SAFETY CLIMATE

Peer-Reviewed

HEALTH LITERACY as a Predictor of Worker Perceptions of Safety in the Workplace

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A SAFE WORKPLACE CAN BE DEFINED AS a place provided by an employer where the risk of harm to persons or property is limited to acceptable levels (Yarlagadda et al., 2010). Creating a safe work environment is a high priority for employers around the world (Cunningham & Jacobson, 2018; Khrais et al., 2013; Schwatka & Rosecrance, 2016). In the U.S. alone, 5,333 workers died on the job in 2019 (OSHA, n.d.). If decreasing health risks to workers is not enough to motivate employers to make workplaces safer, mitigation of financial losses, productivity gains and improved corporate reputation can also be realized through the implementation of safety programs (Medina, 2018).

In this article, the authors suggest that the health literacy of employees may affect the safety of workplaces. Health literacy is defined as "the degree to which an individual has the capacity to obtain, communicate, process and understand basic health information and services to make appropriate health decisions" (Grossman et al., 2010, p. 518). Health information includes disease terminology, treatment information, prescription instructions, follow-up instructions and knowing how to navigate the healthcare system with its web of providers and insurers. This information can help people make informed decisions about their healthcare.

KEY TAKEAWAYS

- **This article reports the results of survey-based research on health literacy as a predictor of worker perceptions of safety climate in the workplace.**
- **Two safety climate constructs, performance while fatigued and safety behaviors, were significantly correlated with health literacy.**
- **Four safety climate constructs were not significantly correlated with health literacy: 1. safety practices; 2. safety performance; 3. management commitment to safety; and 4. safety knowledge.**
- **Levels of health literacy affect safety behaviors of workers under stress. Individuals with higher levels of health literacy are more likely to continue to work safely on the job when fatigued, in the presence of other tradespeople and under pressure to meet deadlines. Individuals with lower levels of health literacy may not be able to do the same.**
- **The article discusses practical application of these findings for educating workers on health literacy.**

If health literate employees make decisions that are good for their own personal health, the researchers hypothesize that these decisions will contribute to a more positive workplace safety climate. If workers have a high level of health literacy, the researchers expect workers to prioritize safety policies and procedures when making behavioral safety decisions. Furthermore, the researchers predict that higher levels of health literacy will positively impact worker safety in that workers will consider how behavioral safety decisions impact their own personal health status. The goal of this study is to empirically test whether health literacy is a predictor of worker perceptions of safety in the workplace.

Contribution of Health Literacy to Safety in the Workplace

Imbuing workplace safety with health literacy will support knowledge-based decision-making on the part of workers, thereby reducing health risks on the job. Higher levels of health literacy have been shown to improve patient outcomes. Efforts to educate patients in health literacy came about in healthcare because lower levels of health literacy were associated with adverse health outcomes such as hospitalization, contraction of disease, poor medication adherence and inability to appropriate guidelines for better health (Brega et al., 2019; Tutu et al., 2019).

Previous studies have often focused on individual worker perceptions of safety to evaluate safety climate in the workplace (Bhattacharya, 2015; Rubin et al., 2020). To the authors' knowledge, no studies have employed individual health-related decision-making as a resource to counter negative safety climate and safety culture. This is the contribution of this study.

Safety in the Workplace

Two concepts related to safety in the workplace are safety culture and safety climate. Safety culture is regarded as an enduring organizational or group-level characteristic espoused by top management that conveys the "organizational principles, norms, commitments and values related to the operation of safety and health" (Chen & Jin, 2013, p. 807; Teo & Feng, 2009). Safety climate, on

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TABLE 1
SAFETY CLIMATE ITEMS

