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Assessing the Physical and Psychological Well-being of Construction Workers During the COVID-19 Pandemic

A Prospective Study in Italy

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Objective: This prospective study aimed to assess the physical and psychological health of construction workers and examine the relationship between their well-being and the preventive measures implemented against SARS-CoV-2. **Methods:** During occupational visit, the workers were invited to participate the survey. Two measurements were made and compared: after the Italian lockdown and on the second wave of COVID-19 pandemic. **Results:** Fifty-three workers participated in the study. The percentage of workers who considered themselves in good health increased from 66.0% to 81.1%, and there was a significant decrease in the 12-item General Health Questionnaire score (16.8 vs 14.0, $P = 0.0003$). This reduction was associated with a higher perception of security by preventive measures. **Conclusions:** The study highlights the importance of addressing the health and safety concerns of construction workers during the pandemic, and the positive impact of effective preventive measures.

Keywords: building workers, SARS-CoV-2, General Health Questionnaire, risk perception, prevention measures

LEARNING OUTCOMES

- Describe physical and psychological health status of construction workers during the COVID-19 pandemic
- Discuss items that can affect health status of construction workers
- Discuss the importance of preventive control measures in the workplace

On January 30, 2020, the World Health Organization (WHO) declared a public health emergency of international concern. Italy, which was the first European country to deal with the SARS-CoV-2,[1] implemented the "Shared protocol regulating the measures to contain the spread of the COVID-19 virus in the workplace," with the approval of various social partners, companies, and trade unions.[2] In 2020, the Italian National Institute for Insurance against Accidents at Work developed a methodological approach[3] to estimate the occupational risk of infection, classifying each economic sector as at low, medium-low, medium-high, and high risk, based on the following three parameters: exposure probability, proximity index, and aggregation factor. This classification system provided a theoretical framework for understanding and addressing the risk of infection. The construction industry was classified at medium risk of SARS-CoV-2 infection. Italian construction workers returned to work in May 2020, as soon as the first lockdown ended. Thus, it was necessary to avoid, or at least to decrease, the risk of infection, by imposing specific and appropriate measures to ensure the safety of all workers. However, these measures often raised doubts about their interpretation, implementation, and solution were not always easy. The 2021 survey by Olanrewaju et al[4] was the first to analyze measures to prevent the spread of COVID-19 on the construction site, these measures, including isolating sick workers, conducting daily health checks, promoting hygiene practices, and providing protective equipment, contribute to the practical implementation of safety protocols. The authors claim that research findings have the potential to keep sites "Covid-safe," which helps construction companies increase productivity, reduce project costs, reduce claims, and deliver projects on schedule: isolating sick workers, conducting daily checks for COVID-19 symptoms, preventing hugging/handshaking at the site, displaying health advisory posters and infographics, and providing face masks to workers are seen to be the main measures toward keeping sites "Covid-safe." Similar studies have investigated the difficulty to minimize the spread of the virus for construction workers. These studies conducted a risk stratification investigation about every specific task (eg, workers in an indoor environment have an increased risk when compared with workers employed in civil construction and who generally work outdoor), and finally they have provided possible protection requirements.[5] By simulating how COVID-19 spread among construction workers, it resulted that the workforce from a construction project may be reduced by 30% to 90% because of the spread of COVID-19. Thus, understanding how COVID-19 spreads among workers may assist construction project managers in creating adequate conditions to minimize the chances of getting infected.[6]

The spread of COVID-19 has caused unprecedented psychological stress among health care workers worldwide, resulting in the risk of anxiety, depression, insomnia, work-related stress, and posttraumatic stress disorder.[7,8] Pandemics are known to generate anxiety,

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The present study applied the Strengthening the Reporting of Observational Studies in Epidemiology statement to observational studies guidelines.
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depressive disorders, or posttraumatic stress among hospital-based healthcare workers.[9] However, the effects on other workers in essential activities, such as pharmacies, and rehabilitation providers that have also been exposed to people who may be infected, have been less studied.[10,11] In addition, medical school students who were forced to distance learning during pandemic experienced psychological and physical stress.[12] In addition to solving the problems of health and safety at work, during the years of the pandemic, studies have also focused on the mental and physical well-being of construction workers by considering the research done during the prepandemic period that provides the correlation between psychological distress and attitudes are associated with a higher risk of work injury.[13] Furthermore, research has aimed at identifying the causes and effects that determine emotional stress and physical stress, because (1) safety behaviors were maximized by moderate levels of emotional stress and increased in line with physical stress and inappropriate safety equipment, (2) emotional stress was positively predicted by the provision of training and inappropriate safety equipment, and (3) physical stress was predicted only by inappropriate safety equipment.[14] Studies showed that construction workers are often exposed at the same time to physical and mental stress, being necessary to simultaneously monitor both the conditions to better evaluate the job strain. Umer et al[15] set the goal of monitoring carefully and simultaneously the physical and mental stress, using physiological measures and learning algorithms. To prove that in 2021, they carried out a survey that revealed that using only physiological measurements does not give a complete range of the psychological disorders of construction workers. However, the study has increased our understanding related to the interaction of physical and mental stress by revealing interindividual differences, which can be highlighted by examining each worker separately and then creating better mitigation strategies, especially for more vulnerable workers.

