International Journal of Occupational Safety and Ergonomics

ISSN: 1080-3548 (Print) 2376-9130 (Online) Journal homepage: http://www.tandfonline.com/loi/tose20

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To cite this article: Haji Omid Kalteh, Seyyed Bagher Mortazavi, Eesa Mohammadi & Mahmood Salesi (2018): The relationship between safety culture and safety climate and safety performance: a systematic review, International Journal of Occupational Safety and Ergonomics, DOI: 10.1080/10803548.2018.1556976

To link to this article: https://doi.org/10.1080/10803548.2018.1556976

Accepted author version posted online: 10 Dec 2018.

Publisher: Taylor & Francis & Central Institute for Labour Protection – National Research Institute (CIOP-PIB)

Journal: *International Journal of Occupational Safety and Ergonomics*

DOI: 10.1080/10803548.2018.1556976

The relationship between safety culture and safety climate and safety performance: a systematic review

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The relationship between safety culture and safety climate and safety performance: a systematic review

Abstract

Introduction: It is known that there is a close relationship between safety culture and safety climate and safety performance. However, this relationship is somewhat unclear, due to different attitudes toward the safety culture and safety climate and the use of various tools for their evaluation, and various measures of safety performance.

Methods: In this study, articles published in English from 2005 to 2017 were selected from various databases. Then, certain journals in the field of safety were specifically searched using the keywords “safety and safety performance”, “safety climate and safety performance”, “safety culture and safety performance”, “safety climate and safety outcome”, “safety culture and safety outcome”, “safety culture and injury and fatalities”, and “safety climate and injuries and fatalities”.

Results: In the current paper, the role of safety culture and safety climate in improving safety performance was evaluated in 31 selected studies. It seems that reactive criteria and safety compliance is more consistent with safety climate and safety culture.

Conclusions: The findings emphasized that increasing the level of safety climate and safety culture could be effective in reducing incidents and improving safety performance indicators.

Keywords: safety culture, safety climate, safety performance, accident rate, safety compliance, safety participation

1. Introduction

Occupational accidents are studied in terms of risk factors and prevention methods. Heinrich's domino models explained that 88% of accidents occur due to unsafe acts and unsafe conditions resulted in only 10% of the accidents[1]. Later, with the completion of this model, management failures were also added[2]. In addition, human attitude, belief, and behaviors have a considerable role in the occurrence of accidents. Safety culture and safety climate are two terms for describing the status of organization policy and employee's perception toward the safety issues [3, 4, 5].

Safety culture and safety climate have a narrow relationship and in some studies have been used as a single concept. However, in many studies safety, climate and safety culture have distinctly mentioned as a critical concept for explaining safety condition in the workplace [6]. Various definitions of safety culture and safety climate have been reported in the scientific literature but yet there is no consensus among researchers on a single definition. In this regard, some of the definitions of the indicators are more favored. One of the most popular definitions of safety culture was mentioned in safety of nuclear installation report: "safety culture of an organization is the product of individual and group values, attitudes perceptions, competencies, and patterns of behavior that determine the commitment to and the status and proficiency of organization's health and safety management" [7, 8, 9]. Safety climate is more superficial than safety culture and is supposed as a snapshot. Gadd argued that safety culture has a deeper meaning than safety climate. In fact, safety culture is a set of beliefs in the organization, while safety climate includes the effects of environmental and organizational factors on these beliefs [10, 11].

In recent decades, safety culture and safety climate have been an interesting topic because of its impact on safety outcomes such as injury and fatality rates and safety performance. The aim of safety culture and climate as a component of organizational culture and climate is to create positive space in which staff are aware of the risks and preventing accidents [12, 13]. Several studies have discussed the relationship between safety culture and safety climate and their effect on safety outcomes for instance safety performance [14, 15]. Several studies have examined the role of safety and safety culture in improving the organization's safety performance. Review studies have also been conducted in this area; however, according to the authors' knowledge, their no review study that looked at the distinctive features of safety performance. This paper investigates various studies to analyze evidence association safety culture and safety climate on improving the safety performance.

