

Personal Protective Equipment Usage and Injury Type

Nathan T. Giannini
California Polytechnic State University
San Luis Obispo, California

Workers in the construction industry have many injuries both minor and life-altering. The industry suffers from injuries of all kinds such as falls, electrocution, and being struck by flying objects. To protect against this, workers wear certain types of personal protective equipment (PPE) on construction sites as a last line of defense. The equipment available such as hard hats, safety glasses, gloves, respirators, and hearing protection either protects against acute injuries (those that occur instantly) or chronic injuries (those that occur over time). This study investigates whether the type of injury that PPE protects against, acute or chronic, affects the likelihood of individuals utilizing that protective equipment, when necessary, on the job site. An anonymous survey collected responses from construction industry workers to determine if a pattern is indeed present. Based on the data received, the types of personal protective equipment that protect against chronic injuries such as respirators and hearing protection are less likely to be worn when required or strongly recommended by the Occupational Safety and Health Administration, when compared to PPE that protects against acute injuries.

Key Words: Safety, PPE, Acute Injury, Chronic Injury, Construction

Introduction

Personal protective equipment (PPE) is used as a last line of defense (Occupational Safety and Health Administration [OSHA], 2006) in a variety of industries. Its function is to protect workers from numerous occupational hazards ranging from the medical field with items such as facemasks and latex gloves to the military with items such as ear protection and safety glasses. One of the most well-known and largest industries utilizing personal protective equipment is the construction industry. Falling objects, toxic chemicals, loud noises, and harmful particulates are some of the dangers workers encounter on a job site. Around the globe, construction is “considered the riskiest industry” where workers have a “doubled risk of being injured” when compared to other occupations (Sehsah et al., 2020, p. 2). Because of this, strict rules are put in place and enforced by the Occupational Safety and Health Administration regarding the usage of protective equipment on site. According to OSHA, personal protective equipment is “designed to protect workers from serious workplace injuries resulting from contact with chemical, radiological, physical, electrical, mechanical, or other

workplace hazards” (OSHA, 2006, p. 1). However, the requirement to wear PPE is not always followed exactly as OSHA intended. Employees decide for one reason or another to forgo the PPE provided by employers. The purpose of this research project is to determine if there is a pattern between the type of injury specific personal protective equipment protects against, and the likelihood that workers wear that PPE.

Injury Types and Common Construction Injuries

There are two categories of injury that personal protective equipment protects against: acute and chronic. An acute injury is “the normal, predicted physiological response to an adverse chemical, thermal or mechanical stimulus associated with surgery, trauma, and acute illness” (Carr, 1999, p. 1). In other words, acute injuries are injuries that happen suddenly and do not take long to develop. For example, instantly losing vision due to a sharp object entering the eye is an acute injury. A chronic injury is one that develops over time due to long-term exposure or overuse (U.S. Department of Health and Human Services, 2022). An example of a chronic injury is gradually losing the ability to hear due to long and frequent exposure to loud noises.

Both types of injuries are all too common in the construction industry. Depending on the task workers are doing, they could be at risk of one or both of these types of injuries throughout their workday. For example, chipping concrete has many risks associated with it that make wearing PPE required. When chipping, particles could eject and hit the eye causing damage to the tissue through the force of the impact. In addition, throughout one’s career, exposure to the loud noises that machines used to chip concrete produce can cause gradual hearing loss if proper ear protection is not used. In 2020, the most reported construction injuries were complications caused by being hit by falling objects, falls from height, and tool-related accidents (Sehsah et al., 2020). All these types of accidents can be prevented or reduced with the proper use of PPE and frequent training.

Types of Protective Equipment

There are various types of personal protective equipment utilized in the construction industry. The most commonly required PPE on a job site according to an OSHA Quick Card are safety glasses, safety-toed footwear, gloves, hard hats, and ear plugs in high-noise areas (OSHA, 2005). PPE should fit correctly and be used correctly during the intended task. In addition, there are many different brands or types of the above protective equipment mentioned. It is important that a worker selects the appropriate type of hard hat, safety glasses, footwear, etc. for the task they want to complete. It is the responsibility of the worker and that worker’s employer to ensure PPE is well maintained and has not expired. For example, hard hats are to be replaced after a heavy blow or electrical shock (OSHA, 2005). Many other more specific types of PPE are used in construction such as welding masks during welding operations, and nonconductive footwear to “prevent the wearer’s feet from completing an electrical circuit to the ground” (OSHA, 2004 p. 23) (see Figure 1).



