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PPE NON-COMPLIANCE AMONG CONSTRUCTION WORKERS: AN ASSESSMENT OF CONTRIBUTING FACTORS UTILIZING SURVEY-BASED ANALYSIS

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Abstract
Despite the critical role of Personal Protective Equipment in preventing workplace injuries, non-compliance persists in the construction industry. This study investigates the contributing factors influencing PPE non-compliance among construction workers in Pakistan. A quantitative research design was employed, using a structured questionnaire distributed via WhatsApp for greater accessibility. The survey included 15 close-ended questions across three sections: demographics, PPE awareness and knowledge and key factors affecting PPE compliance. Sixty construction workers participated in the study, selected using convenience sampling. Findings revealed that while most participants were aware of PPE requirements, actual compliance was inconsistent. Key reasons for non-compliance included inadequate safety training, lack of enforcement, lack of awareness about the importance of PPE usage and insufficient penalties upon violation. Furthermore, employer and supervisor attitudes toward safety significantly impacted worker behavior. This study offers valuable insights into key barriers to PPE compliance and underscores the need for improved training, enforcement, and cultural changes within the construction industry.

INTRODUCTION

Industries worldwide experience a high rate of accidents, with the International Labor Organization reporting over 250 million incidents annually and approximately 160 million workers are facing health-related problems due to hazardous environments (Harahap et al., 2024). A significant concern is that nearly 80% of these incidents are linked to non-compliance with Personal Protective Equipment protocols, underscoring the urgent need to address the factors contributing to this issue. The construction industry, in particular, sees severe occupational accidents resulting from neglecting PPE (Wong et al., 2020).The construction industry, while crucial for infrastructural development, inherently involves hazards, leading to a high incidence of workplace accidents (Abas et al., 2020). A notable proportion of these accidents, approximately 80–90% can be attributed to unsafe behaviors among workers (Andersen & Grytnes, 2021). Addressing the factors necessitates a comprehensive understanding of the psychological and behavioral factors influencing workers' actions, especially concerning adherence to safety protocols and PPE use (Bundalevski, 2022). Several human factors are thought to be critical in determining safe behaviors. The hierarchy of controls, which includes elimination, substitution, engineering controls, administrative controls, and PPE, focuses on the most efficient methods to reduce exposure to hazards (Eng, 2023).

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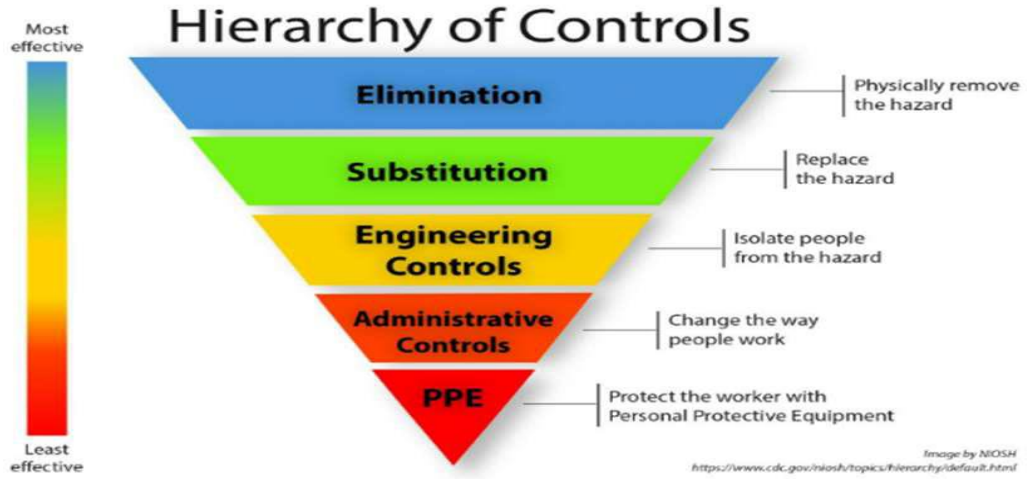


Fig1.1: The figure depicts the Hierarchy of five Control measures from least effective to more effective (Eng, 2023)

Construction industry employees often neglect to use personal protective equipment properly, even with the risk of fatal injuries and serious accidents. This lack of attention to PPE usage may stem from a belief that their safety is the responsibility of the industry administration (Martin et al., 2021).