Subscales	Items
Safety practices	• There is enough PPE available to allow work to be done safely. • I have received enough training to do my work safely. • I always get enough site-specific information about a job to do it safely. • Toolbox talks about safety are given regularly.
Safety performance	• I always report safety hazards that I see. • I know who to report a hazard to when I see one. • I assist others to make sure that they perform their work safely.
Performance while fatigued	• Fatigue is an issue for me. I have caught myself making mistakes on the job when I was tired. [a]
Management commitment to safety	• Doing the work safely on this job has definite priority over getting it done on schedule.
Safety knowledge	• I know what my safety responsibilities are at work. • Toolbox talks are helpful to me. • I believe that safety committees for the project would be very beneficial.
Safety behaviors	• Sometimes I cannot do my job safely because other trades are in my way. [a] • Sometimes I ignore a safety rule or policy in order to carry out an assignment to meet the schedule. [a]

Note. [a] **Reverse coded.**

FIGURE 1
SAMPLE QUESTION FROM FLIGHT HEALTH LITERACY SCALE

Maria is having a bad allergic reaction. Her doctor tells her to take 30 mg a day of prednisone. She gets a prescription that has the label below. How many pills should she take every day?

A) 1
B) 3
C) 4
D) 6
E) 10

#66119552
Doctor: Jameson, Sandra
Prednisone, 5 mg
Take as directed
#50
Refills: 1

the other hand, is a more ephemeral set of shared worker perceptions and attitudes about workplace safety that reflects safety culture (Chen & Jin, 2013). In addition, safety climate includes the extent to which employees prioritize the importance of safety procedures and policies of the workplace (Neal et al., 2000).

Some researchers suggest that safety climate can be a predictor of safety culture (Teo & Feng, 2009). Safety culture and safety climate are highly related concepts; however, because the focus of this article is on worker perceptions of safety in the workplace, safety climate is a more appropriate construct for this study than safety culture.

Parameters such as social environment [e.g., the presence of workplace bullying (Bond et al., 2010)], individual differences [e.g., worker variation in risk taking behavior (Yule et al., 2007)] and variations in behavioral compliance (Kvalheim & Dahl, 2016) have all been shown to be correlated with safety in the workplace and safety climate. The literature clearly demonstrates that a positive safety climate contributes to a safe working environment by reducing risk to its lowest level, which results in fewer injuries and work-related illnesses experienced by workers. However, worker attitudes toward risk may preclude workers from performing safe actions on the job. Such behavior has been correlated with production pressure of the work, especially for a dynamic work environment such as construction (Guo et al., 2016). These unsafe actions, however explainable they may be, frequently leave workers with poor health status and long-term illnesses. For example, unsafe actions based on higher risk-taking behavior among coal miners results in increased work-related injuries and even death (Rubin et al., 2020). Among construction workers, work-related low back injuries causing lost time at work or permanent partial disability have been shown to be significantly related to increased mortality due to opioid drug overdose and suicide (Martin et al., 2019). The current literature does not explain whether workers consider the effect of behaviors on the job on their long-term health; in other words, will health literate workers factor in the impact of actions on the job on their health? Will they avoid unsafe actions because of a potential negative impact on their personal health status?

Methodology

A survey instrument was employed to collect data about safety climate and health literacy. Perceptions of safety climate were assessed using the methodology adopted by Gittleman et al. (2010), which used a 14-item scale (overall scale $\alpha = .742$). Participants rated each item on a five-point Likert-type scale, with response categories ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The safety climate scale (Table 1) was comprised of six subscales: safety practices (four items, $\alpha = .798$), safety performance (three items, $\alpha = .729$), performance while fatigued (one item), management commitment to safety (one item), safety knowledge (three items, $\alpha = .697$) and safety behaviors (two items, $\alpha = .553$).

One survey item related to performance while fatigued and two items related to safety behaviors were reverse coded for the analysis. Reverse coding simply flips the responses where a 1 response becomes a 5, a 2 response becomes a 4 and so on. The items that were reverse coded were negatively worded, which changed the polarity of the response. For example, a "strongly agree" answer for these items would suggest a perception of an unsafe climate, whereas for the other items, a "strongly agree" response would infer the perception of a safe climate. Reverse coding simplifies interpretation of the results.

