

## ORIGINAL ARTICLE

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**Assessment of potential risk factors for SARS-CoV-2 infection among nurses in a health care setting in Turkey****✉Zerife Orhan<sup>1</sup>, ✉Arzu Kayis<sup>1</sup>, ✉Mehtap Sonmez<sup>2</sup>, ✉Burak Kucuk<sup>3</sup>,  
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**Abstract**

Healthcare workers are at greater risk because of the frequency of exposure to the virus SARS-CoV-2 infection (COVID-19) worldwide. This study aimed to determine the potential risk factors of nurses to COVID-19. This cross-sectional descriptive study was conducted on a population formed of nurses working in any type of health-care institution in Turkey. The research was conducted online, and the link for the questionnaire was delivered to nurses through the nursing services management of the healthcare institutions of the province. A total of 525 nurses participated voluntarily in the study. Of the total nurses included in the study, 44.6% stated that they had been in contact with a patient diagnosed with COVID-19. The nurses reported that after contact with a COVID-19 positive patient, they had a higher level of awareness and paid more attention to protective measures (personal protective equipment, hand hygiene, isolation). Nurses with chronic disease (OR;16.97); who do not trust the scientific board (OR;5.93); who do not receive biosecurity training (OR; 2.22) feel at risk. Also, it was determined that despite taking standard precautions, nurses felt more at risk than those who did not take standard precautions (OR; 2.77). COVID-19 is a highly infectious disease in the community and presents a great threat to healthcare workers. All nurses who do not have sufficient knowledge of COVID-19 and do not take the necessary precautions are at great risk of contracting the disease. To minimize the risk of infection, it is of vital importance that effective measures are taken both personally and institutionally and should be done further research.

**Keywords:** SARS-CoV-2, COVID-19, Nurses, Risk factors SARS-CoV-2, COVID-19, Nurses, Risk factors**Introduction**

With the diagnosis of the first case of infection with SARS-CoV-2 virus in Wuhan, China in November 2019, the disease spread rapidly throughout the world causing human deaths and interruptions to healthcare services [1]. In February 2020, the World Health Organization (WHO) named the disease COVID-19 and declared it to be a pandemic in March. Throughout the world, healthcare workers are at greater risk because of the frequency of exposure to the virus. In terms of high-risk occupations, as the numbers of cases increased with the emergence of the disease, so there was

seen to be an increase in the disease in healthcare personnel. With a 4-fold higher risk of exposure to the virus, healthcare personnel is accepted as the highest risk occupational group.

It has been determined that nurses are at risk of close contact in first, second, and third stage procedures [2]. As of May 2020, at least 90,000 healthcare workers were reported to have been diagnosed with COVID-19 and more than 260 had died [3]. Healthcare workers in Turkey are known to have died because of COVID-19 infection, and more than 7428 have been diagnosed as COVID-19 positive, and approximately 600 nurses were reported to have died due to COVID-19 [3,4]. However, there is still no global systematic record of the number of nurses and other HCWs who have contracted or died from the disease. According to the International Council of Nurses, (14 August 2020), more than 20.7 million people had been infected with COVID-19, resulting in 750,000 deaths worldwide [5].

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This study aimed to determine the potential risk factors of nurses for COVID-19 infection.

## Material and Methods

### Study design and participants

This cross-sectional descriptive study was conducted on a study population formed of nurses working in any type of healthcare institution in Turkey. There is a total of 149,112 nurses registered in Turkey [6]. Using the universal sampling method, the minimum sample size was calculated to be 384 at a 95% confidence interval and 0.05 error. A total of 525 *voluntary* nurses were included in the study. All were volunteers and there were no restrictions in respect of the hospital or unit worked in.

### Data collection

The study data were collected using a questionnaire prepared by the researchers *between 28 April and 28 June 2020*. This questionnaire was formed with the benefit of a literature scan and the WHO "Protocol for the assessment of potential risk factors for SARS-CoV-2 infection among healthcare workers in a healthcare setting" [7].

The preliminary testing of the questionnaire was conducted with 20 nurses working in district hospitals. The data form included socio-demographic variables and status of contact by the nurses with patients diagnosed with COVID-19, the duration of contact, the proximity of contact, the hospital unit in which the nurse worked, and duration of professional experience. Questions were also included to determine the level of knowledge of the nurses about COVID-19 and protective measures, and compliance with precautions and hand hygiene. The research was conducted online, and the link for the questionnaire was delivered to nurses through the nursing services management of the healthcare institutions of the provinces where the study was applied.