Workers safety in construction industry became a matter of great concern for industry administration and researchers throughout the world. Despite of implementing sufficient controls and doing risk assessment, a construction industry is still experiencing hazard exposures and occupational accidents (Delhi et al., 2020). Previous studies were based on physiological factors involved in non-compliance of personal protection equipment (Nunfam & Afrifa-Yamoah, 2021). Various other factors including risk perception, supervision, behaviors and safety attitudes were neglected (Dakhilallah, 2023). Moreover, various psychological determinants which create hurdle in PPE compliance have been neglected and not addressed properly (Moda et al., 2024). There is a limited research about exploring the reason of non-compliance of PPE among construction workers (Wong et al., 2020).Existing research has indeed laid the groundwork by pinpointing several factors contributing to PPE non-compliance within the construction sector (Graveling et al., 2011). Nevertheless, a more profound investigation into issue is warranted (Wong et al., 2021). There is a need for sufficient awareness and practice for the use of personal protection equipment but there is still a large gap in the study (Hossain et al., 2021). Identification of various factors which create hurdle in PPE compliance in construction industry is also very crucial to ensure workers safety (Harrod et al., 2020).

Understanding the key factors influencing PPE non-compliance is essential for designing effective safety interventions. Recent studies highlight various determinants of non-compliance including weak safety culture, insufficient knowledge and training, lack of supervision, and negative worker attitudes toward PPE usage (Al-Bayati, 2023). The study reveals that the worker's behavior and supervisor's monitoring activities about PPE compliance play an important role in occupational safety. Moreover training and workshops about the importance and compliance of PPE also motivate workers about PPE compliance (Abd Rahman et al., 2021). The results of this study also lead to conduction of training workshops and formulation of novel

policies that can minimize the non-compliance of PPE and reduce the risk of occupational accidents (Dasandara & Dissanayake, 2021) because it is necessary to conduct trainings and workshops to educate workers about correct use of personal protection equipment (Barratt et al., 2020). In order to remove the hurdles in proper compliance of personal protection equipment and enhance the acceptance of PPE, it is necessary to identify the key barriers and problems and formulate the policies and strategies (George et al., 2023).

The construction industry, while vital to economic development, is fraught with inherent dangers, consistently exhibiting elevated rates of occupational injuries and fatalities compared to other sectors (Wong et al., 2021). Addressing safety concerns within this dynamic landscape necessitates a comprehensive understanding of the multifaceted factors influencing worker behavior, particularly concerning the utilization of personal protective equipment (Sehsah et al., 2020; Singh et al., 2024). Despite the demonstrable benefits of PPE in mitigating risks and preventing injuries, consistent and proper utilization remains a persistent challenge in the construction industry (Guan et al., 2019). Understanding the reasons behind PPE non-compliance is crucial for creating effective safety interventions and fostering a safer work environment (Boakye et al., 2022).

In light of the persistent challenges in achieving consistent PPE compliance within the construction industry, this study aims to delve into key factors that underpin worker decisions regarding PPE usage. Through a survey-based analysis, this research seeks to identify the key determinants of PPE non-compliance among construction workers. By elucidating the influence of individual beliefs and attitudes on safety behaviors, this study aims to provide valuable insights for developing targeted interventions that address the root causes of non-compliance. Ultimately, this research contributes to create more effective safety culture, fostering a safer work environment and reducing the incidence of preventable injuries within the construction industry. The objective will be met by answering the following questions:

1. What are the factors that contribute to PPE non-compliance in construction workplaces?
2. What is relation between PPE non-Compliance and key factors
3. What are the recommended proactive measures to manage the contributing factors to PPE non-compliance?

