ID 52

COVID-19 Vaccination Hesitancy and Perceived Risk of Infection Among Construction Workers

Fahim Ridwan Nabil[1], Mostafa Namian[2], Jamel R. Pittman[3]

[1,2,3] East Carolina University, Greenville, North Carolina, USA
namianm19@ecu.edu

Abstract
The number of cases for COVID-19 is increasing across the United States. Construction workers are also affected by the COVID-19 as most of the construction work is done in person. Construction work is full of different hazards, and COVID-19 has introduced additional health hazards to the workers. Identifying hazards is an essential element to avoid injuries, illnesses, and accidents. Significantly less research has been done to determine how construction workers perceive COVID-19. The goal of this research is to observe based on vaccination status how construction workers perceive COVID-19. A questionnaire was prepared to test the research goal, and in-person interviews were conducted to get workers' responses. Workers who are working on the construction projects were only interviewed. Based on the data analysis work, it was observed that unvaccinated workers do not think COVID-19 is a risk or threat to them. Vaccinated employees (M=7.13, SD=1.84) had a significantly different assessment of COVID-19 risk than unvaccinated workers (M=5.60, SD=1.74), $t(41)=2.801$, $p<0.01$. The research finding indicates that more workshop and safety awareness programs are needed to create awareness among construction workers. The study's findings can assist safety practitioners and experts in implementing safety procedures that encourage workers to adopt a safety mindset.

Keywords
COVID-19, Risk Perception, Pandemic, Vaccination, Construction Hazard.

1. Introduction
Wuhan, China, saw an outbreak of acute atypical respiratory illness in December of 2019 ,and during the Chinese new year the virus quickly spread from Wuhan to other parts of the world (Yuki et al., 2020). A new coronavirus was found to be the reason behind the respiratory illness, and as a result of its high similarity (80%) to SARS-CoV, the new coronavirus was renamed the severe acute respiratory distress syndrome coronavirus-2 (SARS-CoV-2, 2019-nCoV), which caused ARDS and significant mortality in 2002–2003 (Ksiazek et al., 2003). The illness caused by this virus is widely known as COVID-19. On January 30, 2020, the World Health Organization (WHO) labeled the issue a public health emergency of international significance. Later on March 11, 2020, WHO marked the issue as a global health pandemic (BBC, 2020; WHO, 2020). The first reported COVID-19 case in the U.S. was on January 23, 2020, and since then, the number of cases has proliferated (CDC, 2022). Due to the surge of COVID-19 infection in the U.S., on March 13, 2020, the president declared a national emergency concerning the COVID-19 (Presidential Actions, 2021). As of February 2022, the number of total confirmed cases for COVID-19 is 75,937,801, and the total number of deaths is 894,810 (CDC, 2022). Figure 1 illustrates the reported daily number of deaths in the U.S. due to COVID-19 from the start of the pandemic till February 2022. COVID-19 was identified as the leading cause of death in the U.S. (Woolf et al., 2021).

The emergence of an unusual COVID-19 pandemic brought the world to a stop. Like all other industries construction industry was not exceptional from this pandemic. As the construction industry is mostly labor orientated, it was hit hard by the pandemic. Works had to be stopped due to the transmission of the virus. There are several trades that