Figure 1. Types of PPE in construction (Personal Protective Equipment, n.d.)

Reasons People Avoid Using PPE

Despite personal protective equipment being the last line of defense between workers and injury or death, many workers still opt to go without the necessary protection regardless of whether it was required or not. In a study that was carried out with 384 workers from different job sites utilizing an interview-administered questionnaire, only 60% of workers used PPE during work (Sehsah et al., 2020). The reasons for workers deciding to skip wearing PPE include but are not limited to discomfort, lack of knowledge on how to use the equipment, and poor fit (Sehsah et al., 2020). Discomfort is a frequently cited reason why people do not follow PPE guidelines. Guo (2009) found that “PPE may significantly influence clothing comfort, heat perception, breathing difficulty, [and] skin moisture” (p. 1). A major step for increasing workers utilizing PPE is ensuring that the PPE is not unbearably uncomfortable. In addition, the lack of availability of protective equipment and therefore lack of training is a cause for its absence on site, especially in developing countries. In Kenya, Muema (2017) found that only 49% of respondents that partook in a questionnaire confirmed the presence of various types of basic PPE. If PPE is not made easily available to workers, then they will have no option but to work without its protection.

Avoiding the use of PPE can have lasting effects on workers’ lives. In a study conducted among the Korean armed forces, it was found that “the average number of injuries was higher for individuals

who did not wear PPE routinely” (Kim, 2017, p. 3). Continuing to identify reasons people forgo its use is a crucial aspect of increasing PPE usage and effectiveness in all industries and all countries throughout the world. There is a gap in knowledge on reasons why workers forgo certain types of PPE over others and this research aims to help fill a portion of that gap.

Methodology

An online anonymous survey utilizing Microsoft Forms was used to collect the data. The survey was posted on the researcher’s LinkedIn and was also sent out to the Cal Poly Construction Management Advisory Council (CMAC). The survey first gathered demographic data to analyze if specific demographics are more likely to wear certain personal protective equipment over others. This data was obtained by asking those surveyed their age, whether they work on the physical or management side of construction, and whether they are a student or a full-time employee. Next, the survey asked participants a variety of questions regarding the use of PPE in various scenarios. A five-point Likert scale was used to determine the likelihood of the respondents utilizing various types of PPE in different scenarios.

Results and Analysis

Survey responses were collected between December 2022 and March 2023. In total, 56 responses were collected. Out of these responses, 20 people were ages 18-29, seven were ages 30-39, 11 were ages 40-49, 11 were ages 50-59, six were ages 60-69, and one response was 70 or up. In addition, out of the 56 respondents, seven were students and 49 were already in the construction industry with a vast majority of those who participated in the survey working on the management side of construction (see Figures 2 and 3).

Of those who responded, 94.6% said they would be very likely to wear a hardhat on site when necessary and 83.6% of them said they would be very likely to wear safety glasses on site. However, when asked if they would wear ear protection or a respirator, 26.8% were very likely with 19.6% proclaiming it very unlikely and 17.9% saying it is somewhat unlikely that they would wear it. For respirators, 16.1% of respondents were very likely but 37.5% of respondents were very unlikely to wear them on site. Lastly, when asked about wearing gloves, 33.9% were very likely, 28.6% were somewhat likely, 8.9% were somewhat unlikely, and 19.6% were very unlikely. Assigning a numerical value of 0-5 to the possible responses with 0 being not applicable, 1 being very unlikely, and 5 being very likely, one can average out a number value assigned to each type of PPE stated above to determine how likely it is that a worker wears that type of PPE. Upon doing this calculation, the following numbers are given for each type of PPE: hardhat received a 4.82, safety glasses received a 4.71, gloves received a 3.32, ear protection received a 2.95, and respirators received a 1.81 (see Figure 4).

In general, respondents were slightly more likely to wear PPE that protects them against acute injuries when looking at specific construction-related activities. For example, out of the 56 respondents, 73.2% of them were very likely to wear safety glasses when chipping concrete or cutting material compared to 50% of respondents answering very likely to wear ear protection when chipping concrete and 43.6% of respondents selected very likely for wearing ear protection when cutting with a saw (see Figure 5).