2. Review of literature

The construction industry, characterized by its dynamic and hazardous work environments, consistently faces significant challenges in maintaining worker safety and minimizing occupational risks (Jung et al., 2020). Worker's behavior, encompassing both safe and unsafe acts, plays a pivotal role in the occurrence and prevention of accidents. Unsafe behaviors, such as non-compliance with safety procedures, failure to use personal protective equipment, and disregard for potential hazards, have been consistently identified as major contributors to construction accidents (Bundalevski, 2022). Despite the enhancements in quality of PPE, there are still many areas of improvements for mitigating the problem regarding use to PPE to prevent the accidents in construction industry. It has been reported in Ethopia that 47.8% of construction workers utilized PPE under the influence of safety training, supervision, and access to proper equipment (Yosef & Shifera, 2023). Cultivating an inclusive and empowering organizational culture that values worker input and prioritizes safety as a collective goal is crucial for encouraging participation. Furthermore, studies have investigated the impact of psychological symptoms, safety climate, and safety behaviors, revealing the interplay between these factors in shaping worker safety outcomes (Guo et al., 2025). Addressing these issues can lead to a more engaged and safety-conscious workforce (Lintanga & Rathakrishnan, 2024).

Training on PPE use, safety training, safety orientation before commencing work, and the presence of supervision have been identified as factors associated with PPE utilization (Alemu et al., 2020).

(Martin et al., 2021) explored the role of PPE knowledge, attitude, and correct practices in safety outcomes on construction sites. They

conducted a survey through questionnaire in which total 100 workers participated and 20 interviews with construction workers. The results showed that knowledge of PPE use and behaviors are more important than practice in order to predict the likelihood of accidents. They also reported that the proper and regular use of personal protective equipment depends more on age and safety attitudes than on their experience.

(Abas et al., 2020) conducted a research on factors affecting safety performance of construction projects and highlighted that leadership commitment to safety and the consistent use of Personal Protective Equipment are paramount for fostering a safe working environment and minimizing accidents.

(Othman et al., 2020) also studied critical factors influencing construction safety program implementation in developing countries and reported that accidents in construction projects lead to direct costs, such as medical expenses and damages, as well as indirect costs, such as delays, interruptions, poor reputation, and decreased worker morale .

(Williams et al., 2018) suggested that it is paramount to pinpoint the root causes of these accidents, paving the way for stakeholders to implement effective strategies that mitigate the occurrence of accidents on construction sites.

(Enwereuzor et al., 2020) studied relationship between leadership and safety compliance. It has been reported that leadership affects the safety practices among workers at work place. But it is important for the workers to trust the leadership regarding safety measures. The study involved 237 participants including men and women. The hypothesis has been tested through statistical package for the social sciences (SPSS) and results showed that there is a direct link between safety compliance and trust in leadership. It has been suggested that proper and trust worthy leadership can be used to improve the safety compliance among workers at work place.

(Dasandara & Dissanayake, 2021) studied Limiting reasons for use of personal protective equipment among construction workers and reported that without proper enforcement, workers do not pay attention towards PPE compliance and take it optional while under proper supervision and monitoring, workers are more likely to adopt personal protective equipment on regular basis.

(Xu et al., 2019) also worked on formulating a learner model for evaluating construction workers' learning ability during safety training and reported that safety trainings along with training technologies and material play a vital role in safety of construction workers. They suggested that individual trainings are more beneficial than that of general trainings because every worker has different attitude and behavior especially in construction industry. They conducted a survey on 170 different construction workers having a variable knowledge, behaviors and attitudes and found that learning abilities of construction workers are directly linked with their age, experience, nature of job and work environment. They also highlighted that every worker have different ability to perceive safety trainings and adopt safety practices.

(Ahmad & Iqbal, 2022) emphasized that improper leadership styles, such as laissez-faire approaches, can diminish professional commitment, potentially leading to lower compliance with safety measures. Our findings align with this evidence, showing that effective leadership not only shapes behavior but also builds trust and accountability. Commitment from management is thus essential for sustaining a safe and compliant work environment.

Physiological stress and fatigue hinders the regular use of PPE by construction workers. (Ajayi et al., 2019) highlighted that construction industry is notorious for its high-stress work environment, which can have a significant impact on the safety and well-being of its workers. (Chen et al., 2017) highlighted that one factor that may influence the relationship between occupational stress, fatigue, and PPE usage is the safety climate of the organization. Numerous studies have shown that a strong safety culture and climate can improve safety performance, including the consistent use of PPE.