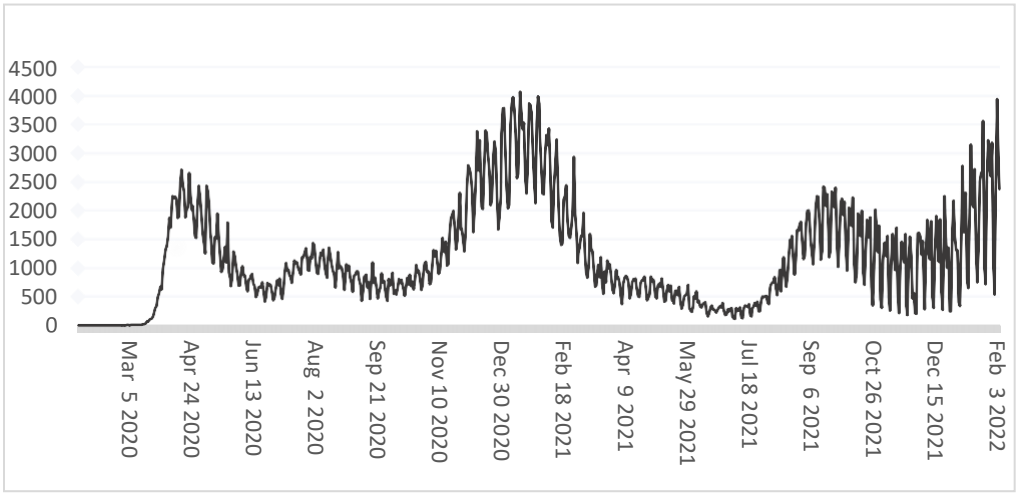

Fig. 25. COVID-19 Deaths in the U.S. (CDC, 2022).

are regarded essential in the 20 states that adhere to Cybersecurity & Infrastructure Security Agency (CISA) standards, and construction was one of them (NCSL, 2021). As the construction work resumed, to undertake tasks or supervise the job appropriately, workers began to work in the job site during the pandemic as most of the construction work needed to be done on-site (Gamil & Alhagar, 2020). Construction workers had the highest positive rates for asymptomatic cases when tested, according to a research study of over 730,000 COVID-19 tests indicated among all occupants (Allan-Blitz et al., 2020). These occupations were essential workers, including healthcare workers, first responders, corrections officers, senior caretakers, grocery store, and food service employees. Another study found that construction workers were five times more likely to be hospitalized with COVID-19 than employees in all other industries, including those who could work from home (Pasco et al., 2020). These two studies can give an idea about the general scenario of COVID-19 infected construction workers, but there is no definite census available for construction workers, which can represent the actual number of workers who have been infected by the COVID-19. A recent research study observed that 41% of unvaccinated workers are hesitant to be vaccinated (Nabil et al., 2022).

A hazard is a circumstance that puts people's lives, health, property, or the environment at risk. Chemical, biological, environmental, health, natural, and other calamities, as well as fire and other workplace risks, fall under the broad umbrella term of hazards. The construction industry is already present with different kinds of hazards. The number of reported fatalities in 2021 is 1008, which is 4.991% lesser than the reported number of deaths in 2020 (U.S. BLS, 2022). Construction workplaces have around six times as many fatalities per employee and twice as many permanently disabling injuries compared to manufacturing industries (Helander, 1991). Because of the COVID-19 pandemic, this situation has worsened significantly and now poses a significant threat to construction workers' health. As revealed by different studies, the significant number of cases found among construction workers, COVID-19, poses a serious concern (Allan-Blitz et al., 2020; Pasco et al., 2020).COVID-19 is a biological hazard in the workplace and poses a risk to the health and safety of workers (Amaechi et al., 2022). A proper understanding of the COVID-19 biohazard among the construction workers can prevent the transmission and can be used as an effective control tool to stop transmission.

Workers' risk-taking behavior may be influenced by their subjective perceptions of risk and the workplace environment, which in turn may affect objective measures of risk and safety. Understanding how construction workers perceive dangers, especially those that aren't readily apparent, is therefore critical for any workplace safety policy. Workers may engage in risky behavior if their perceptions of risk are inaccurate(Arezes & Miguel, 2008; Namian et al., 2018). However accidents are preventable if they are identified by the construction workers for most of the cases (Albert & Hallowell, 2012). The majority of risk perception studies have looked at the likelihood of an accident

occurring. Therefore, there is a lack of knowledge of how workers perceive "invisible" dangers of COVID-19 in the workplace. The current study aimed to determine the COVID-19 safety risk perceived by the construction workers.

2. Research Method

The research goal was achieved in three phases: Phase I was the questionnaire preparation. The data collection work was conducted in North Carolina construction projects in phase II. For phase III, the collected data were integrated and statistically analyzed using SPSS. The data analysis is divided into two sections. One is the descriptive analysis of demographic information, and another is risk perception. The details are as follows in the below sections.

