



Dimensions of Safety Climate among Iranian Nurses

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Abstract

Background: Workplace safety has been a concern of workers and managers for decades. Measuring safety climate is crucial in improving safety performance. It is also a method of benchmarking safety perception.

Objective: To develop and validate a psychometrics scale for measuring nurses' safety climate.

Methods: Literature review, subject matter experts and nurse's judgment were used in items developing. Content validity and reliability for new tool were tested by content validity index (CVI) and test-retest analysis, respectively. Exploratory factor analysis (EFA) with varimax rotation was used to improve the interpretation of latent factors.

Results: A 40-item scale in 6 factors was developed, which could explain 55% of the observed variance. The 6 factors included employees' involvement in safety and management support, compliance with safety rules, safety training and accessibility to personal protective equipment, hindrance to safe work, safety communication and job pressure, and individual risk perception.

Conclusion: The proposed scale can be used in identifying the needed areas to implement interventions in safety climate of nurses.

Keywords: Nurses; Safety climate scale; Reliability; Validity; Questionnaire

Introduction

The theory of safety climate was originated in 1980, when Zohar was studying industrial organization. He defines safety climate as "employees' perceptions about the relative importance of safe conduct in their occupational behavior."¹ The theory of positive safety climate-safe behavior-accidents prevention path was studied several times.²⁻⁶

Stability of safety climate dimensions across organizations is in doubt.⁷ The questionnaire is the most commonly used tool for measuring safety climate. Several

safety climate questionnaires have so far been developed. However, their usefulness depends on their psychometric quality and reproducibility.⁶ Measuring safety climate between an aviation industry and a health care providers (HCPs) using similar questions, has reported little similarity between their extracted dimensions.⁸ Flin, *et al*, in their review noted that management/supervisors, safety systems, risk perception, job demands, reporting/speaking up, safety attitudes/behaviors, communication/feedback, teamwork, personal resources and organizational factors as safety climate features in health care. However,

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TAKE-HOME MESSAGE

- The stability of safety climate dimensions across organizations is in doubt.
- In health care organizations, researchers have concentrated much more on patient safety climate than personnel safety climate.
- The employees' involvement in safety and management support was a main factor of safety climate (explaining 18% of the variance) with more loadings for employees' involvement items.

they concluded that the developed instruments for measuring health care's safety climate need more consideration in terms of their psychometrics properties.⁹

On the other hand, in health care organizations, researchers have concentrated much more on patient safety climate than personnel safety climate.¹⁰⁻¹⁴ There are limited studies that have addressed safety climate among HCPs,¹⁵⁻¹⁷ probably, because of powerful laws that support patient rights and surveillance of this issue. Dimensions of safety climate in health care organizations are not the same.⁹ Researchers concluded that safety climate is affected by work area as well as disciplines. Multicultural nurses in Saudi Arabia revealed that safety climate was significantly affected by national background.¹⁴ HCPs are busy people so it is not practical to use time-consuming methods such as interview or focus group discussion to investigate safety climate among them.¹⁷

We therefore tried to develop and validate a new native scale for exploration the safety climate dimensions for Iranian nurses—a subgroup of HCPs.

Materials and Methods

Sampling

Nurses with more than one-year work ex-

perience in Alborz province hospitals, were considered the study population. Nurses from surgery, pediatric, dialysis unit, intensive care units, and neurology wards as well as the emergency department participated in this study voluntarily. All participants were briefed on the study. They had two weeks times to respond.

Content validity

The initial items of safety climate scale (71 items) were developed based on literature review of existing safety climate tools.¹⁸⁻²⁰ Each distinct safety climate dimension adopted from literature, had at least three items in the initial questionnaire to provide requirements of scale's construct validity test.²¹ The questionnaire was sent to 10 members' panel of experts via e-mail or delivered by paper. They were asked to rate each item in terms of relevance, clarity, and simplicity criteria using a 4-point scale (for example about relevancy of item: "Not relevant"=1, "Needs some revision"=2, "Relevant but needs minor revision"=3, "Very relevant"=4). In addition, they were sought to evaluate the overall comprehensiveness of the entire measure by either adding new items or deleting the existing ones. Experts' responses were entered to a spreadsheet and content validity index (CVI) of each item was calculated as the count of experts who rated the item 3 or 4 divided by the total number of experts. Those items with relevancy's CVI <0.75 were omitted.²² The remaining items that obtained CVI <0.75 in terms of clarity and simplicity were revised based on experts' judgment for wording, clearness, and simplicity. In the next step, questionnaires were presented to 13 nurses with more than one-year experience in their profession to involve target population in content validity process. Same as experts, after determining CVI for each item, deletion or modification were done.^{22,23}

For more information on factors influencing compliance with infection control practice in Japanese dentists see <http://www.theijoem.com/ijoem/index.php/ijoem/article/view/298>



Reliability Assessment

The reliability of the measure was assessed by test-retest analysis. For this purpose, anonymous questionnaires were distributed twice among 30 nurses within two weeks interval. Total internal consistency of the scale was checked based on Cronbach's α coefficient.

