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Research Article

ANALYSIS OF KNOWLEDGE AND ATTITUDES ON PPE COMPLIENTE AMONG PRODUCTION WORKERS AT PT.X

Dewi Kusuma Febrianti[1], Puspita Puji Rahayu[2]
[1] Universitas Nasional Karangturi Semarang, Indonesia
[2] Universitas Nasional Karangturi Semarang, Indonesia

Corresponding Author:

Dewi Kusuma Febrianti,
Department of Psychology, Faculty of Economics, Business and Humanities, Universitas Nasional Karangturi Semarang.
Semarang City, Central Java, Indonesia
Email: dewi07022001@gmail.com

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Abstract

This study aims to analyze the relationship between knowledge and attitudes and compliance with the use of Personal Protective Equipment (PPE) among production workers in the food industry in Semarang. The study employed a quantitative approach with a cross-sectional design involving production workers as respondents. Data were collected through questionnaires to measure levels of knowledge and attitudes, as well as direct observation to assess compliance with PPE usage. Data analysis was conducted using descriptive and bivariate methods to identify relationships between variables. The results showed that there is a relationship between knowledge and attitudes and compliance with PPE usage. Workers with a higher level of knowledge and positive attitudes tend to be more compliant in using PPE compared to those with lower knowledge and negative attitudes. However, compliance is not only influenced by individual factors but also by workplace environmental factors such as supervision, safety culture, and the comfort of PPE use. These findings emphasize that improving compliance requires a comprehensive and integrative approach. The conclusion of this study is that knowledge and attitudes are important determinants in shaping compliance behavior in PPE usage; however, their effectiveness is strongly influenced by workplace support. Therefore, strategies to improve occupational safety should include continuous education, strengthened supervision, and the development of a safety culture within the industrial environment.

Keywords: knowledge, attitudes, compliance, personal protective equipment (PPE), occupational safety

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INTRODUCTION

Occupational Safety and Health (OSH) is a fundamental aspect of human resource management aimed at protecting workers from the risks of occupational accidents and work-related diseases. International organizations and governments across various countries continue to emphasize the importance of implementing OSH as part of efforts to enhance productivity, organizational sustainability, and employee well-being. In the manufacturing sector, including the food industry, workers are exposed to various potential hazards such as production machinery, noise, extreme temperatures, cleaning chemicals, dust, and repetitive work activities that may cause injuries and long-term health problems (Ahmed et al., 2023; Baye et al., 2022; Hussein et al., 2024). Therefore, the implementation of an effective occupational safety system has become an indispensable requirement in modern industrial operations.

One of the most commonly used forms of risk control is Personal Protective Equipment (PPE). PPE serves as the last line of defense within the hierarchy of hazard control when risks cannot be completely eliminated through elimination, substitution, engineering controls, or administrative controls. The proper use of PPE has been proven to reduce the risk of occupational injuries, exposure to hazardous substances, noise-induced hearing loss, and work-related diseases that develop over time (Wright et al., 2019; Fauzan et al., 2023; Fatah et al., 2025). In addition to protecting workers, PPE in the food industry also helps maintain product quality and safety, thereby influencing production quality and consumer trust.

Although the benefits of PPE have been demonstrated in numerous studies, compliance with its use remains a challenge across various industrial sectors. Research conducted among workers in manufacturing, construction, mining, and healthcare sectors indicates that employees often fail to use PPE consistently or completely, even when the equipment is available and clear safety procedures are in place (Sa et al., 2016; Subramaniyan et al., 2019; Teym et al., 2025). This condition suggests that PPE compliance is influenced not only by the availability of equipment but also by individual behavioral factors and workplace conditions.

From the perspective of industrial and organizational psychology, safety behavior is influenced by interacting cognitive, affective, and contextual factors. One of the most extensively studied individual factors is knowledge. Knowledge refers to workers' ability to understand occupational risks, recognize the functions of PPE, and comprehend the consequences of failing to comply with safety procedures. Adequate knowledge enables workers to assess risks more rationally and make decisions that support workplace safety (Mengesha et al., 2023; Sifanu et al., 2023a; Ginandhani et al., 2021).

