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Original Article

# Evaluation of Pre- and Post-Vaccination Coronavirus Disease 2019 Status of Emergency Ambulance Service Workers in Regional Province

Yasin Bilgin

Department of Emergency, Erzincan Binali Yıldırım University, Faculty of Medicine, Erzincan, Türkiye

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**ORCID iDs of the author:** Y.B. 0000-0002-1582-223X.

## ABSTRACT

**Objective:** This study was designed to evaluate the coronavirus disease 2019 (COVID-19) status of emergency ambulance service workers, who were in front-line contact with patients during the COVID-19 epidemic, before and after the vaccination program was initiated (March 2020-July 2021).

**Methods:** The variables gender, age, location of employment, role, COVID-19 diagnosis, immunization status, and contact with patients were evaluated among 223 Erzincan emergency ambulance service workers.

**Results:** No significant differences in age, gender, and role in COVID-19-positive patient transfers (whether active or passive) were found between COVID-19-positive and negative healthcare workers. Moreover, there was a measurable decrease in COVID-19 cases after vaccination.

**Conclusion:** In this study, which is one of the few investigations involving emergency ambulance service workers, 93.8% of the workers participated in the vaccination program and received 2 doses of the vaccine, and there was a measurable decrease in COVID-19 cases after vaccination. Multi-center studies may offer more statistically valuable results for this occupational group, which remained constantly active while the stay-at-home order was in place.

**Keywords:** Ambulance service workers, COVID-19, vaccine

## INTRODUCTION

After the coronavirus disease 2019 (COVID-19) was declared a global pandemic on March 11, 2020, especially during the stay-at-home order, it was necessary to continue emergency ambulance services, whose operators are the first professionals to see a patient, and they provide quick referrals with on-site diagnoses and transport to the eligible hospital. Protecting the health of healthcare professionals increased in importance in preventing transmission of the virus to patients and controlling the loss of labor (supplying new personnel instead of sick personnel, increasing the working hours of other employees instead of those workers in isolation, etc.).[1] For a long while, the only defense against COVID-19 was the use of masks and other personal protective equipment. Altough the use of personal protective equipment for the duration of work is uncomfortable for healthcare workers, care was taken to apply it, unfortunately a significant number of healthcare professionals still contracted the disease and died. In addition to social isolation and mask-wearing, immunization is known to be the most effective way to manage the COVID-19 virus.[2] Healthcare professionals are the occupational group at the greatest risk of contracting infectious diseases and have priority in vaccination campaigns, as in the COVID-19 pandemic.[3,4] Studies demonstrate that vaccines can reduce the number of infections and severe cases of COVID-19.[5-8] Despite the high efficiency and effectiveness of the vaccination campaign, infections, possibly due to new variants, persist in the vaccinated population.[9,10]

**Corresponding Author:** Yasin Bilgin, **E-mail:** dr.ysn.blgn@gmail.com



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Studies on the situation of ambulance service employees, who had an active role in patient transport from the beginning of the pandemic, are limited. The aim of the present study was to evaluate the COVID-19 status of emergency ambulance service workers, who were in front-line contact with patients during the COVID-19 epidemic, in the pre- and post-vaccine periods (March 2020-July 2021).

## METHODS

A total of 223 Erzincan emergency ambulance service workers between 18 and 65 years old participated in this study. The research entailed comparing the workers' COVID-19 status between March 2020 and July 2021—that is, before and after they received the COVID-19 vaccine. The variables gender, age, location of employment, role, COVID-19 diagnosis, immunization status, and contact with patients were evaluated. The study was deemed ethically appropriate with the decision of Erzincan Binali Yıldırım University Clinical Research Ethics Committee (Date: January 10, 2022, Number: E-21142744 -804.99-13872) Approval was also received from the Scientific Research Platform of the T.C. Ministry of Health, General Directorate of Health Services. Written informed consent was obtained from ambulance service workers who participated in this study.