2. Method

2.1. Search strategy

In this study, the researchers selected two groups of the databases for searching articles. Group 1 included Google Scholar, PubMed, PsycINFO, and Scopus. In group 2, recent and in press articles in relevant journals such as *safety science, Journal of safety research, Accident Analysis & Prevention, Journal of Applied Psychology, Journal of Occupational & Organizational Psychology, Journal of Organizational Behavior, and Journal of Occupational Health Psychology* were searched. The search terms used in this review include "safety and safety performance", "safety climate and safety performance", "safety culture and safety performance", "safety climate and safety outcome", "safety culture and safety outcome", "safety culture and injury and fatalities", and "safety climate and injury and fatalities".

2.2. Inclusion and exclusion criteria

The articles were addressed with the following conditions: 1) the articles are published in English; 2) the articles are published from January 2005 to January 2017; 3) the assessment of safety culture/climate was through self-reported questionnaire or face-to-face interview; 4) the indicators of safety performance included accident, injury, and fatality rates and proactive measures such as safety compliance and safety participation.

2.3. Selecting appropriate paper and data analysis

Procedures for the selection of suitable articles related to the study are shown in Fig. 1. The procedure of the study was divided into three steps: a systematic review, identify variables, and content analysis. In the systematic review step, the search was conducted among databases to

find related articles. According to the title and keywords, 156 articles were selected. Then, the abstract of the articles was carefully reviewed by the authors and 84 articles were selected based on the criteria of the study. After reviewing the articles, based on compliance with the research criteria, 31 articles were selected that included all the characteristics of the entry. In the next step, the specifications of the article, including the name of the authors and the year of publication, the type of assessment tool of safety culture, safety climate, and safety performance and the studied population, were identified. These specifications are reported in Table 1. In the content analysis step, the associations of dimension, aspect, and subscales of safety climate and safety culture with safety performance measures were investigated. Based on the results of statistical tests such as correlation and regression, the relationship between the safety and safety culture dimensions and safety performance indicators is reported in Table 2. These relationships were expressed in three ways: 1) There is a positive and significant relationship between variables (+); 2) There is a negative and significant relationship between the variables (-); and 3) No significant relationship was found between the variables (&).

3. Results

3.1. Selection

The selection process for the articles to enter the study was conducted in three stages shown in Fig. 1. At the end of the step 1, we found 156 articles with suitable titles. After surveying the abstracts and whole articles, 31 appropriate articles (19.8% of the total articles) were selected to enter the review. We identified that 33% (n = 10) of the articles had been conducted in the USA, the UK (n = 3, 10%), China (n = 3, 10%), Denmark (n = 2, 6.4%), Taiwan (n = 2, 6.4%), Australia (n = 2, 6.4%), Italy (n = 1, 3.2%), Singapore (n = 1, 3.2%), South Africa (n = 1, 3.2%), India (n = 1, 3.2%), New Zealand (n = 1, 3.2%), South Korea (n = 1, 3.2%), Turkey (n = 1, 3.2%), Spain (n = 1, 3.2%), and Norway (n = 1, 3.2%).

The characteristics of selected articles are reported in Table 1. These characteristics include Author(s), year, context industry, and safety climate, safety culture, and safety performance assessment tools.

3.2. The feature of variables

The relationship between variables is tested as follows: 4 articles between safety culture and safety performance, 25 articles between safety climate and safety performance, and 2 articles simultaneously between safety culture and safety climate and safety performance. In 10 of 31 articles, safety performance was measured with proactive measures. Safety compliance and safety participation is mentioned in the category of proactive measures. Also, 17 articles used only reactive indices such as incident and injury rates. Five articles used both reactive and proactive measures to assess safety performance, using which the ability to predict each one can be compared. Table 2 presents the associations between safety and safety culture and their

dimensions with safety performance.