### Data analyses

Data obtained in the study were analyzed statistically using SPSS vn. 22.0 software. Data were reported as number and percentage. Analysis of the status of caring for patients diagnosed with COVID-19 with some independent variables was made with the Chi-square test. Multiple regression analysis *showed* the association between risk perception and some variables. Data were accepted as statistically significant in a 95% confidence interval with a margin of error of 0.05.

## Results

The demographic characteristics of the nurses in the study are shown in Table 1. Of the total group of nurses, 76.4% were female, 31.0% were in the 25-30 years age range, 54.1% were married, 53.7% had an educational level of high school, and 48.2% had professional experience of  $\geq 7$  years. Most of the respondents worked at a state hospital (44.6%) followed by a university hospital and private hospital. The units where they worked were reported to be intensive care by 28.8%, medical/surgical wards by 27%, and the Emergency Department (ED) by 13%.

About half of the total nurses included in the study stated that they had been in contact with a patient diagnosed with COVID-19. The nurses caring for COVID-19 patients comprised 54% females and 46% males. More the half of nurses were educated to the high

school level, and 51.6% had been working for 3-5 years. Most of the nurses who contact COVID-19 patients were working in a state hospital and inpatient clinics and emergency services ( $p < 0.05$ ).

The data relating to the level of knowledge of the nurses in the study about the COVID-19 pandemic are shown in Table 2. Of the total nurses, 82.3% had been informed about COVID-19 and 87.6% about the standard precautions by the SARS-CoV-2 committee. The training received by 63.6% of the respondents was less than 2 hours in total. The healthcare system of Turkey was trusted by 64% in the context of dealing with SARS-CoV-2, the Science Board was trusted by 56.2%, and 38.1% of the nurses in the study considered the testing and algorithms to be sufficient. Of the total group, 72.2% thought they had sufficient knowledge about SARS-CoV-2. While 43.2% felt partially safe in the units where they worked, 25.5% did not feel safe at work. COVID-19 was thought to be more dangerous than other infections by 62.7% of the nurses.

The data relating to the exposure of the nurses to COVID-19-positive patients are shown in Table 3. Contact with a COVID-19-positive patient was reported as 4 times or more by 87% of the nurses, 78.3% had been in close contact ( $< 1$  meter) since admittance of the patient to the unit, the close contact was reported to have lasted 5-15 minutes by 42.3%, and 56.4% stated that they had not had face-to-face contact of  $> 15$  minutes. Direct contact with materials of a COVID-19-positive patient was reported by 52.6% of the nurses and contact with bodily fluids of the patient by 27.5%. A diagnosis of COVID-19 had been received by personnel in the unit where they worked was reported by 31.6% of the nurses.

Data related to compliance with the precautions taken against the COVID-19 pandemic in the healthcare institutions are shown in Table 4. Of the nurses in the study, 66.3% stated that they always wore personal protective equipment (PPE) according to the risk evaluation. No problems had been experienced in obtaining PPE by 53.1%, 50.7% stated that the sterilization/disinfection rules were followed in the unit where they worked, 44% thought that the biosecurity precautions were partially sufficient in the unit, 79.6% stated that they knew what to do if there were an accident, 39.8% had received biosecurity training, and 76.4% stated that there was a procedure for the disposal of infectious waste. Following contact with a patient, 98.7% of the nurses stated that they removed gloves, and PPE was worn by 86.9% before contact with a COVID-19-positive patient and by 93.9% when in close contact. Social distancing rules were adhered to by 63.2% when eating meals at work, 50% were self-quarantining in their own home, and 78.9% had not been tested for SARS-CoV-2.

Data related to compliance of the nurses with the precautions related to hand hygiene are shown in Table 5. Before contact with a patient, 60.1% of the nurses stated that they used alcohol-based hand antiseptic, and after contact with a patient, 56.3% used soap and water. The general rate of compliance with hand hygiene was 67%. There was usually compliance with hand hygiene by 69.7% of the nurses before cleaning procedures, by 66.7% before touching a COVID-19-positive patient, by 83.4% after touching, by 88.4% after exposure to bodily fluids of a COVID-19-positive patient, and by 74.9% after touching the surroundings of such a patient. The rate of hand hygiene compliance before contact with any patient was usually 75.1%, and 87.9% after contact with any

patient. General compliance with standard precautions while in contact with any patient was reported as 73.9%.

