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Evaluating the safety climate of ethnic minority construction workers in Hong Kong

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Abstract

The Hong Kong construction industry is facing a severe labour shortage due to an ageing workforce and a lack of new entrants, even at a time of construction boom. To improve this situation, ethnic minorities (EMs) have been attracted to join the construction industry. In many developed countries, however, some unofficial statistics show that EMs suffer higher fatality rates than their local counterparts. It is clear that the safety of ethnic minority (EM) construction workers requires more attention. The objectives of this study, therefore, were to evaluate the safety climate among EM construction workers in Hong Kong, to predict the impact of safety climate factors as they affect the likelihood of injury occurrences and to determine the relationships between safety climate and the safety performance of EM workers. A questionnaire survey was administrated to Pakistani and Nepalese construction workers in Hong Kong. The results revealed that the overall average safety climate score for both EM groups was not very high and that the Pakistani worker scores were higher than the Nepalese worker scores. EM frontline-workers scored less than EM supervisors and managers. Among seven safety climate factors, "Workers personal involvement in safety and health (F5)" was ranked highest and "Perception of safety rules and regulations (F4)", was ranked lowest. "Risk taking behaviour and perception of work risk (F3)" and "Workers personal involvement in safety and health (F5)" were identified as significant predictors of injury occurrence. Furthermore, the safety climate was significantly associated with the degree of safety participation and safety compliance. It was expected that the findings of the study would provide an insight into the level of safety climate among EM workers, enabling organizations and practitioners around the world to improve safe working among EM workers.

Keywords: Construction safety and health, ethnic minorities, safety climate, Hong Kong

1. Introduction

The safety of ethnic minority (EM) workers is of global concern (Bust et al. 2008; Toh and Quinlan 2009; Tutt et al. 2011; Institution of Occupational Safety and Health 2014). The construction industries in many developed societies all face the problems of ageing workforces and a shortage of new entrants (Chan et al. 2012). Migrant workers, often EM in society at large, are new blood to the construction industry. For example, in the United States, it was estimated in 2005 that around 27 percent of construction workers were Latino and more than 40 percent of those were low skilled, and involved in high risk activities as labourers and roofers (Center for Construction Research and Training 2008). In Hong Kong, the population of EMs has increased significantly, by 31 percent, over the past 10 years, from 343,950 in 2001 to 451,183 in 2011 (Census and Statistics Department 2013). According to the 2011 Population Census Thematic Report on Ethnic Minorities, around 7.4 percent of EM males (4,656) work in the construction industry, representing 1.5 percent of the total construction sector workforce (Census and Statistics Department 2013, p. 68). Nepalese (23.2 percent) and Pakistanis (18.9 percent) constituted the highest percentages of male EM construction workers in the industry (Census and Statistics Department 2013, p. 69).

As EM workers are of growing importance to the construction industry, their safety, as a significant group must be safe guarded. Previous research shows that EMs are more vulnerable to injuries for various reasons, including a lack of safety training, language barriers, and the fact that lower safety standards often apply in their home countries. In the United States, Hispanic workers in 2008 had a fatality rate of 18 percent (12.4 per 100,000) of the full-time equivalent workers (FTEs), higher than the rate for non-Hispanic construction workers of 10.5 per 100,000 FTEs (Center for Construction Research and Training 2008). “On average, the annual death rate for Hispanic workers was about 48 percent higher than for white, non-Hispanic workers between 1992 and 2002, but only 6 percent higher from 2008 to 2010” (Center for Construction Research and Training 2013, p. 41). In the UK, migrant workers comprise approximately 8 percent of the total construction workforce, but they account for around 17 percent of total fatalities (Center for Corporate Accountability 2009). Officially there is no separate record for EM workers’ fatalities and injuries in Hong Kong. A recent Occupational Safety and Health Statistics report of the Hong Kong Labour Department (2016) and a comprehensive search through local newspaper archives from 2000 until June 2016 showed that EM workers accounted for 22 fatalities (6.9 percent) out of the total of 343 fatalities in the construction industry (shown in Table 1). In 2013 and 2014, six EM workers fatalities occurred, accounting for around 14 percent of 42 fatalities in the construction industry. This high fatality rate of EM construction workers is alarming. The fatality rate of EM workers is greater than their representation in the industry indicating EMs in Hong Kong are suffering a disproportioned fatality rate. The accident statistics obtained from local newspaper archives may not be underestimated. The actual number is deemed to be much larger.

A number of studies have adopted qualitative approaches to reveal the safety problems experienced by EM workers (e.g. Bust et al. 2008). What is currently lacking is an investigation into the attitude of EM workers towards safety, and their understanding of risks and dangers, and their knowledge and support for safety regulations and site safety procedures. Also relevant is the attitude of site management towards care for the safety of EM workers.

The safety climate is a snapshot of the safety culture and the employees' perception of safety in their working environment (Mearns et al. 2001; Flin et al. 2006; Hann et al. 2007; Health and Safety Laboratory 2013). The objectives of this study are to assess the level of safety climate of EM workers, and predict the impacts of safety climate on the occurrence of injuries and safety behaviors. The study contributes to our understanding of the perception of EM workers towards safety and the degree to which safety climate factors affect injury occurrences and safe working.