Various studies have shown that workers with higher levels of knowledge tend to demonstrate better safety practices than those with lower levels of knowledge. Mengesha et al. (2023) found that safety knowledge was significantly associated with the implementation of risk prevention measures among factory workers. Similar findings were reported by Sifanu et al. (2023a), who found that knowledge of workplace hazards and self-protection was positively associated with PPE compliance among mining workers. However, other studies have indicated that adequate knowledge does not necessarily lead to compliant behavior if it is not accompanied by supportive psychological and environmental factors (Wright et al., 2019; Fauzan et al., 2023).

In addition to knowledge, attitude plays a crucial role in shaping occupational safety behavior. Attitude reflects an individual's evaluation of a particular object or behavior, including beliefs about the benefits of PPE use and the tendency to accept or reject such behavior. A positive attitude toward workplace safety increases workers' motivation to comply with PPE procedures, whereas a negative attitude tends to reduce compliance (Alinejad et al., 2023; Shubayr, 2024; Liu et al., 2024).

The relationship between knowledge, attitude, and compliance behavior can be explained through the Health Belief Model (HBM). This model suggests that individuals are more likely to engage in health-related behaviors when they perceive themselves as vulnerable to specific

risks, understand the severity of potential consequences, recognize the benefits of preventive actions, and believe they are capable of performing such actions. In the context of PPE use, workers who understand workplace hazards and believe that PPE can protect them are more likely to use it consistently (Amini et al., 2021; Alinejad et al., 2023; Shubayr, 2024).

In addition to the HBM, the Theory of Planned Behavior (TPB) explains that behavior is influenced by intentions formed through attitudes, subjective norms, and perceived behavioral control. According to this theory, workers who hold positive attitudes toward PPE and receive social support from colleagues and supervisors are more likely to comply with occupational safety procedures (Guerin & Sleet, 2020; Liu et al., 2024).

Although individual factors are important, research suggests that occupational safety behavior cannot be separated from the influence of the organizational environment. One of the most widely studied organizational factors is safety climate. Safety climate refers to employees' perceptions of an organization's commitment to workplace safety. A positive safety climate encourages workers to comply with safety regulations because they perceive support, concern, and supervision from the organization (Le, 2025; Satoto, 2020; Abdurrouf et al., 2023).

Another important organizational factor is safety culture. Safety culture reflects the values, beliefs, norms, and practices that develop within an organization regarding workplace safety. Organizations with a strong safety culture generally demonstrate higher levels of compliance because safety has become an integral value internalized by all organizational members (Stevianingrum & Erwandi, 2022; Yanriatuti et al., 2020; Mutia & Dhamanti, 2023). Safety-supportive leadership has also been shown to strengthen safety culture and improve workers' compliance with PPE use (Nabilla & Dhamanti, 2023; Abdurrouf et al., 2023).

Furthermore, safety training and education play a significant role in improving PPE compliance. Well-structured training programs have been shown to enhance knowledge, foster positive attitudes, and strengthen workers' safety behavior. Donkoh et al. (2023) demonstrated that safety training significantly improved safe work behavior among industrial workers. Similar findings were reported by Ada et al. (2025), who emphasized that strategies to improve PPE compliance require a combination of education, supervision, and organizational support.

Technological advancements have also begun to support PPE compliance in the workplace. The application of technologies such as the Internet of Things (IoT), artificial intelligence, and digital monitoring systems enables companies to supervise PPE use more effectively and in real time (Ahmed et al., 2023; Gamberini et al., 2021). Nevertheless, technology cannot replace the role of psychological factors and organizational culture in shaping workers' safety behavior.

In the food industry, compliance with PPE use is particularly important because it affects not only worker safety but also the quality of the products produced. However, most previous studies have focused on healthcare, mining, construction, and heavy industries, while research specifically examining PPE compliance in the food industry remains relatively limited (Subramaniyan et al., 2019; Baye et al., 2022; Teym et al., 2025).

