A Study on the Use of Personal Protective Equipment among Construction Workers in Türkiye

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Abstract: This study examines the habits and attitudes of construction sector employees in Türkiye regarding the use of personal protective equipment (PPE). A comprehensive face-to-face survey was conducted with 398 randomly selected employees from small- and medium-sized construction companies across various regions of Türkiye. The survey aimed to identify the frequency of PPE usage and the factors influencing its use and to provide actionable suggestions for improving PPE compliance. The results indicate that while a majority of workers recognize the importance of PPE, actual usage rates are inconsistent. Key factors affecting PPE use include the ergonomics and comfort of the equipment as well as worker perceptions and attitudes. Notably, the study found that the discomfort associated with PPE and the belief that it slows down work pace are significant barriers to its regular use. Additionally, the research highlights the need for a robust punishment–reward system to enforce PPE compliance and suggests that more stringent legislative measures are required to enhance occupational health and safety (OHS) standards in the construction industry. This study contributes to the existing body of knowledge by providing a detailed analysis of PPE usage in the Turkish construction sector and offering practical recommendations for policymakers and industry stakeholders. Implementing these suggestions can lead to improved worker safety and reduced occupational accidents.

Keywords: personal protective equipment; occupational health and safety; construction workers; construction industry

1. Introduction

There has been a significant improvement in occupational health and safety (OHS) activities in the construction industry both in Türkiye and globally; however, accidents with severe consequences still occur more often than necessary [1]. Construction procedures tend to produce similar risks worldwide; however, the rate of fatal occupational injuries in developing countries is often higher than that in developed countries [2]. Despite this, most developing countries fail to give adequate attention and oversight to construction safety measures to better protect their employees [3]. Thus, the high rate of occupational injuries and diseases on construction sites is identified as a major health and development problem worldwide [4].

An analysis of construction site accident reports indicates that most accidents occur when working at heights and involve the lack or improper use of personal protective equipment (PPE) [5]. The construction sector in Türkiye is, unfortunately, known for producing many occupational injuries. According to Turkish Social Security Institution statistics, 384,262 occupational accidents occurred in Türkiye in 2020, and 44,304 of those were accidents (11.6%) in the construction industry. A total of 1231 fatal occupational accidents across all occupational sectors were recorded in Türkiye in 2020, and 347 (28%) took place in the construction sector [6].
The Turkish Occupational Health and Safety Law No. 6331 [7] on OHS, brought into legislation in 2012, regulates the tasks, limitations of power, responsibilities, rights, and obligations of employers and employees to ensure proper OHS in working environments and to improve the overall health and safety conditions in Türkiye. This law and regulation, issued after its passing, has brought innovation to occupational fields. The primary characteristic of this law is to embrace an approach aimed at anticipating occupational accidents and occupational diseases before they occur and thus working to eliminate them. A better integration of modern OHS practices with the current OHS practices in Türkiye is a major focal point of the law.

Working environments hold a wide variety of risks arising from workplace hazards that may adversely affect the health and safety of everyone, especially the employees in that workplace. Occupational safety specialists seek to identify possible hazards through effective risk assessments. Their primary focus is to eliminate hazards and risks, thus reducing injury and death. To ensure that construction workers, site visitors, additional employees, materials, equipment, and the environment are all safe to a certain degree, it is crucial for transparent oversight to enact collective protection methods. In other words, the fundamental principle of all the related precautions is to eliminate a hazard at its source. In circumstances where measures taken to provide collective protection require the use of PPE by employees, the employee must always be provided with it by the employer. PPE refers to any tools, instruments, materials, and devices designed to protect the worker against possible risks. PPE can be worn, used, or held by the worker [8]. PPE is often used in the construction industry, where it is difficult to take collective protective measures.

The importance of addressing OHS in the construction industry cannot be overstated, as this sector remains one of the most hazardous worldwide. The main problems include high rates of accidents and injuries, often due to inadequate use of PPE. This study aims to investigate the habits and attitudes of construction workers in Türkiye regarding PPE use. By identifying the factors that influence PPE utilization, this study seeks to bridge the existing gap in understanding the barriers and motivators for PPE compliance. The purpose is to provide actionable insights that can enhance PPE usage rates, thereby reducing occupational accidents and improving worker safety. Additionally, this study fills a crucial research gap by focusing on the ergonomic aspects of PPE and the socio-cultural factors influencing its use, offering recommendations that could be beneficial not only for Türkiye but also for other developing countries with similar OHS challenges.

1.1. Literature Review

Research on OHS has primarily focused on the causes of occupational accidents and measures that can be taken to prevent or reduce them. Studies have indicated that insufficient safety measures and poor safety awareness among employers and employees are the primary reasons for the high rates of occupational accidents in the construction industry [9,10]. Cheng et al. [11] suggested that occupational accidents occur due to a combination of factors, such as working at heights without protective precautions, a failure to use PPE, a loss of balance while moving, and inadequate experience. Evidence also suggests that inaccurate and incomplete OHS practices, including the failure to conduct regular safety meetings, inadequate PPE usage, and insufficient OHS training, have resulted in an increased number of occupational accidents in the industry [12].