2.1 Questionnaire Preparation

A questionnaire was prepared to observe the risk perception of COVID-19 by the construction workers. After preparing the questionnaire, it was submitted to Institutional Review Board (IRB) for approval. No personal identifiers were used in the survey. The questionnaire was divided into three sections: demographic information, Vaccination attitude, COVID-19 contraction, and Risk perception of COVID-19. Section one of the survey collected participants' demographic information. Section two asked about the vaccination status and COVID-19 contraction-related questions. The last section had questions about perceiving the risk of COVID-19. Likert scale was used in the risk perception to determine the perception and attitude towards COVID-19. Sample questions that are used in the survey are shown in Table 1.

Table 24. Example questions for COVID-19 Safety Concerns on Construction Sites Perceived by Construction Workers.

Section	Example questions
Demographic	"Construction Experience" "What is your current job title/specialty?" "Type of Current Project you are currently working on."
Vaccination attitude and COVID-19 contraction	"Have you ever been tested positive with COVID-19?", "How severe was your COVID-19?", "How many days did it take to recover from COVID-19.", "Have you received your COVID-19 vaccine?"
Risk perception COVID-19	"COVID-19 can affect my safety performance.", "All individuals are universally susceptible to be infected by COVID-19.",

2.2 Data Collection

After getting the IRB approval, the researchers conducted a data collection. Data collection was held in person. No survey link was distributed online to avoid non-response bias. Participants were selected from construction sites randomly. During the research, 43 construction employees from ten different projects in North Carolina were questioned. The participants were actively engaged in the construction trade during the time of the interview. There is no response or completion rate in the survey as they were in person.

2.3 Data Analysis and Result

2.3.1 Descriptive Analysis (Demographic and Vaccination Attitude)

All the interviewed participants were from different parts of North Carolina. Though some of the participants also have worked in other states at some point in their career. Table 2 represents the participant's age and construction experience. The participant's maximum age was sixty-one years, and the minimum was twenty-one years. Among 43 participants, 40 were male, and only 3 participants were female, accounting for only 7% of the total number of participants. When participants were asked about whether they had contracted COVID-19, only 25.4% said they had contracted COVID-19, and 74.6% said they never contracted COVID-19.

Table 2. Distribution of age and construction experience of the participant.

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age (years)	43	40	21	61	37.63	10.983
Construction experience (years)	43	40	0	40	14.17	9.115

The results show that a quarter of the participants were affected by COVID-19. As part of the questionnaire, participants were also asked whether they have OHSA 10/30 certification. OSHA 10/30 is a training program provided by the Occupational Safety and Health Administration for 10 or 30 hours of instruction about common job-related health and safety hazards (OSHA, 2022). 67.4% said they have OHSA 10/30 Certification, and 32.6% said they don't have any certificate. Table 3 gives an idea of the general characteristics of the participants.

Table 3. Distribution for general characteristics construction workers.

Characteristics	Number	%
Gender		
Male	40	93%
Female	3	7%
COVID-19 Contraction		
Positive	11	25.6%
Negative	32	74.4%
Vaccination		
Vaccinated	22	51.2%
Not Vaccinated	21	48.8%
OHSA 10/30 Certification		
Yes	29	67.4%
No	14	32.6%

2.3.2 Risk Perception Analysis

Independent samples T-Test was done to study the risk perception of the construction workers. Groups were created based on the workers' vaccination status, and all the perception questionnaires were test variables. The risk perception capacity of the two groups was calculated and analyzed.

An independent samples t-test was conducted to compare the perception of COVID-19 risk between vaccinated and unvaccinated workers. Results revealed that there was a significant difference in the perception of COVID-19 risk between vaccinated workers (M=7.13, SD=1.84) and unvaccinated workers (M=5.60, SD=1.74), $t(41)=2.801$, $p < 0.01$. Workers who are vaccinated tend to think COVID-19 is a risk for them.

Table 4. Analysis result risk perception based on vaccination status.