(Gómez-Salgado et al., 2023) highlighted that multiple factors can compromise cognitive functions such as attention, decision-making,

and reaction time, all of which are crucial for safe and effective performance on construction sites. (Chavan et al., 2024) conducted a cross-sectional study on Psychological and physical impact of wearing personal protective equipment among health care workers during the COVID-19 pandemic. The results of the study highlighted multiple factors that affect the PPE compliance among workers. Our findings echo these concerns, highlighting the need for strategies and supportive safety cultures.

METHODOLOGY

Study Design and Methodology

Sample Size and Method

The research design serves as the architectural blueprint, outlining the strategic approach to address the research objectives, while data collection involves the systematic gathering of pertinent information, and data analysis employs rigorous techniques to extract meaningful insights (Jilcha, 2025). The initial phase of research methodology involves specifying research questions, developing review protocols, and establishing a suitable research strategy (Kumar et al., 2021).

Selection of participants and Site

The participants of the study were construction workers and laborers working in construction industries of Pakistan where PPE was mandated for safety. A total of 60 participants from construction industry under the age of 18 to 56 plus were targeted for this study to facilitate the analysis of behavioral responses to PPE usage in construction industry.

Construction of questionnaire

A structured self-prepared questionnaire consists of multiple choice options based on literature was created using the JISC online tool. The questionnaire was specifically designed to capture data on key factors such as Demography, awareness and usage of personal protection equipment and Safety attitudes at workplace. The questionnaire consisted of 15 close ended questions ensuring that the responses could be easily quantified and analyzed. The online approach also negates the need for printing and mailing, facilitates rapid data collection from diverse participants, and potentially increases participation rates through engaging design features (Waheed et al., 2020).

Distribution of questionnaire

The questionnaire was distributed to participants through WhatsApp, which is extensively used medium for quick and timely distribution of information (Boczek and Koppers, 2020). WhatsApp was selected as the primary medium for distribution due to its accessibility and high usage rates among the Participants of the research (Suárez-Lantarón et al., 2020).

Data collection and analysis

The responses were collected from JISC and analyzed through Microsoft Excel. Microsoft Excel was selected due to its ability of efficient data management and analysis (Kumar, 2023). Moreover, Visualization tools such as bar graphs were used to make the data more accessible and interpretable, allowing for a clear presentation of findings (Few, 2012).

Statistical analysis

A Chi-square test of independence was conducted to determine the relation between PPE non-compliance and different factors

Results and Discussion

All 60 construction workers from construction industry of Pakistan completed the online survey. All the respondents who completed the survey were identified as male, with over participants being under the age of 24, while the remainders were 25 and older. To delve into the research questions, the data gathered from the survey was organized into four sections. The insights derived from the survey responses are visually presented in charts, offering a clear and concise overview of the findings.

Table 4.1.Distribution of demographic factors

Independent variables	Sub categories	Frequency	Percentage%
Age	18-25	17	28.3
	26-35	21	35.0
	36-45	14	23.3
	46-45	6	10.0
	56 and above	2	3.3
Gender	Male	60	100%
	Female	0	0
Education	No formal Education	29	48.3
	High school diploma		
	Vocational training	14	23.3
	Bachelor's degree		
	Master's degree or higher	7	11.7
		7	11.7
		3	5.0
Experience	Less than 1 year	6	10
	1-5 years	14	23.3
	6-10 years	21	35.0
	11-15 years	10	16.7
	More than 15 years	9	15.0
Frequency of work	Rarely	1	1.6
	Occasionally	6	10.0
	Weekly	12	20.0
	Daily	41	68.3

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Table presents the age distribution of the respondents. The largest proportion (35.0%) falls within the 26–35 age group followed by 28.3% in the 18–25 age group, 23.3% in the 36–45 age group and 10.0% in 46–55 age group. Only a small fraction of participants (3.3%) were aged 56 and above. These findings suggest that the construction workforce in the study area is predominantly composed of young to middle-aged individuals. The findings are aligned with the findings of (Aka et al., 2024). In case of gender, 100% of the participants in the study were male, with no female respondents. This reflects the male-dominated nature of the construction industry in the study area and may also indicate limited female representation in on-site construction roles as reported by (Çınar, 2020). In case of education, a significant proportion, 48% reported having no formal education followed by 23% with high school diploma, 12% with vocational training and bachelor's degree. Only 5% held a master's degree or higher. The level of education of respondents revealed that the majority of individuals in the sample possess low levels of formal education, which may influence their understanding of workplace safety protocols and contribute to non-compliance with personal protective equipment (PPE) regulations in the construction industry as reported by (Abaya and Ondieki, 2021). In case of respondents' work experience in the construction industry, majority, 35% reported having 6 to 10 years of experience, indicating a relatively experienced workforce. This was followed by 23% with 1 to 5 years of experience, and 17% and 15% who had been in the industry for 11 to 15 years and more than 15 years respectively. A smaller portion, 10%, had less than one year of experience. The response to question 4 highlighted that most of the participants have a moderate to substantial

