Abstract

Context: Noncompliance with personal protective equipment (PPE) in industrial workers results in increased injury or illness and is commonly reported worldwide. Numerous guidelines and management policies are employed to prevent work-related health hazards, yet industrial workers still exhibit low rates of PPE compliance, especially in outsourced workers. Aims: The aim of this study was to develop a holistic-comprehensive assessment framework model summarizing the key factors in achieving the stated goals of interventions targeting PPE compliance in Indonesian cement workers. Settings and Design: An analytic observational study was conducted among 183 Indonesian cement workers from a simple random sampling technique. Methods and Material: A self-designed questionnaire was used to investigate factors influencing PPE compliance among cement workers as well as management policies in place. Statistical Analysis Used: Statistical analysis was conducted using SPSS version 24. Results were tabulated using frequency distribution and mean with a standard deviation. The logistic regression model was developed to identify the factors that affect PPE compliance. Results: The highest rate of compliance was 43.7%, a still low figure. Using correlation coefficients and logistic regression, both the behavior of the workers and the existing management policies were found to be significant contributing factors (P < 0.05). Punitive management policies were also found to be a determining factor (OR 5.22; 95% CI 1.01–1.07). Conclusions: Management policy, specific punishment for noncompliance, was shown to be the strongest influence on PPE compliance in Indonesian cement workers.

Keywords: Compliance, holistic-comprehensive, personal protective equipment, punishment

Introduction

Rates of noncompliance with personal protective equipment (PPE) in industrial workers results in increased injury and illness and is commonly reported worldwide. The International Labour Organization reported that 2.3 million workers die annually from work-related fatalities, 160 million workers suffer from occupational diseases, and 313 million workers are treated for nonfatal accidents annually. Despite numerous recommendations and guidelines, and the prevalence of work-related health hazards, industrial workers still exhibit low rates of PPE compliance. In Indonesia, PPE noncompliance rates with environmental regulations decreased from 96 to 71% at the end of a fifth assessment, this is largely due to job environments improvement.[1] However, a safe and protected workspace does not necessarily guarantee a safer performance unless a positive safety culture is promoted.

Previous studies have shown that the safe behavior displayed by supervisors plays an important role when it comes to influencing the behavior of the workers. Strong safety culture and climate could reduce the incidence of injuries, illnesses, and fatalities on construction sites. Safety culture is defined as an organized culture favoring safe behavior that in turn

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influences positive outcomes within a safety management system. A workplace’s values, beliefs, attitudes, perceptions, competencies, and behaviors all affect the commitment to safety management. A strong safety culture is developed by improving communication in the workplace, increasing mutual trust, and respecting shared perceptions regarding the importance of safety performances.\[2,3\]

Industrial workers and management policy are two main factors influencing PPE compliance. Previous studies have shown four factors related to safety in the workplace: facilities management (0.049; \( P < 0.05 \)), hazards management (0.02; \( P < 0.05 \)), safety management programs (0.000; \( P < 0.05 \)) and safety behaviors of employees (0.020; \( P < 0.05 \)). Managers are encouraged to improve the efficiency and productivity of workers. Their influence over whether workers used personal protective equipment was found to be a key factor in compliance.\[4,5\] Therefore, the development of programs associated with safety matters, as well as encouragement and valuing of participants enrolled are supported.

Personal protective equipment in the workplace is utilized expressly for the protection of workers from the risks of health hazard exposure. It includes items such as gloves, foot and eye protection, protective hearing devices, and full bodysuits. Previous studies have linked PPE compliance with several factors: subpar knowledge, education and training, intolerance of the PPE provided in the workplace, a perception that PPE has a negative impact, heavy workloads, poor provision of PPE, and a lack of support from managers. One-third of workers reported no prior experience with PPE use. Due to a lack of PPE training, its use was learned only while already working, consequently affecting compliance. Management commitment, support, and attitudes about occupational safety all contributed to the culture of safety.\[6,7\]

In Indonesia, there are two types of workers: in-house and outsourced. Employers recruiting outsourced workers do so based on the belief that it can improve the productivity and quality of the business. Indeed, these types of workers benefit the profit margins of a company. However, PPE compliance is especially sub-optimal in outsourced workers. Safety management systems can predict workers’ engagement levels.\[8,9\] To this end, engaging a high number of outsourced workers in Indonesia with the practice of PPE use is likely to improve safety performance outcomes.