The construction industry is widely regarded as one of the most stressful sectors, and this situation has only been exacerbated by the COVID-19 pandemic. The impact of the pandemic on mental and physical well-being has been significant, with fear and job insecurity being the main drivers of negative emotions.[16] The construction workforce reported their mental health worsened during the COVID-19 pandemic, with an increased frequency or level of anxious or depressed feelings in 2020 compared with 2019, with increases more common in those aged 18 to 54 years.[17] Several studies focused only on the economic implications of the various lockdowns and on how financial aids could be better bestowed upon construction workers.[18,19] Other studies showed how construction workers may be differently exposed to the economic effects of COVID-19; in particular, the labor market shock has led to a convergence of factors that may significantly exacerbate suicide risk among construction workers, who are already considered a vulnerable group.[20] Excess mortality from suicide in the construction workforce has been consistently observed in several countries, including Italy.[21]

In addition to having an increased risk of exposure to the virus, field workers also showed concern for the hours of work, heavier workloads, wages, and access to paid leave; instead office workers working remotely showed concern for factors such as isolation, technology management, home situation, and job stability[22]; if the employee is female or is from ethnic minorities, more barriers will be added (increased family care, managing parental leave, suffering the greater job loss), in a way that creates an important gender and demographic gap.[23,24] All these criticalities caused an increase in labor rights violations and an increased risk of anxiety, depression, and even suicide.[25]

The construction industry has played a dominant role in the urban reality of the city of L'Aquila (Italy) since the earthquake in 2009. During the pandemic, the Italian National Institute for Insurance against Accidents at Work wrote a technical paper (April 2020), which classified the construction industry as at medium/low risk of contracting the virus, based on factors such as exposition, proximity, and aggregation. For these reasons, we consider it necessary to study the health and well-being of this group of workers. This study aims to evaluate the impact of specific preventive measures implemented in the construction industry during the pandemic. By examining the effectiveness of these measures, it contributes to the theoretical understanding of best practices for mitigating the spread of COVID-19 in high-risk work environments. The findings of this study can inform construction companies and policymakers about which preventive measures are most effective in safeguarding the health of workers. This knowledge can guide the development and refinement of safety protocols for future outbreaks or similar health emergencies.

METHODS

This was a prospective study conducted in collaboration with the Prevention Department of the Local Health Unit 1 of Abruzzo Region, Italy, on a sample of construction workers. The study was authorized by the internal review board of University of L'Aquila (IRB: N.31/2020) and the STrengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines were used for its implementation (Supplemental Digital Content, http://links.lww.com/JOM/B477). Participation was voluntary. During the occupational visit, construction workers were invited to participate in the survey by filling out a questionnaire after giving informed consent.

The questionnaires were administrated first after the Italian lockdown (May 2020) and during the second wave of COVID-19 pandemic in Italy (December 2021). At follow-up, a new section was added in the questionnaire to know the workers opinion on prevention measures applied by the company's management.

Measures

The questionnaire administered consisted of the following four sections:

1. Sociodemographic information including gender and age.
2. Health-Related Quality of Life questionnaire (HRQoL),[26] developed by the Center for Disease Control and Prevention and adopted by the Italian behavioral risk factor surveillance system Progress of Health Care Companies in Italy.[27] It consists of the following questions:
3. How is your health in general? (Excellent, very good, good, fair, or poor).
4. Now thinking about your physical health, which includes physical illness and injury, how many days during the past 30 days was your physical health not good?
5. Now thinking about your mental health, which includes stress, depression, and problems with emotions, how many days during the past 30 days was your mental health not good?
6. During the past 30 days, approximately how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?