PPE is essential for ensuring employee safety in workplaces. However, several studies have shown that PPE usage among employees is low. Man et al. [12] reported that a significant proportion of employees do not use PPE occasionally. Similarly, Lette et al. [3] found that a majority of construction workers neglect to use PPE while working. Izudi et al. [13] also showed that temporary workers use PPE less frequently than permanent workers. While these studies emphasize the low usage of PPE among employees, it should be noted that the results may vary by country. Man et al. [12], Tanko et al. [14], and Wu et al. [15] found that compliance with safety rules is negatively related to the pace of work. Employees may avoid using PPE if it is uncomfortable or slows down their work. Wu
et al. [15] suggested that unannounced site visits by governments can improve compliance with safety rules. However, studies in various countries have shown that OHS inspections are lacking, resulting in low compliance with safety rules [3,12,16–19]. Although monetary rewards do not effectively reduce workplace injuries, Awwad et al. [17] reported that employees are more likely to follow safety rules when unsafe behaviors are punished. However, some studies have shown that punishing employees who disobey safety rules is not effective in reducing accident rates [16,20–22]. Therefore, creating an effective safety system based on cultural, educational, and working condition factors is the most effective method of promoting employee safety. Lette et al. [3] demonstrated that employees who do not use PPE have a three times higher risk of injury than those who use PPE. However, despite the increased risk, many employees still do not use PPE. Regular OHS training is important to keep up with new developments and to share experiences learned from past events or mistakes [16,23]. OHS training should focus on introducing dangerous actions and sharing detailed information on occupational accidents that workers may encounter to enhance employees’ understanding of PPE usage.

On a construction site, wearing PPE appropriately is one of the most important but most neglected rules [24]. Despite efforts to communicate the rule, employees often disregard the use of PPE [14]. Farooqui et al. [25] identified several reasons for this situation, such as discomfort caused by PPE, the claim that it reduces productivity, the insufficient availability of PPE, employers rarely enforcing PPE usage, and inadequate training on PPE utilization. To encourage workers to use PPE consistently, ergonomic PPE should be designed to eliminate the discomfort factor [26]. Studies have been carried out to determine the comfort parameters of PPE [27] and to search for markets where PPE is manufactured in different sizes [28]. Workplace audits are also thought to foster PPE usage; however, the gaps in current enforcement laws cause workplaces to be inadequately audited [15,17]. Admittedly, due to the size and relative disorganization of most construction sites, it can be difficult to monitor the use of PPE properly; however, the development of auto-monitoring systems has assisted in reducing the likelihood of this problem. The system works via the use of a remote computer to check, via censors, if the PPE is in use when it should be [29,30].

In conclusion, research on OHS in the construction industry has highlighted several key factors contributing to occupational accidents and injuries. Insufficient safety measures, poor safety awareness, inadequate PPE usage, and non-compliance with safety rules have been identified as major causes of workplace injuries. While monetary rewards and punishments have been shown to have limited effectiveness in promoting workplace safety, regular OHS training and workplace audits have been found to play an important role in improving PPE usage and reducing workplace injuries. To address these issues and promote a safe work environment, a comprehensive safety system based on cultural, educational, and working condition factors should be implemented. Employers should prioritize safety measures and provide adequate PPE and training to employees. Regular safety meetings and workplace audits should also be conducted to ensure compliance with safety rules and identify potential hazards. Furthermore, the development of ergonomic PPE that eliminates discomfort and the use of auto-monitoring systems can assist in promoting consistent PPE usage. Finally, a collaborative effort between employers, employees, and government agencies is necessary to create a culture of safety in the construction industry and reduce the high rates of occupational accidents and injuries.

1.2. Aim of Research

Due to the unique characteristics of the construction industry, collective protective measures may sometimes be insufficient or not considered at all. In such cases, the provision, utilization, and audit of PPE become significantly more critical. Most studies to date have only considered PPE as a parameter for occupational accidents, which means a more detailed analysis of PPE and its use is lacking. This study aims to identify the habits of PPE use among employees, their attitudes towards PPE, and the necessary actions to increase
PPE utilization in the construction sector in Türkiye. To understand the failures in PPE use and subsequently present methods to address these shortcomings, various work sectors (e.g., carpentry, soldering, etc.) within the construction industry were examined in detail.

The results of this study can serve as a guide for researchers aiming to develop OHS procedures. Additionally, different societies exhibit various behaviors based on their unique socio-cultural features. Thus, the information presented in this study can be directly applied in countries with socio-cultural features similar to those of Türkiye.

2. Materials and Methods

In this qualitative research study, a statistical search pattern was used along with the use of surveys as part of data collection. The survey consisted of 22 questions designed to identify the frequency of the use of PPE and the factors influencing its use. The survey questions are provided in Figure 1. Participants were also asked to provide demographic information. It was important to determine the importance, necessity, frequency, ease of use, social climate, and impacts of PPE utilization. The survey consisted of multiple choice questions and Likert scale questions. The Likert scale was developed in 1932 by Rensis Likert [31]. Likert-type questions include an expression containing attitudes or opinions about the topic investigated and options indicating the level of participation in this statement. In order to determine the level of participation in Likert-type questions, multiple options are offered between the two extremes. These options are gradually ranked from the highest to the lowest or from best to worst. In the analysis stage, these options are coded by assigning numerical values according to their degrees, and thus, the qualitative data are converted into quantitative data and analyzed [32]. Likert-type questions in the survey prompt respondents to indicate their agreement or frequency of occurrence on a scale that typically ranges from “Never” to “Always” or “Easy” to “Difficult”. For instance, questions such as “How often do you use the following PPE?” and “How easy is it to use the following PPE related to your job?” are designed to capture both quantitative data (frequency of use) and qualitative insights (perceived ease of use).

A relevant literature review was performed, and the draft form of the survey was developed before finalizing the questions. Three expert opinions were consulted concerning the content of the survey and its scope. In consideration of suggestions made by experts, a trial survey was first conducted in order to determine and eliminate potential errors that might be encountered on a work site and obtain more systematic, efficient, and reliable results. Surveys were completed by 14 employees working on a construction site.