2. Safety of EM workers in Hong Kong

Due to the growing ageing problem and labour shortage, the Hong Kong government has taken initiatives to assist EMs to join the construction industry (Chan et al. 2012; 2014; Hong Kong Government 2014). With the rising number of EM workers, not only the number of accidents, but also the accident rate of EM workers has increased. Many accidents to EM workers are caused by the inappropriate handling of excavators and a lack of appropriate safety precautions (Labour Department 2016). According to a report published by the Catholic Diocese of HK, Diocesan Pastoral Centre for Workers (Kowloon) and Hong Kong Workers' Health Centre (HKWHC) (2011), most of the EM workers in Hong Kong are discriminated against and assigned the more laborious and dangerous types of work. As a result, EM workers are usually more vulnerable to construction accidents (Chan et al. 2012). As the proportion of EM workers continues to increase, attention must be paid to improving the safety and health related practices particularly as relevant to EM workers. A number of initiatives have been put in place by the Occupational Safety and Health Council (OSHC) and the Labour Department in promoting the health and safety of EM workers in the form of organized safety talks and safety training in EM native languages, the translation of safety and health materials into different EM languages and safety promotion activities, including the provision of safety awards and safety seminars (Occupational Safety and Health Council 2011). The Labour Department (2016) and the OSHC (2011) do publish Occupational Safety and Health (OSH) posters and pamphlets in different EM languages including Pakistani, Nepalese, Indian dialects, Tagalog, Bahasa Indonesia and Thai. However, to the authors' knowledge, no study has been carried out to evaluate the level of safety climate applying to EM workers in Hong Kong.

[Insert Table 1 here]

3. Safety climate

The term safety climate refers to psychological characteristics of employees (i.e. how people feel), corresponding to the values, attitudes, and perceptions of employees with regard to safety within an organization (Health and Safety Executive 2005). Earlier researchers have used safety climate factors as a means of determining the safety performance of construction workers (Mohamed 2002; Chan et al. 2005; Choudhry et al. 2009; Hon et al. 2013; 2014a). From a practitioner's perspective the main purpose of a safety climate survey is to reveal the strengths and weaknesses of safety management practices and to suggest appropriate remedial measures. From an academic point of view a survey can be used to establish relationships between safety climate factors, and outcome measures such as accident and injury occurrence (Cooper 2000). Budworth (1997) argued that measuring safety climate is similar to taking the "safety temperature" of an organization. The safety climate can be measured periodically with the help of a predetermined questionnaire survey. Safety climate factors help to identify and improve overall organizational management practices in relation to serious accidents (Zohar 2010). Safety climate can be compared at different working levels i.e. managers, supervisors and frontline workers and for different nationalities (Marin et al. 2015). In most situations, the frontline workers are at the greatest risk of injury. It is important; therefore, to find out how safety climate levels influence workers' safety related actions.

Zohar (1980) identified eight factors affecting safety climate: (1) importance of safety training programs; (2) management attitudes towards safety; (3) effect of safety on promotion; (4) perceived levels of risk at the workplace; (5) perceived effects of the workplace on safety; (6) perceived status of safety officers; (7) perceived effects of safe conduct on social status; and (8) perceived status of the safety committee. Glendon and

Litherland (2001) identified six safety climate factors for a road construction organization in comparing construction and maintenance workers. Nielsen and Mikkelsen (2007) and Nielsen et al. (2007) used a Danish safety climate questionnaire which consisted of 27 items distributed across the seven factors: (1) immediate supervisor's general leadership; (2) safety leadership; (3) safety representative's engagement in safety; (4) safety instruction; (5) safety compliance; (6) attention to safety; and (7) workplace involvement. Similarly, Kines et al. (2011) refined these and used the Nordic Safety Climate Questionnaire (NOSACQ-50) consisting of 50 items across the seven dimensions: (1) management safety priority, commitment and competence; (2) management safety empowerment; (3) management safety justice; (4) workers' safety commitment; (5) workers' safety priority and risk non-acceptance; (6) safety communication, learning, and trust in co-workers' safety competence; and (7) workers' trust in the efficacy of safety systems. Hon et al. (2013) identified the three safety climate factors: (1) management and employee commitment to occupational health and safety; (2) application of safety rules and work practices; and (3) responsibility for the health and safety of the repair, maintenance, minor alteration and additions sector of Hong Kong. Table 2 shows that *organization and management commitment*, *perception of safety rules and procedures*, *resources for safety* and *risk taking behaviour* are the most common safety climate factors identified by earlier researchers. To date, there have been many studies using different safety climate questionnaires targeting local construction workers. This study, however, focused on safety climate of EM construction workers.

[Insert Table 2 here]

4. Safety performance

Earlier studies employed various traditional techniques to evaluate safety performance including accident rates for work sites and injuries data (Chhokar and Wallin 1984) or behavior sampling (Reber and Wallin 1984; Reber et al. 1984; 1990; 1993; Cooper et al. 1994; Walker 1995; Vassie 1998; Shannon et al. 1999). Recently, however, Siu et al. (2004); Huang et al. (2006); Hon et al. (2014a) have used alternative tools, such as self-reported injury data collected through a questionnaire which could be considered as a reliable and valid source of injury data (Begg et al. 1999; Gabbe et al. 2003). Safety performance can be defined as "actions or behaviours that individuals exhibit in almost all jobs to promote the health and safety of workers, clients, the public, and the environment" (Burke et al. 2002, p. 432). Apart from using lagging indicator self-reported injury data, safety performance can be measured using leading indicators such as *safety participation* and *safety compliance* (Neal and Griffin 2004; Hon et al. 2014b). Lagging indicators are reactionary whereas leading indicators are proactive. Leading indicators can better reflect the future performance of the company. Safety participation is defined as "behaviours that do not directly contribute to individual personal safety but do help to develop an environment that supports safety" (Neal and Griffin 2006, p. 947). Safety compliance is described as "obeying safety regulations, following correct procedures, and using appropriate equipment" (Neal and Griffin 2004, p. 16). It refers to "the core activities that individuals need to carry out to maintain workplace safety. These behaviours include adherence to standard work procedures and wearing personal protective equipment" (Neal and Griffin 2006, p. 947).