Health literacy was assessed using the 10-item Fostering Literacy for Good Health Today (FLIGHT) scale developed and validated by Ownby et al. (2013). The scale is comprised of 10 multiple choice questions, each of which has a correct response. A sample question is shown in Figure 1. Items that survey participants answered correctly were given a point value of 1; incorrect responses were given a point value of 0. Thus, the possible health literacy score for each participant ranged from 0 to 10.

After background information about the survey was shared and consent was obtained, paper and pencil surveys were given to participants by one of the authors or an undergraduate research assistant in a face-to-face environment, typically in small groups. Some employers allowed for administration of the survey at the work site. Other surveys were administered in participants' homes or public places such as coffee shops. Survey data were collected over a 3-month period from February through April 2019.

The authors examined the correlation between health literacy scores and the safety climate subscales, and the safety climate scale overall. The authors also looked for potential variation in health literacy and safety climate using one-way analysis of variance for a number of participant demographic factors, including race/ethnicity, age group, industry of occupation, county/parish of residence, zip code of residence, education level and supervisory status.

Results

Participant Characteristics

The survey instrument was administered to 161 employees working in construction, industrial plants, manufacturing and other related industries. One survey was excluded from the data analysis due to incomplete data and one other employee withdrew from participation during the survey administration for personal reasons. Employees were chosen for sampling based on convenience for the authors.

All persons who agreed to participate were given an English language survey. Only one participant indicated that English was a second language but was also fluent in English. Of the individuals surveyed, 21% said that they served as supervisors. Race, age, education and industry demographics are summarized in Table 2.

Health Literacy Bivariate Correlations With Safety Climate

Pearson correlation indicated that health literacy scores were significantly correlated with two safety climate variables: performance while fatigued ($p = .032$) and safety behaviors ($p = .043$).

TABLE 2
PARTICIPANT CHARACTERISTICS

Race	Percent	Education	Percent
White	79.2	High school	37.7
Black	17.0	Some college	30.2
Other	3.8	College graduate	32.1
Age group		**Industry**	
18 to 29	39.6	Industrial plant	37.1
30 to 39	18.9	Manufacturing	25.2
40 to 49	15.7	Construction	18.9
50 and older	25.8	Other	18.8

Note. Data on gender were not collected. Anecdotally, less than 15% of participants were female.

None of the other four safety climate variables were correlated with health literacy scores. Correlations are shown in Table 3.

The multivariate analysis of covariance (MANCOVA) requires that covariates be correlated with the dependent variables. Therefore, only performance while fatigued and safety behaviors with health literacy as the covariate were included in an initial MANCOVA.

Analysis of Variance

Skewness and kurtosis statistics for health literacy scores (covariate), and performance while fatigued and safety behaviors (dependent variables) were insignificant, indicating that all variables are normally distributed. Box's test for equality of covariance matrices confirmed that covariance matrices of the dependent variables are equal across groups ($F = 1.033$, $p = .412$).

Levene's tests for equality of error variance across groups were mixed for the two dependent variables. For performance while fatigued, the hypothesis of equal error variance across groups was rejected ($F = 1.555$, $p = .026$). For safety behaviors, the Levene's test showed that that error variance is likely to be equal across groups at $\alpha = .05$. Because the assumption of equal error variance across groups was violated for the dependent variable performance while fatigued, this dependent variable was excluded from the analysis of variance.

Thus, the final analysis of variance model was an analysis of covariance rather than a MANCOVA that included safety behaviors as the dependent variable; race, age, education and industry group as fixed factors; and health literacy as the covariate.

The results of the between-subject tests for race, age group, education group and industry group are shown in Table 4, along with statistically significant interaction effects. Also, the covariate, health literacy, is shown to have a significant effect on safety behaviors (Table 4).

Discussion

This study had three major findings. First, two safety climate constructs, 1. performance while fatigued and 2. safety behaviors, were significantly correlated with health literacy. Second, four safety climate constructs, 1. safety practices, 2. safety performance, 3. management commitment to safety, and 4. safety knowledge, were not significantly correlated with health literacy. Third, there was a significant interaction effect for age and industry group on safety behaviors. These findings are discussed in this section, followed by recommendations for management. The authors conclude with directions for future research.