Based on the literature review, a research gap remains. Most previous studies have focused on a single variable, such as knowledge or attitude, without examining their simultaneous relationship in influencing PPE compliance. In addition, studies on safety behavior among food industry workers in Indonesia remain limited, highlighting the need for more contextual empirical evidence to support the development of effective OSH programs (Mengesha et al., 2023; Sifanu et al., 2023a; Le, 2025).

The novelty of this study lies in its analysis of the simultaneous relationship between knowledge and attitudes toward PPE compliance among production workers in the food industry in Semarang. This study integrates health behavior perspectives through the Health Belief Model and the Theory of Planned Behavior within the context of workplace safety culture in the food industry. The findings are expected to contribute theoretically to the

development of occupational safety behavior research and provide a foundation for companies to design more effective and sustainable PPE compliance programs.

Based on the above discussion, the research question of this study is: "Is there a relationship between knowledge and attitudes and compliance with Personal Protective Equipment (PPE) use among production workers at PT X in Semarang?"

Based on theoretical reviews and previous research findings, this study develops a conceptual framework that examines the relationships among knowledge of PPE use, attitudes toward PPE, and PPE compliance behavior. Knowledge is expected to influence attitudes, while both knowledge and attitudes are expected to jointly influence PPE compliance behavior. In addition, workplace factors such as supervision, safety culture, and PPE comfort are considered contextual variables that may strengthen or weaken these relationships. The conceptual framework of this study is presented in Figure 1.

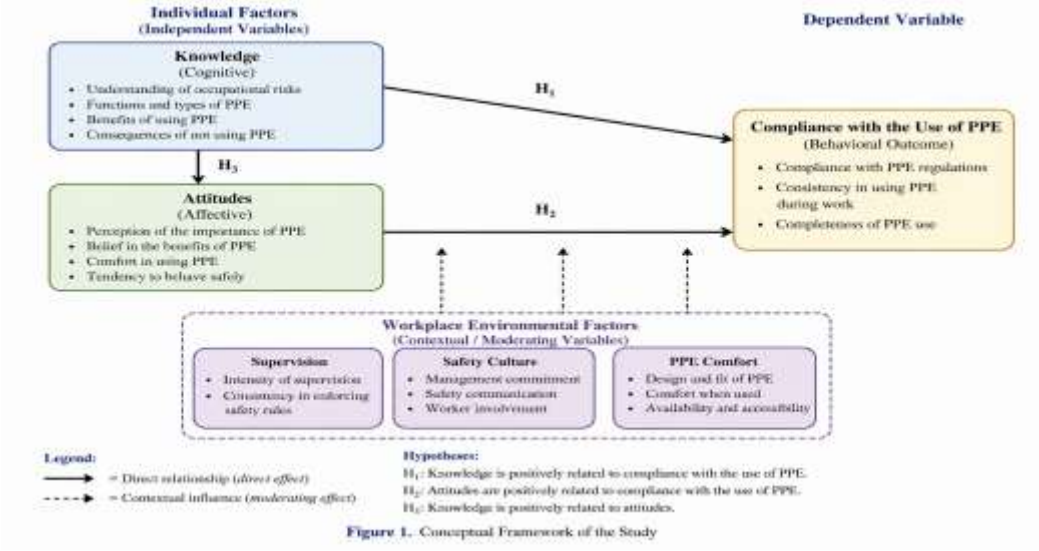

Figure 1. Conceptual Framework of the Study

RESEARCH METHOD

Based on the objective of this study, which is to analyze the relationship between knowledge and attitudes and compliance with the use of Personal Protective Equipment (PPE), a quantitative approach with an analytical observational design was employed. This method was selected to obtain empirical evidence regarding the relationships among the variables under investigation among production workers within the context of occupational safety and health.