Nurses with chronic disease (OR;16.97); who do not trust the

scientific board (OR;5.93); who do not receive biosecurity training (OR;2.22) feel at risky. Also, it was determined that despite taking standard precautions, nurses felt more at risk than those who did not take standard precautions (OR; 2.77).

**Table 1.** Comparison of some characteristics of the nurses and the status of contact with a patient diagnosed with COVID-19

| Characteristics                                       | Total |       | Status of contact with patients with confirmed Diagnosis of COVID-19 |      |     |       | X/p*         |
|-------------------------------------------------------|-------|-------|----------------------------------------------------------------------|------|-----|-------|--------------|
|                                                       |       |       | Yes                                                                  |      | No  |       |              |
| Age (years)                                           | n     | %     | n                                                                    | %    | n   | %     | 0.847/838    |
| 18-24                                                 | 125   | 23.8  | 58                                                                   | 46.4 | 67  | 53.6  |              |
| 25-30                                                 | 163   | 31.0  | 71                                                                   | 43.6 | 92  | 56.4  |              |
| 31-40                                                 | 142   | 27.0  | 60                                                                   | 42.3 | 82  | 57.7  |              |
| 41+                                                   | 95    | 18.1  | 45                                                                   | 47.4 | 50  | 52.6  |              |
| Gender                                                |       |       |                                                                      |      |     |       | 0.128/0.399  |
| Female                                                | 401   | 76.4  | 177                                                                  | 44.1 | 224 | 55.9  |              |
| Male                                                  | 124   | 23.6  | 57                                                                   | 46.0 | 67  | 54.0  |              |
| Educational level                                     |       |       |                                                                      |      |     |       | 2.852/0.583  |
| Healthcare vocational high school                     | 117   | 22.3  | 49                                                                   | 41.9 | 68  | 58.1  |              |
| Associate degree                                      | 82    | 15.6  | 34                                                                   | 41.5 | 48  | 58.5  |              |
| Degree                                                | 282   | 53.7  | 132                                                                  | 46.8 | 150 | 53.2  |              |
| Master's degree                                       | 42    | 8.0   | 19                                                                   | 45.2 | 23  | 54.8  |              |
| Doctorate                                             | 2     | 0.4   | 0                                                                    | 0.0  | 2   | 100.0 |              |
| Marital status                                        |       |       |                                                                      |      |     |       | 0.399/0.293  |
| Married                                               | 284   | 54.1  | 123                                                                  | 43.3 | 161 | 56.7  |              |
| Single                                                | 241   | 44.0  | 111                                                                  | 46.1 | 130 | 53.9  |              |
| Smoking status                                        |       |       |                                                                      |      |     |       | 0.438/0.286  |
| Yes                                                   | 145   | 27.6  | 68                                                                   | 46.9 | 77  | 53.1  |              |
| No                                                    | 380   | 72.4  | 166                                                                  | 43.7 | 214 | 56.3  |              |
| Years of work                                         |       |       |                                                                      |      |     |       | 0.847/0.838  |
| 1-3 years                                             | 106   | 20.2  | 48                                                                   | 45.3 | 58  | 54.7  |              |
| 3-5 years                                             | 91    | 17.3  | 47                                                                   | 51.6 | 44  | 48.4  |              |
| 5-7 years                                             | 75    | 14.3  | 30                                                                   | 40.0 | 45  | 60.0  |              |
| 7+ years                                              | 253   | 48.2  | 109                                                                  | 43.1 | 144 | 56.9  |              |
| Hospital where employed                               |       |       |                                                                      |      |     |       | 14.306/0.006 |
| University hospital                                   | 140   | 26.7  | 55                                                                   | 39.3 | 85  | 60.7  |              |
| State hospital                                        | 234   | 44.6  | 123                                                                  | 52.6 | 111 | 47.4  |              |
| Private hospital                                      | 132   | 25.1  | 52                                                                   | 39.4 | 80  | 60.6  |              |
| Provincial/Local Health Authority                     | 5     | 1.0   | 2                                                                    | 40.0 | 3   | 60.0  |              |
| Other (old people's home, family health center, etc.) | 14    | 2.7   | 2                                                                    | 14.3 | 12  | 85.7  |              |
| Unit where working                                    |       |       |                                                                      |      |     |       | 35.970/0.000 |
| Emergency                                             | 68    | 13.0  | 37                                                                   | 54.4 | 31  | 45.6  |              |
| Inpatient Clinics                                     | 142   | 27.0  | 82                                                                   | 57.7 | 60  | 42.3  |              |
| Intensive Care                                        | 151   | 28.8  | 65                                                                   | 43.0 | 86  | 57.0  |              |
| Polyclinic                                            | 64    | 12.2  | 22                                                                   | 34.4 | 42  | 65.6  |              |
| Operating theatre                                     | 47    | 9.0   | 11                                                                   | 23.4 | 36  | 76.6  |              |
| Infection unit                                        | 34    | 6.5   | 16                                                                   | 47.1 | 18  | 52.9  |              |
| Other (administrative units, etc)                     | 19    | 3.6   | 1                                                                    | 5.3  | 18  | 94.7  |              |
| Total                                                 | 525   | 100.0 | 234                                                                  | 44.6 | 291 | 55.4  |              |