level of experience in the construction field, which may influence their attitudes and behaviors toward the use of personal protective equipment (PPE), potentially shaping their compliance practices based on long-term exposure to industry norms and practices as reported by (Diana and Widayanti, 2021). The frequency of respondents' involvement on construction sites depicted that substantial majority, 68% reported working on construction sites daily, indicating consistent exposure to on-site conditions and potential hazards. This was followed by 20% who reported working on-site weekly, while 10% indicated occasional involvement. Only 2% stated that they rarely worked on construction sites. These findings revealed that most participants are regularly exposed to construction site environments, which may heighten their familiarity with safety practices and potential hazards, thereby influencing their behavior and compliance regarding the use of personal protective equipment (PPE) because they work on daily basis without any holiday as reported by (Rahman et al., 2019).

Table 4.2. Workers knowledge about Personal protective equipment and their usage

Independent variables	Sub categories	Frequency	Percentage%
Are you aware of the required PPE for your specific job role?	Yes No	44 16	73.3 26.7
How often do you wear PPE while working?	Never Rarely Some times Most of the times Always	8 15 16 12 9	13.3 25.0 26.7 20.0 15.0
Do you believe PPE can significantly reduce workplace injuries?	Strongly disagree Disagree Neutral Agree Strongly agree	0 0 12 29 19	0.0 0.0 20.0 48.3 31.7
Does your workplace have clear PPE compliance policies?	Not sure No Yes	28 16 16	46.7 26.7 26.7
Have you ever been reprimanded for not wearing PPE	NO YES	55 5	92 8

The table presents the respondents' knowledge of the required PPE according to the nature of their job. A majority, 73% of respondents, indicated that they are aware of the PPE required for their tasks, while 27% reported being unaware. These findings suggested that although most workers possessed basic knowledge about necessary protective equipment yet there was a significant gap in the staff's training and education on essential safety protocols.This gap was concerning because (Al Blooshi et al., 2024) emphasized that awareness of personal protection equipment for all construction workers is of utmost importance so it is necessary to preplace the construction workers , conduct examinations and arrange trainings for them.According to (Mhando, 2021) improper use of personal protection equipment due to lack of awareness plays a key role in occupational accidents at construction