Research Design

This study employed a quantitative approach with an analytical observational research design using a cross-sectional method, in which variables were measured at a single point in time to examine the relationship between knowledge and attitudes and compliance with the use of Personal Protective Equipment (PPE). This design was chosen because it allows researchers to efficiently identify relationships among variables within a dynamic workplace context and is consistent with commonly used approaches in Occupational Safety and Health (OSH) studies that examine worker behavior based on cognitive and affective factors (Sifanu et al., 2019; Guerin & Sleet, 2020). The study was conducted in a food industry production environment, specifically in the production division of PT X, Tbk Semarang, which is characterized by high occupational risks due to exposure to machinery, production materials, and noise. This research setting is relevant for examining the relationships among variables, as there are variations in

PPE compliance among workers despite the company having established clear standard operating procedures (SOPs) related to occupational safety.

Research Target/Subject

The population in this study consisted of all production workers, particularly those in the packing division who are directly involved in operational processes. The sample was selected using a total sampling (census) technique, in which all members of the population who met the inclusion criteria were included as research respondents. The inclusion criteria included active workers, willingness to participate as respondents, and direct involvement in production activities requiring PPE use. Respondent characteristics included being of productive age, having predominantly high school/vocational school educational backgrounds, varying lengths of work experience, and working in shift systems that influence work behavior dynamics. The use of total sampling aimed to obtain a comprehensive overview of actual field conditions and to minimize sampling bias, as recommended in studies on work behavior and safety compliance (Mengesha et al., 2023; Fauzan et al., 2023).

Instruments, and Data Collection Techniques

The research instruments consisted of three main components: a knowledge questionnaire, an attitude scale, and an observation checklist for PPE compliance. The knowledge questionnaire was designed to measure workers' understanding of occupational risks and the importance of PPE use, reflecting the cognitive aspects of health behavior theories such as the Health Belief Model (HBM). The attitude scale was used to assess respondents' perceptions, beliefs, and tendencies toward PPE use as part of occupational safety behavior, in line with constructs in the Theory of Planned Behavior (TPB). Meanwhile, the observation checklist was used to directly assess the level of worker compliance in using PPE during work activities. The use of these combined instruments aimed to enhance data validity by integrating self-reported data and direct observation, as recommended in previous studies (Alinejad et al., 2023; Huang et al., 2023).

Research Procedure

The data collection procedure was conducted through several systematic stages. The first stage involved obtaining research permission from the company and informing respondents about the objectives and benefits of the study. The second stage involved providing instructions to respondents on how to complete the questionnaires and emphasizing the importance of honest responses. Respondents were then asked to complete the knowledge and attitude questionnaires independently within a specified time. Afterward, the researcher conducted direct observations of PPE usage behavior in the workplace to obtain objective data on compliance levels. All data collection processes were carried out in accordance with research ethics principles, including informed consent, data confidentiality, and respondent anonymity. This approach aligns with OSH research practices that emphasize data integrity and the protection of research subjects (Wright et al., 2019; Alinejad et al., 2023).

Data Analysis Technique

The data analysis method in this study employed inferential statistical analysis to examine the relationship between independent variables (knowledge and attitudes) and the dependent variable (PPE compliance). Data obtained from questionnaires and observations were first tested for validity and reliability to ensure the quality of the research instruments. Subsequently, univariate analysis was conducted to describe the frequency distribution of each variable, followed by bivariate analysis to examine relationships between variables using appropriate statistical tests, such as the chi-square test or correlation analysis. In more complex contexts, the analysis can be further developed using path analysis to examine both direct and indirect effects among variables, as suggested in studies based on health behavior theories

integrating HBM and TPB constructs (Ginandhani et al., 2021; Guerin & Sleet, 2020). Through this analytical approach, the study is expected to provide a comprehensive understanding of the factors influencing PPE compliance and their implications for improving occupational safety in industrial settings.

RESULTS AND DISCUSSION

This study was conducted in the production environment of PT X, Tbk Semarang, focusing on packing division workers who are directly involved in operational production processes. Based on field data, the number of informants in this study consisted of all active workers in the division who met the inclusion criteria. In general, the characteristics of the informants indicate that most are of productive age, have high school/vocational school educational backgrounds, and possess varying lengths of work experience. The work system applied is a shift system, which results in variations in working conditions and levels of supervision at different operational times. The work environment is categorized as high-risk due to the use of production machinery, exposure to materials, and significant noise levels. These conditions require consistent use of Personal Protective Equipment (PPE) as part of standard occupational safety procedures.