5. Safety climate and safety performance

The influence of the safety climate upon safety performance varies across different work contexts and environments (Hofmann and Stetzer 1996; Hon et al. 2014b). Some earlier studies have identified a significant relationship between the safety climate and safety performance (Gillen et al. 2002; Siu et al. 2004; Pousette et al. 2008). Recent meta-analysis studies by Clarke (2006) and Christian et al. (2009) on safety climate and safety performance found that safety climate is a significant factor affecting safety performance. Reber and Wallin (1983; 1984); Reber et al. (1984); Tyler (1986) found that the higher the level of safe performance, the lower the accident rate. The studies of Arcury et al. (2012; 2015) revealed that safety climate is significantly related to the safety behaviors of migrant workers. However, some found no significant relationship between safety climate and safety performance (Glendon and Litherland 2001; Cooper and Phillips 2004). In view of the contrasting results, this study will examine whether safety climate affects safety performance in the context of EM construction workers.

6. OSHC safety climate index

The Safety Climate Index (SCI) is adopted in this study (Occupational Safety and Health Council 2008). It is a software package for the construction industry to calculate their safety climate scores. Safety climate is measured by 38 questions and they are grouped into seven predetermined safety climate factors (Table 3). Four out of seven safety climate factors are in line with the most common safety climate factors identified in Table 2. The SCI software produced seven factor scores and a total safety climate score. These predetermined safety climate factors were developed and validated by previous research conducted by OSHC when developing this SCI software package. They are elaborated below:

[Insert Table 3 here]

6.1. Factor 1: Organization and management safety commitment and concern for occupational health and safety

Perceptions of organization and management commitment to safety and health have been identified as the most important factor affecting safety climate success (Flin et al. 2000; Flin 2003). Earlier researchers, Zohar (1980) identified eight safety climate dimensions including top management commitment and priority given to safety under two main themes including workers' perceptions of management attitudes about safety and their perceptions regarding the relevance of safety in general production processes. Langford et al. (2000) argued that when workers think that management is committed to and care about their personal safety; they will cooperate to improve workplace safety performance.

6.2. Factor 2: Allocation of resources for health and safety and its effectiveness

An important indicator of an organization’s commitment to safety and health is the resources it allocates to OSH aspects. This factor relates to employees’ perceptions of organizational support for improvement of safety and health and its effectiveness in implementation. Safety programme’s goals cannot be accomplished without adequate resources. Top management must allocate sufficient resources to day-to-day activities. The resources required for effective safety management may include staff, time, money, information, safe working methods, facilities, tools, and machines etc.

6.3. Factor 3: Awareness of risk taking behaviour and perception of work risk hazard

This factor explores employee perceptions of what constitutes risky behaviour of hazardous work situations. Workers' abilities to determine risky situations might be influenced by factors such as the ease with which past situations can be recalled or imagined, "on-the-job" experience of the individual, the manner in which hazards are presented in communications, attributions of blame for accidents, and the amount of control individuals feel they have in hazardous situations. Such views and perceptions are related in some way to employees' readiness to avoid accidents and therefore affect the probability of accidents (Occupational Safety and Health Council 2008).

6.4. Factor 4: Perception of safety rules and procedures

One of the main controls employed by organizations to ensure safety and health is the set of rules and procedures. The set of safety rules and procedures is considered to be the core component of a safety management system (Mohamed 2002). This factor explores workers' levels of understanding and respect for the safety rules and procedures as well as their compliance with these rules and procedures in the workplace. Many such rules and procedures tend to be drafted by line-managers rather than those who do the job. There is always a danger that they do not adequately reflect all aspects of job risk. It is important, therefore that frontline workers should be involved in the development of the set of safety rules and procedures, for them to feel a sense of ownership and respect. The safety rules and work practices contribute significantly to safety performance so it is important that they are up-to-date, technically correct, and clear (Choudhry et al. 2009).

6.5. Factor 5: Workers' personal involvement in safety and health

Workers' personal involvement has also been identified as an important safety climate factor (Dedobbeleer and Beland 1991). The success of a safety management system, in essence, hinges on employees' recognition and support. Sustained success in ensuring safety and health at work demands that everyone recognizes its importance and acts accordingly (Hon et al. 2014a). Mohamed (2002, p. 376) study reported that the higher the level of workers' personal involvement in safety matters, the more positive the safety climate. This factor explores how individuals perceive their own contributions to good safety and health performance and how important they think it is.

6.6. Factor 6: Safe working attitude and workmates' influence

Cox and Cox (1991) found that a safe working attitude is one of the most important safety climate elements. Rundmo (1996) argued that attitude towards safety is associated with personal risk perception. The tendency to act dangerously, or not, stems from an individual's inherent attitude towards safety and this can be affected by peer group workmates. This factor, therefore, essentially explores attitudes towards safety by a group of workmates. March and Shapira (1992) argued that individuals differ in their perceptions of risk and willingness to take risks.

6.7. Factor 7: Safety promotion and communication

Effective promotion and communication is essential if an organization is to successfully convey safety messages to its employees (Han et al. 2008). A smooth communication channel and conscious efforts to promote safety and health are essential for both conveying messages to employees and facilitating feedback. Baxendale and Jones (2000) suggested that management should use a variety of formal and informal safety communication tools to communicate its commitment to safety. Both management commitment and employee feedback are essential for continuous safety improvements (Simon 1991).