site. In case of respondents' view about frequency of PPE usage while working, only 15% of the respondents reported that they always wear PPE, indicating low adherence to consistent safety practices. Among the remaining respondents, 20% stated they wear PPE most of the time, 27% reported using it sometimes, 25% said they wear it rarely, and 13% admitted to never using PPE at all. These findings highlighted a concerning trend of irregular PPE usage among workers despite of having the knowledge about PPE, there was a significant PPE compliance gap among a notable portion of construction workers, which could directly impact the safety measures. The fact that most of the workers were aware of required PPE but they did not have much awareness about the importance of required PPE so they did not use them regularly. The lack of PPE compliance could be tied to less awareness about importance of PPE. As reported by Kurmi et al., (2025), the major cause of occupational accidents at construction site is less usage of personal protection equipment. The fact that only 15% of workers wear PPE always and 20% of the workers wear PPE most of the time suggested that there is an urgent need of awareness programme about the importance of PPE for construction workers. Hameed et al., (2021) further underscore that the usage of PPE was directly linked to awareness about the importance of PPE among construction workers so proper safety trainings and safety examinations is necessary to attain the safety goals at construction sites. The respondents' views on whether PPE can significantly reduce workplace injuries depicted that he majority of respondents agreed with this statement, with 32% (19 respondents) selecting "Strongly agree" and 48% (29 respondents) choosing "Agree." A smaller portion, 20% (12 respondents) selected "Neutral," while no respondents disagreed or strongly disagreed. These findings indicated that most of the respondents were agree with the statement. Despite of the knowledge that use of personal protection equipment can reduce the number of construction accidents, almost half of the respondents did not believe in severity of consequences by non-compliance of PPE. As reported by Ijaola et al., (2021), construction workers are aware about the fact that compliance of safety practice is linked to occupational safety. (Saputra and Nataya, 2024) reported that there is a close relationship between non-compliance of PPE and occupational accidents. The respondents' views about the clarity of PPE compliance policies in their workplace showed that a significant portion (47%) was unsure about the existence of clear policies, while 27% indicated that clear policies were present, and another 27% reported the absence of such policies. This distribution suggests a lack of consistent communication and awareness regarding PPE guidelines, which could lead to non-compliance and increased safety risks in the workplace. The research findings were concerning as most of the workers were not sure about their company's policies. It is necessary for the workers to be aware about compliance policies of their company in order to ensure the occupational safety. As reported by (Huang and Yang, 2019), every construction worker should have knowledge about safety rules and safety policies of company in order to ensure the safety environment at construction site. (Ameh and Farinde, 2020) reported that, construction industry is one of the most dangerous industries in terms of health and safety so it is necessary for the workers to be fully aware about safety policies of the company. The respondents' answer to the question about reprimanded for PPE violation revealed that a significant 92% answered "No," indicating that they have never been reprimanded for PPE non-compliance. Only 8% reported having been reprimanded. The results depicted that employers are also responsible for non-compliance of safety practices due to their attitude which leads towards occupational accidents. As reported by Elosta and Alzubi, (2024), there is a direct link between safety behaviour of supervisors and safety behaviour of workers. Martin et al., (2021) reported that poor safety behaviour or irregular check and balance by supervisor lead towards non-compliance of safety practices at workplace. Additionally, the reprimanded rate on non-compliance of PPE among workers is very low which depicted the ignorant behaviour of supervisors and employers towards PPE

compliance. As reported by Bsisu, (2020), low punishment rate on non-compliance of PPE can leads towards more ignorant safety behaviours among construction workers.

Table 4.3.Factor affecting the PPE compliance in construction industry

Independent variables	Sub categories	Frequency	Percentage%
Does your supervisor enforce PPE usage on-site?	Never Rarely Some times Most of the time Always	7 16 19 13 5	11.7 26.7 31.7 21.7 8.3
Have you ever received formal training on PPE usage?	No Yes	38 22	63.3 36.7
Does peer pressure influence your decision to wear PPE?	Not at all Yes somewhat Yes significantly	11 34 15	25.0 56.7 18.3
Do you think there are adequate penalties for not wearing PPE at your workplace?	No Yes	49 11	81.7 18.3
In your opinion, what is the biggest challenge to PPE compliance in your workplace?	Lack of awareness Poor safety culture Lack of enforcement Discomfort All of above	19 6 11 10 14	31.7 10 18.3 16.7 23.3

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The table presents the respondent's views about key factors which affect the PPE compliance in construction industry. According to the respondents' views on whether their supervisor enforces PPE usage on-site. Only 7% of respondents answered "Always," and 22% said "Most of the times," indicating that enforcement is limited. A larger portion, 32%, answered "Sometimes," while 27% responded "Rarely" and 12% stated "Never." The results depicted that employers are also responsible for non-compliance of safety practices due to their attitude which leads towards occupational accidents. As reported by (Elosta and Alzubi, 2024), there is a direct link between safety behavior of supervisors and safety behavior of workers. The importance of positive safety attitude of supervisors and employers are further supported by (Zin and Ismail, 2012) who reported that safety goals can't be achieved without employer's positive safety behavior because employers behavior plays a crucial role in implementation of safety practices. The response about formal safety trainings revealed that a significant 63% of respondents indicated that they did not participate in any formal training on PPE, highlighting a potential gap in safety education. In contrast, only 37% of respondents reported having received training on PPE usage. These findings suggest that many workers may not be adequately trained about the proper use of PPE while safety trainings play a crucial role in maintaining the safetyculture in industry as reported by (Taha et al., 2024). The respondents' views on whether peer pressure influences their decision to wear PPE showed that he majority (57%) answered "Yes, somewhat," indicating that peer pressure has a moderate influence on their PPE usage, while 18% said "Yes, significantly," suggesting a stronger peer influence. On the other hand, 25% of respondents stated that peer pressure does not affect their decision to wear PPE at all. These mixed responses indicate that while peer