\*Chi-Square test p<0.05

**Table 2.** Data related to the level of knowledge of the nurses about the COVID-19 pandemic

| <b>Variables</b>                                                                                                                        |          |          |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------|----------|
| <b>Were you informed by the SARS-CoV-2committee?</b>                                                                                    | <b>n</b> | <b>%</b> |
| Yes                                                                                                                                     | 432      | 82.3     |
| No                                                                                                                                      | 93       | 17.7     |
| <b>Were you informed about standard precautions?</b>                                                                                    |          |          |
| Yes                                                                                                                                     | 460      | 87.6     |
| No                                                                                                                                      | 65       | 12.4     |
| <b>The total duration of the training you received</b>                                                                                  |          |          |
| <2 hours                                                                                                                                | 334      | 63.6     |
| 2 hours                                                                                                                                 | 68       | 13.0     |
| >2 hours                                                                                                                                | 123      | 23.4     |
| <b>Do you trust the Science Board?</b>                                                                                                  |          |          |
| Yes                                                                                                                                     | 295      | 56.2     |
| No                                                                                                                                      | 57       | 10.9     |
| Partially                                                                                                                               | 173      | 33.0     |
| <b>Do you trust the healthcare system in Turkey in respect of dealing with COVID-19?</b>                                                |          |          |
| Yes                                                                                                                                     | 336      | 64.0     |
| No                                                                                                                                      | 22       | 4.2      |
| Partially                                                                                                                               | 155      | 29.5     |
| I have no idea                                                                                                                          | 12       | 2.3      |
| <b>Do you think the testing method and algorithms for COVID-19 are sufficient?</b>                                                      |          |          |
| Yes                                                                                                                                     | 200      | 38.1     |
| No                                                                                                                                      | 182      | 34.7     |
| I have no idea                                                                                                                          | 143      | 27.2     |
| <b>Do you think you have enough information about COVID-19?</b>                                                                         |          |          |
| Yes                                                                                                                                     | 379      | 72.2     |
| No                                                                                                                                      | 146      | 27.8     |
| <b>Do you feel safe when working in your unit?</b>                                                                                      |          |          |
| Yes                                                                                                                                     | 164      | 31.2     |
| No                                                                                                                                      | 134      | 25.5     |
| Partially                                                                                                                               | 227      | 43.2     |
| <b>In respect of danger, do you see any difference between other infectious patients you have cared for and patients with COVID-19?</b> |          |          |
| COVID-19 is more dangerous                                                                                                              | 183      | 62.7     |
| There is no difference                                                                                                                  | 100      | 34.2     |
| Other infections are more dangerous                                                                                                     | 9        | 3.1      |