Descriptively, the results of data collection through questionnaires show variations in workers' levels of knowledge regarding occupational safety and PPE usage. Some workers have a high level of knowledge, indicated by a good understanding of PPE functions, types of occupational risks, and the consequences of not using PPE. However, there are also groups of workers with moderate to low levels of knowledge, particularly in understanding long-term risks and the importance of consistent PPE use. Field observation data also show that although most workers are aware of the obligation to use PPE, implementation in practice is not always consistent with their knowledge.

In addition, the results of attitude measurements indicate differences in workers' affective tendencies toward PPE usage. Some informants demonstrate positive attitudes, such as perceiving PPE use as important for personal safety and as part of their work responsibility. However, others show less supportive attitudes, such as feeling uncomfortable using PPE, perceiving it as hindering work, or only using PPE when supervision is present. These variations in attitudes are reflected in the questionnaire results, which show a non-homogeneous distribution of attitude scores among respondents.

Table 1. Distribution of Knowledge, Attitudes, and PPE Compliance

Variable	Category	Frequency (n)	Percentage (%)
Knowledge	High	18	45%
	Moderate	12	30%
	Low	10	25%
Attitudes	Positive	20	50%
	Negative	20	50%
PPE Compliance	Compliant	22	55%
	Non-compliant	18	45%
Variable	Category	Frequency (n)	Percentage (%)

Based on the table above, knowledge distribution tends to be higher in the high category, although there are still significant proportions in the moderate and low categories. Meanwhile, the distribution of attitudes shows a balance between positive and negative attitudes. In terms of compliance, more than half of the respondents are categorized as compliant; however, the proportion of non-compliant workers remains substantial.

Direct field observations reinforce these quantitative findings. In several work situations, workers were found not using PPE completely, such as not wearing masks, gloves, or safety

boots in accordance with established standards. This inconsistency was particularly evident when supervision was not directly conducted by supervisors. One excerpt from an initial interview with an informant (initial: R) stated: “Usually, when supervised, we wear complete PPE, but when not, sometimes only part of it is used.” Another informant (initial: S) stated: “PPE can feel hot and uncomfortable, so when the work is fast-paced, it is sometimes removed.”

These statements indicate variations in PPE usage behavior influenced by situational conditions in the workplace. Observational documentation also shows that SOPs for PPE usage have been established and socialized by the company; however, their implementation is not yet fully consistent among all workers.

Bivariate analysis was conducted to examine the relationship between knowledge and PPE compliance. Cross-tabulation results indicate that workers with higher levels of knowledge tend to have higher levels of compliance compared to those with lower knowledge levels. The results are presented below:

Table 2. Relationship Between Knowledge and PPE Compliance

Knowledge	Compliant (n)	Non-compliant (n)
High	14	4
Moderate	5	7
Low	3	7

The data show that the majority of workers with high knowledge fall into the compliant category, whereas workers with low knowledge are more frequently categorized as non-compliant.

Furthermore, the relationship between attitudes and PPE compliance was also analyzed. The results indicate that workers with positive attitudes tend to be more compliant compared to those with negative attitudes.

Table 3. Relationship Between Attitudes and PPE Compliance

Attitudes	Compliant (n)	Non-compliant (n)
Positive	16	4
Negative	6	14

These results indicate a significant difference in compliance distribution between workers with positive and negative attitudes. Workers with positive attitudes toward PPE usage are more likely to demonstrate compliant behavior, whereas those with negative attitudes tend to be non-compliant.

Overall, the findings of this study indicate a pattern of relationships between knowledge and attitudes and PPE compliance. Workers with better knowledge and more positive attitudes toward occupational safety tend to demonstrate higher levels of compliance. Conversely, workers with lower knowledge and negative attitudes tend to exhibit non-compliant behavior in PPE usage.