4. Discussion

4.1. Measurement of safety climate and safety culture

As reported in Table 1, safety culture and safety climate are assessed with diverse tools such as questionnaire, interview, injury, and fatality rates. However, among the reviewed articles, self-reporting questionnaires are more commonly used to assess the safety culture and the safety climate. The questionnaires were divided into two groups: standardized questionnaires were developed and presented in other studies. For example, Ajslev et al. used the Nordic Safety Climate Questionnaire (NOSACQ-50) to assess the safety climate. The NOSACQ-50 was developed by a team of Nordic researchers based on the safety and organizational climate theory and the results of empirical studies. Using these questionnaires, the safety culture and safety climate were assessed based on dimensions, aspects, and sub-dimensions. The other group included questionnaires developed by researchers in accordance with the conditions, participants, and industry. In these questionnaires, the dimensions of the instrument were determined based on the study's merits and the objectives of the study. Flin et al. identified five main factors of the safety climate: i.e., management, safety system, risk, work pressure, and competence [16].

Table 3 presents a list of dimensions in safety climate and safety culture assessment. The managers and supervisors commitment to employee safety and organization policies to track safety were the most important dimensions for assessing safety culture. Although using a questionnaire can make it easier to assess the safety climate or safety culture in an organization, this method has some drawbacks. Given that there is no comprehensive agreement among the researchers on the definition of these terms, the choice of dimensions and specific aspects for assessing the safety culture or safety climate is a difficult task.

The management commitment is evaluated to the extent that organization managers are committed to employee safety [17]. Muniz et al. have considered the aspect of management commitment based on behavior and attitude [18]. One of the benefits of assessing the safety culture is to provide a significant indicator of the status of progress in the safety culture in the organization. In addition to qualitative methods, the use of quantitative methods is also common in assessing the safety culture. Warszawska and Kraslawski developed a quantitative methodology for assessing the safety culture based on the Assessment Tree Method (ATM). The ATM makes it possible to quantify and determine the main aspects of the safety culture based on the fault tree [19].

4.2. Safety performance indicators

There are various measures for assessing safety performance in organizations and industrial projects. Several conceptual models have been proposed for understanding the safety performance of the organization. These models are based on factors such as the characteristics of the organization's environment and the workplace, individual differences, and statistics on accidents, injuries, and unsafe behaviors [20]. In this regard, Cooper and Phillips categorized these criteria into two groups of reaction criteria (after incidents) and proactive measures (before incidents) [21]. The selection of each of these criteria depends on the purpose of the assessment and available resources. Reactive measures are appropriate when evaluating previous attempts to provide safety or comparison when the project is completed and there is no access to individuals, while precautionary measures are used to check the status of the organization or project [22, 23]. Insufficient sensitivity, vague accuracy, retrospective, and ignoring risk exposures are another disadvantage of reactive measures[24]. The type of industry is effective in the selection of safety

performance indicators. Generally, proactive measures are used in high-reliability industries, such as nuclear power, with no significant incidents. In these industries, employee behavior testing is more commonly used as a measure of safety performance [3, 25].

As stated, reactive scales are used after the completion of the project and for comparing projects. Accident Rate (AR), Incident Rate (IR), and Experience Modification Rating (EMR) are reactive criteria which are frequently used in the scientific literature. The AR is one of the criteria that have the highest use of reactive criteria. However, it does not appear to have sufficient accuracy to compare the projects [26, 27]. For example, in the construction industry, the contractors did not correctly report the number of incidents due to legal consequences [28]. Also, the accident statistics show just the management safety performance in the past [29]. The number of events is expressed based on the number of lost days, the number of injuries, diseases, or deaths with or without lost time. In fact, events such as the severity of an incident fall into this category. The correctness of this criterion depends on the extent to which employers report cases of lost days due to injuries or how much workers are familiar with the legal requirements of their job [30]. The EMR refers to the amount of financial cost to receive compensation from insurance. It has to be noted that the calculation of this value is complicated and the use of this criterion is not recommended for any company to find safety performance [31, 32]. Also, since the EMR is based on the amounts distributed over the past years, it is not appropriate to assess the safety performance [33].