Self-rated health status was divided into two categories for the first HRQoL measure: fair or poor health and good, very good, or outstanding health. The "Summary Index of Unhealthy Days," which can last up to 30 days, was calculated by combining the results of the two HRQoL questions on physical and emotional health. The Summary indicator measure of Unhealthy Days, a validated measure of self-reported mental and physical health, enables researchers to look at trends in health over time and pinpoint populations that might benefit from attention.[28]

1. The 12-item General Health Questionnaire (GHQ-12),[29] a commonly used instrument for measuring perceived psychological distress: every item assesses the seriousness of a psychologic health problem in the last 4 weeks, using a 4-point scale (from 0 to 3). This questionnaire was developed to identify two main problem categories: inability to accomplish healthy normal

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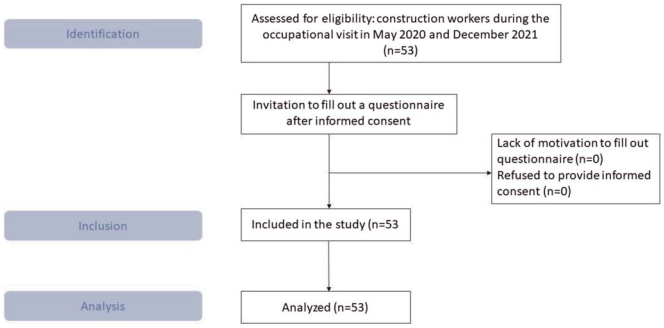

FIGURE 1. STROBE Flowchart for observational studies.

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functions and the onset of new stressful events.[30] It could be used to identify a "probable clinical case" (based on cutoff score) and to define the morbidity seriousness (based on total score). The focus is on the change of the normal psychic functioning of the individual. In fact, the questionnaire does not aim at assessing the presence of mental disorders, but it has been designed to examine personality disorders or the ability to adapt to stressful situations. The total score ranges from 0 to 36: a score up to 15 suggests a normal level of stress, a score from 15 to 20 suggests an average stress, and a score higher than 20 indicates a stronger psychological distress.

2. COVID-19 section. This section was added at follow-up to collect information on vaccination status, previous positivity in COVID-19, number of cases in the workplace, and personal opinion on the preventive measures taken by the company's management. It consists of the following questions:

Did you get anti–COVID-19 vaccination? (Yes/No).
If your answer was yes, does being vaccinated make you feel safe? (Yes/No).
If you received anti–COVID-19 vaccination, would you get an extra dose, if recommended? (Yes/No).
From March 2020 to today, have you ever tested positive for COVID-19? (Yes/No).
If you have answered Yes above, when? (Before vaccination/After vaccination)
Have you ever been put into isolation? (Yes/No).
Have there been reported cases of COVID-19 at your workplace? (Yes, from 1 to 5 cases/Yes, more than 5 cases/No).
If you have answered Yes above, do you think the cases were managed properly? (Yes/No).
Do you think that the company you work for has adopted EFFECTIVE measures to prevent infection from COVID-19? (4-point Likert scale)
Do you think that the company you work for has adopted SUFFICIENT measures to prevent infection from COVID-19? (4-point Likert scale)
To what extent do you think anti–COVID-19 measures are respected in the company you work for? (4-point Likert scale)
How widespread is the information about anti–COVID-19 measures in the company you work for (brochures; meeting…)? (4-point Likert scale)
To what extent do preventive measures make you feel safer? (4-point Likert scale)
Do you believe that the anti–COVID-19 measures encumber your work or make it more stressful? (4-point Likert scale)

Statistical Analysis

Continuous variables were analyzed using Student *t* test or Mann-Whitney test, as appropriate, after having tested normality with Shapiro-Wilk test. Categorical variables were compared using Chi-Quadro tests or the exact Fisher test. Finally, a linear regression model was constructed to investigate the determinants of a higher level of stress, measured through GHQ-12. The analyses were conducted using the STATA 17 software (StataCorp LLC., College Station, TX). For all analyses, an α significance level of 0.05 was chosen. The estimated sample was calculated using GPower software 3.1 (GPower Release 3.1.9.7, Franz Faul, Universitat Kiel, Germany) (https://www.psychologie.hhu.de/): setting the type I error to 5% and the statistical power to 80%, the estimated sample size for a medium effect size was 47 units.