The number of insured employees registered as being part of the construction sector, according to the Social Security Institution (SSI) of Türkiye, was determined. The sample number has been calculated as 381 using the equilibrium given in Equation (1) [33] with a confidence level of 95% and a sampling error margin of 5%.

\[
n = \frac{z^2 N p q}{(N D^2 + z^2 p q)}
\]

where \( n \) is the sample size, \( N \) is the population size, \( D \) is the accepted sampling error, \( z \) is the confidence level, \( p \) refers to the proportion of sample elements that have a particular attribute, and \( q \) refers to the proportion of sample elements that do not have a particular attribute (\( q = 1 - p \)). The study was conducted across 30 different housing project sites belonging to small- and medium-sized construction companies in Trabzon, which is located on the northeastern coast of Türkiye. Participants were selected as employees previously employed on construction sites in different parts of Türkiye. Interviews with employees were conducted face to face across worksites. A total of 398 participants completed the surveys, and all 398 surveys were evaluated in statistical analyses; the number of surveys was slightly higher than the number of samples (\( N = 398 \)).

Statistical analyses of the obtained data regarding PPE utilization within the construction industry but on an individual basis were conducted with SPSS (Statistical Package for the Social Sciences) 23.0 for Windows. Cronbach’s alpha test was used to measure the reliability of the questionnaire [34]. Cronbach’s alpha coefficient was found to be 0.906.
This value indicates that the collected questionnaire is highly reliable. An exploratory factor analysis was conducted in order to assess the construct validity of the survey and identify its factor structure. Principal components and direct oblimin methods were used for this purpose. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was found to be 0.869, indicating that the sample size was sufficient for conducting an exploratory factor analysis. According to Field [35], a KMO value above 0.50 is considered adequate, while values between 0.80 and 0.90 are classified as “excellent”. The KMO values calculated for each item ranged from a minimum of 0.792, further confirming the adequacy of the sample.

Frequency analysis was made, and the frequency distribution of the data obtained was studied for detailed information about the data. Descriptive statistical analyses were also used to determine the frequency distribution of the data. In aid of this, frequency tables and pie charts were used to specify the frequency distributions. In order to determine the relationship between the variables, cross tables and chi-square tests were conducted as well. Whether there was a significant relationship between the variables and the chi-square test was assessed. The data obtained were also interpreted by the eligible legislation in Türkiye. Not all of the overall participants in the survey were taken into consideration while creating the cross tables. The criterion for the study area selection was the number of employees in the working area (desired to be 40 or more).

Figure 1. Questions in the survey.

| 1. Your age: | ............ |
| 2. Marital status: | Single | Married |
| 3. Place of birth: | ............ |
| 4. Educational level: | Primary school (5 years) | High school | Undergraduate |
| 5. Your field of work: | Plaster worker | Carpenter | Installer |
| 6. Do you have a professional qualification certificate? | Yes | No |
| 7. How long have you been working in the construction industry? | Through an apprenticeship | I received formal education |
| 8. Have you ever had a work-related accident? | Yes | No |
| 9. Have you received training on occupational health and safety? | Yes | No |
| 10. Do you agree that using personal protective equipment (PPE) is important? | Agree | Indecisive | Disagree |
| 11. If you were injured in a work-related accident that could have been prevented by using PPE, who would you hold responsible for not using it? | Myself | Employee | Site manager | Offic specialist |
| 12. What PPE do you need to use for the work you do? | Safety helmet | Fall arrest harness | Protective footwear | Respiratory protection | Face and eye protection |
| 13. How often do you use the following PPE? | Safety helmet | Never | Occasionally | Always | Sometimes | Often |
| 14. How easy is it to use the following PPE related to your job? | Safety helmet | Easy | Normal | Difficult |
| 15. Are the following PPE provided by the employer for you to use in your job? | Safety helmet | Provided | Not enough | Not provided |
| 16. In your opinion, which of the following situations would be more effective in encouraging employees to use PPE? | Safety helmet | Provided | Not enough | Not provided |

Figure 1. Questions in the survey.
3. Results

The surveys, which were conducted with a total of 398 people working in the construction sector in Türkiye, have been evaluated. In order to determine the relationship between pie graphs, bar graphs, frequency distributions, cross tables, and binary variables, the results of the chi-square test were given as follows.

3.1. Frequency Analysis

A frequency analysis, including the frequency distribution of the results, allows for detailed descriptive information about the obtained data. For this purpose, the answers of the employees in the study sample are rendered in pie–bar graphs and tables as frequency percentages.

Table 1 presents all the demographic characteristics of the participants, including age, marital status, and educational level. The distribution of participants across work areas in the construction sector is also given in Table 1.

