and low income. Thus, employers need to not only establish a communication channel between the new workers and the organization while encouraging them to feel the sense of ownership and responsibility but also provide them with psychological training that will support them to manage and cope with occupational stress. A step-by-step professional training can also help them foster active stress-coping styles.

Nevertheless, the research faced limitations during the study and there remain several opportunities for further research. Unlike the respondents from other construction types, the respondents of bridge construction sites were from two different locations, North Jeollar and South Jeollar Provinces. Although the effect of regional characteristics can be considered, the analysis was more focused on the general tendency and occupational characteristics. Next, the questionnaire used in this study was designed based on the comparisons of normal and abnormal, more relative than absolute, and thus limited to explaining how a certain score demonstrates a certain level of psychological condition more concretely. Additionally, this study did not fully address how onsite safety and productivity can be affected by stress, personal temperament, emotional disturbance, and drinking habits. Future research needs to investigate the relationships among psychological conditions, safety

consciousness, and productivity behaviors for better safety and productivity control on construction sites.

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ORCID

Soram Lim  <http://orcid.org/0000-0001-5405-3392>
 Seokho Chi  <http://orcid.org/0000-0002-0409-5268>
 Joon Deuk Lee  <http://orcid.org/0000-0002-9480-6237>
 Hoon-Jin Lee  <http://orcid.org/0000-0002-7758-4011>

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Appendix A: Examples of the survey questionnaire and their measurement scales

Categories	Subcategories	Subscales	No. of questions	Question examples	Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
Stress	Job Stress (four-point Likert scale)	Job demand	4	I have to do various jobs simultaneously	1	2	-	3	4		
		Insufficient job control	4	My work requires creativity	4	3	-	2	1		
		Inadequate social support	3	My supervisor is helpful in getting job done	1	2	-	3	4		
		Job insecurity	2	My future is uncertain because the current situation of my company is unstable	1	2	-	3	4		
		Organizational system	4	The organizational policy of my company is fair and reasonable	1	2	-	3	4		
		Lack of reward	3	I acquire respect and confidence from my company	1	2	-	3	4		
		Occupational climate	4	Dining out after work makes me uncomfortable	1	2	-	3	4		
		Problem-focused	16	Just concentrated on what I had to do next	1	2	-	3	4		
		Personal Temperament (five-point Likert scale)	-	Seeking social support	5	Talked to someone to understand the situation more clearly	1	2	-	3	4
				Emotion-focused	4	Try to forget the whole thing	1	2	-	3	4
				Wishful thinking	7	Hoped a miracle would happen	1	2	-	3	4
				Novelty seeking	20	Commercially sold questions (Confidential)	0	1	2	3	4
				Harm avoidance	21		0	1	2	3	4
				Reward dependence	20		0	1	2	3	4
				Persistence	20		0	1	2	3	4
				Depression (five-point Likert scale)	20	During the past week: I was bothered by things that usually don't bother me	0 (Rarely)	1 (Sometimes)	2	3 (Frequently)	4 (Often)
Trait anxiety (five-point Likert scale)	20			I worry too much over something that really doesn't matter	1	2	3	4	5		
Drinking habit	-			Alcohol abuse (five-point Likert scale)	10	How often during the last year have you found that you were not able to stop drinking once you had started?	0 (Never)	1 (Hardly)	2 (Once a month)	3 (Once a week)	4 (Daily)