In addition, other factors identified from observations and interviews include the role of supervision and work habits. Under conditions of strict supervision, compliance levels tend to increase. Conversely, in situations with minimal supervision, compliance with PPE usage decreases. This indicates that compliance behavior is influenced not only by individual factors but also by situational factors in the work environment.

Field findings also indicate a need for more intensive and continuous OSH training. Several informants stated that more frequent training and consistent supervision could help improve awareness and compliance with PPE usage. This is reflected in a statement from an informant (initial: A): “If we are reminded frequently and given training, we might become more disciplined in using PPE.”

Thus, the results of this study provide an empirical overview of the actual conditions of PPE compliance in the food industry production environment and demonstrate variations

influenced by knowledge, attitudes, and workplace conditions. The quantitative and qualitative data complement each other in describing the phenomenon of PPE compliance comprehensively without further interpretation of the relationships among variables.

The results of this study indicate that there is a relationship between knowledge and attitudes and compliance with the use of Personal Protective Equipment (PPE) among production workers in the food industry. This finding is consistent with occupational health and safety and health behavior theories, which explain that compliance behavior is influenced by cognitive, affective, and workplace environmental factors. From the perspectives of the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB), knowledge plays a role in shaping risk perception, while attitudes influence individuals' intentions and actual behaviors regarding PPE use (Guerin & Sleet, 2020; Sifanu et al., 2023a). Furthermore, Shubayr (2024) demonstrated that workers' perceptions of benefits and risks are important factors in enhancing their commitment to using personal protective equipment in the workplace.

The findings revealed that workers with higher levels of knowledge tended to demonstrate better compliance with PPE use than those with lower levels of knowledge. This result supports the findings of Mengesha et al. (2023), who reported a significant relationship between workers' knowledge levels and occupational safety practices. Adequate knowledge enables workers to understand the risks of occupational accidents and work-related diseases, thereby increasing their awareness and willingness to use PPE consistently. These findings are also consistent with Teym et al. (2025), who identified awareness of workplace hazards as one of the primary determinants of PPE compliance among industrial workers.

However, high levels of knowledge do not always guarantee compliance. Some workers in this study continued to exhibit non-compliant behavior despite understanding the importance of PPE. This finding reinforces the results of Huang et al. (2023) and Sifanu et al. (2023a), who argued that knowledge must be supported by positive attitudes, motivation, and adequate risk perception in order to be translated into consistent safety behavior. Therefore, increasing knowledge alone may not be sufficient to change workers' behavior without the support of other contributing factors.

This study also found that attitudes were strongly associated with PPE compliance. Workers with positive attitudes toward occupational safety demonstrated higher levels of compliance than those with negative attitudes. This finding is in line with the study conducted by Alinejad et al. (2023), which showed that interventions based on the Health Belief Model effectively improved positive attitudes and workers' compliance with occupational safety standards. Similar findings were reported by Amini et al. (2021), who stated that attitude change is a critical factor in the success of occupational safety education programs.

In addition to individual factors, observational findings indicated that supervision influences PPE compliance behavior. Compliance levels increased when direct supervision from supervisors was present and decreased when supervision was inconsistent. This finding supports the study by Wright et al. (2019), which found that PPE compliance tends to be higher in workplaces that implement effective monitoring and supervision systems. Donkoh et al. (2023) also demonstrated that continuous training and supervision can enhance workers' awareness of the importance of workplace safety.

The comfort of PPE was also identified as a barrier to compliance in this study. Several workers reported that PPE felt hot, uncomfortable, or interfered with work activities, leading to inconsistent use. This finding is consistent with the systematic review conducted by Fauzan et al. (2023), which concluded that comfort, equipment design, and ease of use are important determinants of PPE compliance. Similarly, Fatah et al. (2025) identified discomfort associated with PPE as one of the major obstacles to the implementation of occupational safety programs in industrial settings.

Workplace safety culture also emerged as a relevant factor in explaining the findings of this study. Although the company had provided adequate PPE and established standard

operating procedures (SOPs), workers' compliance levels still varied. This suggests that the success of safety programs is determined not only by the availability of facilities but also by the presence of an organizational culture that supports safe behavior. This finding is consistent with Anwar et al. (2023), who emphasized the importance of safety culture in improving workers' compliance with occupational safety procedures. Moreover, Satoto (2020) explained that safety leadership plays a crucial role in fostering a work culture that prioritizes safety.