influence plays a role in PPE compliance for some workers, others are less affected by the behavior of their colleagues. According to (Setiawan and Budiono, 2025), peer influence also contributes in ensuring the compliance of personal protection equipment. (Pooladvand and Hasanzadeh, 2023) reported that safety compliance and non-compliance is strongly affected by peer pressure. The workers are more likely to get influenced by the safety behaviors of their co-workers and decide to adopt safety practices. The respondents' views on the adequacy of penalties for not wearing PPE in the workplace depicted that a large majority (82%) believed that penalties were inadequate, while only 18% felt they were sufficient. This significant imbalance indicates that PPE non-compliance may not be taken seriously by employers. (Tanko et al., 2020) reported that, the construction workers who despite of having awareness about the PPE failed to adopt the safety measures including personal protection equipment should be subjected to penalties in order to enhance the PPE compliance. The participants views about main challenges to PPE compliance showed that most frequently cited issue was "Lack of awareness" at 32%, followed by "All of the above" at 23%, indicating a combination of contributing factors. "Lack of enforcement" accounted for 18%, while "Discomfort/inconvenience" was selected by 17% of respondents. "Poor safety culture" received the fewest responses at 10%. These results suggest that awareness, enforcement, peer pressure and penalties over violation play a significant role in PPE compliance at construction sites. The research findings are aligned with the findings of (Ahmed et al., 2015) who reported that non-compliance of PPE is caused by multiple such as lack of awareness about proper use of PPE, lack of monitoring and negligence of administration to enforce the PPE compliance.

Table 4.4. Relationship between "How often do you wear PPE while working?" and "Have you ever received formal training on PPE usage?"

			Have you ever received formal training on PPE usage?		Total
			Yes	No	
How often do you wear PPE while working?	Always	Count	9	0	9
		% of Total	15.0%	0.0%	15.0%
	Most of the time	Count	10	2	12
		% of Total	16.7%	3.3%	20.0%
	Sometimes	Count	3	13	16
		% of Total	5.0%	21.7%	26.7%
	Rarely	Count	0	15	15
		% of Total	0.0%	25.0%	25.0%
	Never	Count	0	8	8
		% of Total	0.0%	13.3%	13.3%
Total		Count	22	38	60
		% of Total	36.7%	63.3%	100.0%

Chi-square value = 42.33**; P-value = 0.000
** = Highly significant (P<0.01)

A Chi-square test of independence was conducted to examine the relationship between the frequency of PPE usage and whether workers had received formal training on PPE usage. The results showed a statistically significant association between these two variables, with a Chi-square value of 42.33 and a p-value of 0.000, indicating a highly significant relationship at the 0.01 level.

Table 4.5.Relationship between "How often do you wear PPE while working?" and "Does your supervisor enforce PPE usage on-site?"

			Does your supervisor enforce PPE usage on-site?					Total
			Always	Most of the time	Some-times	Rarely	Never	
How often do you wear PPE while working?	Always	Count	4	5	0	0	0	9
		%	6.7%	8.3%	0.0%	0.0%	0.0%	15.0%
	Most of the time	Count	1	8	3	0	0	12
		%	1.7%	13.3%	5.0%	0.0%	0.0%	20.0%
	Sometimes	Count	0	0	12	4	0	16
		%	0.0%	0.0%	20.0%	6.7%	0.0%	26.7%
	Rarely	Count	0	0	3	12	0	15
		%	0.0%	0.0%	5.0%	20.0%	0.0%	25.0%
	Never	Count	0	0	1	0	7	8
		%	0.0%	0.0%	1.7%	0.0%	11.7%	13.3%
Total		Count	5	13	19	16	7	60
		%	8.3%	21.7%	31.7%	26.7%	11.7%	100%

Chi-square value = 125.10**; P-value = 0.000
** = Highly significant (P<0.01)

A Chi-square test of independence was conducted to examine the relationship between the frequency of PPE usage and supervisor enforcement of PPE on-site. The results revealed a statistically significant association between these variables, with a Chi-square value of 125.10 and a p-value of 0.000, indicating a highly significant relationship at the 0.01 level.