RESULTS

A total of 53 employees participated in the study, and all of them were frontline workers (Fig. 1). During the investigation, all questionnaires were valid and correctly completed and were included in subsequent analyses. The average age of the participants was 40.3 years with an SD of 12.0, 88.7% (47) were males (with the job of construction worker and blue-collar vs technical staff for females). Overall, 35 workers (66.0%) referred being healthy by answering "well" or "very well" to the first question of the HRQoL questionnaire; this proportion increased to 81.1% (43) at follow-up. During the first study, participants reported 2.5 days (SD = 7.2) of poor health on average, and a GHQ-12 of 16.8 (SD = 4.1). Females scored significantly higher than males as they reported several days of poor health (9.0 vs 1.7, $P = 0.0038$). Instead, the GHQ-12 score was almost identical in both sexes (16.7 in males vs 17.0 in females). After Spearman correlation, neither of these variables was correlated with age.

At follow-up examination, participants reported 3.0 days (SD = 6.7) of poor health on average, and a GHQ-12 of 14.0 (SD = 4.9) (Table 1). Although females reported more days of poor health than males (7.0 vs 2.5), this difference was not statistically significant ($P = 0.1418$). The GHQ-12 showed a modest difference between the two sexes: it was slightly greater in females (15.2) than in males (13.4), even if not significantly ($P = 0.9888$). In addition, there was no association between these variables and age. Comparing the values of the two measurements, we found no significant differences in the days of poor health ($P = 0.460$). Instead, the reduction in the GHQ-12 score was statistically significant ($P = 0.0003$). The post hoc analysis revealed a power more than 90%.

During the follow-up, further information was requested from the workers (Table 1). Most of them (49; 92.5%) were vaccinated against SARS-CoV-2; among these, 77.6% (38/49) reported feeling safer after vaccination and being willing to receive an extra dose if necessary. Almost one-third of the respondents reported no positive cases of COVID-19 at their workplace. Most of those who reported some

TABLE 1. Comparison of Basal and Follow-up

	Baseline	Follow-up	*P*
Healthy workers	35 (66.0%)	43 (81.1%)	0.8150
Days of poor health	2.5 ± 7.2	3.0 ± 6.7	0.4600
GHQ-12 score	16.8 ± 4.1	14.0 ± 4.9	0.0003

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TABLE 2. Main Results From the Follow-up

Items		No.	%
Did you get anti–COVID-19 vaccination?	Yes	49/53	92.5%
Does being vaccinated make you feel safer?	Yes	38/49	77.6%
If recommended, would you get an extra dose of vaccination against COVID-19?	Yes	40/49	81.6%
Have there been reported cases of COVID-19 in your company?	No	18	—
	Yes, from 1 to 5 cases	26	—
	Yes, more than 5 cases	8	—
Do you think the cases were managed properly?	Yes	31/34	91.2%
		Mean	SD
Do you think that the company you work for has adopted EFFECTIVE measures to prevent infection from COVID-19?		3.29	0.71
Do you think that the company you work for has adopted SUFFICIENT measures to prevent infection from COVID-19?		3.27	0.71
To what extent do you think anti–COVID-19 measures are respected in the company you work for?		3.29	0.68
How widespread is the information about anti–COVID-19 measures in the company you work for?		3.31	0.78
To what extent do the preventive measures make you feel safer?		3.06	0.76
Do you believe that the anti–COVID-19 measures encumber your work or make it more stressful?		2.65	1.06

cases in their company gave a positive opinion about the effectiveness of the anti–COVID-19 measures adopted by their company and they considered these measures sufficient. Almost all the respondents reported that the measures had been "sufficiently" or "highly" respected by employees and the information about anti–COVID-19 measures spread by the company was considered worthwhile. Overall, 56.3% of the respondents believed they have felt sufficiently safe after the introduction of the preventive measures. However, more than half of the workers deemed that the measures encumbered their work or made it more stressful (Table 2).

The assessment of the perceived effectiveness, sufficiency, and security of the preventive measures taken was high for all respondents. According to Spearman correlation, a greater safety for preventive measures was correlated with a greater perception of information dissemination ($\rho = 0.6709$, $P < 0.0001$) and a greater perception of the effectiveness of measures ($\rho = 0.4936$, $P = 0.0004$). The perception of measures as stressful or encumbering was not associated with their perception as effective or sufficient.

Figure 2 summarizes the anti–COVID-19 prevention measures provided by the company, and it classifies them in descending order of application. Our results showed that the most frequently applied measures were as follows:

1) Availability of face masks and other personnel protective equipment when the type of work does not allow staff to maintain the interpersonal distance of 1 meter.
2) Verbal communication to notice safety and prevention provision.
3) Posting of visible posters to indicate the proper behavior.

