

Original Article

Behavior-Based Safety Approach at a Large Construction Site in Iran

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Objectives: Behavioral-based safety is a term used to describe the prevention of accidents, injuries and loss in the workplace. An effective behavior-based safety program relies on engaging employees to understand how unsafe behaviors lead to injuries and how to eliminate them from the workplace. This paper examines behavior-based safety program in a massive construction site.

Method: For this purpose experiment and control groups were selected and performance feedback of workers about unsafe and critical behaviors has been reviewed.

Result: Test results show that among the critical behaviors, using ladder correctly among the workers had good feedback, but there is still a problem in concrete pouring behavior. Safety performance index of the experimental group has changed from 66% to 92%.

Discussion: Behavioral-based safety, an approach of identifying and preventing accidents, has many advantages. Implementing behavioral-based safety practices in the workplace ensures a protected environment. Observations identify which behaviors may be unsafe; therefore the best practices may be developed.

Keywords: Construction site, Critical behavior, Behavior-based safety

Introduction

The construction sector is considered one of the most dangerous parts of industry. Construction is always dangerous because of external activities, working height, machinery and equipment. Accidents occurred because of a combination of various factors (1). Conventionally they are classified into unsafe behavior and unsafe condition. HSE concluded that the behavior of individual is involved in approximately 80% of events (2). Many studies have proven that workers unsafe behavior more than unsafe conditions are involved in accidents.

Discussion is that if there are unsafe conditions, workers accepting the risk associated with work will continue normal activities of construction. In such a situation the construction site accidents can not be

attributed only to unsafe behavior. Accidents in construction sites occurred due to three major reasons. The first, failure to identify unsafe conditions that there are before activity or after start has been expanded, the second decision to continue working after the worker identified unsafe current conditions and the third decision to unsafe performance regardless of initial conditions at work (3). In the model introduced by Abdelhamid and Everett, unsafe conditions are induced by four major causes include management practices, unsafe acts of workers and coworkers, and inhuman events, which considered as a component nature of construction site. According to law, engineering methods, safety awareness and safety training and behavior based

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safety programs will bring better results for the site (4).

With an overview of available resources in the field of behavior-based safety, it can be seen that safe behavior promotion in the workplace, particularly in the construction sites is considered as a vital factor of health and safety management. Behavior-based safety technique is considered as a useful tool in raising the level of safe behaviors in workers. There are many resources and studies in this field in various industries that confirm this issue. Studies in the construction sector have revealed that behavior-based safety technique can be treated even in the construction sites. Behavior-based safety is the way mainly aimed at modification of unsafe behavior that is traditionally practiced in different industries. Using behavior-based safety technique as seen in the various sources can be effective in raising the level of behavior and safety of workers and as an alternative to reduce accidents in the industry. Behavioral analysis has shown its ability to strengthen safe behavior in work settings. Furthermore, it also has been shown in construction industry that organizational and managerial factors are linked with the accident rates (5-10).

Behavior-based safety in Hong Kong construction sites is one of the available studies in the area of behavior-based safety in the construction sites. In this study, Helen Lingard and Steve Rowlinson have used behavior-based in the construction sites in behaviors such as housekeeping, access to height, scaffolding, personal protective equipments in several different sites in Hong Kong. The procedure for the experimental design was used (11). They gathered information and carried out measures among 4 groups through 34 weeks. They also used Baseline Scores before treatment technique based on the safety of each group. The relative level of performance in each group was prepared as a graphic curve. Their studies concluded in two cases, namely housekeeping and access to favorable desirable results were obtained (12).

Geller identified seven key principles in the success of behavior-based safety program:

1. Interventional focus on observable behavior
2. Look for external factors that help to understand and improve the behavior
3. Direct with activators and motivate with their consequences

4. Focus on positive consequences of behavior motivators
5. Apply the scientific method to improve intervention
6. Use theory to integrate information, not to limit possibilities
7. Design interventions with consideration of internal feelings and attitudes

Geller described in a study five factors as staff participation in the process of behavior-based safety process:

- 1) Perceptions that BBS training was effective
- 2) Trust in management abilities
- 3) Accountability for BBS through performance appraisals
- 4) Whether or not one had received education in BBS
- 5) Tenure with the organization

Geller defined behavior-based safety process which includes behaviors, observing and collecting data and finally the effect of behavior intervention (13).