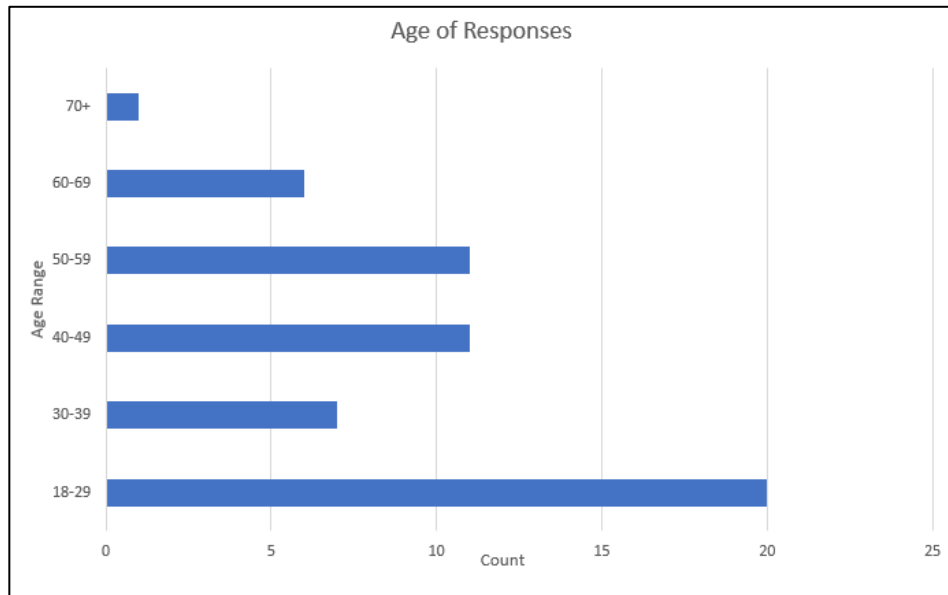


Figure 2. Age ranges of survey respondents

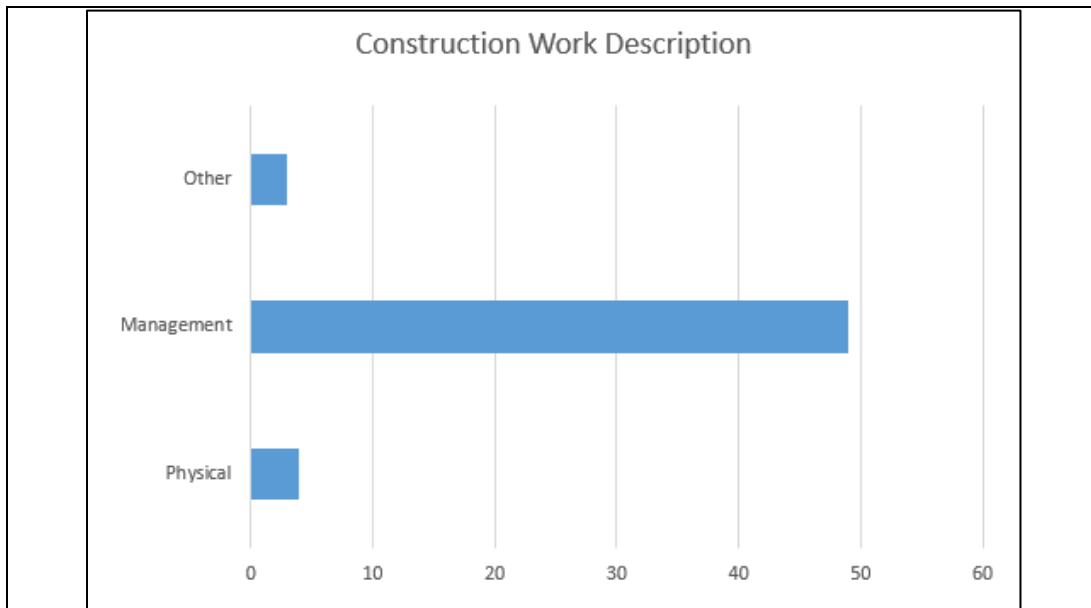


Figure 3. What respondents do within the construction industry or plan to do upon graduation

