ORIGINAL ARTICLE

Investigating Safety Climate, Safety Performance, and Needlestick and Sharps Injuries in Iranian Hospitals

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Abstract

Background: Needlestick and sharps injuries (NSIs) are a major issue in healthcare settings and should be properly managed. As a type of occupational accident, NSIs are rooted in many causes, including poor safety climate. The current study was conducted to find links among safety climate, safety performance, and NSIs.

Methods: The study was cross-sectional and all data were collected in 2020. The sample was composed of 221 nurses. Two dimensions of safety performance and six dimensions of safety climate alongside the experience of NSIs in the last year were investigated using validated questionnaires. The path analysis model was built and tested using Mplus software package.

Results: The path analysis model was acceptable in terms of goodness-of-fit metrics. The model supported the mediating role of safety performance on the relationship between safety climate and NSIs. Among safety climate dimensions, safety training had the highest relationship with safety performance dimensions, followed by attitude toward error reporting and cumulative fatigue. Safety participation had a stronger effect on NSIs than safety compliance.

Conclusion: As all safety climate dimensions were significantly correlated with safety performance dimensions and NSIs, promoting safety climate can be effective in improving safety performance and preventing NSIs among nurses.

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Introduction

Many types of occupational accidents may occur in healthcare settings, such as electrocution, falling from height, slipping and tipping, exposure to hazardous chemicals and medicines, injuries to musculoskeletal system, exposure to radiation, and so on.[1] However, needlestick and sharps injuries (NSIs) has been reported to be the most prevalent type of occupational injury among hospital staff, particularly nurses.[2] Many nurses experience various forms of NSIs annually. Transmission of blood-borne infectious diseases,[3] psychiatric consequences,[4] and economic burden[5] are the main challenges created by NSIs. Therefore, NSIs need to be properly managed and prevented. Similar to other accidents, NSIs are multifactorial and there are a variety of factors with the potential to affect them. As reviewed by Akbari et al.[6] job stress, insufficient skills, not considering the precautions, improper work scheduling, inadequate staffing, deficiencies in the guidelines and procedures, fatigue, and suboptimal safety training all can influence the occurrence of NSIs in healthcare settings. Safety climate is another important factor reported by several studies.[7]

First conceptualized by Zohar,[8] safety climate has been defined as the shared perception of employees toward safety within an organization. It reflects the relative importance of safety over other organizational

issues and metrics, particularly production. Safety climate determines the way of performing tasks and interaction among employees.[9] It also has been regarded as the foundation of other safety-directed activities. In other words, without a proper and positive safety climate, other safety-related activities in the organization are unlikely to be effective. Therefore, in order to improve overall safety and related indices in an organization, it is of pivotal importance to equip the organization with a positive safety climate.

Safety climate can affect many aspects of employees' health and safety at workplaces. It was demonstrated that a poor safety climate is significantly associated with burnout among healthcare staff.[10] Safety climate affects the psychological well-being of construction workers.[11] According to another study, safety climate is able to negatively affect both stress and inattention at work.[12] Safety climate has also been introduced as a determinant of employees' safety performance and other safety outcomes. Safety climate is a strong moderator as well because it can alleviate the negative effects of some upstream factors on safety outcomes. In this vein, it was demonstrated by previous studies that safety climate can compensate for the negative effect of poor staffing, unpleasant work conditions,[13] and job insecurity[14] on occupational injuries and other safety outcomes.

Safety performance encompasses all behaviors of employees at workplace, which directly or indirectly affect the safety of the organization. It is composed of two dimensions: safety compliance and safety participation. Safety compliance are those behaviors which should be adopted by mandatory safety rules, standards, and regulations, while safety participation is voluntary but can promote overall safety profoundly. Unsafe conditions and anomaly reporting are common types of safety participation. Deviation from safety compliance may cause the punishment of employees while there is no enforcement on safety participation. In contrast to incidents and injuries, safety performance is a leading indicator of safety. The desired level of safety performance in an organization is a sign of good safety practices and a low probability of incidents. Previous studies have found that a high proportion of accidents are because of poor safety performance and unsafe behaviors.[15, 16]

According to the previous literature,[17–21] both dimensions of safety performance are tremendously affected by safety climate.

The current work was conducted to assess the relationship among safety climate, safety performance, and NSIs in selected Iranian teaching hospitals. The followings are the hypotheses to be investigated in this study:

Hypothesis 1: Safety climate dimensions can positively affect safety performance dimensions

Hypothesis 2: Safety performance dimensions can negatively affect NSIs

Hypothesis 3: Safety performance dimensions mediate the relationship between safety climate dimensions and NSIs.