The study further revealed that a supportive work environment can serve as a reinforcing factor for safety behavior. Management commitment, safety communication, and employee involvement in occupational safety and health (OSH) programs can improve compliance with PPE use. These findings align with Le (2025), who found that organizational barriers significantly influence the implementation of workplace safety practices in industrial settings. In addition, Ginandhani et al. (2021), through path analysis, demonstrated that organizational factors have both direct and indirect effects on PPE-use behavior.

From a scientific perspective, this study provides evidence that PPE compliance results from the interaction between individual and workplace environmental factors. Knowledge and attitudes are important determinants; however, their effectiveness is strongly influenced by safety culture, supervision, organizational support, and PPE comfort. These findings reinforce the view that occupational safety behavior should be addressed through a multidimensional approach rather than focusing on a single factor alone (Guerin & Sleet, 2020; Le, 2025).

From a practical perspective, the findings suggest that companies should develop integrated OSH programs through enhanced education, the promotion of positive attitudes, the strengthening of safety culture, improvements in PPE quality, and continuous supervision. Such a comprehensive approach is expected to improve PPE compliance and reduce the risk of occupational accidents within the food industry sector.

CONCLUSION

This study aims to analyze the relationship between knowledge and attitudes and compliance with the use of Personal Protective Equipment (PPE) among production workers in the food industry in Semarang. Based on the research findings, it can be concluded that there is a significant relationship between knowledge and attitudes and the level of PPE compliance. Workers with higher levels of knowledge tend to demonstrate better compliance behavior compared to those with lower levels of knowledge. However, knowledge alone does not automatically guarantee compliance unless it is accompanied by positive attitudes toward occupational safety. Attitudes have been shown to play an important role in shaping worker behavior, as workers with positive attitudes are more consistent in using PPE than those with negative attitudes.

In addition, this study shows that PPE compliance is influenced not only by individual factors but also by workplace environmental factors, such as supervision, safety culture, and the comfort of PPE use. Field conditions indicate that compliance increases when supervision is consistent and decreases when supervision is inadequate. This suggests that compliance behavior is the result of interactions among cognitive, affective, and contextual factors. Therefore, efforts to improve PPE compliance must be carried out comprehensively by considering these various factors.

The main contribution of this study is to provide empirical evidence that an integrative approach combining knowledge and attitudes within a real workplace context can offer a more comprehensive understanding of PPE compliance behavior. This study also enriches the body of knowledge in the field of Occupational Safety and Health (OSH), particularly in the food industry sector, which has been relatively underexplored in previous research. These findings can serve as a basis for developing more effective and behavior-based OSH policies and programs.

Based on the research results, several recommendations can be proposed. First, companies should enhance continuous OSH training programs using approaches that focus not only on increasing knowledge but also on shaping workers' attitudes and awareness of the importance of occupational safety. Second, there is a need to strengthen supervision systems to ensure consistent and structured enforcement of PPE compliance in all work activities. Third, companies are advised to improve the quality and comfort of PPE to prevent it from becoming a barrier to workers in performing their tasks. Fourth, the development of a strong safety culture should be prioritized through active involvement of both management and workers in creating a safe and conducive work environment.

For future research, it is recommended to employ more complex research designs, such as longitudinal or experimental approaches, to better identify causal relationships among variables. In addition, future studies may include other variables such as subjective norms, self-efficacy, and safety climate to obtain a more comprehensive understanding of the determinants of PPE compliance behavior. A mixed-methods approach may also be used to explore more deeply the aspects of work culture and social dynamics that influence workers' safety behavior.

Thus, this study is expected to make a meaningful contribution to improving occupational safety in industrial environments and to serve as a reference for future research in the field of Occupational Safety and Health.

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AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Methodology; Data curation; Investigation; Formal analysis; Writing – original draft.
Author 2: Supervision; Validation; Writing – review and editing.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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