Addressing the challenges of PPE compliance requires an ongoing commitment from management in providing resources and effective and consistent teamwork. Employers must take into account all PPE policies and strategies available when promoting PPE compliance. A root cause analysis should be performed in order to understand the underlying problems as well as assist in decision management. A holistic-comprehensive assessment model is one such preventive strategy to achieve this. Medical doctors are able to gather appropriate data, provide relevant insights, and make recommendations by considering whole aspects of the system, including the bio-psycho-socio-spiritual dimensions which interact with one another.\[12,14\] The aim of this study was to develop a holistic-comprehensive assessment framework model summarizing the key factors needed to achieve a stated goal of interventions targeting PPE compliance in Indonesian cement workers.

**Subjects and Methods**

This analytic observational study of workers in the cement industry of Indonesia was conducted in July and August of 2018. 335 Indonesian cement workers made up the sampled population in Malang Area, East Java. A simple random sampling was used to select 183 respondents, using the formula \( N = N/N.d + 1 \) in order to determine sample size. Confounding variables were controlled for based on the following inclusion criteria: (1) subjects were employed for a minimum of 6 months; (2) subjects worked in the production department; (3) they could understand and sign consent documents. The subjects were free to participate after informed consent was obtained, which included the procedures, risks, and benefits of this study.

A self-designed questionnaire used to investigate PPE compliance included factors related to the behavior of cement workers as well as management policy. The independent factors were age, knowledge, duration of employment, provision of PPE, as well as rewards and punishments for its use. PPE compliance was the stated outcome variable and was computed as the percentage of respondents wearing gloves, foot protection, eye protection, protective hearing devices, hard hats, and full bodysuits.

Statistical analysis was done using SPSS version 24. Results were tabulated using frequency distribution and mean with a standard deviation. The Logistic Regression Model was developed to identify factors affecting PPE compliance. The regression analysis output was presented as odds ratio (OR) with 95% confidence intervals and a level of significance of \( P < 0.05 \). Ethical approval was obtained from the Ethical Committee at the University of Muhammadiyah Malang (Reg. No. E.5.a/075/KEPK-UMM/IV/2018).

**Theoretical Framework**

A holistic-comprehensive assessment (HCA) model provided a theoretical framework for this study [see Figure 1]. It contained factors related to PPE compliance, worker-related factors (age, knowledge, and duration of employment) and management policy-related factors (provision of PPE, reward, and punishment for its use). The rationale for developing an HCA model came from combining both management and individual factors in assessing PPE compliance as prior studies have stated that each is related and has significant relationships between variables within its framework.\[2,9\]

As shown in Figure 2, there are three factors related to PPE compliance among workers: age, knowledge, and duration
of employment. Increasing age suggests heightened ability and productivity, yet highly productive workers under the age of 40 had the least compliance with PPE compared to groups of other ages. This was due to factors such as knowledge, and employment duration, etc.\[11\] Employers should encourage and motivate workers towards better behavioral safety. To accomplish this, a broadening of the working knowledge of PPE must be made through adequate training about health hazards, safety skill improvements and adoption of safety culture. Outsourced employees who have worked for less than 1 year often find that their rights may be limited and therefore they are at a higher risk for PPE noncompliance. Meanwhile, workers who have worked for more than 1 year may have better compliance due to employment contracts, permanent positions, benefits, and allowances.\[15-17\]

As shown in Figure 3, management policy factors include how PPE is provided in the workplace, as well as rewards and punishments for compliance. Several steps that should be planned by employers include selection, correct use, and maintenance of PPE, periodic review, assessment of compliance components and effectiveness overall and providing support for worker safety, including enforcement of PPE policies. Motivating employees to retain positive behaviors of PPE compliance through the use of rewards has been shown to increase their safety performance.

There are two types of rewards: tangible and intangible. Tangible rewards include increases in salary and wages, incentives, bonuses, and allowances. Intangible rewards consist of providing a flexible working environment, days off, annual leave, training, positive feedback for wearing PPE, role-model status for worker safety, and support in dealing with

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**Figure 1:** A core conceptual framework on holistic-comprehensive assessment model on factors associated with personal protective equipment (PPE) compliance

- **Occupational Hazards** → **Holistic-Comprehensive Assessment** → **Personal Protective Equipment (PPE) Compliance** → **Reduce hazard risks**

**Workers-related factors**
- Age
  - < 40 y.o: highly productive workers, yet poorer compliance due to other factors, such as knowledge, employment duration, etc.
  - > 40 y.o: lower level of productivity, stress-related financial issues or family issues.