Significant Correlations

Health literacy scores were significantly correlated with two safety climate variables: performance while fatigued ($p = .032$) and safety behaviors ($p = .043$). Recall that the performance while

TABLE 3
CORRELATIONS

		Health literacy score	Safety practices	Safety performance	Performance while fatigued	Management commitment to safety	Safety knowledge	Safety behaviors
Health literacy score	Pearson correlation	1.000	.066	.031	**.161** [a]	.082	-.005	**.170** [a]
	Significance (2-tailed)		.406	.694	.043	.305	.949	.032

Note. $N = 159$.
[a] Correlation is significant at the 0.05 level (2-tailed).

fatigued item was worded thus: "Fatigue is an issue for me. I have caught myself making mistakes on the job when I was tired" (Table 1). For this item, participants with higher levels of health literacy did not perceive fatigue to be a factor for their job performance as much as did participants with lower levels of health literacy. The general hypothesis that higher levels of health literacy positively affects safety climate is supported by this finding. Individuals with higher levels of health literacy may recognize levels of fatigue and exhibit the safer behaviors of taking breaks or stopping work. On the other hand, individuals with lower levels of health literacy may continue to work through the fatigue and thus have issues with fatigue and the consequence of making mistakes on the job.

For safety behaviors, the first item was related to being able to work safely amid other trades working in the same environment. This item reflects the ability of different tradespeople to collaborate well on a job (Gittleman et al., 2010). The second safety behavior item focused on whether workers sometimes ignore safety rules or policies to meet a deadline. Positive safety behaviors (continuing to work safely when other trades were around and not ignoring safety rules) were significantly correlated with health literacy. The researchers' finding is that individuals with higher levels of health literacy perceive that their safety behaviors will continue, and individuals with lower levels of health literacy are not as confident that they can complete a job safely under these conditions.

In summary, levels of health literacy appear to impact safety behaviors of workers under stress. Individuals with higher levels of health literacy are more likely to continue to work safely on the job when fatigued, in the presence of other tradespeople and under pressure to meet deadlines. Conversely, individuals with lower levels of health literacy may not be able to do the same.

Insignificant Correlations

The researchers' second finding was insignificant correlations with health literacy for the remaining four safety climate constructs: safety practices, safety performance, management commitment to safety and safety knowledge (see Table 1 for survey items). Different levels of health literacy do not appear to impact perceptions of safety practices (e.g., adequate PPE and training), safety performance (e.g., reporting safety hazards) and safety knowledge (e.g., responsibilities with respect to safety). They also do not appear to affect perceptions of management commitment to safety. One possible explanation may be that these factors are more related to *job conditions* that impact safety climate rather than *worker behavior* that affects safety climate. Workers may perceive safety as part of the job, but not as something that affects their individual health. The authors suggest that this is a gap in understanding that should be addressed. Safety on the job (or the lack thereof) is known to affect individual health, even to the point of preventing or causing death of a worker (Cheng et al., 2010; Choudhry & Fang, 2008; Haslam et al., 2005).

Significant Interaction Effect

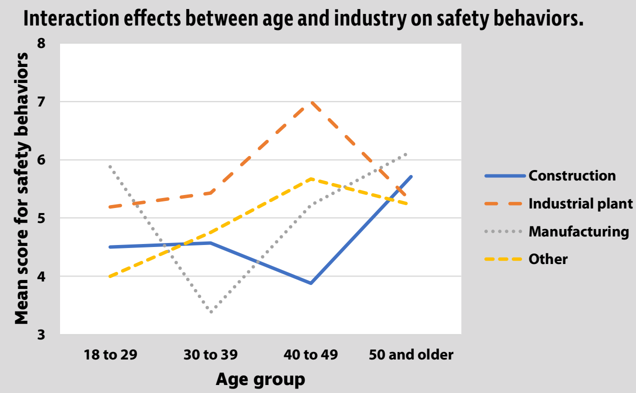
The third and final finding was a significant interaction effect for age and industry group on safety behaviors. There are no significant main effects for the fixed factors, but there is one significant interaction effect between age and industry group (Table 3). The best way to interpret interaction effects in multivariate analysis is to view a line graph of the means for the various groups (Hair et al., 1998). Thus, the means for this interaction effect are graphed in Figure 2.

