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Transmission and Clinical Characteristic of COVID-19 in Healthcare Workers: Cross-sectional Study

Sağlık Çalışanlarında COVID-19 Bulaşı ve Klinik Özellikleri: Kesitsel Çalışma

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The study was presented at the ESCMID Conference on Coronavirus Disease (ECCVID) which took place online, 23-25 September 2020.

ABSTRACT Objective: Frontline healthcare workers (HCW) exposed to coronavirus disease-2019 (COVID-19) patients at their work environment are at a higher risk of acquiring the disease. The aim of this study was to research the COVID-19 risks due to the occupational exposure of HCW and the clinical characteristics of the affected. **Material and Methods:** In this retrospective study, HCW, employed by The Ümraniye Research and Training Hospital, who were diagnosed with COVID-19 between 20th March 2020 to 20th May 2020 were analysed. **Results:** A total of 128 (3.8%) HCW were diagnosed with COVID-19. Most of the infected HCW were medical staff (34%), nurses (24%), physicians (22%) and staff with no patient contact (20%). Fifty-six percent of the infected HCW were working in COVID-19 wards and outpatient clinics. Twenty-nine percent acquired the infection in hospital from an index patient and 32% of them from an infected HCW. The highest transmission was during the sharing of the same environment (53%) like offices. Thirteen per cent of the HCW took the virus during examination or treatment, 31% of the individuals were unaware of the transmission. The number of the infected HCW was higher during the beginning of the outbreak in Turkey. The symptomatic cases were more (88%) than the asymptomatic cases (12%). A total of 28 (22%) HCW were hospitalised and only 4% of the cases were severe. **Conclusion:** The asymptomatic COVID-19 carrying HCW are to be considered as the source of the spread of the disease among their colleagues. Stricter measures should be implemented to prevent in-hospital transmission.

Keywords: Healthcare workers; coronavirus; transmission

ÖZET Amaç: Sağlık çalışanlarının koronavirüs hastalığı-2019'a [coronavirus disease-2019 (COVID-19)] yakalanma riskleri, hastalara ön safhada maruz kaldıklarından dolayı fazladır. Bu çalışmada, sağlık çalışanlarının mesleki maruziyetine bağlı COVID-19 risklerini ve etkilenenlerin klinik özelliklerini araştırmak amaçlanmıştır. **Gereç ve Yöntemler:** Bu retrospektif çalışmada, 20 Mart-20 Mayıs 2020 tarihleri arasında Ümraniye Eğitim ve Araştırma Hastanesi'nde çalışan COVID-19 teşhisi konulan sağlık sektörü çalışanları analiz edilmiştir. **Bulgular:** Toplam 128 (3,8%) sağlık çalışanı COVID-19 tanısı almıştır. Enfekte olan sağlık çalışanlarının %34'ü sağlık personeli, %24'ü hemşire, %22'si doktor ve %20'si hasta teması olmayan personeldi. Enfekte sağlık çalışanlarının %56'sı COVID-19 servis ve ayaktan tedavi kliniklerinde çalışıyordu. Sağlık çalışanlarının %29'u hastanede enfeksiyonu bir indeks hastadan ve %32'si enfekte bir sağlık çalışanından almıştır. En yüksek bulaşma, ofisler gibi aynı ortamın paylaşılması sırasında gerçekleşti (%53). Sağlık çalışanlarının %13'ü virüsü muayene veya tedavi sırasında alırken, %31'i bulaşmanın farkında değildi. Semptomatik vakalar (%88) asemptomatik vakalardan (%12) daha fazlaydı. Toplam 28 (%22) sağlık çalışanı hastaneye yatırılarak tedavi edildi, vakaların sadece %4'ü ağırdı. **Sonuç:** Asemptomatik COVID-19 taşıyıcısı olan sağlık çalışanlarının, hastalığın kaynağı olarak meslektaşları arasında yayılmasında sorumlu olduğu kanısına varılmıştır. COVID-19'un hastane içi bulaşını önlemek için daha sıkı önlemler alınmalıdır.