Proactive measures are another category of safety performance assessment tools that have attracted increasing attention in recent years due to some features and ease of use in industry and scientific literature. In addition to the term "*proactive*", other terms such as protective measures refer to this group of criteria, which are a measure of the level of safety performance in the

organization prior to the occurrence of accidents or injuries. According to the study objectives and available information, other terms are also suggested for describing active measures. Körvers and Sonnemans and Laitinen et al. argued that proactive criteria are classified into predictive or monitoring subcategories [34, 35]. Monitoring measures refer to indicators that are evaluated before major accidents such as chemical leakage or near misses, as well as the results of audits and safety observations at work [36, 37].

Considering these deficiencies in reactive measures for assessing safety performance, many new studies have tried to use safety behavior as an indicator of safety performance. Accordingly, safety performance can be defined as the actions or behaviors that individuals do in their work to promote the health and safety of workers, customers, public people, or the environment [38]. Neil and Griffin developed safety compliance and safety participation as two groups of indicators among proactive measures to assess voluntary and involuntary behaviors. Compliance and participation are related to the task and context, respectively. Safety compliance refers to the essential activities by which the individuals have to improve work safety (e.g., complying with safety instructions and using personal protective equipment). Safety participation also refers to behaviors that are volunteered. However, these behaviors are not considered directly in the safety of the workplace; however, it is important to pay attention to safety in the organization; e.g., attending safety meetings or helping colleagues in safety. In recent decades, the use of safety and safety participation has increased significantly. Researchers point out that ease of use, the lack of statistics on accidents and injuries, and the predictive approach are the reasons for the expansion of the use of these criteria.

4.3. Association safety climate, safety culture, and safety performance

Table 2 shows the relationship between the dimensions of safety climate and safety culture and safety performance measures. Based on descriptions of the various types of safety climate and safety culture dimensions, the relationship between variables was examined based on two approaches. In the first approach, the relationship between safety climate and safety culture dimensions and reactive measures of safety performance was investigated. It was found that data on reactive measures of safety performance such as incident rates, number of injuries, and incident rates were collected through self-reporting questionnaires and reviewing the organization's statistical documentation. The study of the dimensions of safety climate and safety culture and reactive measures of safety performance is carried out in two ways: 1) the correlation of safety performance criteria with each dimension of safety climate and safety culture and 2) the correlation of safety performance criteria with safety climate and safety culture as a single structure. In general, the relationship between safety culture and reactive criteria has been explained in two respects in terms of statistical tests. In the first case, a non-intermediate relationship was investigated using correlation coefficients and bivariate test analysis.

In the latter case, the relevance of safety climate and safety culture with reactive criteria has been investigated at a higher level using structural equations and mediator variables. In these studies, the impact of occupational factors or other environments such as investment safety, occupational stress, and safety behaviours on the relationship between safety climate and safety culture structures has been studied on safety performance criteria. The result is a more comprehensive look at the causes of incident events. Based on these findings, there may be possible mediations between safety culture and safety performance. Liu et al. reported that safety climate could predict safety behaviors and safety behaviour play a mediator role between safety

climate and occupational accidents. Hence, the impact of safety culture on reducing injuries is due to human effort and project conditions [39].

The second approach has analysed the relationship of safety climate or safety culture with active safety performance criteria such as safety compliance and safety participation. These two criteria offer a trend to predict occupational accidents based on individual and social factors that can have significant effects on safety performance. With this regard, numerous studies have been done on their impact on safety climate and safety culture. In particular, it has been demonstrated that safety climate can be recognized as a reliable predictor of behaviour and outcomes safety. Safety climate and safety culture structures are based on the understanding of the organization's employees about policies, beliefs, values, and beliefs related to safety; this perception relates to the motivation of individuals to perform their duties and thus to influence on safety behaviours and occurrences of events.