Methods

Participants

Three teaching hospitals agreed to involve in the current study. The study was cross-sectional and all data were collected in 2020. Nurses with at least one year experience were recruited. The convenience sampling was the method of data collection and the participation was voluntary.

Data Collection Tools

The questionnaire developed and validated by Zarei et al.[10] was utilized for assessing the perceived safety climate among participants. This tool assessed six dimensions of safety climate: relationships among nurses (four items), cumulative fatigue (four items), communication with physicians (four items), attitude of supervisors (four items), attitude toward reporting (three items), and safety training (five items). All items should be answered on a 5-point Likert scale, ranging from totally disagree (score 1) to totally agree (score 5).

Safety performance was assessed using the scale validated by Ghasemi et al.[21] The questionnaire assessed two dimensions of safety performance on a 5-point Likert scale, including safety compliance (three items) and safety participation (four items). NSIs during the last six months were also asked and recorded.

The reliability of the tools used in this study was assessed with Cronbach's α.[22] As this index was higher than 0.7 for all scales, their reliability was in an acceptable range.

Statistical Analyses

As mentioned in the introduction section, the aim of the current study was to create a path analysis model to explain the association between nurses' safety climate, safety performance, and NSIs. Path analysis was accomplished by Mplus version 7.1. The significance of each path was evaluated using t-value (t-value>1.96, significant at 0.05). Goodness-of-fit (GFI), comparative fit index (CFI), incremental fit index (IFI), root mean square error of approximation (RMSEA), and χ^2/df were the indices based on which the model fit was judged.

Arak University of Medical Sciences approved the step-by-step procedure of this study (Ethical code: IR.ARAKMU.REC.1400.088).

Results

Participants

The average age of the nurses was 31.4 years (SD=5.7). The average years of experience were 6.7 years (SD=5.2). About 60% of the nurses were female and 58% of them were married. Table 1 shows the characteristics information of the study subjects.

Bivariate Analysis

Table 2 shows the Pearson correlation coefficients among the variables The correlations among all variables were significant except for the correlations between "cumulative fatigue" and "safety participation", "communication with physicians" and "safety compliance", and between "attitude of supervisors" and "NSIs".

Path Analysis

Table 3 shows the results of the model fit. According to the table, all model fit indices are at a desired value.

Figure 1 shows the path diagram model. The effects of all dimensions of safety climate on NSIs

Table 1: Characteristics of the study subjects

Characteristic	Group	n (%)
Gender	Male	91 (41.2)
	Female	130 (58.8)
Marital status	Single	83 (37.5)
	Married	128 (58.0)
	Other	10 (4.5)
Age (years)	20-30	121 (54.7)
	30-40	74 (33.5)
	40-50	22 (10.0)
	>50	4 (1.8)
Education degree	Diploma	9 (4.0)
	Bachelors	187 (84.6)
	Master	25 (11.4)
Job experience (years)	1-5	114 (51.6)
	5-10	50 (22.6)
	10-15	42 (19.0)
	>15	15 (6.8)
Shift type	Morning	58 (26.2)
	Afternoon	22 (10.0)
	Night	18 (8.1)
	Rotational	123 (55.7)

Table 2: Inter-correlation matrix for latent variables and needlestick and sharps injuries

	Mean±SD	CF	ST	CP	NR	AS	ATR	SC	SP
CF	2.41±1.14								
ST	3.22±0.81	0.392**							
CP	3.11±0.83	0.161**	0.323**						
NR	3.49±0.82	0.320**	0.467**	0.416**					
AS	3.31±0.89	0.457**	0.519*	0.237**	0.515**				
ATR	3.61±0.91	0.182**	0.532**	0.099*	0.208**	0.412**			
SC	3.63±0.90	0.104**	0.664**	0.319**	0.413*	0.516**	0.675**		
SP	3.71±0.81	0.283	0.532**	0.186	0.576**	0.314**	0.492**	0.674**	
NSIs	N/A	0.231**	-0.132*	-0.010*	-0.147*	0.098	-0.328**	-0.415**	-0.460*

CF: Cumulative fatigue; ST: Safety training; CP: Communication with physicians; NR: Nurses relationships; AS: Attitude of supervisors; ATR: Attitude toward reporting; SC: Safety compliance; SP: Safety participation; NSIs: Needlestick and sharps injuries; **P<0.01, *P<0.05.