7. Research methods

7.1. Questionnaire design and data collection

The questionnaire was divided into three sections. In Section A, respondents' personal information including socio-demographic and employment characteristics was collected. Section B solicits respondents' perceptions on the 38 SCI attributes. A five point Likert scale (1=strongly disagree to 5=strongly agree) was used for Section B. While there are many safety climate measurement tools (e.g. NOSACQ-50), they are not specifically designed for the construction industry. This study adopted SCI of the OSHC in Hong Kong. SCI was purposely designed for the adoption of the construction industry. It had been validated by the OSHC. Questions on safety performance measures were asked in Section C. Four questions were used to capture near misses and occupational injuries of the respondents in the past 12 months. A sample of the questionnaire survey is available as Supplemental Data. The questionnaire was translated into Nepali (for Nepalese workers) and Urdu (for Pakistani workers) by a professional translation organization, because these two ethnic groups represent the highest proportion of EM construction workers. The quality of translation was validated by two EM researchers.

The study involved human subjects so the researchers obtained ethical clearance from the Human Subjects Ethics Sub-committee (HSESC) of authors' employing institution. Before collecting questionnaire data, a pilot study was carried out with ten experts and researchers. The survey targeted new works only, including building, rail and civil engineering projects. In total 22 construction sites were targeted and 15 of them agreed to participate in the survey. The remaining seven construction sites refused to participate because they did not employ EM workers. The selected construction sites were operated mainly by ten main contractors and 16 subcontractors. The targeted survey respondents were EM managers, frontline supervisors and frontline workers. During data collection process, four trained student helpers were hired who were fluent in Nepalese and Urdu to brief about the purpose and items of questionnaire. In total 450 questionnaires were distributed and 349 completed questionnaires were received. 29 questionnaires were incomplete which were discarded. At the end 320 questionnaires were deemed valid for further analysis, 261 from the Nepalese (80 percent) and 68 from the Pakistanis (20 percent).

7.2. Respondents' profile

In this study, more than 90 percent of respondents were male (N = 306) and frontline workers (N = 289). Half of them were general labourer (N = 160) and remaining half were skilled workers (N = 160), representing different common construction trades include bamboo scaffolder, metal scaffolder, bar bender and fixer etc. (see Table 4). Around 70 percent of the respondents were married (N = 244). About 27% (N = 86) of the respondents were aged between 21-30 years and 42% (N = 134) 31-40 years old and 25% (N = 81) aged between 41-50 years old. In response to the question about education level, around 20 percent (N = 82) reached primary or below primary level and 50 percent (N = 157) of the respondents reached secondary level. Around 65 percent (N = 207) and 35 percent (N = 113) of the respondents were working with main contractors and subcontractors respectively. Around 35 percent (N = 112) and 40 percent (N = 128) of the respondents respectively had less than one and between one to five years of working experience with the same company. Respondents were also asked whether they possessed a safety training certificate, for example, and whether they had attended the Mandatory Basic Safety Training Course (commonly known as Green Card in Hong Kong) or Silver Card (some trade specific card) or whether they had received any other type of trade specific safety training. In an attempt to update construction workers' records, all those holding a valid Green Card need to register under the Construction Workers Registration Ordinance 2014. All respondents possessed a Green Card which is mandatory for all construction workers. Half of the respondents (N = 160) have obtained Silver Card. Most of the respondents' family sizes were between one and four persons. Around 77 percent (N = 245) and 71 percent (N = 227), respectively, said that they do not smoke or drink at work. It was also observed that 36 percent (N = 92) of Nepalese workers consumed alcohol but only one of the Pakistani workers.

[Insert Table 4 here]

7.3. Data analysis

Data was analyzed using *SPSS 20.0* statistical software. First, Cronbach's alpha reliability test was carried out on the survey data to test the reliability of the 5-point Likert scale (Nunnally and Bernstein 1994). The overall coefficient value for the seven safety climate factors was 0.794 (Nepalese workers 0.793 and Pakistani workers 0.739) which is above 0.70, indicating adequate internal consistency (Nunnally and Bernstein 1994; Geroge and Mallery 2003).

To achieve objective one, descriptive statistics including the mean values and standard deviation (SD) were employed to discovers whether the differences in mean value scores for each safety climate variable between the EM groups were statistically significant (i.e. Nepalese and Pakistanis). Worth noting is the fact that the SCI questionnaire was a mix of positive and negative statements. The values of negative statements were transposed to corresponding positive values. For example, score "1" for the question B26 "work health and safety is not my concern" (Likert scale of 1 to 5) was changed to "5" because a higher ranking of this attribute corresponds to a higher safety climate level.

To achieve the second objective, which relates to the safety climate factors affecting the likelihood of EM workers injury occurrences, binary logistic regression was adopted to establish the relationships between the safety climate and injuries to EM workers (Hon et al. 2014a). Binary logistic regression is a form of regression used when the dependent variable is dichotomous and the independent variables are either continuous or categorical. A logistic regression was performed to ascertain the effect of the safety climate factors on the likelihood of respondent injury occurrences (Hon et al. 2014a). It was observed that the self-reported injury data were highly positively skewed. More than 70 percent (N = 231) of the respondents reported no injury or had suffered injury requiring no absence from work. Since the data (in Section C) were dichotomously distributed, they were re-coded into the dichotomous variables "0" for no injury and "1" for any type of injury (Tabachnick and Fidell 2007). Logistic regression was selected because it predicts the probability that an observation falls into one of the two dichotomous dependent variable injury occurrences of "yes" or "no" with the safety climate factors being the independent variables (Field 2005).

To achieve objective three, Pearson correlation analysis was used to determine the strength of the relationships between safety climate factors and safety participation/safety compliance. Since data collected for the final Section C were based on ratio scales, Pearson correlation is suitable for measuring the linear correlation between variables (Ho 2006). The strength of the relationships between variables ranges from +1 (a positive relationship between variables) to -1 (an inverse relationship between variables). A value of 0 indicates no association between the two variables.