Anahtar Kelimeler: Sağlık çalışanı; koronavirüs; bulaş

Coronavirus disease-2019 (COVID-19) emerged in China around December 2019 and then spread rapidly around the world.[1] The outbreak was declared by the World Health Organization as a pandemic on March the 11th 2020. At that very same date the first patient with COVID-19 was confirmed in Turkey. This disease is mainly transmitted through respiratory droplets.[2] Asymptomatic people can spread this infection since they carry this virus in their respiratory secretion.[3] Healthcare workers (HCW) at the frontline who play the most essential role in fighting with COVID-19 face a high risk of contracting this disease.

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Infected HCW may also cause secondary transmissions to patients, their family members and the community. Therefore, it is important to investigate the infection risks and the clinical characteristics of HCW diagnosed with COVID-19. The aim of this study was to research the COVID-19 risks due to the occupational exposure of HCW and the clinical characteristics of the affected.

MATERIAL AND METHODS

In this study, HCW, employed by The Ümraniye Research and Training Hospital, who were diagnosed with COVID-19 between 20th March to 20th May 2020 were analysed retrospectively. Diagnosis was based on severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) polymerase chain reaction (PCR) positive test results and typical radiological findings (bilateral and multifocal ground-glass opacities, peribronchovascular thickening, vascular dilatations and thin reticulations in the lungs were considered as typical torax computed tomography findings of COVID-19 pneumonia).

We obtained the data from the medical records of our hospital. Then, we directed a questionnaire through direct phone interviews to the respecting HCW. The mode of exposure, the place of exposure, the source of transmission and the demographic information were retrospectively collected through a structured questionnaire. Additionally, clinical, radiological and laboratory information were collected from our hospital's medical database.

The study was conducted in accordance with the principles of the Declaration of Helsinki. The ethics committee of the Ümraniye Research and Training Hospital at the Health Sciences University of Turkey approved this study (Ref. No.B.10.1.THK.4. 34. H.GP.0.01/212, Date: 28.05.2020). Informed consent was obtained from the patients. Approval for the study was obtained from the Ministry of Health.

STATISTICAL ANALYSIS

In this study, we used the IBM Statistical Package for the Social Sciences (SPSS), Windows 21.0 for the analysis of our data. Descriptive (mean, standard deviation, frequency) statistical methods were used while evaluating the study data.

RESULTS

Our premises, the Ümraniye Research and Training Hospital is a large tertiary hospital with 3332 staff on the Anatolian side of İstanbul. A total of 128 (3.8%) HCW among our staff were diagnosed with COVID-19 between March the 20th and May the 20th 2020.

The number of cases according to the reported dates is shown in a graph, Figure 1. Overall, 82 (64%) of those HCW with COVID-19 were women, of a median age of 32 (20-57) years. Most of the infected HCW were medical staff (44.34%), nurses (31 24%) and physicians (28.22%). The remaining 25 (20%) were staff with no patient contact. Seventy-two (56%) of the infected HCW were working in COVID