### Exclusion Criteria

Forty-six individuals with pre-vaccine COVID-19 infection were excluded from the post-vaccine period comparison because a previous COVID-19 infection is known to be a protective factor against reinfection.

### Statistics

The data were summarized using descriptive statistics, with continuous (numerical) variables presented as mean ± SD or median, minimum, and maximum values based on their distribution. Categorical variables were expressed as counts and percentages. The normality of the numerical variables was assessed using the Shapiro–Wilk, Kolmogorov–Smirnov, and Anderson–Darling tests.

To compare differences between categorical variables by group, the Pearson Chi-square test was employed for 2 × 2 tables with expected values of 5 or higher, Fisher's exact test was used for tables with expected values below 5, and the Fisher–Freeman–Halton test was applied for R × C tables with expected values under 5.

When numerical variables did not exhibit a normal distribution, the Mann–Whitney *U*-test was utilized for comparing 2 independent groups.

Statistical analyses were conducted using Jamovi (version 2.3.24.0) and Jeffreys' Amazing Statistics Program, version 0.17.1 (JASP version 0.17.1) software, with a significance level of .05 (*P*-value) considered for all statistical tests.

### MAIN POINTS

- Among emergency service workers in Erzincan province, 93.8% took part in the vaccination program and received 2 doses of the vaccine, and there was a measurable decrease in coronavirus disease 2019 (COVID-19) cases after vaccination.
- No differences were found between COVID-19-positive and negative healthcare workers concerning their roles in COVID-19-positive patient transfers (whether active or passive) before and after the vaccination program.
- There were no differences in the age and gender of healthcare workers who did and did not contract COVID-19 before and after the vaccination program.
- The incidence of COVID-19 was significantly higher among personnel working in auxiliary services (technicians, assistants, data preparation and control operators, and employees) before the vaccination program.

## RESULTS

The study involved 223 emergency ambulance service workers. Participants had a mean age of 33.6 ± 9.1 years, with 105 (47.1%) being female. Among the participants, 80 (35.9%) were emergency medical technicians, 65 (29.1%) were paramedics and ambulance and emergency care technicians, 36 (16.1%) were drivers, 17 (7.6%) were providers of auxiliary services (technicians, janitors, data preparation, control operators, and employees), 12 (5.4%) were doctors, 9 (4%) were health officers, and 4 (1.8%) were nurses (Table 1). As none of the emergency ambulance service workers required hospitalization or intensive care, the severity of the disease among them was not categorized.

Prior to the vaccination program, 46 (20.6%) healthcare workers contracted COVID-19, and following the vaccination program, this number reduced to 8 (4.5%). Among the healthcare workers, 198 (93.8%) took part in the vaccination program and received 2 doses of the vaccine. Categorizing employees into active and passive groups according to their involvement in transporting COVID-19 patients revealed that 158 (70.9%) employees actively participated in the transportation of COVID-19 patients, while 65 (29.1%) employees were passively involved (i.e., minimal patient contact) (Table 1).

A total of 34 (15.2%) healthcare workers were employed in COVID-19 command and control centers, 29 (13%) held administrative positions within the chief medical directorate, and the remaining 160 (71.8%) worked at various transport stations (Table 1).

There was no significant difference in the ages of healthcare workers who did and did not contract COVID-19