Experimental condition	n	Mean	SD	Std.Error Mean	p-value
Vaccinated	22	7.1250	1.83509	0.39124	0.008
Unvaccinated	21	5.5952	1.74190	0.38011	

3. Research Implication

Workers' safety attitude and risk perception play a critical role in preventing casualties at construction workplaces. The current study shows a relationship for perceiving COVID-19 as a threat among vaccinated and unvaccinated construction workers. As COVID-19 is an invisible threat to construction workers' health, safety, and environment, this study will help the researcher understand the construction worker's attitude toward making the construction workplace safer. The results shows that strong relationship between risk perception and vaccination status reveals that unvaccinated workers tend not to consider COVID-19 a threat. Therefore, awareness and safety programs can be organized targeting unvaccinated construction workers to raise awareness. In addition, the study will help safety managers, owners, and project managers better understand workers' attitudes towards COVID-19.

4. Conclusion

The construction industry is one of the most dangerous industries to work in. Workers in the construction industry fail to recognize many risks in their workplaces and frequently underestimate the related safety risk of those hazards detected. The safety attitude of construction employees has been found to significantly impact their performance (Namian et al., 2016). This research studies the perspective of construction workers on how they perceive the COVID-19 threat. The research study aims to serve as a reference in improving construction workplace safety culture.

Construction projects are full of hazards. It is ranked as the most dangerous industry which experienced the most workplace fatalities (NSC Injury Facts, 2020). COVID-19 has introduced a new threat to the construction workplace, which can cause illness, injuries, or fatalities (Koh, 2020; Wolff et al., 2021). The frequency of injuries in the construction workplace increases when hazards remain unrecognized by the construction workers (Carter & Smith, 2006). Therefore, if workers can identify COVID-19 as a safety hazard, there is a chance of having lesser contraction of COVID-19 among construction workers.

In this study, forty-three workers were interviewed across the same state. Four questions were used in the study to evaluate the risk perception of COVID-19. The results from the data analysis showed that there is a strong correlation between the vaccination attitude and risk perception of COVID-19. The result suggests that vaccinated workers acknowledge COVID-19 as a threat in the construction workplace. The limitation of the research is all data were collected from a single state North Carolina. The data might have been different if the researchers could get data from several states across the U.S. In addition, the sample size of the study was relatively small. A bigger sample size is always preferable in any research project. But due to COVID-19 restrictions, not all worksites were accessible by the researchers.

Acknowledgment

The authors would like to thank all participants and construction managers who helped and participated in this study. Special thanks to Duke Facilities Management's Stephen Carrow (ECU Alumni 94), Monteith Construction's Steven Almanzar (Superintendent), and Erin Stitt (People Department). Without everyone's assistance, this research would not be possible.

References

Albert, A., & Hallowell, M. R. (2012). Hazard recognition methods in the construction industry. Construction research congress 2012: Construction challenges in a flat world,

Allan-Blitz, L.-T., Turner, I., Hertlein, F., & Klausner, J. D. (2020). High Frequency and Prevalence of Community-Based Asymptomatic SARS-CoV-2 Infection. *medRxiv*, 2020.2012.2009.20246249. https://doi.org/10.1101/2020.12.09.20246249

Amaechi, C. V., Amaechi, E. C., Amechi, S. C., Oyetunji, A. K., Kgosiemang, I. M., Mgbeoji, O. J., Ojo, A. S., Moure Abelenda, A., Milad, M., & Adelusi, I. (2022). Management of Biohazards and Pandemics: COVID-19 and Its Implications in the Construction Sector. *Computational Water, Energy, and Environmental Engineering*, *11*(1), 34-63.

Arezes, P. M., & Miguel, A. S. (2008). Risk perception and safety behaviour: A study in an occupational environment. *Safety Science*, *46*(6), 900-907.

BBC. (2020). *Coronavirus confirmed as pandemic by World Health Organization.* Retrieved February 01, 2022 from https://www.bbc.com/news/world-51839944

Carter, G., & Smith, S. D. (2006). Safety hazard identification on construction projects. *Journal of Construction Engineering and Management*, *132*(2), 197-205.