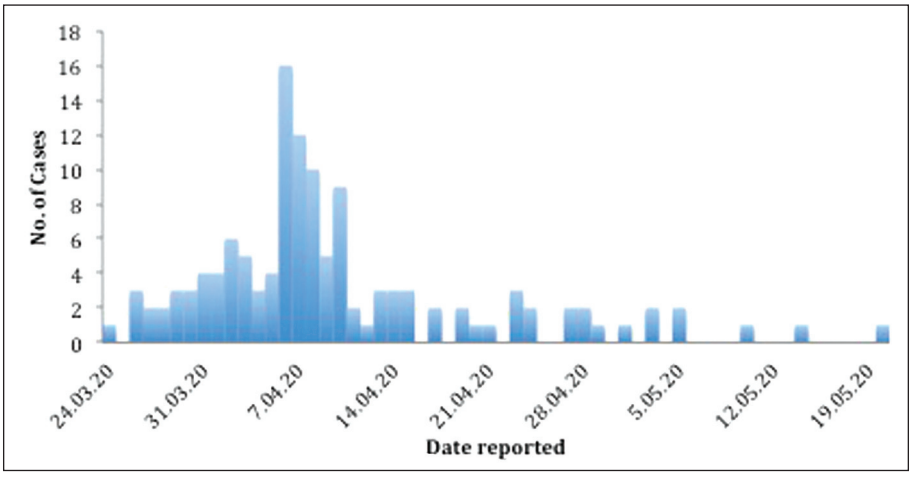

FIGURE 1: The number of the healthcare workers with coronavirus disease-2019 according to the reported date.

wards and outpatient clinics. Most of the HCW (93.73%) did not have any chronic underling diseases (Table 1).

All of the 128 patients (HCW) were tested for the SARS-CoV-2 nucleic acid, 105 of them were positive. The symptomatic cases were more (112.88%) than the asymptomatic cases (16.12%). Fever (22.17%) and shortness of breath (14.11%) were the most common symptoms. The percentage of the patients presented with pneumonia was 46%. A total of 28 (22%) of the patients were hospitalized. Only one of them was admitted to intensive care unit and none of them died. Most of the patients were treated with hydroxychloroquine [123 (97%)], only 5 (4%) of the individuals were treated with favipiravir. The number of the patients who received tocilizumab and corticosteroid was 2 and convalescent plasma was administered to only 1 patient. Three of the HCW received psychiatric consultations. Two of the HCW had taken hydroxychloroquine for pre-exposure prophylaxis and 7 of them took hydroxychloroquine for post-exposure prophylaxis. Clinical characteristics of HCW diagnosed with COVID-19 were listed at Table 1.

Sixteen (12.5%) of the individuals declared that they acquired the infection from the community. Thirty-seven (29%) of them acquired the infection in our hospital from patients and a further 41 (32%) of them acquired the infection from fellow HCW. Thirty-four (26.5%) of the infected HCW did not know the source of their infection.

The highest rate of transmission (68.53%) happened while sharing the same environment (office). The number of HCW who got the virus during a medical examination or a medical treatment was 16 (13%). Fourty (31%) of the individuals were unaware of the mode of transmission (Table 1).

TABLE 1: Exposure information and characteristics of healthcare workers with coronavirus disease-2019.

	n=128 (%)
Female gender	82 (64)
Age	
Mean (SD)	34 (SD: 9)
Median (Minimum-maximum)	32 (20-57)
Professions	
Physicians	28 (22)
Nurses	31 (24)
Medical staff	44 (34)
Non medical staff (with no patient contact)	25 (20)
Mean duration of work (SD)	7.8 (SD: 7.4)
Working in COVID wards and outpatient clinic	72 (56)
Comorbidities	
Hypertension	4 (3.1)
Diabetes	8 (6.3)
Chronic obstructive pulmonary disease	11 (8.6)
Chronic kidney disease	2 (1.6)
Rheumatoid arthritis	2 (1.6)
Any comorbidity	93 (73)
Exposure	
Community acquired	16 (12.5)
Hospital acquired (from patients)	37 (29)
Hospital acquired (from healthcare workers)	41 (32)
Unknown	34 (26.5)
Transmission	
Unaware	40 (31)
Examination/treatment	16 (13)
Sharing of the same environment	68 (53)
Nasopharyngeal sampling	1 (0.8)
Intubation	1 (0.8)
Extubation	1 (0.8)
Resuscitation	1 (0.8)
Prophylaxis	
Pre-exposure	2 (1.6)
Post-exposure	7 (5.5)
Symptoms	
Asymptomatic/symptomatic	16 (13)/112 (88)
Fever	22 (17)
Shortness of breath	14 (11)
Pneumonia	59 (46)
Hospitalization	28 (22)
ICU	1 (0.8)
Exitus	0 (0)
Computerized tomography compatible with COVID-19	56 (44)
Appropriate use of PPE	115 (90)
Reasons of inappropriate PPE	
Personal ignorance	9 (7)
Lack of material	3 (2)
Ineffective material	1 (0.8)
Treatment	
Hydroxychloroquine	124 (97)
Azithromycin	36 (28)
Favipiravir	5 (4)
Lopinavir/ritonavir	0 (0)
Tocilizumab	2 (1.5)
Anakinra	0 (0)
Corticosteroid	2 (1.6)
Convalescent plasma	1 (0.8)
Psychiatry consultation	3 (2.3)