8. Research findings

8.1. Descriptive statistics

Table 5 shows the mean safety climate scores for EM construction workers. The mean value of SCI was ranged between (1=very low to 5=very good). It is assumed that the mean score of 3 is the demarcation point, i.e. ≤3 is considered "low" and >3 as "good". The mean safety climate scores for Nepalese and Pakistani workers were 3.49 and 3.72 respectively (Table 5). Pakistani workers have a slightly higher average score of 3.72 than the mean of 3.54 for all EM workers and the 3.49 of Nepalese workers mean score. The SD shows that there is not a notable difference between both ethnic groups. The safety climate score for Factors 1, 3, 4 and 6 for all respondents are lower than the average safety climate score. The Pakistani workers' mean value scores were higher for all factors except for Factor 6 "*Safe working attitude and workmate's influence"* and their perception about Factor 2 "*Resources for safety and its effectiveness"* is considerably higher than other factors.

Similarly, the overall mean safety climate scores and SD for frontline workers, supervisors and managers were 3.53 (.40), 3.66 (.24) and 3.69 (.46) respectively (Table 5). Although, the overall mean safety climate score differences between frontline workers, supervisors and managers group are minimal, the supervisors and managers have slightly better mean value scores than frontline workers. The safety climate score for Factors 1, 3 and 4 were also higher for the higher level workers. However, the managers, supervisors and frontline workers all gave a significantly less positive response to Factor 4 *"Workers' perception of the applicability of safety rules and procedures"*. Most supervisors and managers had a more positive response to resources provisions and their effectiveness (Factor 2), whereas the workers groups ranked lower this factor.

[Insert Table 5 here]

It was observed that 90 percent of the respondents gave safety climate a "good" score. It is also interesting to note that the workers with low mean safety scores <3 also reported more injury occurrences (60 percent of workers) as compared with 21 percent of those with a mean score >3. Table 6 shows the mean safety climate analysis results according to demographic factors. The younger respondents below 30 years old had a mean safety climate score of 3.55, almost similar to the 3.53 of the older respondents. Married workers, with more family members to support, scored higher than single persons. The SCI score of subcontractors (3.60) is slightly higher than main contractors (3.50).

[Insert Table 6 here]

8.2. Logistic regression

Results of the binary logistic regression analysis between safety climate factors and injury occurrence of EM workers are shown in Table 7. Factor 3 *"Risk taking behaviour and perception of work risk"* and Factor 5 *"Workers' personal involvement in safety and health"* are significant predictors of injury occurrence. The coefficient value shows that each unit decrease in *"Risk taking behaviour and perception of work risk"* score is associated with a decrease in the probability of injury occurrence by a factor of 0.544 and that each unit increase in *"Workers' personal involvement in safety and health"* is associated with a decrease in the probability of injury occurrence by a factor of 0.217. The model seems significantly reliable (χ^2 = 73.831, df = 7, *p*=.000). The Hosmer and Lemeshow test (χ^2 = 11.393, df = 8, *p*=.180) is found to be insignificant, it implies that the null hypothesis cannot be rejected. The model adequately fits the data. The model explained 21 percent to 31 percent (Cox and Snell R^2 and Nagelkerke R^2) of the variance in injury occurrences and correctly classified 81 percent of injury occurrences.

[Insert Table 7 here]

8.3. Relationship between the safety climate and safety performance (safety participation and safety compliance) using Pearson correlation

Table 8 shows significant positive correlations between the safety climate and both safety participation and safety compliance. The relationships between individual safety climate factors and worker personal efforts to improve the safety of the workplace (e.g. reminding co-workers about safety procedures at work) was positive for all factors except Factors 1, 3 and 4. The relationships between the safety climate and voluntary participation in safety tasks or activities that help to improve workplace safety (e.g. attending safety meeting, receiving safety training) was positively correlated with all safety climate factors except Factor 3. Similarly, respondents' self-safety compliance has a positive but weak correlation with all factors except Factor 2 and co-workers safety compliance has a positive but weak relationship to all safety climate factors.

[Insert Table 8 here]

9. Discussion

The objectives of this study were: (1) to evaluate and compare the safety climate for different EM construction workers in Hong Kong, (2) to predict the impact of safety climate factors on the likelihood of injury occurrence, and (3) to determine the relationships between safety climate and safety performance of EM workers. The study results reveal that the overall mean safety climate score of all EM construction workers (3.54) was higher than demarcation point of 3. The differences in mean safety climate score between workers, supervisors and managers were minimal, although the scores were slightly higher for those at the higher managerial levels as was also found by Fung et al. (2005) in a study of ten construction projects in Hong Kong. This study showed that the overall mean safety climate perception of Pakistani workers (3.72) was higher than that of Nepalese workers (3.49). EM workers' safety climate perceptions may be intuitively affected by the safety standards of their home countries. According to Mohamed et al. (2009), there is little enforcement of national safety regulations in Pakistan. Accident reporting and recording systems in Pakistan are also dysfunctional (Ali 2006). Working in the Pakistani construction industry is likely to be more vulnerable and hazardous than in the construction industry of Hong Kong. In comparison with Nepalese workers, Pakistani workers' mean value scores for Factor 6 "*Safe working attitude and workmate's influence*" was lower. One possible reason for this low scores (Factor 6) could be that Pakistani workers were mainly involved in manual labour whereas the Nepalese workers were mainly specialized metal scaffolders. The latter spent most of their time working at height and were, therefore, more susceptible to injuries. The difference in the types of work may have influenced their perceptions of safety climate. It can also be seen that the Pakistani workers' perception about Factor 2 "*Resources for safety and its effectiveness*" is higher than other factors. The Pakistani workers perceived that resources for health and safety were better in Hong Kong than in their home country's construction industry.

It was observed that average overall SCI score of subcontractors was slightly higher than main contractors. This finding is very interesting to explore further because it is perceived that large scale main contractors may have better and more robust safety management policies, practices and resources for EM workers than small scale subcontractors. For example, Chan et al. (2016b) found that main foreign contractors were better managing the safety and health of EM workers than the small local contractors.