CDC. (2022). *COVID Data Tracker: Trends in Number of COVID-19 Cases and Deaths in the US Reported to CDC, by State/Territory*. Retrieved March 14 , 2022 from https://covid.cdc.gov/covid-data-tracker/#trends_dailydeaths

Gamil, Y., & Alhagar, A. (2020). The impact of pandemic crisis on the survival of construction industry: a case of COVID-19. *Mediterranean Journal of Social Sciences*, *11*(4), 122-122.

Helander, M. G. (1991). Safety hazards and motivation for safe work in the construction industry. *International Journal of Industrial Ergonomics*, *8*(3), 205-223.

Koh, D. (2020). Occupational risks for COVID-19 infection. *Occupational medicine (Oxford, England)*, *70*(1), 3.

Ksiazek, T. G., Erdman, D., Goldsmith, C. S., Zaki, S. R., Peret, T., Emery, S., Tong, S., Urbani, C., Comer, J. A., & Lim, W. (2003). A novel coronavirus associated with severe acute respiratory syndrome. *New England journal of medicine*, *348*(20), 1953-1966.

Nabil, F. R., Namian, M., Shukes, J., Batie, D., & Al-Mhdawi, M. (2022). *COVID-19 vaccine acceptance among construction workers* 58th Annual ASC International Conference,

Namian, M., Albert, A., & Feng, J. (2018). Effect of Distraction on Hazard Recognition and Safety Risk Perception. *Journal of Construction Engineering and Management*, *144*(4). https://doi.org/10.1061/(asce)co.1943-7862.0001459

Namian, M., Albert, A., Zuluaga, C. M., & Behm, M. (2016). Role of safety training: Impact on hazard recognition and safety risk perception. *Journal of Construction Engineering and Management*, *142*(12), 04016073.

NCSL. (2021). *National Conference of State Legislature:COVID-19: Essential Workers in the States*. Retrieved February 01,2022 from https://www.ncsl.org/research/labor-and-employment/covid-19-essential-workers-in-the-states.aspx#:~:text=For%20the%2020%20states%20deferring,works%20and%20infrastructure%20to%20communications.

NSC Injury Facts. (2020). *Industry Incidence and Rates:Most Dangerous Industries*. Retrieved February 01,2022 from https://injuryfacts.nsc.org/work/industry-incidence-rates/most-dangerous-industries/

OSHA. (2022). *Occupational Safety and Health Administration:Outreach Training Program (OSHA 10-Hour & 30-Hour Cards)*. https://www.osha.gov/training/outreach#:~:text=The%2010%2Dhour%20class%20is,workers%20with%20some%20safety%20responsibility.

Pasco, R. F., Fox, S. J., Johnston, S. C., Pignone, M., & Meyers, L. A. (2020). Estimated association of construction work with risks of COVID-19 infection and hospitalization in Texas. *JAMA network open*, *3*(10), e2026373-e2026373.

Presidential Actions. (2021). *Notice on the Continuation of the National Emergency Concerning the Coronavirus Disease 2019 (COVID-19) Pandemic.* Retrieved February 1, 2022 from https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/notice-on-the-continuation-of-the-national-emergency-concerning-the-coronavirus-disease-2019-covid-19-pandemic/

U.S. BLS. (2022). *U.S. BUREAU OF LABOR STATISTICS:Census of Fatal Occupational Injuries (CFOI) -Current*. Retrieved February 01,2022 from https://www.bls.gov/iif/oshcfoi1.htm

WHO. (2020). *Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV)*. Retrieved February 01, 2022 from https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)

Wolff, D., Nee, S., Hickey, N. S., & Marschollek, M. (2021). Risk factors for Covid-19 severity and fatality: a structured literature review. *Infection*, *49*(1), 15-28.

Woolf, S. H., Chapman, D. A., & Lee, J. H. (2021). COVID-19 as the leading cause of death in the United States. *Jama*, *325*(2), 123-124.

Yuki, K., Fujiogi, M., & Koutsogiannaki, S. (2020). COVID-19 pathophysiology: A review. *Clinical immunology*, *215*, 108427.