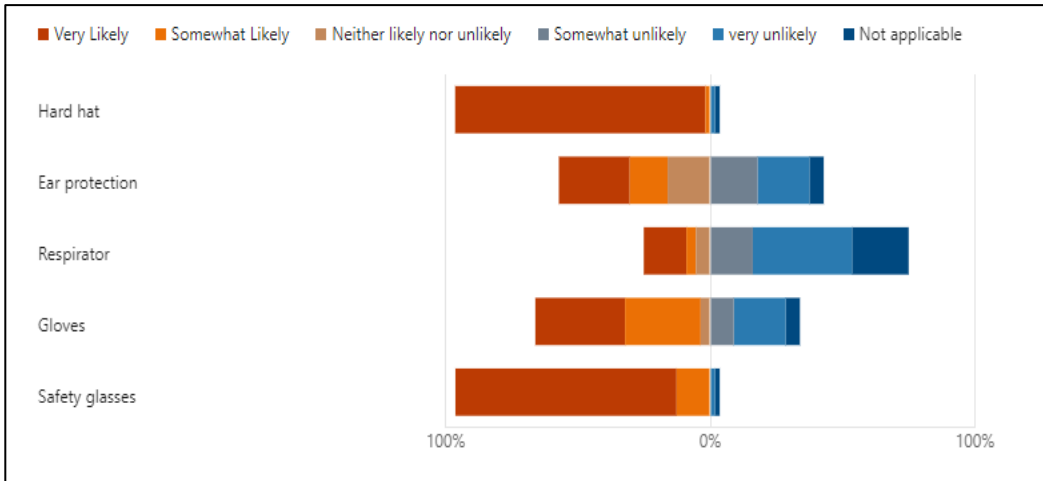


Figure 4. Likelihood of respondents wearing certain types of PPE over others

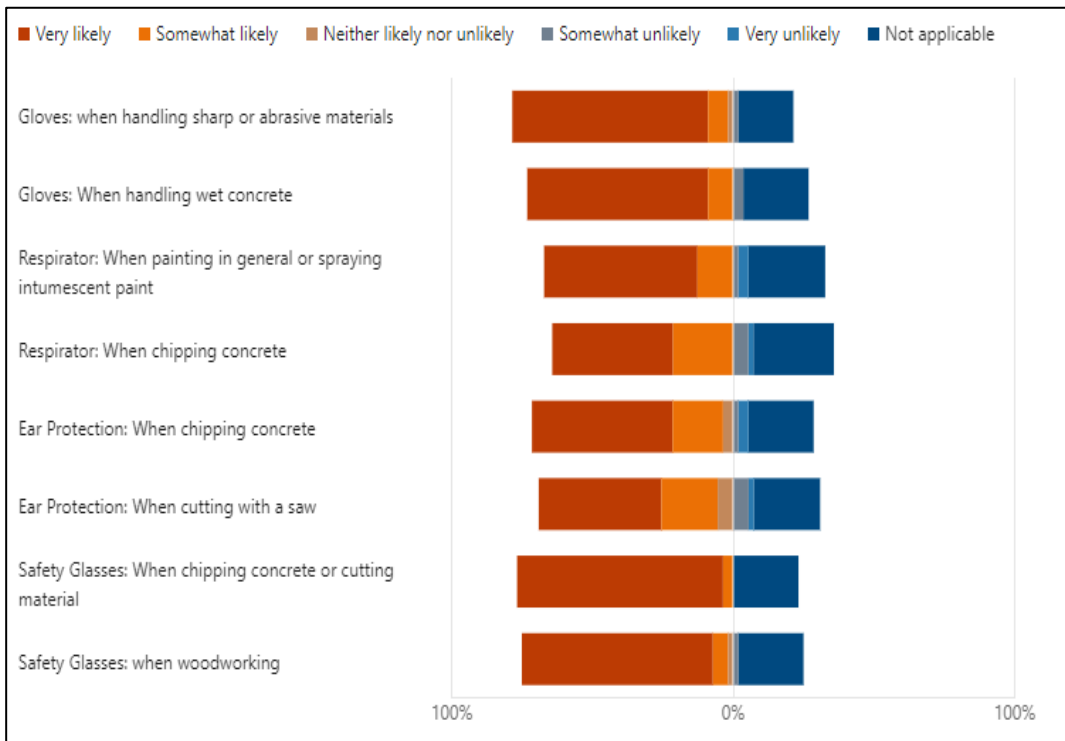


Figure 5. Likelihood of wearing certain PPE types during various construction tasks