**Management policy-related factors**
- Provision of PPE
  - Reward
  - Punishment

**Figure 2:** Workers-related factors

- **Knowledge**
  - Knowledge about PPE: risk and benefits, motivation
  - Ability to use PPE: motivation, barriers, discomfort wearing PPE
  - Knowledge about health hazards: consequences, motivation
  - Knowledge about safety skills: perceptions, motivation
  - Knowledge and practice about safety culture: beliefs, risk perceptions

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the discomfort of wearing PPE, thereby enhancing worker well-being.\[18\]

Workers who are reprimanded for having negative attitudes towards PPE compliance serve to alert other workers to comply with safety behaviors as well as to understand how punishment can inhibit performance and productivity. There are four types of punishment: verbal and written warnings, written suspension and termination. Verbal warnings include those which could simply remind of the consequences of non-compliance. Written reprimands are warnings that aim to improve performance wearing PPE. Furthermore, written suspension occurs when a worker’s behavior is damaging and poses a risk to other employees; these workers are still provided for, in their rights and obligations. Employee termination is the final corrective effort sought for behavioral misconduct.\[19-21]\n
**RESULTS**

Selected study participants completed a structured questionnaire investigating worker and management policy-related factors as well as current PPE compliance in the workplace. 183 questionnaires were filled out completely, returned and then analyzed after validation (giving a response rate of 100%). All questionnaires were immediately checked for any missing data or errors to ensure correctness.

In this study, most respondents were 40 years old or less (55.2%) \[Table 1\], had poor knowledge related to PPE (58.5%), had worked for less than a year (64.5%), had poor provision of PPE by management (57.4%), enjoyed no rewards for compliance (64.5%) nor punishment for noncompliance (56.8%). The highest rate shown for compliance was 43.7%—a low figure.

As seen in Tables 2 and 3, knowledge and punishment have a strong correlation with PPE compliance. Using correlation coefficients and logistic regression, worker factors and management policy were found to be significant variables \((P < 0.05)\). Specifically, the management policy of punishment was found to be a particularly determinant factor for PPE compliance \((OR 5.22; 95\% CI 1.01–1.07)\).

**DISCUSSION**

Many factors have been shown to affect the use of PPE, including worker demographics and workplace situations.
Professional competency factors affecting use include bio-psycho-socio-spiritual aspects such as belief, attitude, the comfort of PPE, fear of correct use, and the provision for and availability of PPE in the workplace.\[22\] In this study, most respondents were less than 40 years of age (55.2%) and showed poor knowledge related to PPE use (58.5%). Age is often associated with the ability to learn new knowledge to utilize that information to perform complex tasks. It also influences an individual’s ability to comply with safety practices.\[11\] This study revealed that outsourced employees who had worked for less than 1 year (64.5%) were at the highest risk for PPE noncompliance. This finding is in line with a previous study showing that length of employment was a significant contributing factor to the awareness of PPE compliance.\[17\]

Management policy-related factors also influenced compliance. These included a poor provision of PPE by management (57.4%), no rewards for workers who complied (64.5%) nor punishment for those that didn’t (56.8%). The highest rate of PPE compliance was 43.7%, which is still a low figure. The results indicated that workers’ rights and responsibilities were being ignored either involuntarily and that policies for safety behaviors were limited and/or deficient for the studied population. A lack of training and poor safety performance reviews were considered key factors in influencing PPE compliance among workers in construction sites. The safety attitudes and performance of employers can impact worker safety behavior. It is believed that workers are more likely to improve safety performance when management provides full support and encouragement for safety behaviors. The ease of the use of PPE influenced workers because some felt discomfort while using it and working. Management should, therefore, take this into consideration when selecting appropriate PPE for their workplace and make selections based on fit, comfort, and freedom of movement.\[22-26\] Rewards and recognition regarding safety behaviors can be beneficial to safety outcomes. Previous studies have shown that the adoption of new incentive systems improved the safety of working behaviors within the first 6 months of project implementation. Meanwhile, reprimanding employees with punishment ensured workers behaved in acceptable ways, complied with workplace regulations and improved their performance.\[27,28\]

Management policies including punishment were a determining factor in PPE compliance (OR 5.22; 95% CI 1.01–1.07). The punishment was implemented to ensure that the work environment was both safe and pleasant for employers and employees alike. Workers are expected to know compliance regulations and the consequences if they are not met. Before reprimanding employees, employers should clearly state what the consequences will be if employees continue their unsafe behavior. PPE compliance depends not only on the workers’ knowledge and safety skills but also on their motivation to work as cement workers in the face of enforcement from management. Moreover, safety management systems provide a positive influence on safety compliance overall.\[29,30\]

**Conclusion**

This study found that the largest area of influence over PPE compliance among Indonesian cement workers was related to management policy (\(P < 0.05\)). Therefore, it is advisable that employers should promote activities supporting safety performance and culture. A commitment to safety behaviors shows that management is involved in improving and maintaining an efficient and safe workplace.
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Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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