COVID-19: Coronavirus disease-2019; SD: Standard deviation; ICU: İntensive care unit; PPE: Personal protective equipment.

DISCUSSION

HCW exposed to COVID-19 patients at their work environment are at a higher risk of acquiring the disease. Researches on the transmission of COVID-19 within health care settings are scarce.[4] According to China's National Health Institude, more than 3.300 health-care workers had been infected as of early

March 2020, according to China's local media, at least 22 of them had died by February 2020.[5] In Italy, at the beginning of the pandemic, 20% of the HCW dealing with COVID-19 were infected with the disease by February 2020.[6] The Ministry of Health reported that the number of healthcare workers who tested positive for CoV was more than 120 thousand, and 216 healthcare workers died due to COVID-19, by 9 December 2020.

In our study, out of 3.332 total HCW, 128 (3.8%) were diagnosed with COVID-19, 105 (3.2%) were confirmed by PCR test. In a recently published study from Turkey, researchers reported the rate of the infected HCW as 3.2% among 1,300 HCW.[7]

Our results indicated that HCW who worked in COVID-19 wards or outpatient clinics had a similar infection rate compared to HCW who worked in COVID-19 free areas. Our infection rates were observed as being different from China compared to where HCW were infected at a higher rate while working at COVID-19 areas in Chinese hospitals.[8] At the beginning of the pandemic, little was known about the disease and it was difficult to identify patients with COVID-19, from December 2019 in China and later on in much of the world until March 2020. The Turkish Ministry of Health thoroughly followed the international spread of the disease and was relatively prepared compared to China for the inevitable arrival of COVID-19 cases in Turkey. Prior to the identification of the first COVID-19 case in Turkey, all HCW had been informed about the disease and its means of transmission. Triage areas were determined, personal protective equipment (PPE) were supplied and the new rules about handling potential patients were thoroughly instructed to the HCW.

Our results indicated that the number of the infected HCW were proportional to the number of the infected patients in Turkey. The peak in the number of infected HCW happened on April 6th 2020. In parallel Turkey reached its highest number of daily COVID-19 infected patients on April 11th 2020. We noted that the number of the infected HCW was higher at the beginning of the outbreak. The sudden influx of a large number of infected patients inevitably increased the risk of exposure to COVID-19 of the HCW. The information gathered through infected HCW led to a decrease in the numbers of COVID-19 transmission among HCW.

The respective job categories/professions of the most infected HCW, were physicians (22%), nurses (24%), other medical staff (34%) and non-medical staff (20%).

All HCW were provided with, education on COVID-19 safety and sanitation, emphasizing the importance of hand hygiene, instructions on the use of PPE and workplaces safe distancing regulations. For the physicians, who were assigned to work in COVID-19 wards were provided additional daily briefing and instructions.

These daily briefings were proven to be effective on the low rate of transmission of COVID-19, among physicians.

The risk of severe COVID-19 is known to be higher among the elderly and among those who have underlying chronic health conditions.[9,10] The mean age of HCW diagnosed with COVID-19 was 34. Most of them (73%) did not have any other chronic underlying disease.