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>Category</th>
<th>Percentage, (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>18–24</td>
<td>15.33</td>
</tr>
<tr>
<td></td>
<td>25–29</td>
<td>17.09</td>
</tr>
<tr>
<td></td>
<td>30–34</td>
<td>19.59</td>
</tr>
<tr>
<td></td>
<td>35–39</td>
<td>18.34</td>
</tr>
<tr>
<td></td>
<td>40–44</td>
<td>13.82</td>
</tr>
<tr>
<td></td>
<td>45–49</td>
<td>7.79</td>
</tr>
<tr>
<td></td>
<td>50 or over</td>
<td>8.04</td>
</tr>
<tr>
<td>Marital status</td>
<td>Married</td>
<td>74.62</td>
</tr>
<tr>
<td></td>
<td>Single</td>
<td>25.38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Educational level</th>
<th>Category</th>
<th>Percentage, (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school (5 years)</td>
<td>Primary education (8 years)</td>
<td>34.42</td>
</tr>
<tr>
<td>High school</td>
<td>Associate degree</td>
<td>33.17</td>
</tr>
<tr>
<td>Undergraduate</td>
<td></td>
<td>26.38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work area</th>
<th>Category</th>
<th>Percentage, (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plaster worker</td>
<td>Carpenter</td>
<td>30.65</td>
</tr>
<tr>
<td></td>
<td>Ironsmith</td>
<td>20.60</td>
</tr>
<tr>
<td></td>
<td>Bricklayer</td>
<td>12.31</td>
</tr>
<tr>
<td></td>
<td>Ceramic worker</td>
<td>10.30</td>
</tr>
<tr>
<td></td>
<td>Installer</td>
<td>7.29</td>
</tr>
<tr>
<td></td>
<td>Insulation worker</td>
<td>5.53</td>
</tr>
<tr>
<td></td>
<td>Painter</td>
<td>5.03</td>
</tr>
<tr>
<td></td>
<td>Joiner</td>
<td>2.26</td>
</tr>
<tr>
<td></td>
<td>Lift worker</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>Operator</td>
<td>1.76</td>
</tr>
</tbody>
</table>

3.1.1. Employees’ PPE Usage Frequency

In this study, the respondents were asked whether PPE use is necessary and, if so, how often they use PPE. As the PPE used by employees varies depending on the work areas in the construction sector, cross-tabulations were made between the PPE frequency utilization of the survey participants and their work areas. The answers include 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Usually, and 5 = Always, and the participants were asked to choose only one option. The answers to five options have been averaged, and the results are provided below in Figure 2. If the frequency result of a PPE unit is approximated to 5, it is interpreted as ‘Always’, and if approximated to 1, it is interpreted as ‘Never’.
Figure 2. Employees’ PPE utilization frequency depends on the work areas in the construction.

Figure 2 represents the mean frequencies for PPE utilization of plaster workers, carpenters, ironsmiths, and bricklayers. The ironsmiths have the highest mean of frequencies for using a safety helmet and protective footwear, while the plaster workers have the lowest mean. However, the results show that not all the workers use safety helmets and/or protective footwear, although the frequency of using this PPE is high.

3.1.2. Employees’ Views on PPE

The percentage distribution of the participants’ opinions on whether paying more attention to audits would encourage employers and on whether PPE programs would improve work pace, were also asked which PPE they use. A total of 95.98% of the participants believe that PPE protects workers from work accidents, while 1.51% disagree and 2.51% are indecisive. These results indicate a strong belief that PPE plays an important role in preventing work accidents.

Figure 3. Easiness of PPE utilization.

Figure 3 shows the distribution of answers to the question ‘What would be the most effective way to encourage workers to use PPE?’. According to the results, there should be an effective method for encouraging workers to use PPE.

Figure 4 represents the impact of PPE utilization on work pace. According to Figure 4, 69.35% of participants believed that using PPE slows down work pace, while 30.65% believed that PPE use does not affect work pace.

Figure 4. Impact of using PPE on work pace.
In this study, 276 workers, who expressed that PPE use has a negative impact on work pace, were also asked which PPE they find most cumbersome. Figure 5 shows the distribution of answers to this question.

![Figure 5. PPE identified as affecting work pace.](image)

Figure 6 shows the distribution of answers to the question 'What would be the most effective way to encourage workers to use PPE?'. According to the results, there should be a properly functioning punishment–reward system to ensure PPE use in the workplace.

![Figure 6. The most effective method for encouraging workers to use PPE.](image)

The distribution of participants’ opinions on whether paying more attention to audits relating to OHS could encourage employees to follow the rules and on whether PPE protects workers from work accidents is given in Figure 7. According to Figure 7, 93.22% of the participants agree that paying attention to audits would encourage employers and employees to follow the rules, while 4.02% disagree and 2.76% are indecisive. These results indicate a strong belief that audits could promote appropriate behaviors in the workplace. A total of 95.98% of the participants believe that PPE protects workers from work accidents, while 1.51% disagree and 2.51% are indecisive. These results indicate a strong belief that PPE plays an important role in preventing work accidents.

![Figure 7. Participant opinions on the use of audits to promote rule following and the effectiveness of PPE in case of accidents.](image)
Figure 8 shows the distribution of participants and their opinions on who should be held responsible for workplace accidents that could be prevented by PPE utilization. The obtained results suggest that the requirement to inform workers has not been fulfilled as set out in article 16 of Law No. 6331 [7] (p. 11,655), and the workers have been provided with insufficient training as described in article 17 (p. 11,655) of the same law. In the legislation, the first degree responsible is the employer/employer’s agent for a potential work accident, which is followed by a project manager, health and safety coordinator, and occupational health specialist. According to the legislation, the workers’ responsibility stands in the lowest position.

![Figure 8](image_url)

**Figure 8.** Distribution of persons being held responsible by workers for work accidents.

Figure 9 illustrates the percentage of employers who provide workers with PPE. Thus, some employers fail to fulfill their obligation as described in paragraph e, article 6 of Regulation on the Use of PPE at Workplaces [8]: ‘PPE is to be provided free of charge by the employer, and periodically maintained, repaired and inspected under instructions for use; the parts are replaced as necessary, and PPE is stored in hygienic conditions and made ready for use’.

![Figure 9](image_url)

**Figure 9.** The percentage of whether employers provide PPE to workers.

### 3.1.3. Employees’ Views on PPE Requirement

Figure 10 shows the distribution of participant opinions on whether it is necessary to use a safety helmet and protective footwear in the workplace. As shown in Figure 10, 90.45% of participants consider wearing a safety helmet to be required, while 93.47% consider wearing protective footwear to be essential on the construction site.