Although a wide range of statistical tests was used to examine the relationship between variables, it was revealed that there is a negative and significant relationship between reactive criteria and a positive and significant relationship between active measures and climate safety and safety culture. However, it is difficult to determine the magnitude of this effect on climate safety and safety culture on reactive or active criteria. Reviewing articles that simultaneously examine the relevance of safety or safety culture to reactive and proactive measures has shown that safety compliance and the number of incidents will have a greater impact on safety climate and safety culture. Examining reactive and active safety measures showed that no one could be considered superior to the other, and it is true that the industry's standard determines the type of criteria. According to the finding, reactive criteria in construction and contract projects are more appropriate due to the changing working conditions, and proactive measures in the

manufacturing industry are due to uniform conditions and behaviors that are repeated at work time.

Finally, in the reviewed articles, there was no study evaluating the effect of safety interventions on safety performance changes. Perhaps the reason is that the effects of changes in safety culture or safety climate can be displayed in the long run. However, most studies have suggested considering climate safety and culture safety dimensions that are statistically effective for safety performance criteria as interventional factors in subsequent studies.

5. Conclusion

This study examines articles on safety performance indicators and the impact of safety climate and safety culture on these indicators. Today, the importance of evaluating safety performance is confirmed to investigate the efficiency and identifying risks in the safety management system. Reactive and proactive measures provide two essential categories of safety performance assessment tools. A review of statistical results showed that reactive and proactive measures have a negative and positive relationship with safety climate and safety culture, respectively. Nevertheless, it is difficult to determine the magnitude of such effects due to the use of different assessment tools and the various characteristics of societies and industries. Also, it seems that researchers prefer proactive measures for ease of use and preventive approach in this regard. In few studies that simultaneously investigated the association between reactive and proactive measures with climate safety and safety culture, it became clear that compliance safety is more solid. The results showed that the impact of climate safety and safety culture on reactive criteria might be mediated through variables such as safety behavior or safety attitudes.

Figure caption

Figure 1: Process of articles selection

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Table 1: the selected articles

Study	Type	Assessment method		Type of industry or occupation
		Safety culture and safety climate	Safety performance	
[40]	Safety climate & safety performance	Self-reported questionnaire	8-item scale questionnaire	Blue collar worker
[41]	Safety culture & safety performance	Self-reported questionnaire	Accident Frequency Rate	Construction industry
[42]	Safety climate & safety performance	22-item questionnaire	three broad indicators to measure safety performance: injuries, Safety participation and safety compliance (questionnaire)	RMAA workers
[43]	Safety culture& safety performance	Self-reported questionnaire	Safety participation, safety compliance and accident rates	Railway companies
[25]	Safety culture & safety performance	Self-reported questionnaire	A set of technical criteria (none-questionnaire)	Nuclear power installations
[44]	Safety climate & safety performance	Self-reported questionnaire	Total number of events	Hospital personnel
[45]	Safety climate & safety performance	Self-reported questionnaire	Safety compliance	explosive ordnance industry
[46]	Safety climate & safety performance	Self-reported questionnaire	39-items safety performance scale	University personnel
[39]	Safety climate & safety performance	self-administered structured questionnaire	work-related injuries in the past 12 months	50 manufacturing enterprises
[47]	Safety climate & safety performance	Self-reported questionnaire	Safety participation and safety compliance	Hospital staff