**Table 3.** Data related to exposure of the nurses to patients diagnosed with COVID-19

| <b>Variables</b>                                                                                      |          |          |
|-------------------------------------------------------------------------------------------------------|----------|----------|
| <b>How many times in total have you been in contact with a patient diagnosed with COVID-19?</b>       | <b>n</b> | <b>%</b> |
| Once                                                                                                  | 24       | 4.6      |
| Twice                                                                                                 | 26       | 5.0      |
| 3 times                                                                                               | 18       | 3.4      |
| ≥ 4 times                                                                                             | 457      | 87.0     |
| <b>Since admittance to your unit have you been in close contact (&lt;1 meter) with the patient?</b>   |          |          |
| Yes                                                                                                   | 209      | 78.3     |
| No                                                                                                    | 58       | 21.7     |
| <b>How long have you been in close contact with a COVID-19- positive patient when providing care?</b> |          |          |
| <5 minutes                                                                                            | 83       | 37.4     |
| 5-15 minutes                                                                                          | 94       | 42.3     |
| > 15 minutes                                                                                          | 45       | 20.3     |
| <b>Have you been in face-to-face contact for more than 15 minutes?</b>                                |          |          |
| Yes                                                                                                   | 99       | 43.6     |
| No                                                                                                    | 128      | 56.4     |
| <b>Have you been in direct contact with material from a COVID-19- positive patient?</b>               |          |          |
| Yes                                                                                                   | 142      | 52.6     |
| No                                                                                                    | 128      | 47.4     |
| <b>Have you been in contact with the body fluids of the patient?</b>                                  |          |          |
| Yes                                                                                                   | 83       | 27.5     |
| No                                                                                                    | 219      | 72.5     |
| <b>Have any of the personnel in the unit in which you work been diagnosed with COVID-19?</b>          |          |          |
| Yes                                                                                                   | 166      | 31.6     |
| No                                                                                                    | 306      | 58.3     |
| I don't know                                                                                          | 53       | 10.1     |

**Table 4.** Data related to compliance with the precautions taken against the COVID-19 pandemic

| Variables                                                                                       | n   | %    |
|-------------------------------------------------------------------------------------------------|-----|------|
| <b>Do you wear PPE* when working?</b>                                                           |     |      |
| Always according to the risk evaluation                                                         | 348 | 66.3 |
| Usually according to the risk evaluation                                                        | 137 | 26.1 |
| Sometimes                                                                                       | 21  | 4.0  |
| Occasionally                                                                                    | 19  | 3.6  |
| <b>Have you experienced problems obtaining PPE?</b>                                             |     |      |
| Yes                                                                                             | 101 | 19.2 |
| No                                                                                              | 279 | 53.1 |
| Sometimes                                                                                       | 145 | 27.6 |
| <b>Are the sterilization/disinfection rules followed in your unit?</b>                          |     |      |
| Yes                                                                                             | 266 | 50.7 |
| No                                                                                              | 79  | 15.0 |
| Partially                                                                                       | 180 | 34.3 |
| <b>Are the biosecurity precautions sufficient in your unit?</b>                                 |     |      |
| Yes                                                                                             | 184 | 35.0 |
| No                                                                                              | 110 | 21.0 |
| Partially                                                                                       | 231 | 44.0 |
| <b>Do you know what to do in case of an accident?</b>                                           |     |      |
| Yes                                                                                             | 418 | 79.6 |
| No                                                                                              | 30  | 5.7  |
| Partially                                                                                       | 77  | 14.7 |
| <b>Have you received biosecurity training?</b>                                                  |     |      |
| Yes                                                                                             | 209 | 39.8 |
| No                                                                                              | 202 | 38.5 |
| Partially                                                                                       | 114 | 21.7 |
| <b>Is there a procedure in your unit for the disposal of infectious waste?</b>                  |     |      |
| Yes, and it is followed                                                                         | 401 | 76.4 |
| Yes, but it is not followed                                                                     | 11  | 2.1  |
| Yes, but it is only partially followed                                                          | 83  | 15.8 |
| There is no procedure                                                                           | 30  | 5.7  |
| <b>If you wear gloves, do you remove them after contact with a patient?</b>                     |     |      |
| Yes                                                                                             | 309 | 98.7 |
| No                                                                                              | 3   | 1.0  |
| It varies according to workload intensity                                                       | 1   | 0.3  |
| <b>Do you wear PPE before making contact with a patient?</b>                                    |     |      |
| Yes                                                                                             | 133 | 86.9 |
| No                                                                                              | 20  | 13.1 |
| <b>Have you worn PPE when you have been in close contact with a COVID-19-positive patient?</b>  |     |      |
| Yes                                                                                             | 201 | 93.9 |
| No                                                                                              | 13  | 6.1  |
| <b>Do you adhere to social distancing rules when eating meals at work?</b>                      |     |      |
| Yes                                                                                             | 332 | 63.2 |
| No                                                                                              | 193 | 36.8 |
| <b>Where have you been in quarantine outside the hospital?</b>                                  |     |      |
| Places especially assigned for quarantine (student halls of residence, hotel, guesthouse, etc.) | 32  | 10.6 |
| A floor of the hospital has been specifically assigned for us                                   | 2   | 0.7  |
| I am applying self-quarantine in my own home                                                    | 151 | 50   |
| I am going to and from home as normal continuing with daily life                                | 113 | 37.4 |
| Other (rented flat, friend's house, etc.)                                                       | 4   | 1.3  |
| <b>Have you been tested for SARS-CoV-2?</b>                                                     |     |      |
| Yes                                                                                             | 111 | 21.1 |
| No                                                                                              | 414 | 78.9 |