The study showed that EM workers safety perceptions of safety rules and procedures score the lowest among all seven factors. Mohamed (2002) found that the better the perception of safety rules and procedures, the more positive the safety climate. The construction industry of Hong Kong does have clear safety rules and guidelines, but they are bi-lingual (in Chinese and English) and the majority of EM workers are unable to understand Chinese as well as English (Chan et al. 2016a). Although, some EM workers may be able to understand basic Cantonese language, most of them cannot comprehend written Cantonese and their English standard is not high either (Chan et al. 2012; 2014). There is an urgent need to translate the safety promotion material, method statements, safety rules and procedures into EM native languages (Chan et al. 2016b).

Safety is everyone's responsibility and to maintain a safe and healthy workplace is only possible with joint efforts from all workers regardless of their ethnicity. Logistic regression results showed that Factors 3 "*Workers' risk taking behaviour and perception of work risk*" is a significant predictor of injury occurrence for EMs. The possible reason for this may be that EM workers are assigned more labourious and hazardous work without proper training and they are under great pressure to work fast (Dainty et al. 2007; Roelofs et al. 2011; Chan et al. 2016a). While doing the labourious and hazardous work they are facing higher risk of accidents. Factor 5 "*Workers' personal involvement in safety and health"* is another significant predictor of injury occurrences. This may result form the communication barriers of EMs. They have difficulties in reporting hazards to their supervisors, understanding the safety and health materials and training, and communicating with local workers. Also, some personal characteristics of EM workers expose to them to higher accidents such as they are more reserved, afraid of speaking out and cultural barriers (Roelofs et al. 2011; Menzel and Gutierrez 2010; Chan et al. 2016a). To address these problems Chan et al. (2016b) suggested 14 safety management strategies including (1) provide safety training in EM native languages, (2) government and industry associations should take an active role in promoting the health and safety awareness of EM workers, (3) employ EM safety supervisors, officers or managers, and provide career growth and development opportunities for EM workers.

Safety participation is a voluntary act and perhaps frontline workers cannot be forced to participate in such voluntary activities. However, the commitment of managers and frontline supervisors to safety will likely inspire frontline workers to put in extra efforts to improve safety at the workplace (Hon et al. 2014a). Hon et al. further argued that safety compliance is an obligation for workers but safety participation requires extra efforts that are voluntary. This study found safety climate of EM workers was positively related to safety participation and safety compliance echoed with the findings of earlier research. Clarke (2006) and Hon et al. (2014b) found a significant positive relationship between safety climate and safety participation. More self-motivation is needed for safety participation than for safety compliance (Hon et al. 2014b). Christian et al. (2009) argued that safety climate would be strongly related to safety participation than safety compliance, because of voluntary act of participation.

10. Limitations

This study has two limitations. The first concerns with the self-reporting technique used for measuring safety performance. Self-reported injury data may be “insufficiently sensitive, of dubious accuracy, retrospective, and ignores risk exposure” (Glendon and Litherland 2001, p.161). The second limitation lies in Section C of the questionnaire. Questions in Section C were asked to discover near misses and self-reported occupational injuries in the last 12 months. A 12-month reference frame is frequently used in accident surveys to obtain an adequate number of cases for analysis (Nielsen et al. 2008; Hon et al. 2010; 2014a; 2014b). However, a shorter recall period is required for more accurate estimates of self-reported accidents (Landon and Hendricks 1995). To minimize the recall bias, Landon and Hendricks (1995) and Harel et al. (1994) suggested that a recall period between two weeks and a maximum of three months is desirable depending on the severity of the accidents.

11. Conclusions and recommendations

A safety climate questionnaire survey was conducted with 320 EM construction workers in Hong Kong. The study evaluated the level of safety climate reached by EM workers from Nepal (N=255) and Pakistan (N=65). Seven factors effectively defining a healthy safety climate were identified including (1) Safety climate commitment and concern for OSH by organization and management, (2) Resources for promoting safety and its effectiveness, (3) Risk taking behavior and perception of work risk, (4) Workers' perception of safety rules and procedures, (5) Workers' personal involvement in safety and health; (6) Safe working attitude and workmate influence, and (7) Safety promotion and communication. The overall average safety climate score achieved by both EM groups was not very high. The frontline workers group had the lowest safety climate score compared to those of the supervisors and managers. The research found that Factor 5 *"Workers' personal involvement in safety and health"* ranks high. EM workers should actively participate in safety training and for their own safety as well as safety of other coworkers. On the other hand, Factor 4 *"Workers' perception about safety rules and regulations"* ranks below the other factors. The low score for this factor was expected because all safety rules and procedures are bilingual and may not be comprehended by EM workers. Safety enhancement measures and strategies suggested by the authors in another paper should be implemented by the OSHC experts and industry stakeholders. As for the relationships between safety climate and injury occurrences, the study found that the two factors (F3 and F5) were the main ones affecting the likelihood of injury occurrences. The study found that safety climate of EM workers was positively correlated to safety participation and safety compliance.

The safety climate of an organization should be measured on a regular basis which can help safety professionals to identify and improve overall organizational policies, procedures and work practices. The accident statistics of EM workers should be maintained and published by the Labour Department. Research findings would provide an insight into the level of safety climate among EM workers and assist OSH professionals and other industry stakeholders to enhance OSH of EM workers. To the authors' knowledge, this research is the first of its kind in Asia and was conducted in a city where the proportion of EM workers is continuously increasing. The study aimed to analyze the safety climate and safety performance of EM construction workers. Although the study was carried out in Hong Kong, the research findings have wider relevance and are probably useful to the region e.g., Malaysia, Singapore, Korea and could also be applicable in other developed countries such as the US, the UK and Australia as well as the Middle Eastern countries including United Arab Emirates, Qatar, Kuwait and Saudi Arabia which rely heavily on migrant construction workers. Since the number of EM construction workers is continuously increasing, further research on safety of EM construction workers is needed; for example, develop a rigorous structural equation model to evaluate the relationship between the safety climate and safety performance of the EM workers, taking account of the personal demographic variables as control variables. Future work is also needed to explore why there is a difference between Nepalese and Pakistani workers, in their attitudes to safe working, and why there is a difference between local and EM workers.