Method

After an initial assessment based on behavior sampling method of workers behavior, 10 workers were selected as a control group and 10 workers as experimental group. The implementation of a behavior-based safety program includes a rigorous training program for workers. Experimental group was trained for three days for safety issues using various methods including movies, photos and speech in the classroom.

Major behavior based-safety programs in general were composed of three parts: preparation of checklist of critical behaviors (endangered), observations and feedback (14). To prepare checklist critical incidents reports, interviews with workers, brainstorming can be useful. Determine the percentage of safe behavior is a way to get behaviors that more attention is needed. Checklist based on observations obtained recorded behaviors and provide required feedback to workers. Feedback reinforces the necessity of safe behaviors. Critical Behaviors is listed in Table 1. By adding up all the safe observations for a particular behavior and dividing this sum by the total number of observations for this behavior, measuring percent-safe score for each target behavior and multiplying this number by 100 yields a percentage or a percent-safe score for a certain behavior.

Table1. Safety Behavior Checklist

Critical Behavior Variables	Safe	At Risk	Comments
Always face the ladder.			
Only one worker at a time is allowed on a ladder.			
Work at the edges must be avoided.			
Do not climb the reinforcement body for access to higher parts.			
Climbing the form body after its installation should be refused.			
Do not throw the form bolt from top to bottom and vice versa.			
Do not loose concrete delivery hose until complete discharge.			
Carry jack concrete form twosome.			

The CBC observation took place three times a day: morning, mid-day, and toward the last hour of work. The observations implemented daily, Saturday through Thursday (working days in the site). The control group continued to work without any intervention. Total 374 observations for different groups in the testing phase for all three groups were conducted. During the experimental phase 1496 observations have been done for three days a week, considering working hours of the site, morning and afternoon. Feedback for experimental group during

the test toward safety behaviors was conducted and control group without received intervention and of course continued its work. Detail information about behaviors for both groups were collected.

Results

The mean scores of the safety performance for both experimental and control groups before treatment step, based on the safety of all workers in the site were derived. Safety performance indicators for experimental and control groups are shown in Fig. 1.

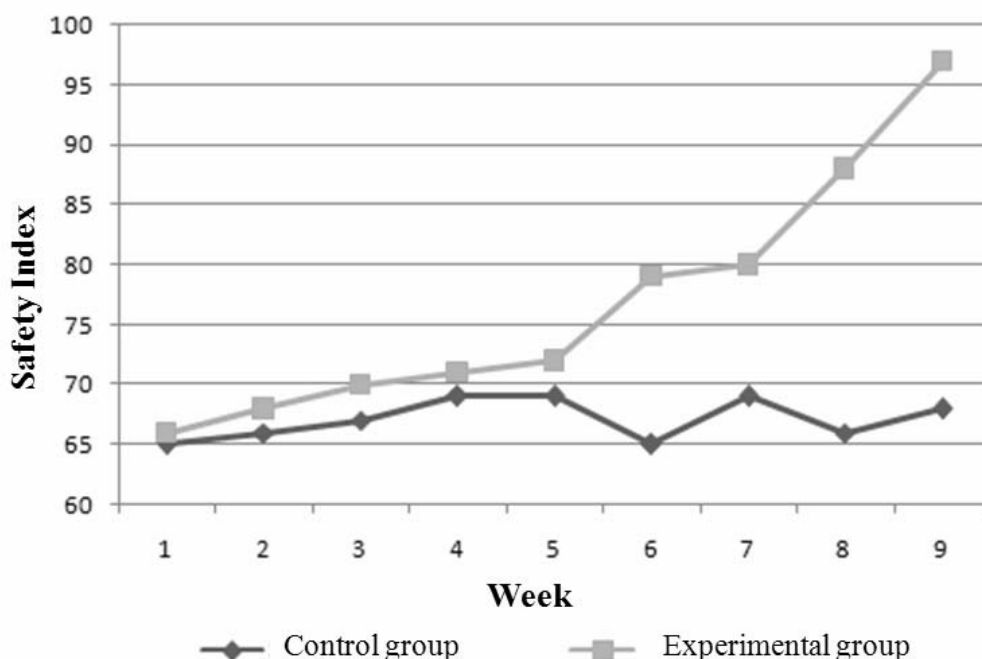


Fig. 1. Mean safety performance index for the experimental and control groups

As can be seen in the Fig.1 safety performance index of the experimental group during the 9 weeks of intervention has changed from 66% to 92%. The t-test for correlated samples was computed between the means of the baseline level phase and feedback phase for each group (Table 2). The control group

showed no significant change from the baseline to the feedback phase, but a significant increase in the mean percent safe scores in terms of target behaviors was evident for the experimental group ($t = - 3.073, p < 0.05$).