\* PPE: personal protective equipment

**Table 5.** Compliance of the nurses with hand hygiene

| Precautions                                                                                     | Usually   | Often     | Sometimes | Occasionally |
|-------------------------------------------------------------------------------------------------|-----------|-----------|-----------|--------------|
|                                                                                                 | n(%)      | n(%)      | n(%)      | n(%)         |
| Compliance with general hand hygiene                                                            | 352(67.0) | 158(30.1) | 11(2.1)   | 4(0.8)       |
| Compliance with hand hygiene before cleaning procedures                                         | 366(69.7) | 143(27.2) | 11(2.1)   | 5(1.0)       |
| Compliance with hand hygiene before touching a COVID-19-positive patient                        | 350(66.7) | 146(27.8) | 20(3.8)   | 9(1.7)       |
| Compliance with hand hygiene after touching a COVID-19-positive patient                         | 438(83.4) | 83(15.8)  | 2(0.4)    | 2(0.4)       |
| Compliance with hand hygiene after exposure to the bodily fluids of a COVID-19-positive patient | 464(88.4) | 54(10.3)  | 4(0.8)    | 3(0.6)       |
| Compliance with hand hygiene after touching the surroundings of a COVID-19-positive patient     | 393(74.9) | 113(21.5) | 15(2.9)   | 4(0.8)       |
| Have you applied hand hygiene before coming into contact with any patient?                      | 232(75.1) | 58(18.8)  | 11(3.6)   | 8(2.6)       |
| Have you applied hand hygiene after coming into contact with any patient?                       | 270(87.9) | 35(11.4)  | 1(0.3)    | 1(0.3)       |
| Compliance with standard precautions when in contact with any patient                           | 388(73.9) | 130(24.8) | 6(1.1)    | 1(0.2)       |

**Table 6.** Multiple regression analysis showing the association between risk perception and some variables (reference category: Risky)

| Factor                             | $\beta$ | SE <sup>a</sup> | df <sup>b</sup> | p-value | OR <sup>c</sup> | 95% CI <sup>d</sup> |
|------------------------------------|---------|-----------------|-----------------|---------|-----------------|---------------------|
| Working Unit (Intensive Cares)     | 2.939   | 1.30            | 1               | 0.024   | 18.89           | 1.46–243.33         |
| Chronic Disease Status (Yes)       | 2.832   | 1.18            | 1               | 0.017   | 16.97           | 1.66–173.38         |
| Standard Precautions (Yes)         | 1.021   | 0.47            | 1               | 0.031   | 2.770           | 1.09-7.010          |
| Trust to Science Board (No)        | 1.780   | 0.62            | 1               | 0.004   | 5.932           | 1.73-20.231         |
| Received Biosecurity training (No) | 0.800   | 0.400           | 1               | 0.046   | 2.226           | 0.76-3.770          |

SE: Standard Error; df: degree of freedom; OR: odds ratio; CI: confidence interval

## Discussion

The COVID-19 infection is a chaotic issue for healthcare personnel. The worldwide is dealing with the COVID-19 pandemic. Mostly, healthcare professionals who were come face to face with COVID-19. In worldwide, a series of precautions and restrictions have been introduced, both to protect healthcare workers and to prevent the spread of the disease [8,9]. But nurses who do not have sufficient knowledge of SARS-CoV-2 and who do not take the necessary precautions are at great risk in this study. Whereas nurses are in the front-line of healthcare-related to prevention and control of infections [10,11]. The WHO reported that during the SARS outbreak, there were 8096 cases and 774 (9.6%) deaths, with healthcare workers comprising 1706 (21%) of the cases [12]. It has been reported that in China alone almost 3000 healthcare workers contracted COVID-19, and 22 died [13]. The results of the current study showed that 31.6% of the nurses in the study reported that personnel in the units where they worked had been diagnosed with COVID-19, and almost half (44.6%) had been in contact with a COVID-19-positive patient.