**Table 1.** Descriptive Statistics on Demographic and Vaccination Status of Healthcare Professionals

| | | Overall (n = 223) |
|---|---|---|
| Age† | | 33.6 ± 9.1 |
| Gender‡ | Female | 105 (47.1) |
| | Male | 118 (52.9) |
| Professional job‡ | Emergency medical technician | 80 (35.9) |
| | Paramedic + ambulance and emergency care technician | 65 (29.1) |
| | Driver | 36 (16.1) |
| | Technician + assistant + data preparation and control operator + employee | 17 (7.6) |
| | Doctor | 12 (5.4) |
| | Health officer | 9 (4.0) |
| | Nurse | 4 (1.8) |
| Pre-vaccination COVID-19 status‡ | No | 177 (79.4) |
| | Yes | 46 (20.6) |
| Post-vaccination COVID-19 status‡ | No | 169 (95.5) |
| | Yes | 8 (4.5) |
| State of being vaccinated‡ | No | 13 (6.2) |
| | Yes | 198 (93.8) |
| Status of being in charge of transport‡ | Active | 158 (70.9) |
| | Passive | 65 (29.1) |
| Workplace‡ | Command and control center | 34 (15.2) |
| | Chief Medical Directorate | 29 (13.0) |
| | Tercan | 28 (12.6) |
| | Station no. 6 | 18 (8.1) |
| | Station no. 2 | 17 (7.6) |
| | Çayırlı | 16 (7.2) |
| | Station no. 1 | 16 (7.2) |
| | Station no. 4 | 15 (6.7) |
| | Station no. 3 | 14 (6.3) |
| | Refahiye | 13 (5.8) |
| | İliç | 12 (5.4) |
| | Üzümlü | 11 (4.9) |

COVID-19, coronavirus disease 2019.
‡mean ±standard deviation.

**Table 2.** Comparison of Mean Ages of Patients With and Without Coronavirus Disease 2019 Infection Before and After the Vaccination Program

| | | Age§ | P* |
|---|---|---|---|
| Pre-vaccination | COVID (+) (n = 46) | 35.0 [23.0-58.0] | .210 |
| | COVID (−) (n = 177) | 30.0 [20.0-59.0] | |
| Post-vaccination | COVID (+) (n = 8) | 29.0 [27.0-37.0] | .863 |
| | COVID (−) (n = 169) | 30.0 [20.0-59.0] | |

§Median [minimum–maximum].
*Mann–Whitney *U*-test.

before the vaccination program ($P = .210$). Similarly, no significant difference was observed in the ages of healthcare workers after the vaccination program ($P = .863$) (Table 2).

Before the vaccination program, no significant differences were found between COVID-19-positive and -negative healthcare workers concerning gender and their roles in COVID-19-positive patient transfers (whether active or passive) ($P = .064$ and $P = .999$, respectively). However, the incidence of COVID-19 was significantly higher among personnel working in auxiliary services (technicians, assistants, data preparation and control operators, and employees) before the vaccination program ($P = .048$) (Table 3).

After the vaccination program, no significant difference was found in gender, active or passive involvement in COVID-19-positive patient transfers, and job characteristics between healthcare workers who were and were not infected with COVID-19 ($P > .05$ for each) (Table 4).

Figure 1 represents data from the Emergency Health Automation System regarding the total incidences of COVID-19 and non-COVID-19 cases of patients transported by ambulance services in Erzincan. There is a clear correlation between the start of the vaccination program in January 2021 and a decrease in COVID-19-positive cases in the community compared to the pre-vaccine period, and the same is evident among ambulance service workers.

## DISCUSSION

Emergency ambulance service workers played a critical role on the front line of the pandemic as they treated patients in place and transported them to hospitals while the stay-at-home order was in force. Emergency ambulance service workers are often the first contacts for people in Türkiye accessing healthcare, making the vaccination of this workforce particularly important for lowering the risk of COVID-19 infection among the workers