Table 2. T-test for experimental and control groups.

Group	N	Baseline-phase mean	Feedback-phase mean	Sig.	t
Experimental	10	66	78.1	0.013	-3.073
Control	10	65	67.4	0.081	-1.964

After 9 weeks of measurement and feedback assessment of influences of behavior-based safety in the experimental group, the trend continued for more two months. While this stage, observations

were performed to assess behaviors. As can be seen in Fig. 2, actions have been somewhat effective.

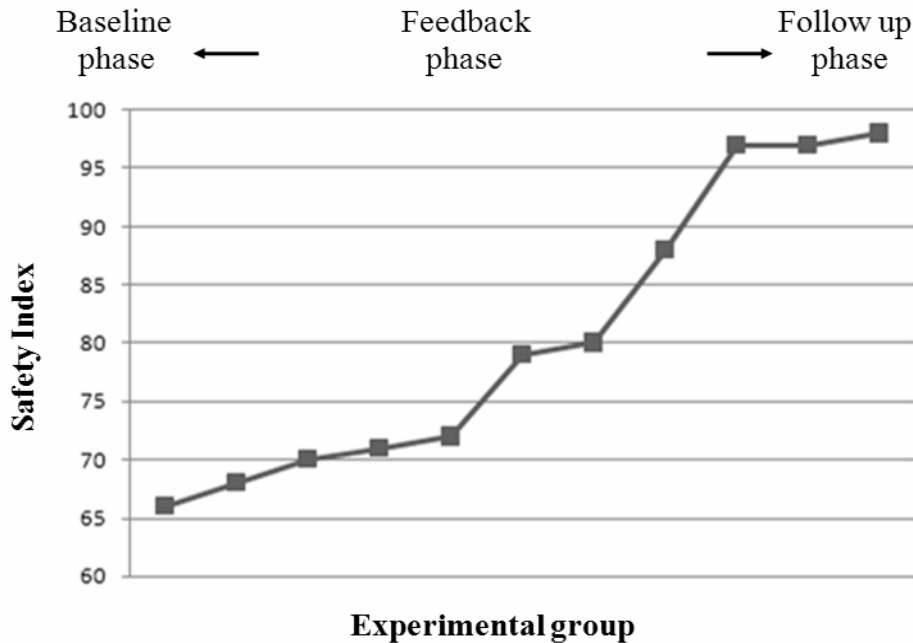


Fig. 2. Mean safety performance index of three phases of study for the experimental group

Discussion

This study has been conducted in a mass-construction site in Iran. Type of site process is concrete tunnel form and reinforcement workers and form workers are exposed to the highest risks; while accidents in these groups are illustrative of this word. So the main workers were selected among these groups. In addition to work on scaffold, as the main risk in each site, is considered as the third group. Overall purpose of this study was the application of behavior-based safety among construction workers. Previous studies on the importance and effectiveness of behavior-based safety practices was mentioned in various industries. The tremendous improvements in safety and performance of companies who have implemented BBS process have given this approach to safety management credibility and status (Geller, 1999). The behavior-based safety approach always targets specific behaviors to evaluate and then attempts support, increase, or decreases them.

Workers in the construction sector usually have less information about job health and safety, and get no specific trainings; therefore their attitudes about behaviors arise from experience and if events from themselves and their co-worker have not occurred continue their behaviors. So the important functions of the behavior-based safety could be first, introduce the unsafe behaviors of workers and second change workers attitudes toward unsure behavior through training programs.

Behavior-based safety involves the practical application of safety procedures based on the real world behaviors of employees in work situations. Everyone is considered responsible not only for their own safety, but for the safety of others. Unsafe behavior can trigger accidents and injuries. Identifying common workplace safety issues enables a company to assess the problem areas and create behavioral-based safety guidelines. All and all, implementing behavioral-based safety practices in

the workplace ensure a protected environment and employees are prompted to work together as a team to help monitor and diminish occurrences of hazardous events. Encouraging employees to be

proactive in both planning safe work settings and watching the habits of coworkers creates a sense of continuity and loyalty.

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