![Figure 10](image_url)

**Figure 10.** Opinions on the necessity of the use of safety helmets and protective footwear.
Table 2 details the opinions of employees on the necessity of PPE use broken down according to trade workers.

Table 2. Percentage of answers of plaster workers, carpenters, ironsmiths, and bricklayers for the necessity of PPE utilization.

<table>
<thead>
<tr>
<th>PPE</th>
<th>Plaster Worker</th>
<th>Carpenter</th>
<th>Ironsmith</th>
<th>Bricklayer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (%)</td>
<td>No (%)</td>
<td>Yes (%)</td>
<td>No (%)</td>
</tr>
<tr>
<td>Safety helmet</td>
<td>94.70</td>
<td>5.30</td>
<td>88.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Protective footwear</td>
<td>91.35</td>
<td>8.65</td>
<td>88.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Protective clothing</td>
<td>84.05</td>
<td>15.95</td>
<td>77.30</td>
<td>22.70</td>
</tr>
<tr>
<td>Respiratory protection</td>
<td>14.15</td>
<td>85.85</td>
<td>45.30</td>
<td>54.70</td>
</tr>
<tr>
<td>Protective gloves</td>
<td>94.95</td>
<td>5.05</td>
<td>85.30</td>
<td>14.70</td>
</tr>
<tr>
<td>Fall arrest harness</td>
<td>73.85</td>
<td>26.15</td>
<td>33.30</td>
<td>66.70</td>
</tr>
<tr>
<td>Face and eye protection</td>
<td>10.75</td>
<td>89.25</td>
<td>33.30</td>
<td>66.70</td>
</tr>
<tr>
<td>Hearing protector</td>
<td>0</td>
<td>100</td>
<td>8.00</td>
<td>92.00</td>
</tr>
</tbody>
</table>

3.2. Cross Tables and Chi-Square Analysis

In this section, the parameters that are thought to be related to each other are scrutinized by matching them with one another. Cross tables and a chi-square test were used to determine the relationship between variables and the data obtained from the survey. Whether there is a significant relationship between the variables has been determined statistically via the chi-square test.

The data that are obtained from the employees who participated in the survey and that cannot be applied to the chi-square test are interpreted as cross tables, while the ones that are suitable for the chi-square test have been interpreted below as cross tables with the chi-square test.

Figure 11 shows the relationship between the level of education, age distribution, and agreement on the importance of PPE use. According to Figure 11, it is seen that regardless of the education level and the age range of the employees, the majority of them agree on the fact that it is important to use PPE. Hence, this request does not differ regarding the level of education and age distribution of the employees.

Figure 11. The cross table shows the relationship between the level of education, age distribution, and agreement on the importance of PPE use.

Figure 12 shows the relationship among respondents’ level of education, age distribution, and agreement on the fact that PPE use protects workers from work accidents. The data for these variables are not suitable for the application of the chi-square test. According
to Figure 12, regardless of the education levels of the employees and the range of age distribution, the majority of the employees appear to agree on the fact that the use of PPE protects workers from work accidents. Therefore, this request does not differ regarding the level of education and age distribution of the employees.

![Figure 12](image1)

**Figure 12.** The relationship among the level of education, age distribution, and agreement on the fact that PPE utilization protects workers from work accidents.

Figure 13 shows the relationship among respondents’ level of education, age distribution, and answers to the question of ‘what is the most effective method to motivate employees to use PPE’. The data for these variables are not suitable for the application of the chi-square test. According to Figure 13, regardless of the education level and the range of the age distribution of the employees, the majority of them stated that the most effective method would be ‘giving punishment to those who do not obey the rule while rewarding those who obey the rules’.

![Figure 13](image2)

**Figure 13.** The relationship among respondents’ level of education, age distribution, and answers to the question ‘what is the most effective method to motivate employees to use PPE’.

Figure 14 shows the relationship among respondents’ level of education, age distribution, and the effect of work tempo on PPE utilization. According to the chi-square test results regarding respondents’ level of education, age distribution, and the effect of
work tempo on PPE utilization, there is not a significant relationship among the variables ($p = 0.331 > 0.05$ for education level, $p = 0.248 > 0.05$ for age distribution). According to Figure 14, regardless of the education level and the range of the age distribution of the employees, the majority of the respondents stated that the use of PPE affected the pace of work and slowed them down.

![Figure 14. The relationship between the level of education, age distribution, and the effect of work tempo on the PPE utilization.](image)

Figure 14 shows the relationship between respondents’ working areas in the construction sector and the effect of PPE utilization on their work tempo. The data for these variables are not suitable for the application of the chi-square test. The majority of respondents in all study areas stated that PPE utilization affects the pace of work and slows them down.

![Figure 15. The relationship among the working areas in the construction sector and the effect of PPE utilization on their work tempo.](image)

Figure 15 shows the relationship between respondents’ working areas in the construction sector and the effect of PPE utilization on their work tempo. The data for these variables are not suitable for the application of the chi-square test. The majority of respondents in all study areas stated that PPE utilization affects the pace of work and slows them down.

4. Discussion

The level of development in countries has a significant impact on OHS practices, particularly with regard to the use of PPE in the construction industry, which is known for its high risk of accidents and injuries. As countries progress economically and technologically, the implementation and enforcement of OHS regulations, including the provision and use of PPE, tend to improve, contributing to a safer work environment. This study, conducted in Turkey, examines the factors influencing PPE usage in the construction sector, taking into account workers’ perspectives and experiences. By analyzing the frequency and reasons for PPE use as well as identifying challenges and barriers to its implementation, this study provides valuable insights that can inform the development of more effective strategies and policies for enhancing occupational safety within the construction industry in Turkey and other countries with similar contexts. The findings and recommendations from this study
have the potential to contribute to the global understanding of PPE utilization and inform best practices across various levels of development, ultimately promoting safer working conditions in the construction sector worldwide. In order to delve deeper into the results and findings obtained within the scope of this study, it is essential to thoroughly examine and discuss the various aspects of PPE usage in the construction industry.