**Table 3.** Comparison of Gender and Job Characteristics in Patients With and Without Coronavirus Disease 2019 Infection Before the Vaccination Program

| | Pre-Vaccination | | |
|---|---|---|---|
| | COVID-19 (−) (n = 177) | COVID-19 (+) (n = 46) | *P** |
| Status of being in charge of transport‡ | | | |
| Active | 131 (74.0) | 27 (58.7) | .064 |
| Passive | 46 (26.0) | 19 (41.3) | |
| Gender‡ | | | |
| Female | 83 (46.9) | 22 (47.8) | .999 |
| Male | 94 (53.1) | 24 (52.2) | |
| Professional job‡ | | | |
| Emergency medical technician | 64 (36.2) | 16 (34.8) | **.048** |
| Paramedic + ambulance and emergency care technician | 55 (31.1) | 10 (21.7) | |
| Driver | 32 (18.1) | 4 (8.7) | |
| Technician + assistant + data preparation and control operator + employee | 10 (5.6)[a] | 7 (15.2)[b] | |
| Doctor | 8 (4.5) | 4 (8.7) | |
| Health officer | 6 (3.4) | 3 (6.5) | |
| Nurse | 2 (1.1) | 2 (4.3) | |

COVID-19, coronavirus disease 2019.
*Pearson Chi-square, Fisher's exact or Fisher–Freeman–Halton test.
[a,b]When multiple comparisons were made, this pair caused the difference according to the post hoc tests.
‡n (%).

**Table 4.** Comparison of Gender and Job Characteristics in Patients With and Without Coronavirus Disease 2019 Infection After Vaccination Program (In this Table, 46 Individuals with Pre-Vaccine COVID Were Excluded)

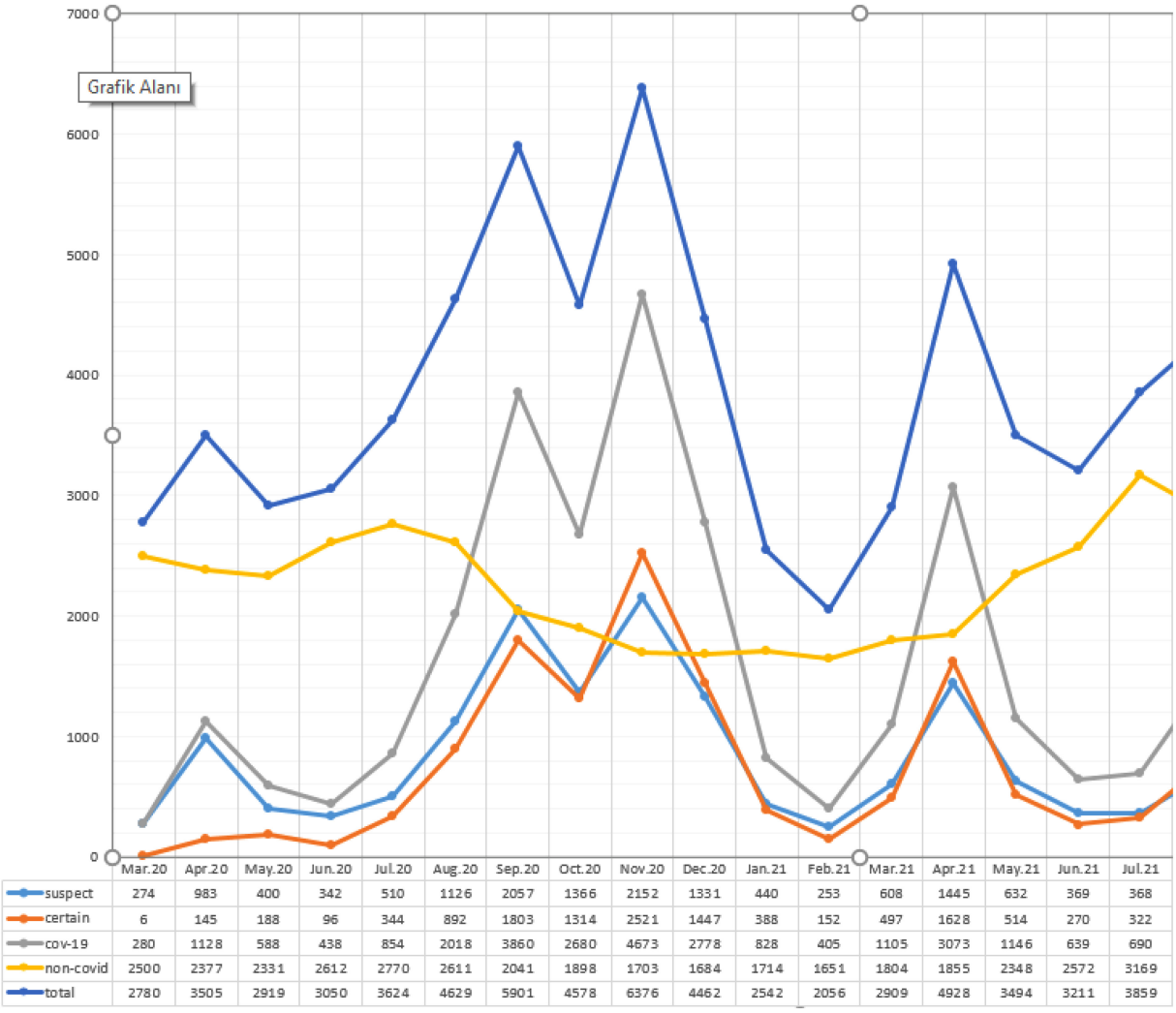
| | Post-Vaccination | | |
|---|---|---|---|
| | COVID-19 (−) (n = 169) | COVID-19 (+) (n = 8) | *P** |
| Status of being in charge of transport‡ | | | |
| Active | 124 (73.4) | 7 (87.5) | .682 |
| Passive | 45 (26.6) | 1 (12.5) | |
| Gender‡ | | | |
| Female | 78 (46.2) | 5 (62.5) | .477 |
| Male | 91 (53.8) | 3 (37.5) | |
| Professional job‡ | | | |
| Emergency medical technician | 61 (36.1) | 3 (37.5) | .933 |
| Paramedic + ambulance and emergency care technician | 51 (30.2) | 4 (50.0) | |
| Driver | 31 (18.3) | 1 (12.5) | |
| Technician + assistant + data preparation and control operator + employee | 10 (5.9) | 0 (0.0) | |
| Doctor | 8 (4.7) | 0 (0.0) | |
| Health officer | 6 (3.6) | 0 (0.0) | |
| Nurse | 2 (1.2) | 0 (0.0) | |

