Safety Science 93 (2017) 76–85

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

Safety Culture Promotion Intervention Program (SCPIP) in an oil refinery factory: An integrated application of Geller and Health Belief Models

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ARTICLE INFO

Article history:
Received 10 August 2016
Received in revised form 27 October 2016
Accepted 21 November 2016

Keywords:
Safety culture promotion
Health Belief Model
Geller Model
Oil Refining Factory
Occupational health

ABSTRACT

As the most of work-related accidents results from unsafe behaviors, there is clearly a need for research in this area. The purpose of this study was to assess safety culture among operation personnel of an Oil Refinery Company (ORC) in Tehran and design and implement a Safety Culture Promotion Intervention Program (SCPIP) based on an integration of Geller and HBM models. In this quasi-experimental study, as the first phase, 190 operational employees of an ORC were recruited. The data were analyzed and the SCPIP was designed. In the second phase, 90 employees were elected for the intervention (45 for the experimental group and 45 for the control group). The evaluation of SCPIP was conducted 2 months after intervention. The environmental factors were in a good condition. About 44% of the behavioral factors and about two thirds of the cognitive factors were rated as moderate/weak. Before intervention, there was no significant difference between the two groups by the total cognitive factors and the HBM constructs. After intervention these differences were significant ($p \leqslant 0.001$). After implementing the intervention in the experimental group, the HBM total score was remarkably improved (Mean Difference = 11.25, t = 10.100, $p = 0.001$). The integrative application of the Geller and HBM Models was helpful in assessing the cognitive predictors of safety culture among the personnel of the ORC. SCPIP was useful in improving the employees' perceptions on safety culture in the occupational setting. HBM may be utilized to promote the human component of Geller model.

1. Introduction

In the Heinrich study in 1931, it was concluded that 88% of the industrial accidents occur as a result of people's insecure performance (Department, 2002; Stringfellow, 2010). Industrial accidents are unexpected events causing damage and injury to people, their properties and consequently the societies (Kjellén, 2000). According to the International Labor Organization (ILO) report (2016), every day about 6300 people die as a result of occupational accidents or work-related diseases. Occupational accidents, also, result in more than 2.3 million deaths per year (ILO, 2016). These accidents have a multidimensional burden for societies. The human costs associated with such incidents result from the loss of manpower, materials, equipment and time, which are above 5 million dollars per year (Harms-Ringdahl, 2003). Based on the estimation of ILO, the annual economic burden caused by poor occupational safety and health practices is about 4% of global Gross Domestic Product (ILO, 2016).

The term "Safety Culture" was firstly used in a nuclear report in 1987 on the Chernobyl disaster (Gibbons, 2007). The report showed that the adverse events were mostly preventable (Flin, 2007). The UK Health and Safety Commission defined the term as "the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management" (Kaafarani et al., 2009). Safety culture is something in which everyone is concerned about safety issues (Bodur and Filiz, 2009). An organization with a promoted safety culture encourages all level individuals and groups to be both active and accountable in the following areas: predicting and managing risks and threats for global success, developing and enhancing safety and improving operation, effectiveness and production (Taghdisi, 2009).

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http://dx.doi.org/10.1016/j.ssci.2016.11.019
0925-7535/

Safety culture appears when it is perceived by all the employees as a key value in a given organization (Roughton and Mercurio, 2002). It is a complex structure in every organization which includes the existing safety attitudes, values and behaviors in the organization, most of which are potentially modifiable factors associated with the real accidental behavior. Wu et al., believed that the quality of safety culture is directly affected by the safety of individuals (Ooshaksaraie et al., 2009; Wu et al., 2009). Creating safety culture through modifications in the incentives of individuals without taking into account the occupational and organizational factors as well as the interaction of psychological and behavioral factors seems to be failed (Heidari et al., 2007). Good design and implementation of safety behavior intervention processes can positively affect the movement of an organization towards safety culture. Taking into account the internal cognitive factors related to behavior is also important (Gilmore et al., 2002).

In industries, safety is considered as an important issue and a key priority. As the most of work-related accidents results from unsafe behaviors (Salminen and Tallberg, 1996; Seo, 2005), there is clearly a need for research in this area. Also, since the behavior of workers is involved in many industrial events, educating them about the workplace hazards and how to manage the risks may increasingly improve their health and safety (Zalewski, 2005).

Nowadays, health education researchers apply behavior change theories of psychology and social sciences to design patterns that are useful and effective in adopting safe behaviors among different populations (Glanz et al., 2008). Theories and models in the various stages of planning, implementation and evaluation of an intervention are beneficial and helpful in understanding the nature and explaining the dynamics of health behaviors (Noar and Zimmerman, 2005).