The questionnaire data indicated that the use of safety helmets among plasterers was lower compared to other sectors. The participants reasoned that this was due to working in enclosed areas where safety helmets were perceived as less necessary. The use of fall arrest harnesses by carpenters was also significantly lower than in other sectors. Carpenters cited the limited need for fall arrest harnesses and their discomfort, which restricted movement and impacted work performance. This study is in line with the previous study by Man et al. [12]; our study also found that 35% of workers do not use fall arrest harnesses due to the unavailability of anchor points in the workplace. The results demonstrated that although employees acknowledge the necessity of using PPE, they do not use it in practice as frequently as they recognize its importance.

This study’s results clearly indicate the awareness of the necessity of PPE utilization among employees. However, the frequency of PPE use is inconsistent with this awareness. The belief that PPE use negatively impacts work performance is a major factor. Furthermore, workers who engage in daily or periodic work, followed by several days off, also tend not to use PPE. This finding is in line with the previous study by Lette et al. [3]; our research also found that over 71% of construction workers do not use PPE during work. The literature lacks detailed studies investigating the frequency of PPE usage in the construction sector, specifically regarding the use of all necessary PPE, depending on the work area. Generally, there are limited studies on PPE usage frequency. Man et al. [12] reported that 46.6% of employees sometimes do not use PPE. This study is in line with the previous study by Izudi et al. [13]; it was found that temporary workers use PPE less frequently than permanent workers. The common emphasis of these studies is the low usage of PPE. However, this result may vary depending on the country in which the research is conducted.

According to this study, the most challenging PPE to use are the fall arrest harness and the safety helmet. This finding suggests that employers should select more ergonomic safety helmet materials in consultation with workers. The primary reason for the difficulty in using a fall arrest harness was the lack of infrastructure required for its use. Workers also indicated that the difficulty of using safety helmets and fall arrest harnesses affected their frequency of use. This study is in line with the previous study by Ahmed et al. [36]; our research also found that ergonomic issues and discomfort are significant factors hindering PPE usage.

The majority of participants in this study believed that PPE usage slows their work pace. This finding is in line with the previous studies by Man et al. [12], Tanko et al. [14], and Wu et al. [15]; it was found that compliance with safety rules and the use of uncomfortable PPE negatively affect the work pace, and employees often avoid using PPE to save time. This study asked workers who believed PPE negatively affected their work pace to identify the most cumbersome PPE. When considering the difficulty of using a safety helmet and the proportion of workers who reported that using a safety helmet affects their work pace, there is a need for ergonomic considerations in PPE selection. This finding implies that assigning or selecting a safety helmet arbitrarily may result in resistance to PPE use among workers. The fall arrest harness was the second most commonly cited PPE for slowing down workers. Similar findings regarding the difficulty of using safety helmets and fall arrest harnesses are present in the literature. Ahmed et al. [36] found that workers cited challenging weather conditions as a reason for not using PPE. Under these conditions, equipment such as safety helmets and protective clothing made them sweat, leading them to avoid using such PPE. Man et al. [12] focused on face and eye protection, which had the lowest percentage of difficulty in this study. They reported that workers experienced sultry weather and foggy eye protection due to sweat, reducing visibility and making them feel more at risk than if they wore eye protection. Tanko et al. [14] identified reasons for not
wearing PPE among construction workers as discomfort, improper sizing, and unsuitable designs for hot weather. Similar to this study, it was revealed that PPE is not ergonomically suitable. However, unlike other studies, ergonomic issues regarding the use of glasses were not emphasized in this study due to the low percentage of glasses usage.

According to this study, a well-functioning punishment–reward system should be in place to ensure PPE use in the workplace. The literature contains studies suggesting that rewards should be offered to encourage employees to comply with safety rules [37]. However, some studies found that projects implementing monetary incentives have higher accident rates than projects without monetary rewards [22]. Additionally, Haines et al. [38] and Vredenburgh’s [39] studies in Canada and the USA suggest that monetary rewards do not effectively reduce workplace injuries. Awwad et al. [17] reported that employees strictly follow rules when unsafe behaviors are punished. Similarly, some studies found that contractors adopt punitive measures for employees who disobey safety rules [16,20]. Other studies have shown that fines are not an effective way to ensure employees follow safety rules and reduce accident rates [21,22]. Most studies emphasize that the most effective method for encouraging employees to obey safety rules and use PPE is not solely rewarding or punishing rule compliance. Societal culture, education, and working conditions play crucial roles in establishing an effective system. Therefore, studies characterizing societies are needed for better comparisons of systems described in the literature.

This study found that the majority of participants believe that increased inspections would encourage employers and employees to comply with rules. Additionally, an effective inspection mechanism, established and enforced by relevant authorities, should be in place to ensure PPE utilization in the workplace. Similarly, Man et al. [12], Tanko et al. [14], Izudi et al. [13], and Ahmed et al. [36] stated that increasing OHS-related audits would improve employee PPE utilization. Wu et al. [15] suggested that governments should organize unannounced site visits more frequently. Studies conducted in countries such as Ethiopia [3], Hong Kong [12], Lebanon [17], South Africa, Singapore [18], and Australia [19] also found that OHS-related inspections are lacking, allowing employees to disregard rules [27].