Table 3: Model fit indices

Index	Value	Acceptable level
χ^2/df	1.811	>2.00
CFI	0.981	<0.90
IFI	0.992	<0.95
GFI	0.991	<0.95
RMSEA	0.061	>0.07

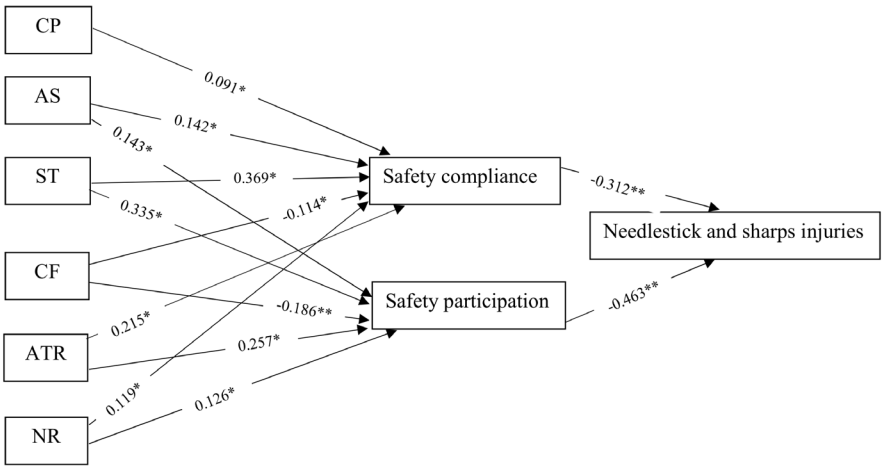

Figure 1: Path diagram model. CF: Cumulative fatigue; ST: Safety training; CP: Communication with physicians; NR: Nurses relationships; AS: Attitude of supervisors; ATR: Attitude toward reporting; **P<0.01, *P<0.05.

Table 4: Direct, indirect, and total effects of safety climate and safety performance on needlestick and sharps injuries

	CF	ST	CP	NR	AS	ATR	SC	SP
SC								
Direct effect	-0.114**	0.369**	0.091*	0.119*	0.142**	0.215**		
Indirect effect								
Total effect	-0.114**	0.369**	0.091*	0.119*	0.142**	0.215**		
SP								
Direct effect	-0.186**	0.335**		0.126*	0.124*	0.257**		
Indirect effect								
Total effect	-0.186**	0.335**		0.126*	0.124*	0.257**		
NSIs								
Direct effect							-0.312**	-0.463**
Indirect effect	-0.041	0.054	0.019	0.031	0.024	0.049		
Total effect	-0.041	0.054	0.019	0.031	0.024	0.049	-0.312**	-0.463**

CF: Cumulative fatigue; ST: Safety training; CP: Communication with physicians; NR: Nurses relationships; AS: Attitude of supervisors; ATR: Attitude toward reporting; SC: Safety compliance; SP: Safety participation; **P<0.01, *P<0.05.

are indirect and mediated by safety performance dimensions. Except for cumulative fatigue, improving other dimensions of safety climate led to improvement of safety performance dimensions. Safety training had the strongest effect; in contrast, the communication with physicians had the weakest.

Also, improving both dimensions of safety performance significantly decreased NSIs. Safety participation had a stronger impact on NSIs than safety compliance.

Table 4 shows the direct, indirect, and total effects of safety climate dimensions and safety performance dimensions on NSIs. "safety compliance", "safety participation", and "safety training" had the greatest total effect on NSIs. Moreover, "safety participation" had the greatest direct effect on NSIs followed by "safety compliance". "safety training", "attitude toward reporting", and "cumulative fatigue" had the greatest indirect effect on NSIs.

Discussion

In this study, the authors investigated the relationships among safety climate, safety performance, and NSIs. The findings suggested that safety climate dimensions could predict nurses' safety performance, and safety performance mediates the relationship between occupational safety climate dimensions and NSIs in the hospital. The study of mediation variables is crucial because it helps to get a deeper insight into the mechanisms through which safety climate may affect nurses' safety performance and decrease the risk of injury. According to the results of the present study, the effect of safety climate dimensions on NSIs was mediated by safety performance dimensions. The findings are in line with those of previous works such as the meta-analysis conducted by Clarke.[23] However, the relationship between safety performance and accidents was weak,[23] which differs from the results of the current study, as we found a significant relationship between these two constructs.

In the path model of this study, there are links between particular dimensions of occupational safety climate, such as cumulative fatigue, safety training, communication with physicians, nurses' relationships, attitude of supervisors, attitude toward reporting, and safety performance, such as safety compliance and safety participation. Based on the path model

results, safety training, nurses' relationships, attitude of supervisors, and attitude toward reporting had a positive relationship with dimensions of safety performance. Also, cumulative fatigue had a negative relationship with dimensions of safety performance. Moreover, two dimensions of safety performance had a negative relationship with NSIs.