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Supplemental Data

The Questionnaire Sample is available online in the ASCE Library (http://www.ascelibrary.org).

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Table 1

Table 1. Number of industrial fatalities for local and EM workers in the construction industry of Hong Kong from 2000 till June 2016 (Labour Department 2016)

Accident/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	June 2016	Total
No. of accidents	11925	9206	6239	4367	3833	3548	3400	3042	3033	2755	2884	3112	3160	3232	3467	3723	766	-
No. of local fatalities	28	22	24	24	17	25	15	19	20	17	8	21	24	19	17	18	3	321
No. of EM fatalities	1	6	0	1	0	0	1	0	0	2	1	2	0	3	3	1	1	22
Total fatalities	29	28	24	25	17	25	16	19	20	19	9	23	24	22	20	19	4	343
% of EM fatalities	3.5%	21.4%	-	4%	-	-	6.3%	-	-	10.5%	11.1%	8.7%	-	13.6%	15%	5.3%	25%	6.41%
Employment	79599	80302	73223	64112	63520	59266	52865	50185	49422	50501	55341	62635	71295	80061	86343	101982	106193	-
Overall accident rate/1000 workers	149.8	114.6	85.2	68.1	60.3	59.9	64.3	60.6	61.4	54.6	52.1	49.7	44.3	40.8	41.9	36.51	7.21	-
Overall Fatalities rate/1000 workers	0.36	0.35	0.33	0.39	0.27	0.42	0.30	0.38	0.41	0.38	0.16	0.37	0.34	0.27	.24	.020	.04	-

Table 2

Table 2. Safety climate factors identified by earlier researchers

Number	Safety climate factors	Zohar (1980)	Brown and Holmes (1986)	Dedobbeleer and Beland (1991)	Glendon and Litherland (2001)	Keil (2002)	Mohamed (2002)	Fang et al. (2006)	Choudhry et al. (2009)	Zhou et al. (2011)	Hon et al. (2013)	Total
1	Organization and management commitment	✓	✓	✓		✓	✓	✓	✓	✓	✓	9
2	Resources for safety	✓	✓		✓			✓				4
3	Risk taking behavior		✓			✓	✓	✓				4
4	Perception of safety rules and procedures				✓		✓	✓	✓	✓	✓	6
5	Worker’s personal involvement			✓			✓		✓			3
6	Safe working attitude and workmates' influence					✓		✓		✓		3
7	Safety promotion and communication	✓			✓		✓					3
8	Work pressure				✓		✓					2
9	Appraisal of risks and hazards						✓	✓				2
10	Competence						✓	✓				2
11	Safety training	✓						✓		✓		3
12	Supervisor’s role/influence	✓				✓		✓		✓		4

Table 3

Table 3. Seven safety climate factors (Adapted from the Hong Kong Occupational Safety and Health Council 2008)

Factors	Safety climate factors	Corresponding survey questions
Factor 1	Safety climate commitment and concern for OSH by organization and management	B1, B8, B14, B22, B27, B34
Factor 2	Resources for safety and its effectiveness	B2, B9, B16, B24, B28, B38
Factor 3	Risk taking behavior and perception of work risk	B3, B10, B17, B29, B36
Factor 4	Workers' perception of safety rules and procedures	B4, B11, B18, B23, B32
Factor 5	Workers' personal involvement in safety and health	B5, B12, B19, B26, B30
Factor 6	Safe working attitude and workmates' influence	B6, B13, B20, B25, B31, B35, B37
Factor 7	Safety promotion and communication	B7, B15, B21, B33

Table 4

Table 4. Demographic information of survey respondents

No.	Variables	Meaning	Options	Overall (N = 320)	Percent (%)
1.	POSITION	Working level	Frontline worker	289	90
			Supervisor	24	8
			Manager	7	2
2.	TRADE	Work trade	General labourer,	160	50
			Skilled workers	160	50
3.	AGE	Age of worker	< 20 years	7	2
			21-30	86	27
			31-40	134	42
			41-50	85	27
			51-60	7	.3
			61 or above	4	1
4.	GENDER	Gender of worker	Male	306	96
			Female	14	4
5.	MARRIED	Marital status	Single	76	24
			Married	244	76
6.	SUPPORT	Number of family members to support	None	22	7
			1-2	89	28
			3-4	142	44
			5-6	50	16
			7 or more	17	5
7.	EDU	Education level	Below primary	11	3
			Primary	71	22
			Secondary	157	49
			Certificate/Diploma	67	21
			Degree or higher	14	4
8.	EMPLOYER	Direct employer	Client	-	-
			Main contractor	207	65
			Subcontractor	113	35
			Others	-	-
9.	SERVICE	Length of service with the current company	< 1 year	112	35
			1-5 years	128	40
			6-10 years	48	15
			11-15 years	30	9
			>15 years	2	.6
10.	EXPERIENCE	Working experience in the construction industry	< 5 years	95	30
			6-10 years	125	39
			11-15 years	43	13
			16-20 years	41	13
			> 20 years	14	4
11.	TRAINING	Safety training received	No green card	-	-
			Green card	320	100
			Trade specific safety training	160	50
			Silver card	160	50
12.	SMOKE	Smoking habit	Don't smoke	245	77
			Smoke, but not at work	63	20
			Smoke, even at work	12	4
13.	DRINK	Drinking habit	Don't drink	227	71
			Drink, but not at work	93	29
			Drink, even at work	-	-