Factor Analysis

The questionnaires were delivered to nurses anonymously in the hospitals to finalize the items and to ensure construct validity. For each item, 10 subjects appointed as sample size for exploratory factor analysis (EFA) according to new scale developing studies.^{24,25} To be more conservative, the questionnaire was delivered to 900 participants. Items were worded in both positive and negative types. A 5-point Likert scale was used to respond to items. The scale ranged from "Strongly disagree" (=1) to "Strongly agree" (=5) for positive items; negative items were ranked inversely. The questionnaire was included 13 negatively worded items. It is believed that using combination of positive and negative items, reduce bias in response style²⁶.

Data were analyzed by SPSS[®] for Windows[®] ver 19. Adequacy of the sample size for factor analysis was tested by Kaiser-Meyer-Olkin (KMO) test.²⁷ Inter-item correlation were tested and the questionnaire items with correlation coefficient of <0.3 as well as items with communality of <0.5 were deleted.²⁴ Principal components analysis (PCA) with unrotated solution was used to identify the associated dimensions. According to the sample size, loading factors ≥ 0.3 were subjected for factor analysis.²⁵ Iterative process was used to remove items with same loading on more than one factor. EFA with varimax rotation were used to improve interpretation of latent factors with loading factors ≥ 0.45 . Factor loading of ± 0.4 indicates the item is more important and ± 0.5 means the item is sig-

nificant.²⁸ After extraction of factors with loading factor ≥ 0.45 , items with cross-loading were dropped (two items) and analysis was performed for the remaining items. Interpretation and labeling of dimensions were done based on items with same loading on a factor and items theme. Internal consistency between items of each factor was tested based on Cronbach's α coefficient.

Result

The mean age of participants was 33.3 (SD 6.2) years. Majority of the participants were female (87.2%). The mean work experience of nurses was 7.5 (SD 5.1) years. Response rate was 62%—153 out of 560 returned questionnaires were dropped from data because of protest responses that showed systematic response patterns or more missing items and also other education. For factor analysis, 407 retained subjects who provided a missing response to any items, were excluded by listwise deletion.¹⁸

Chronbach's α coefficient was 0.91 for the total items of the scale that reflected suitable internal consistency of the scale. Pearson correlation coefficient was 0.765 for test -retest reflecting appropriate stability of the developed scale over time.²⁴ The KMO index was 0.91 that indicated the sample size was adequate. Principal components analysis (PCA) was resulted in 12 factors with eigenvalues >1 that could explain 67% of the observed variance. Some factors had no items or low items loading and did not meet the required criteria to remain as a factor.²⁹⁻³¹ Therefore, factor analysis was conducted in the iterative process for different number of factors.^{5,6} The best solution of factor analysis with varimax rotation resulted in a 40-item scale with six dimensions. These dimensions were able to explain 55% of the variance. Each factor was labeled in accordance to the set of con-

For more information on Persian version of the questionnaire see the online version of the article.

Table 1: Exploratory factor analysis (EFA) results for nurses' safety climate scale[†]