According to this study, most participants believe that PPE protects workers from occupational accidents. However, data revealed that despite recognizing the importance of PPE and its protective role, some workers do not prioritize PPE usage and act carelessly. This finding is also observed in studies by Lette et al. [3], Man et al. [12], Tanko et al. [14], Ahmed et al. [36], and Malekitabar et al. [40]. Lai et al. [16] emphasized that 27.27% of participants used similar expressions, such as, “working unsafely is a foolish act because it threatens my safety.” Lette et al. [3] highlighted that construction workers who do not use PPE have a three times higher risk of injury than those who use PPE, yet non-users still constitute the majority. Comparing this study’s findings with the literature reveals that problems with PPE usage are not unique to Turkey. To improve safety in the construction field, education, ergonomically suitable PPE choices, and an effective control system should be implemented.

This study determined that some employers do not provide PPE to their workers. In the literature, Ahmed et al. [36] reported that only 9% of employees working in construction sites in Pakistan were provided with safety helmets, 13% with protective footwear, 11% with protective gloves, 5% with face and eye protection, and no other PPE was provided at all. Additionally, it was found that PPE is not provided to employees working daily or for several days. It becomes apparent that employers do not provide PPE due to the extra cost incurred for employees working in short-term positions. Wu et al. [15] stated in a study conducted in Hong Kong that the majority of workers were given only a safety helmet and a reflective vest regardless of the company size they worked for; some workers reported that protective footwear and other PPE were always purchased by the workers themselves. Moreover, it was emphasized that workers have to spend their own money to buy and replace PPE when damaged, which may discourage them from using it. Wu et al. [15] also reported that employees were afraid of being fired if they demanded PPE from
their employers. Research conducted in Hong Kong [12], Nigeria [14], Lebanon [17], and China [41] showed that PPE is not provided to workers at construction sites. Malekitabar et al. [40] stated that the failure to supply PPE by employers caused occupational accidents. According to the information obtained, the provision of PPE by employers in Turkey is more satisfactory compared to other developing countries. As a result, studies are needed to ensure the frequent use of PPE by employees in Turkey. To highlight this difference better, the legal regulations of these countries should be examined. According to regulations in Turkey, the supply of PPE is the employer’s responsibility. In Turkey, efforts should be made to encourage the frequent use of PPE at construction sites by employees. Training for both employers and employees should be prioritized in these efforts. Additionally, increasing government inspections will be effective in raising awareness about this issue.

This study revealed that a slight majority of participants perceive wearing safety helmets as non-mandatory and protective footwear as non-essential at construction sites. Similar findings have been reported in previous studies [22,41,42]; however, Tanko et al. [14] observed in their study with Nigerian construction workers that while 90% of participants believed PPE is crucial for protection against injuries, 81.1% did not use PPE on-site, and many preferred to wear sandals and slippers instead of protective footwear. The majority of participants in this study agreed on the importance of PPE utilization. Interestingly, despite working with dusty materials, such as plaster, they did not identify respiratory protection as a requirement. Furthermore, it was hypothesized that a higher percentage of respondents would favor safety harnesses given that employees in these fields often work at elevated heights. If workers are provided with a work environment that includes collective protection measures (e.g., safety guardrails, safety nets), some employees may not view fall arrest harnesses as necessary. PPE utilization becomes even more crucial on construction sites where collective protective measures are largely neglected. Therefore, it was expected that ironsmiths, who typically work at greater heights and face more challenging working conditions, would prioritize safety harness usage. However, the results showed that a significant portion of employees, regardless of their work areas, did not consider it necessary to use a fall arrest harness.

The survey results on PPE utilization necessity, alongside similar findings in the literature [16,43], indicate that there are still employees who have not fully internalized the importance of PPE. According to Man et al. [12], construction workers tend to behave aggressively toward colleagues and even superiors, leading to noncompliance with OHS rules. The primary reason employees do not use PPE adequately is a lack of proper training and awareness regarding PPE’s importance for their safety. This issue has also been highlighted by Başağa et al. [44], who proposed models for developing effective OHS education policies. Abdelhamid and Everett [45] found that insufficient OHS training among construction workers negatively impacted PPE utilization. To initiate change, it is necessary to revise the mandatory OHS training in Turkey. Lai et al. [16] and Sawacha et al. [23] suggest regular OHS training updates to keep up with new developments and share lessons learned from past events or mistakes with employees. OHS training should introduce hazardous actions and discuss potential occupational accidents in detail to help employees better understand the importance of PPE use [16,43]. Izudi et al. [13] discovered that employees with prior knowledge and experience in OHS were more likely to use PPE than those without. This underscores the significance of OHS training in convincing employees of the necessity of PPE use. It is crucial to develop and implement PPE-related policies and regulations to increase employees’ awareness of PPE’s importance [14].

According to this study, the majority of employees, irrespective of their education level and age range, agree that PPE use is essential. Consequently, this perception does not differ based on the employees’ education level or age distribution. Although some studies support these findings [36], others suggest that these factors are influential. Fung et al. [42] found that older, married construction workers or those with more dependent family members held a more positive perception of the safety climate and PPE use importance than younger, single workers or those with fewer dependents. Izudi et al. [13] found
that employees over 30 years of age used PPE more frequently than those aged 18–30. Additionally, those with higher education levels (undergraduate) used PPE more often than those with lower education levels.

The study findings suggest that the majority of employees, regardless of their education level and age range, agree that PPE use is crucial for protecting workers from occupational accidents. This finding demonstrates that the demand for PPE use is not influenced by education level or age distribution. Employers, therefore, must ensure the availability and proper use of PPE in the workplace to protect employees from work-related accidents.