Table 5

Table 5. Mean and SD safety climate factor scores of EM workers

Safety climate factors	All		Ethnic groups				Working level						Employer			
			Nepalese		Pakistani		Frontline workers		Supervisors		Managers		Contractor		Sub-contractor	
	Mean (N = 320)	^SD	Mean (N = 255)	SD	Mean (N = 65)	SD	Mean (N = 289)	SD	Mean (N = 24)	SD	Mean (N = 7)	SD	Mean (N = 207)	SD	Mean (N = 113)	SD
Overall average safety climate score	3.54	.34	3.49	.39	3.72	.36	3.53	.40	3.66	.24	3.69	.46	3.50	.41	3.60	.36
*Factor 1: Safety climate commitment and concern for OSH by organization and management	3.40	.55	3.34	.53	3.63	.57	3.37	.56	3.49	.45	3.73	.45	3.39	.51	3.41	.62
Factor 2: Resources for safety and its effectiveness	3.90	.60	3.82	.58	4.19	.57	3.86	.61	4.12	.35	4.06	.78	3.84	.62	3.99	.55
*Factor 3: Risk taking behavior and perception of work risk	3.27	.62	3.21	.58	3.51	.68	3.25	.62	3.40	.50	3.62	.59	3.24	.58	3.32	.67
*Factor 4: Perception of safety rules and procedures	3.15	.57	3.08	.53	3.42	.64	3.14	.58	3.21	.48	3.34	.40	3.16	.59	3.13	.54
Factor 5: Workers' personal involvement in safety and health	3.40	.63	3.93	.64	4.13	.55	3.95	.64	4.12	.37	4.06	.59	3.90	.66	4.08	.54
*Factor 6: Safe working attitude and workmates' influence	3.45	.51	3.47	.51	3.41	.51	3.45	.52	3.49	.44	3.35	.56	3.41	.49	3.54	.55
Factor 7: Safety promotion and communication	3.62	.69	3.54	.67	3.92	.65	3.60	.69	3.87	.53	3.64	.71	3.56	.68	3.73	.69

^ *SD=Standard deviation*

Table 6

Table 6. Mean and SD safety climate factor scores comparison at demographic level

Safety climate factors	Employees who were 30 years or below (N=93)	^SD	Employees who were over 30 years old (N=223)	SD	Single employees (N=76)	SD	Married employees (N=244)	SD	Primary education or below (N=82)	SD	Higher than primary education (N=93)
Overall mean safety climate score	3.55	.43	3.53	.38	3.42	.43	3.57	.38	3.43	.44	3.57
F1	3.38	.60	3.41	.53	3.29	.58	3.43	.54	3.35	.62	3.41
F2	3.90	.63	3.90	.58	3.75	.65	3.93	.57	3.80	.65	3.92
F3	3.28	.61	3.27	.62	3.19	.54	3.29	.64	3.14	.66	3.31
F4	3.12	.62	3.16	.54	3.09	.63	3.17	.55	3.08	.59	3.17
F5	4.00	.53	3.95	.63	3.76	.67	4.03	.60	3.76	.71	4.04
F6	3.47	.67	3.46	.50	3.33	.53	3.49	.52	3.34	.61	3.49
F7	3.71	.43	3.59	.69	3.52	.67	3.65	.69	3.55	.76	3.64

^SD=Standard deviation, Nepalese = 255 and Pakistani = 65

Table 7

Table 7. Logistic regression model for all ethnic minority workers

Safety climate factors	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Factor1	.288	.356	.653	1	.419	1.334	.663	2.681
Factor2	-.772	.403	3.661	1	.056	.462	.210	1.019
Factor3	-.608	.301	4.077	1	.043	.544*	.302	.982
Factor4	-.116	.323	.129	1	.719	.890	.473	1.676
Factor5	-1.529	.338	20.449	1	.000	.217*	.112	.420
Factor6	.074	.385	.037	1	.847	1.077	.506	2.290
Factor7	.149	.310	.230	1	.632	1.160	.632	2.130
Constant	5.797	1.665	12.123	1	0	329.282		
Omnibus test of model coefficients	$\chi^2 = 73.831$, df = 7, p=.000							
Cox and Snell R^2	.213							
Nagelkerke R^2	.314							
Hosmer and Lemeshow Test	$\chi^2 = 11.393$, df = 8, p=.180							
Classification (overall %)	81.6							

*Note: *p< 0.05 level*

Table 8

Table 8. Pearson correlation between safety climate factors and safety participation and safety compliance

Safety climate factors	*Safety participation*		*Safety compliance*	
	Safety participation extra effort	Safety participation tasks	Self-safety compliance	Coworkers safety compliance
Overall safety climate	.278**	.300**	.245**	.371**
	.000	.000	.000	.000
Factor 1	.105	.155**	.161**	.282*
	.062	.006	.005	.000
Factor 2	.296**	.322**	.113	.241*
	.000	.000	.051	.000
Factor 3	.044	.052	.197**	.183*
	.435	.361	.001	.002
Factor 4	.093	.129*	.147*	.142*
	.101	.023	.011	.014
Factor 5	.260**	.290**	.244**	.334**
	.000	.000	.000	.000
Factor 6	.220**	.163**	.165**	.291**
	.000	.004	.004	.000
Factor 7	.257**	.266**	.128*	.269**
	.000	.000	.027	.000

*Note: **p< 0.01 level and *p< 0.05 level,* Total sample size = 320, Nepalese = 255, Pakistani = 65