‡n (%)
*Pearson Chi-square, Fisher's exact, or Fisher–Freeman–Halton test.

and the patients with whom they had contact. As seen in this study, although 46 (20.6%) healthcare workers contracted COVID-19 before the vaccination program was initiated, after receiving 2 doses of the vaccine, only 8 (4.5%) healthcare workers contracted the virus. This notable difference suggests that immunization reduced COVID-19 regardless of the type of vaccine. In light of increased exposure risks and vaccine availability, our results show that 93.8% of participants had received the COVID-19 vaccine at the time of this study. When compared to previous studies,[11,12] such as one from Israel which found that 39% of nurses and 22% of doctors intended to reject the COVID-19 vaccination, and another reported rejection rates of 35.5% among nurses and 39.9% among assistant nurses in France, during a time when vaccine rejection and hesitancy were concerns, these rates seem extremely high. Vaccination of healthcare personnel is also known to potentially reduce indirect harm, such as spread in hospitals, including to non-COVID-19 patients.[13]

The presence of a previous diagnosis of COVID-19 was a protective factor against reinfections.[14] Studies in Denmark and Qatar have indicated that a previous COVID-19 infection can provide protection against a new infection of up to 78.8% and 95%, respectively.[15,16] Therefore, we excluded 46 individuals with pre-vaccine COVID-19 infection in making comparisons.