[48]	safety culture& safety performance	Self-reported questionnaire	Self-reported questionnaire	construction industry
[49]	Safety climate & safety performance	questionnaire	Accident Rate	Chemical industry
[17]	Safety climate & safety performance	NOSACQ-50	Accident rate	15,000 workers of the general working population
[50]	Safety climate & safety performance	Self-reported questionnaire	Safety participation and safety compliance	Construction industry
[51]	Safety climate & safety performance	18-item scale (questionnaire)	Number of non-reportable accidents Total number of accidents Self-reported questionnaire	31 organizations
[52]	Safety climate & safety performance	Self-reported questionnaire	Accident rate	Multinational car manufacturing
[53]	Safety climate & safety culture safety performance	Questionnaire and interview	Safety participation and safety compliance	construction project workers
[54]	Safety climate & safety performance	Self-reported questionnaire	Work-related accidents	Healthcare workers
[55]	Safety climate & safety performance	Danish Safety Culture Questionnaire	Accident rate	production workers
[56]	Safety climate & safety performance	Self-reported questionnaire	Safety behavior	Hotel workers
[57]	Safety climate & safety culture safety performance	Self-reported questionnaire	Safety behavior	Nuclear power industry
[58]	Safety climate & safety performance	Self-reported questionnaire	Self-reported injury incidence	Different industries
[59]	Safety climate & safety	Self-reported questionnaire	Safety participation and	Contractor workers

	performance		safety compliance	
[60]	Safety climate & safety performance	Self-reported questionnaire	Accident rate	Offshore industry
[61]	Safety climate & safety performance	Self-reported questionnaire	Reported and non-reported accidents	Multi-organization study
[62]	Safety climate & safety performance	Self-reported questionnaire	Safety-related events	Wood industry
[63]	Safety climate & safety performance	Self-reported questionnaire	Injury frequency	Insurance company
[64]	Safety climate & safety performance	questionnaire	accidents	Container shipping context
[65]	Safety climate & safety performance	16-item questionnaire	Injury frequency	Heavy manufacturing company
[47]	Safety climate & safety performance	Self-reported questionnaire	Injury rate	Different industries
[66]	Safety climate & safety performance	Zohar's group-level safety climate measure	Safety participation	Glassware manufacturing

Note: RMAA = Repair, maintenance, minor alteration, and addition; NOSACQ-50 = Nordic Safety Climate Questionnaire.

Table 2: Association safety climate and safety culture dimensions and safety performance measures

Study	Safety climate and safety culture dimension, aspect, or subscale	Association
[40]	• Organizational safety climate • Supervisor's safety climate • Co-workers' safety climate	(+)*
[41]	• Safety culture index	(–)**
[42]	• Management commitment • Safety rules • Safety responsibility	• Safety climate and safety participation (+) • Near misses and injuries safety (–)
[43]	• Communication and emergency • Safety management	(+)
[25]	*Organizational safety culture* • Management commitment to safety • Willingness to raise safety concerns • Decision making • Supervisor responsibility for safety • Questioning attitude • Safety communication • Personal responsibility for safety • Prioritizing safety, and training quality *Safety performance* • Unplanned scrams • Reactor oversight process cross-cutting aspects • Human performance cross-cutting area • Problem identification and resolution cross-cutting area • Substantive cross-cutting issues • Action matrix oversight • Chemistry performance index • Human performance error rate • Forced loss rate • Industrial safety accident rate	• Safety culture and unplanned scrams, total cross-cutting aspects, human performance cross-cutting area, problem identification and resolution cross-cutting area, chemistry performance index, and human performance error rate (+)
[44]	• Senior managers' engagement • Organizational resources • Overall emphasis on patient safety • Unit safety norms	(–)

Study	Safety climate and safety culture dimension, aspect, or subscale	Association
	• Unit support • Recognition for safety efforts • Fear of blame • Fear of shame	
[45]	• Management Commitment to Safety • Safety Communication • Quality of Supervision • Safety Awareness • Adequacy of Resources • Training standards • Manageable Workload • Quality of Documentation • Use of Documentation • Audits • Just Culture	(+)
[46]	• CEOs' safety commitment and action • managers' safety commitment and action • Employees' safety commitment • Perceived risk • Emergency response	(+)
[39]	• Commitment • Safety supervision • Co-worker support • Safety training	(–)
[47]	• Single-dimensional construct (with three questions)	• Safety climate, safety compliance and safety participation (+) • Safety behavior year 4 and accident year 5 (–) • Accident year 2 and 3 and safety climate Year 2 (–)
[49]	• Management commitment and actions for safety • Workers' knowledge and compliance to safety • Workers' attitudes towards safety • Workers' participation and commitment to safety • Safeness of work environment • Emergency preparedness in the organization	(–)