Item	Loading factor						Agree or strongly agree (%)
	1	2	3	4	5	6	
42. I am involved in decision making related to safety.	0.790	0.171	-0.058	-0.078	-0.067	-0.033	44
50. Employees are encouraged to raise safety concerns.	0.750	0.161	0.074	0.067	0.274	-0.031	48.9
41. I am involved in the ongoing issue and revision of safety procedures.	0.746	0.035	0.077	-0.203	-0.006	0.020	38
44. Employees are involved in safety and health training needs assessment.	0.745	0.056	0.241	0.048	0.068	-0.044	49.1
48. I have an active role in planning and decision making related to safety.	0.708	0.005	0.156	0.006	0.217	0.065	43.3
43. Manager/supervisor encourage employees to report unsafe conditions.	0.647	0.335	0.165	-0.010	0.060	-0.041	62.4
49. Co-workers encourage me to report unsafe conditions.	0.624	0.063	0.102	-0.108	0.380	0.084	50.9
31. I often talk to my manager/supervisor about safety related matters.	0.615	0.345	0.036	0.109	0.192	0.028	560.7
53. Employees are encouraged because of their innovation to improve safety.	0.615	-0.036	0.160	-0.005	0.170	-0.150	63.9
21. My manager/supervisor always inform me of current safety and health committee issue.	0.603	0.256	0.275	-0.132	-0.020	-0.055	50.3
32. I easily have access to SDS and safety equipment in my workplace (Safety Data Sheet).	0.595	0.326	0.308	0.129	0.116	-0.028	62.6
51. I can influence health and safety performance here.	0.561	0.392	0.226	-0.044	0.180	-0.014	66.4
45. I am involved in informing my supervisor of important safety and health issues.	0.554	0.272	0.092	-0.157	0.183	0.145	71.7
33. After employees accident investigated, learned lessons communicate to personnel in order to prevent it from reoccur.	0.502	0.261	0.295	0.027	0.345	0.132	62.7
24. In my workplace hospital management acts quickly to correct safety problems.	0.499	0.221	0.394	0.165	0.236	-0.158	41.7
25. Management welcomes feedback on safety issues.	0.453	-0.097	0.319	0.211	0.049	-0.332	47.9
19. Carefully following safety rules and procedures are of my great importance.	0.008	0.714	-0.054	-0.029	0.029	0.245	88.5

Continued

Table 1: Exploratory factor analysis (EFA) results for nurses' safety climate scale[†]

Item	Loading factor						Agree or strongly agree (%)
	1	2	3	4	5	6	
20. I know health and safety rules and procedures related to my job.	0.223	0.676	0.222	-0.084	-0.037	0.162	79.4
14. I trained in correctly apply personal protective equipment to prevent contact with infectious agents.	0.167	0.658	0.322	0.138	0.106	-0.065	77.2
29. I am aware of the hazards associated with my job.	0.251	0.587	0.102	0.080	0.285	-0.003	79.9
22. I think provided safety training is improving safety in my workplace.	0.366	0.569	0.131	0.101	0.196	0.041	73
30. My supervisor often inform me of current concerns and issues related to health and safety.	0.288	0.564	0.141	0.022	0.125	0.134	73.2
9. Disposable masks are available in my workplace.	0.067	0.520	0.088	-0.071	0.487	0.117	71.9
13. Disposable gloves are readily available in my workplace.	-0.023	0.506	0.005	-0.111	0.431	0.081	85.8
38. In my unit, safety rules and procedures has been developed to reduce the hazards.	0.438	0.475	0.323	-0.171	0.112	-0.009	68.1
2. Health and safety training related to my job are conducted.	0.135	0.098	0.755	-0.014	0.056	0.049	77.2
3. Implemented health and safety training have appropriate quality.	0.264	0.177	0.748	0.131	0.175	-0.002	64.8
4. I always get the equipment I need to do the job safely.	0.293	0.152	0.607	0.080	0.294	-0.149	58.4
5. Safety procedures are quickly available when they are needed.	0.326	0.300	0.570	0.047	0.137	-0.031	69.6
37. My workplace is crowded.	0.020	0.213	-0.290	0.695	0.012	-0.180	63.9
40. Sometimes because of work condition, I ignore the safety and health principles.	-0.037	-0.190	0.072	0.680	0.101	0.042	64.2
39. Some health and safety rules and procedures are not really practical.	0.023	-0.240	0.021	0.670	0.052	0.123	64.1
36. My workplace is messy.	-0.083	0.301	0.048	0.656	-0.058	0.014	34.6
17. In my workplace management turn a blind eye to safety issues.	-0.022	0.156	0.233	0.592	0.011	0.125	41
8. Always I am given enough time to get the job done safely.	0.338	0.083	0.262	0.257	0.610	-0.268	39.8

Continued

Table 1: Exploratory factor analysis (EFA) results for nurses' safety climate scale[†]

Item	Loading factor						Agree or strongly agree (%)
	1	2	3	4	5	6	
7. Co-workers often talk to each other on how to work safely.	0.158	0.232	0.122	0.020	0.592	0.189	67.8
47. Co-workers often give tips to each other on how to work safely.	0.428	0.259	0.056	-0.075	0.523	0.108	66.8
10. There are always enough people available to get the job done safely.	0.369	-0.049	0.308	0.114	0.490	-0.218	36.4
28. While working, I take the way that has less hazards.	0.141	0.197	-0.013	0.046	0.121	0.766	72
27. I am rarely worried about being injured on the job.	-0.076	0.155	-0.073	0.242	-0.053	0.765	34.9

[†]Varimax rotation

Note: Bold face shows items comprising each factor.

tained items. Items and their loading factors are presented in Table 1. The extracted factors, Chronbach's α coefficient for items of each factor and the portion of the variance explained by the items are presented in Table 2.