To identify the possible predictors of GHQ-12 difference, we conducted a multivariable regression including variables related to GHQ-12 improvement. The model showed that number of cases reported at the workplace and higher perception of security by preventive measures were associated with GHQ-12 reduction (Table 3).

DISCUSSION

Pandemics are known to cause anxiety, depression, or posttraumatic stress disorder among hospital-based healthcare workers. The COVID-19 virus has had an impact on several economic sectors throughout the world. It has had a massive influence on every aspect of the building construction industry. There is a significant deal of urgency in the construction industry to offer information on the impact and actions to protect construction sites from COVID-19. Despite the importance of the issue, little evidence has been produced and this is one of the few studies investigating the impact of COVID-19 on the health of construction workers. After the disastrous earthquake in 2009, construction sites in the city of L'Aquila have multiplied.[31] The pandemic has hindered the reconstruction works and has also caused considerable economic damage. In such a context, the resumption of activities with the reduction of infections was essential to know the health status of workers with regard to the pandemic and to enable workers to carry out their activities safely.

At baseline, the resumption of activities after the first lockdown and the results showed how the workers interviewed reported on average that they had experienced 2.5 days of not good health in the previous month. This value was lower than the national (4.1) and regional (2.9) average recorded by the Progress of Health Care Companies in Italy surveillance of the Italian Institute of Health. At follow-up, the average of the days falls to a value in line with the national average (3.0). The trend observed in this study was similar to that observed in a study with similar instruments in community pharmacists.[10] In particular, the average number of ill-health days was 2.9 in

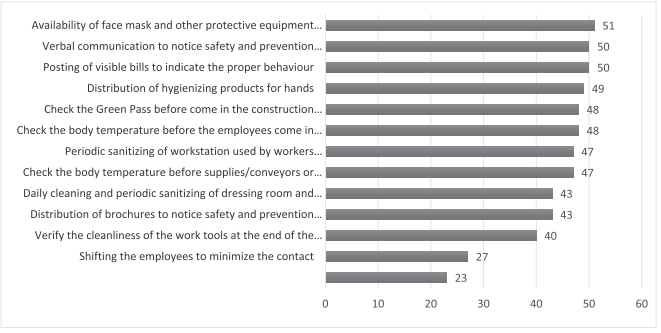

FIGURE 2. Anti–COVID-19 prevention measures.

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TABLE 3. Linear Regression Analysis

	Coefficient	95% CI	*P*
Proper management	7.43	−0.88 to 15.72	0.078
Did measures make you feel safer?	−4.73	−8.48 to −0.98	0.015
Number of cases	−4.84	−8.78 to −0.89	0.018
Sex	−1.81	−8.71 to 5.10	0.595

pharmacists and 2.5 in construction workers. This suggests the need to pay particular attention to a group of workers who more than others need special attention in health protection. Other studies conducted on teachers in telework during 2020 showed a high rate of poor mental health (58%).[32]

At follow-up, we observed a reduction in the stress levels measured with GHQ-12. This improvement in reported health and stress levels is likely due to increased pandemic control and availability of vaccinations; this implies that it is important for employers to have effective measures in place to monitor and respond to COVID-19 cases among employees. Indeed, most of the study participants reported feeling safer after vaccination (79.2%) and being willing to receive an extra dose if necessary (84.0%). Because a significant proportion of the participants reported feeling safer after vaccination, it was important promoting and facilitating COVID-19 vaccinations among frontline workers. Employers should provide information and resources to encourage vaccination. More than half of the workers felt that the preventive measures encumbered their work or made it more stressful. This indicates a need for employers to consider strategies to mitigate these perceived negative impacts, perhaps through training, support, or adjustments to work processes. Finally, the high perceived effectiveness, sufficiency, and security of preventive measures suggest that it is important to continue implementing and reinforcing these measures. This can help maintain a safe working environment and support the well-being of frontline workers.

Our study presents some limitations. The results are not reflective of trends in the general population. Moreover, the sample was unbalanced regarding work category and gender, with a higher presence of men: however, this different gender distribution reflects the Italian national trend where a greater proportion of males are employed in the construction industry. Furthermore, the surveys were conducted at different dates during the pandemic; while this may restrict direct comparison of the data, it helps highlight changes in the behavior and health of employees exposed to different hazards.

In conclusion, our findings suggest that the pandemic also affected the health status of workers not involved in health care, but essential for the recovery of the city. The improvement of the general environment and the local control measures implemented have had a positive role in controlling infections and lowering the level of stress and improving the health status perceived by this category of workers.

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