A previous study showed a higher risk of COVID-19 infection in

healthcare workers as age increases [14]. In the current study, the status of contact with COVID-19-positive patients was compared with socio-demographic characteristics, and it was seen that 47.4% of the nurses caring for COVID-19 patients were aged  $\geq 41$  years. Diminished immunity and an increase in chronic diseases at an older age may be the reason for this increased risk. In a previous study, it was reported that the knowledge and experience of healthcare personnel on the subjects of disasters, decision-making, and personnel and resource management are of great importance at times of great stress [14]. In another study, it was stated that the component of experience from practice rather than theory was the key factor in developing competence and critical thinking [15]. Although 46.8% of the nurses in the current study had a university degree, the clinical experience of 51.6% was short (3-5 years). Nurses with less clinical experience demonstrate higher risk behavior, causing them to be exposed to more professional risks.

As a consequence of the damage caused to the lungs by cigarette smoking, those who smoke are more susceptible to both bacterial and viral lung infections. Therefore, the possibility of contracting influenza has been reported to be 34% greater for smokers than non-smokers [16]. Han et al showed that cigarette smoking was

always associated with a risk of hospitalization following influenza infection [17]. In various studies, there has been a noticeable link between smoking and COVID-19 [18,19]. In the current study, almost half of the nurses who smoked (46.9%) had been in contact with a COVID-19-positive patient. Studies have also shown that there could be a gender predisposition and that males tend to be affected more by the SARS-CoV-2 [20,21]. In the current study, of the nurses in contact with COVID-19-positive patients, 46% were male.

In a study of nurses in Japan, 60% expressed job dissatisfaction [22]. In the current study, 54.4% of those who were not satisfied with the profession had been in contact with COVID-19-positive patients. When the hospitals and units within the hospitals where the nurses worked were evaluated, 52.6% worked in state hospitals. This higher rate could be attributed to there being more state hospitals and that they have a higher patient capacity than other hospitals.

As nurses play an important role in improving healthcare standards, they must update their theoretical and practical knowledge in this area. In-service training is an effective means of updating the professional knowledge and skills of personnel and ensuring various functions and responsibilities [23]. In another study, 64.63% of nurses stated that they had received training in their hospitals related to COVID-19 [24]. In the current study, 82.3% of the nurses stated that they had been informed about COVID-19 and 87.6% about the standard precautions. However, the training received was reported by 63.6% to have lasted less than 2 hours in total. More than half of the respondents in this study trusted the Science Board and the healthcare system in Turkey. However, only 38.1% thought that the COVID-19 testing method and algorithms were sufficient. Nurses were reported to have extensive knowledge of SARS-CoV-2 and COVID-19 disease at the rate of 56.5% in a study by Nemati et al, at 89.51% by Shi et al, and at 89% by Zhang et al. In the current study, 72.2% of the nurses considered that they had sufficient knowledge of the virus and the disease. [24–26]. Lack of knowledge can increase the risk of infection and therefore in-service training should be increased and improved

In a 2005 study in Japan by Imai et al, it was determined that despite not having experienced SARS cases in 2003, healthcare workers felt unsafe in their place of work compared to those in neighboring countries [27]. Similarly, in the current study, while 43.2% of the nurses felt partially safe in the units where they worked, 25.5% did not feel safe. Previous studies of healthcare workers and other infectious agents have emphasized that the profession and the unit in which they work are associated with mental health effects [28,29]. Although infectious diseases such as hepatitis viruses and HIV have been known to cause fatal diseases for many years, healthcare personnel in various areas have thought that their risk of exposure was low provided they were careful about contact with bodily fluids [27]. However, SARS-CoV-2 poses a greater risk of infection for healthcare personnel because of the respiratory spread and potentially asymptomatic course [30]. COVID-19 was stated to be more dangerous than other infections by 62.7% of the current study respondents. As a result of this perceived danger, it is to be expected that the nurses did not feel safe at work.

The WHO has published guidelines for the protection of healthcare workers caring for COVID-19 patients, recommending

precautions to be taken against contact and respiratory droplets [31]. It is recommended to keep a distance of at least 1 meter from an infected patient as a precaution against droplets, in the belief that large droplets can spread a maximum of 1 meter horizontally [32]. Exposure to SARS-CoV-2 has been defined by the WHO as close contact (within 1 meter or for more than 15 minutes) with a patient with a possible, suspected, or confirmed diagnosis of COVID-19 [7]. In the current study, 87% of the nurses reported 4 or more contacts with a COVID-19-positive patient.