Study	Safety climate and safety culture dimension, aspect, or subscale	Association
	• Priority for safety over production • Risk justification	
[17]	• Managerial and employee commitment, participation and engagement	(–)
[50]	• Management safety commitment • Social support • Production pressure	• Safety compliance and safety participation: Management safety commitment (+) , Social support (+),Production pressure (–)
[51]	• Management commitment • Communication • Priority of safety • Safety rules and procedures • Supportive environment • Involvement personal • Priorities/need for safety personal • Appreciation of risk • Physical work environment	(–)
[52]	• Management concern for safety • Workers' response to safety • Conflict between production and safety	(&)
[53]	*Safety culture* • Safety significant • Regulatory procedures *Safety climate* • Managerial priority • Safety communication • Safety regulation • Safety education • Supervisor	• Safety culture and safety behavior (–) • safety Climate and safety behavior (+)
[54]	• Management commitment to safety • Supervisory performance feedback • Worker involvement in safety • Coworker behavior norms	(–)
[55]	• Immediate supervisor general leadership • Immediate supervisor safety leadership • Safety instructions	(+)

Study	Safety climate and safety culture dimension, aspect, or subscale	Association
	• Convenience violations • Safety oversights • Commitment to the workplace	
[56]	• Adequacy & sufficiency of procedures and investigations • Informing through training • Adequacy of training and support • Workload • Labor-management relation • General safety • Communication • Maintenance and spares • Absence of work pressure	(+)
[57]	• Single- dimensional factor	(+)
[58]	• Management commitment to safety • Return-to-work policies • Post-injury administration • Safety training • Employee safety control	• Management commitment to safety and Self-reported injury (–) • Return-to-work policies and Self-reported injury (–) • Post-injury administration and Self-reported injury (&)† • Safety training and Self-reported injury (–) • Employee safety control and Self-reported injury (–)
[59]	• Group safety climate	(&)
[60]	• Management • Safety system • Risk perception • Production or work pressure • Competence	(–)
[61]	• Management values • Safety communication • Safety training • Safety systems	(–)
[62]	• Single- dimensional factor	(–)
[63]	• Management commitment on safety • Quality of return-to-work policies	(–)

Study	Safety climate and safety culture dimension, aspect, or subscale	Association
	• Quality of post-injury administration • Safety training	
[64]	• Management safety practices • Supervisor safety practices • Safety attitude • Safety training • Job safety • Co-worker safety practices	• Management safety practices and crew fatality (–) • Supervisor safety practices and crew fatality (&) • Safety attitude and crew fatality (&) • Safety training and crew fatality (–) • Job safety and crew fatality (–) • Co-worker safety practices and crew fatality (&)
[65]	*Safety climate* • Caring • Compliance • Coaching *Injury rates* • TCIR • LWDCR • LWDR	• Compliance and LWDCR (–) • Coaching and LWDCR (–) • Others associations (&)
[47]	• Management commitment to safety • Return-to-work policies • Post-injury administration • Safety training • Employee safety control	(&)
[66]	• Group safety climate	(+)

* (+) = significant positive association found
** (–) = significant negative association found
† (&) = a statistical association not found
Note: TCIR = Total number of recordable cases per 100 employees per year; LWDCR = Number of lost workday cases per 100 employees per year; LWDR = Number of lost workdays per 100 employees per year.

Table 3: Frequency of safety climate/culture dimensions in the articles

Safety climate and culture dimension	*n*	%
Management and supervisor commitment to safety	19	61
Safety policies, resources, and training	13	42
Co-workers involvement and commitment to safety	9	29
Safety communication	5	16
Priority for safety	8	26