Table 4.6. Relationship between "How often do you wear PPE while working?" and "Does peer pressure influence your decision to wear PPE?"

			Does peer pressure influence your decision to wear PPE?			Total
			Yes significantly	Yes, somewhat	No, not at all	
How often do you wear PPE while working?	Always	Count	6	3	0	9
		%	10.0%	5.0%	0.0%	15.0%
	Most of the time	Count	5	7	0	12
		%	8.3%	11.7%	0.0%	20.0%
	Sometimes	Count	0	15	1	16
		%	0.0%	25.0%	1.7%	26.7%
	Rarely	Count	0	7	8	15
		%	0.0%	11.7%	13.3%	25.0%
	Never	Count	0	2	6	8
		%	0.0%	3.3%	10.0%	13.3%
Total		Count	11	34	15	60
		%	18.3%	56.7%	25.0%	100.0%

Chi-square value = 48.93**; P-value = 0.000
** = Highly significant (P<0.01)

A Chi-square test of independence was conducted to examine the relationship between

the frequency of PPE usage and the influence of peer pressure on PPE compliance. The analysis revealed a statistically significant association between the two variables, with a Chi-square value of 48.93 and a p-value of 0.000, indicating a highly significant relationship at the 0.01 level.

Table 4.7. Relationship between "How often do you wear PPE while working?" and "Do you think there are adequate penalties for not wearing PPE at your workplace?"

			Do you think there are adequate penalties for not wearing PPE at your workplace?		Total
			Yes	No	
How often do you wear PPE while working?	Always	Count	6	3	9
		%	10.0%	5.0%	15.0%
	Most of the time	Count	5	7	12
		%	8.3%	11.7%	20.0%
	Sometimes	Count	0	16	16
		%	0.0%	26.7%	26.7%
	Rarely	Count	0	15	15
		%	0.0%	25.0%	25.0%
	Never	Count	0	8	8
		%	0.0%	13.3%	13.3%
Total		Count	11	49	60
		%	18.3%	81.7%	100.0%

Chi-square value = 27.16**; P-value = 0.000
** = Highly significant (P<0.01)

A Chi-square test of independence was conducted to explore the relationship between the frequency of PPE usage and perceptions of whether adequate penalties exist for not wearing PPE in the workplace. The results revealed a statistically significant association between these variables, with a Chi-square value of 27.16 and a p-value of 0.000, indicating a highly significant relationship at the 0.01 level.
All the factors that affect the PPE compliance in construction industry are closely linked to each other. A Chi-square test of independence was conducted to examine the relationship between the frequency of PPE usage and trainings, enforcement and supervision, penalties, peer influence and PPE compliance policies. The results showed that all the variables show statistically significant association with PPE compliance. These findings suggest that formal training on PPE usage, supervision and enforcement along with all other factors positively influences the frequency of PPE compliance among workers. This emphasizes the importance of structured safety education and policies, motivation and enforcement in encouraging the consistent use of personal protective equipment (Yeon and Shin, 2020).

Conclusion:

This study examined the key determinants of PPE non-compliance among construction workers in Pakistan. While 73% of respondents knew the PPE required for their job, only 15% reported always using it, and 20% used it most of the time. The workforce was predominantly young to middle-aged males with low levels of formal education, which may limit understanding of safety protocols. Key barriers included lack of formal PPE training (63%), uncertainty about workplace PPE policies (47%), inadequate supervisory enforcement, and insufficient penalties for non-compliance (82%). Peer influence also shaped compliance, with 75% reporting their colleagues' behavior affected their own. Chi-square analysis

confirmed highly significant associations between PPE usage and training, enforcement, peer pressure, and penalties. These findings emphasize that improving PPE compliance requires targeted training, consistent supervisory enforcement, stronger safety culture, and effective penalties. A coordinated approach addressing these factors can significantly reduce occupational risks and foster safer construction environments.

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