1.1. Geller's Total Safety Culture Model

Geller's Total Safety Culture Model (Geller, 1994, 1996), known as Geller Model and one of the basic "safety triad" models for safety culture promotion, proposes that in order to design an effective safety promotion program, three major factors should be considered; human (such as the knowledge, beliefs, values, motives, abilities and personality of individuals), behavior (like complying, coaching, recognizing, communicating and demonstrating the active care) and environment (such as equipment, tools, machines, housekeeping and heat/cold engineering) (Sukadarin et al., 2012; Fedorycheva and Hammer, 2015). This model is based on the continuous monitoring of these three dimensions, which are assumed to be dynamic and capable of influencing each other. In this way, when an individual choose to work safely, he/she have to think in this regard and ultimately have to be led to develop the safe behaviors and to make changes in the environmental conditions (Guldenmund, 2000). Fedorycheva et al., in a review on the safety triad models of safety culture noted that the triad models like the Geller Model have made the quantifying of safety culture possible in a meaningful way at various organizational levels. They also noted that incorporating all of the facets of safety culture in a framework is rare and even defining a methodological approach for applying the framework in an industry setting is rare. In the present study, the authors tried to design a methodological approach to not only apply all the components of Geller Model, but also to promote the human component of the model utilizing Health Belief Model (HBM). In Geller Model, the cognitive factors as the constituents of human component play a substantial role in developing the safety culture among individuals. Therefore, in order to study the cognitive factors in a more systematic way, we hypothesized that an integration of Geller model and HBM may result in more success in promoting safety culture of an industrial setting.

1.2. Health Belief Model

Health education and promotion specialists usually apply theory and model-based interventions aiming to change behavior in different settings. The Health Belief Model (HBM) (Hochbaum et al., 1952; Janz and Becker, 1984) is one of the most widely used behavioral change models focused on the cognitive determinants of behavior (Rosenstock et al., 1994). This model suggests that individuals conduct an internal assessment to find out the net pros of changing their behavior, and finally decide whether or not to act (Green and Murphy, 2014). Four domains have been considered for such assessment: perceived susceptibility to a disease or health risk, perceived severity of ill-health, perceived benefits of changing behavior, and perceived barriers to perform the healthy or safe behavior. Based on HBM, if one believes himself as a susceptible person to a specific health problem, he will probably become more sensitive toward it, consider it as a serious issue and consequently accept the preventive behaviors. Indeed, the individual should be convinced on the affordability and effectiveness of those behaviors in preventing ill-health. As HBM has been successfully used to predict and promote the cognitive determinants of various behaviors among individuals in different settings (Carpenter, 2010; Mehri et al., 2011; Zhang et al., 2013; Cao et al., 2014; Cheraghi et al., 2014; Harris, 2016), it was assumed to be applicable for covering the human component in the Geller Model, as well.

The purposes of this study were to (1) assess safety culture in an ORC in Tehran applying the Geller model, (2) assess the applicability of HBM in covering the human component of Geller Model and (3) design and implement a Safety Culture Promotion Intervention Program (SCPIP) based on an integration of Geller and HBM models aiming at safety culture promotion in the ORC in Tehran.

2. Methods

2.1. Study design

This controlled quasi-experimental field trial was conducted on operation staffs in an ORC in Tehran, Iran. The study was conducted in two phases: at the first phase, the safety culture of the ORC was assessed using the Geller and HBM models, which served as a needs assessment for the second phase of the study. In the second phase, based on the findings of the needs assessment, the SCPIP was designed and implemented through a controlled quasi-experimental intervention in the company.

2.2. Instrumentation

The instruments used for the first phase of the study included a Demographic Characteristics Form, a Safety Culture-related Cognitive Factors Questionnaire (SCCFQ), a behavioral and an environmental checklist.

All abovementioned questionnaires and checklists used within the study were developed by the authors after a review of the relevant literature (Heidari et al., 2007; Sanaenasab et al., 2008; Nouri Parkestani et al., 2010) and consultation with scholars in the field. Then, the questionnaires were pilot-tested and found suitable for the purposes of the study.

A panel of experts, consisting of three scholars in the areas of health behavior and education, an occupational health specialist, an epidemiologist, a psychologist and an HSE (Health, Safety and Environment) expert with field experience in safety promotion, reviewed and assessed the questions, orally, by evaluating the appropriateness and relevance of the items to the ORC staffs and the response format. The panel, also, confirmed the items to be representative of the constructs in order to confirm content validity of the instruments. The feedback from the experts was