Conclusions

The construction industry is a statistically dangerous industry. PPE is one way in which the industry attempts to create a safer working environment for its workers. Some PPE protects against acute injuries or injuries that happen quickly and suddenly while other types protect against chronic injuries which happen over longer periods of time. Based on the data collected through the anonymous survey, there appears to be a pattern between the type of injury that certain PPE is protecting against and the likelihood of respondents wearing that PPE. The data suggests a pattern that people are more likely to forgo PPE that protects against chronic injuries than PPE that protects against acute injuries. Respondents were more likely to wear a hard hat, safety glasses, and gloves (PPE that protects against acute injury) when compared to hearing protection and respirators (PPE that protects against chronic injuries that would likely happen over one's entire career). In addition, it was more common for workers to wear safety glasses when chipping concrete or working with a saw than it was for them to wear ear protection while doing the same activities. Both pieces of protective equipment protect against equally life-altering injuries (loss of sight or loss of hearing). However, loss of sight would likely happen instantly with one instance of debris damaging or destroying eye tissue and hearing loss is often gradual and is therefore a chronic injury.

It's worth mentioning that the above conclusion could also have been reached if managers are requiring those doing physical labor to wear all types of PPE discussed in the study but are not themselves wearing it when recommended or required. Since mostly those on the management side responded to this survey, this could have accounted for the many responses forgoing PPE which offers protection against chronic injuries. Regardless, the data in this study points to a pattern between PPE protecting against chronic injuries, and people not utilizing that PPE, when necessary, on the job. However, due to the limited number of responses obtained, the data could be skewed and not represent the general population of construction workers. This study may not be applicable to the construction industry as a whole. Because more construction managers than laborers responded to the survey, the data likely cannot be extrapolated to physical workers within the industry.

Future Research

It is possible, and even likely, that the reason people are more likely to wear a hardhat and safety glasses over hearing protection and a respirator is that the use of hardhats and safety glasses is often heavily enforced on site with them often being included in the minimum protection needed to be on site. Hearing protection, respirators, and other chronic protection are not as heavily enforced in the construction industry which could be the reason people forgo their use. If this is true, this brings up a gap in the enforcement of protection for workers on site that protects against chronic injuries. Further research should be conducted to explore better ways to make workers not only more aware of chronic injuries but more willing to protect themselves against them. The survey was also only answered by 56 respondents and though this is a decent size data pool, it would be helpful in the future if a similar study was conducted that involved more workers partaking in the physical side of construction. The majority of respondents were on the managerial side of construction, and this could also have skewed the data in favor of the conclusion made above.

References

Carr, D. B., & Goudas, L. C. (1999). Acute pain. *The Lancet*, 353(9169), 2051-2058.

- Guo, Y. P., Li, Y., Wong, T. G., Chung, J. H., Wong, A. S., Gohel, M. D., ... & Luximon, A. (2009). Evaluation of different PPE ensembles in terms of sensation, usability, satisfaction and preference. *J Fiber Bioeng Informatics*, 2, 126-136.
- Kim, T. K., Jeon, B. C., Bae, E., Bae, K. K., Han, K. T., & Park, E. C. (2017). Association between personal protective equipment use and injury occurrence among the Republic of Korea armed forces. *Military medicine*, 182(7), e1900-e1907.
- Muema, L. M. (2017). Evaluation of personal protective equipment utilization among construction workers in Mombasa County, Kenya (Doctoral dissertation, COHES, JKUAT).
- Occupational Safety and Health Administration: OSHA Fact Sheet. Personal Protective Equipment. OSHA 3289; 2006.
- Occupational Safety and Health Administration: OSHA Quick Card. Protect yourself, construction personal protective equipment (PPE). OSHA 3289; 2005.
- Occupational Safety and Health Administration: Personal Protective Equipment. OSHA 3151-12R; 2004.
- Personal Protection Equipment. Personal Protection Equipment in Workplace Safety | Minnesota LTAP. (n.d.). http://www.mnltap.umn.edu/topics/workplace/personal_protection_equipment/
- Sehsah, R., El-Gilany, A. H., & Ibrahim, A. M. (2020). Personal protective equipment (PPE) use and its relation to accidents among construction workers. *La Medicina del lavoro*, 111(4), 285.
- U.S. Department of Health and Human Services. (2022, March 3). Niams health information on sports injuries. National Institute of Arthritis and Musculoskeletal and Skin Diseases. Retrieved April 16, 2023, from <https://www.niams.nih.gov/health-topics/sports-injuries#:~:text=Sports%20injuries%20are%20divided%20into.and%20develop%20gradually%20over%20time.>