Approximately one third of patients hospitalized with SARS-CoV-2 infection meet criteria for acute respiratory distress syndrome.[11] COVID-19 is usually reported as mild cases, among HCW, but still severe symptoms and deaths are also reported.[8] Chu et al reported a higher rate (79%) of severe and critical cases from Wuhan.[12] We found out that 88% of the infected HCW had mild to moderate symptoms.

In a recent research, 84.5% of the infected HCW had mild to moderate disease.[13] Only 4% of the infected HCW cases were severe in our study. This was quite low compared to the reports of Li.[13] HCW can easily detect their symptoms at an earlier stage compared to the general population. This fact may explain the lower frequency of fever (17%) reported in our study. The younger mean age was the main reason behind the majority of mild to moderate symptoms in the HCW compared to elderly patients going through severe and critical COVID-19 infections.

Early diagnosis and treatment favored a better outcome for HCW patients with COVID-19.

Two patients were taking hydroxychloroquine as pre-exposure prophylaxis to prevent the transmission of COVID-19. Another 7 of them took hydroxychloroquine for post-exposure prophylaxis to prevent the transmission of COVID-19 after contact with a known COVID-19 case. Neither pre-exposure nor post-exposure prophylaxes got succeeded to prevent the HCW from COVID-19 in our study. The prophylactic use of hydroxychloroquine did not prevent the infection, as in Boulware's study.[14]

The highest transmission risks of COVID-19 for HCW are known as unprotected, prolonged patient contact, aerosol-generating procedures such as airway suctioning, intubation, extubation and resuscitation. HCW should wear full PPE, including eye protection, hair cover, disposable gown, gloves, and a N95 mask during these tasks.[15]

In our study 90% of the infected HCW used PPE appropriately. In the initial stages of the pandemic, some problems were encountered about the timely supply of PPE for HCW. Approximately 2% of the HCW were infected due to the lack of some PPE in this early period.

When we searched the source of the infection, 16 (12.5%) of the HCW had acquired COVID-19 from community and 34 (26.5%) could not identify the source of the infection. Fourty-one (32%) of the patients got the infection from other infected HCW. The remaining 37 (29%) declared a contact with an indexed patient.

COVID-19 is less virulent and has a longer incubation period, hence it has a significant number of asymptomatic carriers compared to SARS or the Middle East respiratory syndrome.[16]

These asymptomatic carriers could become a source of transmission.[13]

Most of the HCW (53%) were infected through sharing the same environment like offices or work places. This percentage is much higher compared to the HCW who got infection while handling COVID-19 patients (13%). This difference is due to COVID-19 infected HCW who were asymptomatic.

CONCLUSION

The asymptomatic COVID-19 carriers are responsible for the transmission of the disease among HCW. The early recognition and isolation for asymptomatic HCW with COVID-19 would minimize the transmission of the disease to other HCWs. Stricter measures and regulations should be adopted and applied in order to prevent the intra hospital transmission of the disease. The recommended PPE use should definitely be adhered to, by HCW, whether they are in the community or whether they are in their work places or whether they are in the COVID-19 wards, respectively.

LIMITATIONS

The low number of cases limits the ability to detect statistically significant differences in exposures and does not allow for multivariable analyses to adjust for potential confounding factors.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Mehtap Aydın;* ***Design:*** *Mehtap Aydın;* ***Control/Supervision:*** *Mehtap Aydın, Ayşe Serra Özel;* ***Data Collection and/or Processing:*** *Ayşe Serra Özel, Lütfiye Nilsun Altunal;* ***Analysis and/or Interpretation:*** *Mehtap aydın, Ayşe Serra Özel, Lütfiye Nilsun Altunal;* ***Literature Review:*** *Mehtap Aydın;* ***Writing the Article:*** *Mehtap Aydın;* ***Critical Review:*** *Ayşe Serra Özel, Lütfiye Nilsun Altunal;* ***References and Fundings:*** *Mehtap Aydın;* ***Materials:*** *Mehtap Aydın.*

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