Moreover, the study findings indicate that the most effective way to motivate employees to use PPE is to penalize those who do not comply with safety rules and reward those who do. This finding emphasizes the importance of enforcing safety regulations and providing incentives for compliance to promote PPE use among workers. However, the majority of respondents, irrespective of their education level and age distribution, reported that PPE use negatively affects work pace and slows it down. This finding highlights the need for employers to consider the impact of PPE on work pace and implement measures to minimize any adverse effects.

Additionally, respondents across all work areas stated that PPE use affects work pace and slows it down. This finding underscores the need for further research to investigate the impact of PPE use on various work environments and job tasks. By understanding how PPE use influences different work settings and tasks, employers and policymakers can develop targeted strategies to improve PPE use among workers.

5. Conclusions and Suggestions

The objective of this study was to examine the attitudes and habits of construction workers in Turkey regarding PPE use. To accomplish this, a face-to-face survey was conducted with employees from various sites owned by small- and medium-sized construction companies in different regions of Turkey. An extensive literature review facilitated the comparison and evaluation of data gathered in various countries. Based on a frequency analysis and cross-tabulations of the data, the results may be beneficial for professionals responsible for designing and improving PPE ergonomics and for researchers working on the development of OHS policies.

The primary finding of this study is that PPE use in Turkey’s construction industry is relatively low, and several factors influence its usage. Additionally, this study offers valuable insights into the attitudes and habits of Turkish construction workers regarding PPE use and proposes numerous practical interventions to increase its adoption.

As this study was conducted in Turkey, it provides a unique perspective on PPE use in a developing country with its specific economic, cultural, and regulatory context. The findings of this study can contribute to the global understanding of PPE use in construction industries and help identify common challenges and effective interventions that could be implemented across different countries. The insights gained from the Turkish context may be particularly relevant for other developing countries facing similar challenges in implementing and enforcing OHS policies and regulations.

The results indicate that while workers acknowledge the importance of PPE, factors such as discomfort and perceived negative impact on work pace hinder consistent usage. This study is significant, as it identifies ergonomic improvements and the enhanced enforcement of safety regulations as key areas for intervention. By providing a detailed analysis and practical recommendations, this study contributes to the existing body of knowledge and offers a roadmap for policymakers and industry stakeholders to improve worker safety.

This study has certain limitations, including the focus on small- and medium-sized construction companies in Turkey, which may limit the generalizability of the findings to larger companies or different regions. Future research should consider a broader range of company sizes and geographic areas to validate and extend these findings.

To further enhance PPE usage, integrating Industry 4.0 technologies can provide significant improvements. Here are several examples and applications of these technologies:
• IoT (Internet of Things) and Wearable Technology:

Smart Helmets and Vests: These can be equipped with sensors to monitor workers’ vital signs, detect the presence and correct usage of PPE, and send alerts to supervisors if any safety protocols are violated. For example, a smart helmet can monitor if it is worn properly and provide real-time data on the worker’s health and safety conditions.

Wearable Sensors: Devices such as wristbands or smartwatches can track physical parameters, such as heart rates, body temperature, and exposure to harmful substances. These sensors can alert workers and supervisors to potential health risks and ensure timely interventions.

• Augmented Reality (AR) and Virtual Reality (VR):

AR Glasses: These can provide real-time instructions and safety information to workers, overlaying digital information onto their field of view. This can be particularly useful for complex tasks where immediate access to information is crucial.

VR Training Simulations: VR can be used to create immersive training environments where workers can learn and practice the correct use of PPE in a controlled and safe setting. This can improve their understanding and compliance with safety protocols.

• Real-Time Monitoring and Data Analytics:

Connected Worksites: By integrating IoT devices across the worksite, the real-time monitoring of PPE usage can be achieved. Data collected from these devices can be analyzed to identify trends and areas for improvement.

Predictive Analytics: Using machine learning algorithms, data from wearable devices and sensors can predict potential safety breaches and proactively address them before accidents occur. This can significantly enhance the overall safety of the work environment.

• Blockchain for Safety Compliance:

Immutable Records: Blockchain technology can be used to maintain tamper-proof records of safety compliance and PPE usage. This can help in auditing and ensuring that all safety measures are being followed consistently.

Incentive Systems: Blockchain can also be used to create transparent and reliable incentive systems for workers who consistently comply with PPE protocols, rewarding them with digital tokens or other incentives.

Implementing these advanced technologies can address the ergonomic and compliance challenges identified in this study. By providing real-time feedback, data-driven insights, and innovative solutions, Industry 4.0 technologies can significantly enhance the effectiveness of PPE and overall safety in the construction industry.

Improving PPE use in the construction industry is a shared responsibility among employers, regulators, workers, and manufacturers. The suggestions in this paper can contribute to enhancing PPE use in the construction industry. However, specific cultural and legislative differences should be considered when generalizing findings to other countries. Further research is needed to understand comfort’s role in PPE use and to develop effective policies for encouraging PPE use and collective protection measures. Future research should explore new technologies and designs for PPE as well as identify factors affecting worker behavior and PPE acceptance. Moreover, more studies examining the effectiveness of different interventions in promoting PPE use in the construction industry are suggested.

In conclusion, increasing PPE uptake is a shared responsibility among stakeholders in the construction industry. The findings of this study, conducted in Turkey, can inform efforts to promote effective PPE use across different countries, especially in developing nations with similar challenges. However, additional research is required to understand the factors influencing PPE usage and to develop effective interventions that are sensitive to the cultural and legislative contexts of various countries.

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