Discussion

The objective of this study was to develop a new native scale for measuring nurses' safety climate. The factor analysis resulted in six dimensions for the new scale. The items' internal consistency for dimensions ranged from 0.70 to 0.93, which on account of the values reported in similar studies (0.71–0.84¹⁵ and 0.62–0.93⁹) are a common range for safety climate studies in health care sector. Chronbach's α coefficient was high for the first factors consisting of 16 items; that would be attributed to the large number of included items in this factor.³¹

The explored dimensions explained 55% of the variance. The value is relatively less than that reported by similar study (64.9%) which was conducted in China.¹⁷

We found the employees' involvement in safety and management support was a main factor of safety climate (explaining 18% of the variance) with more loadings for employees' involvement items. However, review of the implemented studies in both industry and health care settings identified the management commitment as the most important factor in health care organizations. Job demands include items relevant to the adequacy of workforce to manage workload in a timely manner.³³ Gaba, *et al*, emphasized the role of management as an impressive key factor on staff's safety climate perceptions.⁸ Our findings also emphasized on employee's involvement as well as management role in safety climate perception as an important factor. Most of the explored factors in the present study were similar to the initially used scales for item generation including the management support, absence of environmental hindrances, cleanliness of worksite, communication, training and availability of protective equipment.¹⁵ The aforementioned extracted factors were confirmed in another study, which

Table 2: Labeling of extracted dimensions

Factor number	Factor names	Number of items	Percentage of variance explained	Cronbach's α each factor	Cronbach's α total items
1	Employees' involvement in safety and management support	16	18.2	0.93	0.91
2	Accessibility to PPE and compliance of safety rules	9	11.1	0.85	
3	Safety training	4	8.0	0.83	
4	Hindrances of safe work	5	6.7	0.70	
5	Safety communication and job pressure	4	6.4	0.75	
6	Risk perception	2	4.6	0.74	

used the similar scale with minor modifications.³⁴ A study on safety climate in a Chinese health care practice identified the same four factors for safety climate. The extracted factors, however, were labeled with different names, such as “employees interaction,” “housekeeping,” “employee personal perception,” and “time pressure.”¹⁷ Hahn, *et al*, attempted to develop a general short scale for safety climate. Management commitment, feedback of safety performance, worker involvement and norms of safety behavior were elicited for safety climate.¹⁶ Safety climate studies in industries also reported some factors in common with the explored factors in the current study. Management commitment, workers participation and involvement in safety related decision making activities,³⁵ safety training, accessibility to safety resources, performance feedback,³⁶ communication and support, adequacy of procedures, work pressure, personal protective equipment (PPE), and safety rules³⁷ were listed as safety climate factors.

The hypothesized management support and employees' involvement items were merged into one factor after factor analysis. Similar hypothesized factors merging has happened in another study too.³⁷ The same situation happened for PPE and

compliance safety rules, safety communication and job pressure. These findings implied that the studied nurses considered those hypothesized factors as the same construct. In fact, employees' involvement in safety without management support or establishing safety rules without accessibility to safety equipment does not make sense.

In order to minimize bias due to stereotype response patterns, the initial questionnaire was included both negative and positive worded items. The final scale comprised of six negatively worded items including questions 17, 27, 36, 37, 39 and 40, which were ranked inversely. Most of the negatively worded items were included in factor 4. Some researchers believed that use of negatively worded items may introduce artifactual response factor.²⁶ The negatively worded items were then checked for response pattern³⁸ and the results did not show any unique response pattern (Table 2).

More studies are required to determine if the developed scale is applicable to other cultures as well. Furthermore, the ability of the scale in identifying key constituent dimensions of the safety climate structures in other subgroups of HCPs such as physicians, operating room technicians, and

nursing assistance is needed to be evaluated. Moreover, sensitivity of the scale to determine the effectiveness of implemented intervention measures (benchmarking) needs to be verified.

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