From the time of admission to the unit, 78.3% of the nurses had been in close contact (< 1 meter) with the patient, and of these 42.3% reported that the close contact had lasted 5-15 minutes and 56.4% that face-to-face contact had been longer than 15 minutes. In the first guidelines published by the Centre for Disease Control (CDC) in the USA, it is recommended that the patient wears a mask to control the source [33]. With the patient wearing a mask as recommended by the CDC, and the healthcare worker wearing PPE and maintaining a distance of 1 meter, the risk of infection to healthcare workers will be reduced to a minimum.

Viral respiratory tract infections are generally thought to be spread by contact with surfaces touched by an infected person or contact with fomites and surfaces on which droplets are containing the virus and which have remained there for days [34]. It has been proven that SARS-CoV can remain alive for up to 3 days in surrounding fomites. Healthcare workers can be infected via fomites and can therefore spread the infection to other patients and colleagues without even being aware of it. In Taiwan, a nosocomial SARS outbreak was determined to have occurred through fomite transmission after patients were admitted to the hospital, as was also the case in South Korea during the MERS outbreak [35,36]. In the current study, 52.6% of the nurses reported direct contact with materials of a COVID-19-positive patient, and 27.5% with the bodily fluids of a patient. Droplets can pass directly from an infected person to a person nearby. Therefore, frequent hand washing and maintaining a distance of at least 1 meter are accepted as the main preventative measures against infection [37]. In the current study, 98.7% of the nurses stated that they removed gloves after contact with a patient. Two-thirds of the nurses always wore PPE while working according to the risk evaluation, almost half wore PPE before contact with a COVID-19-positive patient, and 93.9% wore PPE when in close contact with a COVID-19-positive patient.

No problems were experienced obtaining PPE according to half the nurses. More than half the nurses in the current study stated that there was compliance with the sterilization/disinfection rules in the unit where they were working, they stated that they knew what to do in the event of an accident, and there was a procedure in the unit for the disposal of infectious waste. Fewer than half of the nurses had received biosecurity training and reported that the biosecurity precautions in their unit were partially sufficient.

Social distance aims to avoid contact with respiratory droplets. Therefore, there should be a distance of at least 1 meter between people [38]. More than half the nurses in the study stated that they observed social distancing rules when eating at work. Healthcare workers who have been in contact with COVID-19-positive patients may be asymptomatic carriers with the potential to infect other patients and colleagues. Therefore, isolation is

very important to prevent transmission [39]. In the current study, 50% of the nurses stated that outside the hospital they were self-quarantining at home.

The rate of usual compliance with general hand hygiene of the nurses in this study was the same as the rate of compliance with hand hygiene before touching a patient diagnosed with COVID-19. The rates of hand hygiene compliance before contact with a patient were seen to increase after touching a patient diagnosed with COVID-19, after exposure to bodily fluids, and after touching the surroundings of the patient. This showed that the nurses viewed the situations related to infection as dangerous and had high levels of awareness of SARS-CoV-2.

In this study, nurses with chronic disease, who do not trust the scientific board, who do not receive biosecurity training feel at risk. However, it was seen that despite taking standard precautions, nurses felt more at risk than those who did not take standard precautions. To overcome the difficulties associated with disease, it has been recommended that frequent handwashing with soap and water is sufficient. Disinfectants and soap are recommended by the WHO to reduce the spread of infection [40]. More than half of the nurses in the current study reported that they used alcohol-based hand antiseptic before contact with a patient and soap and water after contact.

## Conclusion

In conclusion, COVID-19 is a highly infectious disease and poses a very great threat to healthcare workers. Nurses who do not have sufficient knowledge of SARS-CoV-2 and who do not take the necessary precautions are at great risk. The limitations of this study were included only voluntary nurses and it was not known different institutional precautions Taking effective personal and institutional precautions is vital to minimize the risk of infection and should be done further research.

## Conflict of interests

*The authors declare that they have no competing interests.*

## Financial Disclosure

*All authors declare no financial support.*

## Ethical approval

*Approval for the study was granted by the KSU Clinical Research Ethics Committee (Date:13 May 2020; Decision No:15). In the context of the Helsinki Declaration, all the study participants provided informed consent for participation in the online research.*

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