Path analysis results revealed that among safety climate dimensions, safety training was the most important factor affecting safety compliance (β=0.369, P<0.05) and safety participation (β=0.335, P<0.05). Moreover, the total effect of this dimension on NSIs is higher than other safety climate dimensions. These findings are in line with Ghasemi et al.,[21] in which it was showed that safety training is the main factor to predict nurses' safety performance. Workplace high-quality safety training programs can enhance workers' knowledge and improve workers' safety performance.[24] Hassan and Esmail[25] demonstrated that safety management practices such as safety training had significant effects on safety performance. Intensive safety training courses are more effective in improving safety performance of employees.[26] A well-designed training course promotes safety knowledge of employees, while an intensive safety training course increases both the knowledge and skills required to perform the tasks safely. Robson et al.[27] confirmed that occupational health and safety training could be effective in improving safe work behaviors of employees, but its effect on occupational injuries and incidents needs more studies. Similarly, Ricci et al.[28] demonstrated the effectiveness of occupational health and safety training in modifying employees' attitudes and beliefs and improving their safety behavior. Yang et al.[29] reported that training programs were effective in reducing the rate of NSIs. However, it should be noted that safety training must be well-designed to be effective. There are many studies reporting safety training cannot improve safety behavior or reduce the rate of occupational injuries.[30, 31] Casey et al.[32] developed the rich model of safety training engagement and transfer. According to this model, the effectiveness of safety training depends on its ability to engage workers affectively, cognitively, and behaviorally. This model also attempts to explain what should be done before, during, and after a training course to ensure its effectiveness. This method can be useful in designing effective safety training courses.

Based on path model, after safety training, attitude toward reporting was the second important factor in anticipating safety compliance (β=0.215, P<0.05) and safety participation (β=0.257, P<0.05). Richter et al.[33] demonstrated a relationship between attitude toward error reporting and safety performance. Also, Kagan et al.[34] demonstrated a positive significant correlation between personal performance levels and the error-reporting rate.

Cumulative fatigue was the third most influential factor affecting safety performance and NSIs. The negative effect of fatigue on safety outcomes, such as injuries, accidents, safety behavior, and errors, has been well-documented in literature[35, 36] Fatigue can make a disruption in the employees' mental and cognitive functions and negatively affect their performance.[37, 38] Implementation of fatigue countermeasure programs in hospitals seems necessary.[39, 40] Such programs must be comprehensive and encompass all organizational, environmental, social, and cultural issues. As sleep deprivation is commonly regarded as the most important cause of fatigue,[37, 38] improving sleep quality and quantity can be very effective in reducing fatigue. Noise level below 35 dB, ambient temperature between 17 and 28 °C at 40–60% relative humidity, and complete darkness are characteristics of the optimal sleep environment.[41] Aroma-inhalation therapy, shift-rotation, physical activity, and cognitive-behavioral therapy are common strategies for improving the nurses' sleep quality, among them aroma-inhalation therapy is more effective.[42] Moderate physical activity, not rigorous ones, is also very useful.[43]

Furthermore, it was indicated that safety participation is a better predictor (β=-0.463, P<0.01) than safety compliance (β=-0.312, P<0.01) for NSIs. The results align with previous studies.[44-46] Clarke[22] demonstrated that safety participation is more capable than safety compliance in influencing workplace accidents. Although safety compliance is important in preventing occupational accidents, it is employees' safety participation that improves the overall level of safety in the organization. Some strategies such as supervision and punishment systems promote safety compliance, while safety participation is attained when employees deeply believe in safety and its advantages.

Similar to other studies, this study has several limitations to be mentioned. All the results and conclusions are based on a limited data set, so they cannot be safely generalized. Moreover, the design of the study was cross-sectional, so cause and effect relationships should be used and interpreted with caution. Conducting longitudinal studies on the relationship among safety climate, safety performance, and occupational injuries are highly recommended. Moreover, it is recommended to include factors other than safety climate dimensions into the model. Work-family conflict, management/leadership styles, psychosocial factors at workplace, workload, work pressure, and so on are some factors which can affect both safety performance and the rate of NSIs among nurses. The SEM model can be analyzed using other methods such as Bayesian network, which can provide a deeper insight into factors affecting NSIs in healthcare settings. So, it is recommended for future studies to integrate these two approaches.

Conclusion

In conclusion, safety climate was significantly related to safety performance and NSIs. Safety training was the most influential factor among safety climate dimensions and the effect of safety participation was higher than other safety performance dimensions.

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