The most important finding of this study is that none of the emergency ambulance service workers was hospitalized. Consequently, we could not evaluate severity by whether the employees with COVID-19 during the pre- and post-vaccination periods required hospitalization or intensive care. Older age and being male are known to increase the risk for severe COVID-19 infection.[17-19] However, in this study, perhaps due to the small sample size, no significant difference in age and gender was found among the healthcare workers who did and did




| | Mar.20 | Apr.20 | May.20 | Jun.20 | Jul.20 | Aug.20 | Sep.20 | Oct.20 | Nov.20 | Dec.20 | Jan.21 | Feb.21 | Mar.21 | Apr.21 | May.21 | Jun.21 | Jul.21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| suspect | 274 | 983 | 400 | 342 | 510 | 1126 | 2057 | 1366 | 2152 | 1331 | 440 | 253 | 608 | 1445 | 632 | 369 | 368 |
| certain | 6 | 145 | 188 | 96 | 344 | 892 | 1803 | 1314 | 2521 | 1447 | 388 | 152 | 497 | 1628 | 514 | 270 | 322 |
| cov-19 | 280 | 1128 | 588 | 438 | 854 | 2018 | 3860 | 2680 | 4673 | 2778 | 828 | 405 | 1105 | 3073 | 1146 | 639 | 690 |
| non-covid | 2500 | 2377 | 2331 | 2612 | 2770 | 2611 | 2041 | 1898 | 1703 | 1684 | 1714 | 1651 | 1804 | 1855 | 2348 | 2572 | 3169 |
| total | 2780 | 3505 | 2919 | 3050 | 3624 | 4629 | 5901 | 4578 | 6376 | 4462 | 2542 | 2056 | 2909 | 4928 | 3494 | 3211 | 3859 |

**Figure 1.** Total incidence of coronavirus disease (COVID) and non-COVID cases of patients transported by ambulance service in 112 provinces of Erzincan. *This chart has been prepared by taking data from the Emergency Health Automation System information system.

not contract COVID-19 before and after the vaccination program.

Emergency ambulance service workers have different roles; some take an active role in patient examination, treatment, and transfer, while some organize the work without seeing any patients. This study aimed to investigate whether these 2 groups differed in COVID-19 diagnoses before and after vaccination. No significant differences were found between COVID-19-positive and negative healthcare workers concerning their roles in COVID-19-positive patient transfers (whether active or passive) before and after the vaccination program. Robles-Perez et al.[20] reported that compared to administrative workers, ambulance personnel, social workers, patient transporters, and nurses faced a higher risk of infection after adjusting for age and gender. Conversely, in this study, the incidence of COVID-19 was higher among personnel working in auxiliary services (technicians, assistants, data preparation and control operators, employees) before the vaccination program began. This may be due to the higher rate of personal protective equipment usage among frontline healthcare workers.[14] As it was not possible to transport or have contact with patients without wearing such equipment, including surgical masks and eye protection, and taking other contact precautions.

In conclusion, this study, which is one of the few studies involving emergency ambulance service workers, is informative about COVID-19 infections in the pre- and post-vaccine periods and provides a guide for more comprehensive studies. More detailed and multi-center studies are needed for this occupational group, which remained constantly active while the stay-at-home order was in place.

## Limitations

This study had several limitations. Most importantly, the number of participants was relatively low, because the study focused solely on ambulance workers in one province. In addition, antibody tests could not be done owing to financial limitations, and the types of vaccines administered could not be assessed. Finally, as no employees with COVID-19 were hospitalized, it was not possible to evaluate severity by the requirement for hospitalization or intensive care.

**Ethics Committee Approval:** This study was found to be ethically appropriate with the decision of Erzincan Binali Yıldırım University Clinical Research Ethics Committee (Date: January 10, 2022, Number: E-21142744-804.99-138727). An appropriate opinion was also received from the Scientific Research Platform of the T.C. Ministry of Health, General Directorate of Health Services.

**Informed Consent:** Written informed consent was obtained from the personnel participating in this study.

**Peer-review:** Externally peer-reviewed.

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**Declaration of Interests:** The author declared that there is no competing interest.

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