The graph in Figure 2 shows a disordinal interaction (Hair et al., 1998), demonstrating inconsistent effects by age and industry. For construction workers, means for safety behaviors are highest for workers over the age of 50, lowest for workers in their 40s and in between for workers under 40. This may suggest that training

TABLE 4
TESTS OF BETWEEN-SUBJECT EFFECTS FOR SAFETY BEHAVIORS

	F	*p*	Observed power
Race	.145	.705	.066
Age	.609	.610	.173
Education	.935	.396	.208
Industry	.881	.454	.236
Age * industry	2.254	**.025**	**.876**
Health literacy	6.530	**.012**	**.716**

FIGURE 2
SAFETY BEHAVIOR MEANS BY AGE & INDUSTRY GROUPS



programs are effective for workers under 40. Perhaps the 40 to 49 age group becomes more lax in their behaviors with experience, but then as they age consequences of that laxness take hold as physical capability diminishes, thereby reinstating a more cautious mindset.

For industrial plant workers, safety behaviors tend to be better overall than for all other industrial groups, but in this group workers in their 40s scored higher. A review of the data suggests the higher score in the 40 to 49 age group may be a function of too few (only two) workers in that cohort.

For manufacturing workers, safety behaviors are high in the youngest workers, but fall off a great deal (7.875 to 5.375) in the 30 to 39 age group. In this case, the group sizes are more consistent across all age groups for manufacturing. After age 40, safety behavior scores are more consistent with the 18 to 29 group. Perhaps the same effect discussed for construction workers occurs, where laxness in safety behaviors by experience just occurs in the workers' 30s instead of their 40s.

Finally, for other industries, similar effects to industrial plants are demonstrated with a lower mean score in safety behaviors. The variation in scores in this group is less than in the other groups; safety behavior scores start off at the lowest score of any industry group for the 18 to 29 workers, increase through the 30s and 40s, then drop off just a bit for the 50 and older group. This industry group is more heterogeneous, so it may be more difficult to interpret and apply to specific training programs.

Implications for Management

This study demonstrates a correlation between health literacy and fatigue during performance as well as safety behaviors. Health literate workers report not making mistakes when they are fatigued and greater compliance with safety behaviors. In turn, it is anticipated that worker engagement in safety behaviors will reduce the risk of injuries. To leverage the potential impact of health literacy on risk mitigation, key recommendations for employer action are:

1. Health literacy education should be incorporated into safety training to improve worker perceptions of safety climate. Safety climate is the perception of "this is how I should do my job." Incorporation of health literacy training allows an organization to educate workers about the impact of unsafe behaviors on personal health status, and to empower workers to make decisions on the job that not only contribute to a positive safety climate, but also contribute to individuals staying healthy. Ideally, the training should stress the concept for workers that "I need to act safely at work to protect my own health."

2. Health literacy screening can be implemented for all workers. The Agency for Healthcare Research and Quality (AHRQ, 2019) has free tools that are quick and easy to administer, such as the short assessment of health literacy, available in English and Spanish. Workers with lower health literacy scores should be taught about behaviors that may lead to poor health outcomes, stressing the linkage between individual behavior and personal health status. All workers should be apprised of how unsafe behaviors at work may result in poor health outcomes, for both short- and long-term effects.

3. Capture and disseminate case studies from the organization that link safe behaviors to positive health outcomes and that link unsafe behaviors to negative health outcomes. Have coworkers tell their stories.

4. Share pretraining and posttraining safety metrics with workers to demonstrate the consequences of making unhealthy choices in the workplace. This also reinforces the linkage between behaviors and health outcomes.

These actions align with safety best practice, which recommends moving from a reactive approach (safety rules are enforced after an incident or injury) to a proactive approach (management initiates safety programs and encourages workers to participate). PSJ

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