A Serological Analysis of Covid19- Antibody Levels in Hospital Personnel: A Cross-sectional Study in Northeastern Iran

Sayyed Majid Sadrzadeh (MD)[1], Reza Khoshbakht (BSc) [2,3], Seyed Mohammad Mousavi (MD)[1], Elnaz Vafadar Moradi (MD)[1], Behrang Rezvani Kakhki (MD)[1], Mansureh Sadat Musavi (MD)[1], Mahdis Ghavidel (PhD)[4*]

[1] Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.
2 Department of Laboratory Sciences, School of Paramedical Sciences, Mashhad University of Medical Sciences, Mashhad, Iran.
[3] Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran.
[4] Shahid Hasheminejad Hospital, Mashhad University of Medical Sciences, Mashhad, Iran.

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ABSTRACT

Introduction: This study investigated the serum levels of Covid-19 IgM-IgG antibodies in three exposure groups in the Shahid Hasheminejad Hospital in Mashhad, Iran.

Methods: Between March 2020 and March 2021 ,170 serum samples were taken from hospital personnel. To determine the levels of COVID19- IgM-IgG antibodies, we used the ELISA method (Pishgaman kit). Results were categorized as negative if they were less than 0.9, borderline if they were between 0.9 and 1.1, and positive if they were greater than 1.1. We used SPSS version 26 to evaluate the data. The exposure groups were separated into low (first group), moderate (second group), and high-risk (third group) levels.

Results: 53 members of the 170 staff belonged to the first group, 51 to the second, and 66 to the third. There were 135 patients with negative IgG, 13 with IgG in the borderline range, and 22 with positive IgG. Furthermore, 9 individuals exhibited a positive IgM, while one had a borderline range IgM and 160 a negative IgM. In the first group, %56.6 of personnel reported cough, %5.9 of personnel in the second group had fever, and %24.2 of personnel in the third group experienced shortness of breath.

Conclusion: The findings from this research indicated that there was no clear association between working in wards with higher risks and increased IgG and IgM levels. However, the results did reveal that being in wards with a high number of COVID19- patients could result in more fever symptoms.

Introduction

The novel Coronavirus (Covid-19) has been named SARS-CoV-2 due to its similarity to the symptoms of SARS or acute respiratory syndrome (1,2). Interestingly, Covid-19 transmission occurs during the prodromal period, when those infected have only mild symptoms and continue with their usual activities, leading to its rapid spread (3). Moreover, confirmed cases of this disease in people not present at the first epicenter in Wuhan conclusively point to person-to-person transmission (4,5).

This is believed to occur mainly through direct contact or by breathing in respiratory droplets expelled by sneezing and coughing from an infected person. The average Covid-19 incubation period, according to the European Centre for

*Corresponding author: Mahdis Ghavidel ,
Shahid Hasheminejad Hospital, Mashhad University of Medical Sciences, Mashhad, Iran.
E-mail: ghavidelmd@mums.ac.ir
Tel: 989151581367

Disease Prevention and Control (ECDC), is 5.08 days, with a range of 1 to 14 days (6). The standard diagnostic test for Covid-19 is the RT-PCR test, and the serum levels of antibodies among different people are used to understand the level of immunity and to detect asymptomatic carriers (7). Identifying asymptomatic carriers is critical to prevent the potential transmission of the disease to healthy people and to people with underlying risk factors, in whom the disease can have fatal outcomes. Meanwhile, health personnel in contact with Covid-19 patients might display increased IgG antibody titer in their bodies, as carriers, without the appearance of clinical symptoms (8). As Covid-19 has spread across the world, it is necessary to understand what the symptoms of the disease are and whether close contact with the infected person can lead to increased antibody levels without causing clinical manifestations in the personnel. By recognizing the non-specific symptoms of the disease, we can diagnose it faster, allowing us to quarantine the affected person as quickly as possible to stop the chain of transmission (9). The purpose of this study was to investigate the levels of Covid-19-related IgM and IgG antibodies in three groups of personnel: the first group working in wards with direct contact to Covid-19 patients as the high-risk group, the second group of emergency ward personnel as the moderate-risk group, and the third group of employees working in wards with lowest contact to the Covid-19 patients as the low-risk group at Shahid Hasheminejad Hospital in Mashhad, Iran. We set out to uncover any differences that may have existed between the three groups in terms of their antibody levels.

Materials and Methods

In March 2020 to March 2021, this cross-sectional study was conducted at Shahid Hasheminejad Hospital in Mashhad, Iran, to survey 170 personnel. After obtaining informed consent, the participants were asked questions about their age, sex, occupation, related ward, symptoms associated with the virus, whether they had come into contact with a confirm COVID-19 patient, and other conditions such as diabetes, hypertension, and autoimmune diseases. These 170 personnel were divided into three groups:

1.The first group as high-risk group comprised employees working in the wards related to Covid-19 (including the respiratory emergency, internal-infectious, and ICU Covid), where contact with an infected patient was anticipated.

2.The second group as moderate-risk group included employees working in the emergency ward (including the central emergency department and accidents), where contact with Covid-19 patients was unpredictable.

3.The third group as low-risk group is composed of employees working in other wards (including other therapeutic and non-therapeutic departments of the hospital), where contact with Covid-19 patients considered to be the lowest between the three groups.

170 blood samples were collected and subsequently transferred to the laboratory. The serum was separated from the blood using a 2500g centrifuge for 5 minutes, and then the serum level of Covid-19 antibodies (IgM-IgG) was tested using the ELISA method and the Pishgaman kit. Samples with a serum level less than 0.9 were determined to be negative, those between 0.9 and 1.1 were considered borderline, and those with a level greater than 1.1 were labeled positive. The data was then analyzed using SPSS software, version 26. This study project number 990562 and code IR. MUMS. MEDICAL. REC. 2019. 620 has been approved by the Ethics Committee of Mashhad University of Medical Sciences.

Results

53 members of the 170 investigated personnel fell into the first group, 51 members into the second, and 66 members into the third. The average age in the first group was 37.5 years, in the second it was 31.9 years old, and in the third it was 35 years old. The demographic data of each group is shown in Table 1.

Table1. Demographic data of personnel in 3 groups.

		Group A	Group B	Group C
Demographic Data				
Age		37.5	35	31.9
Sex	Male	31 (58.5%)	46 (69.7%)	24 (47.1%)
	Female	22 (41.5%)	20 (30.3%)	27 (52.9%)
Job				
Doctor		1 (1.5%)	1 (2%)	18 (34%)
Nurse		38 (57.6%)	50 (98%)	27 (50.9%)
Health-care worker 1		4 (6.1%)	0	8 (15.1%)
Non health-care worker 2		23 (34.8%)	0	0
Risk factors				
Diabetes		2 (3%)	1 (2%)	2 (3.8%)
Hypertension		2 (3%)	0	0
Chronic lung disorder		1 (1.5%)	0	2 (3.8%)
Kidney disorder		0	0	0
Liver disorder		0	0	0
Heart disorder		0	0	1 (1.9%)
Immunosuppressive disease		0	1 (2%)	0
Use of immunosuppressive drug		0	0	0

1 Personnel that are not doctors nor nurses.
2 Employees of the hospital not major in medical sciences.

In general, 22 staff members had positive IgG, 13 had borderline IgG, and 135 had negative IgG. No significant relationship was found between the studied groups and the amount of IgG (p-value > 0.05).

In addition, 160 employees had negative IgM, 1 had borderline IgM, and 9 employees had positive IgM. After investigation, no connection between the examined groups and IgM levels was found (p-value > 0.05). (Figure 1)
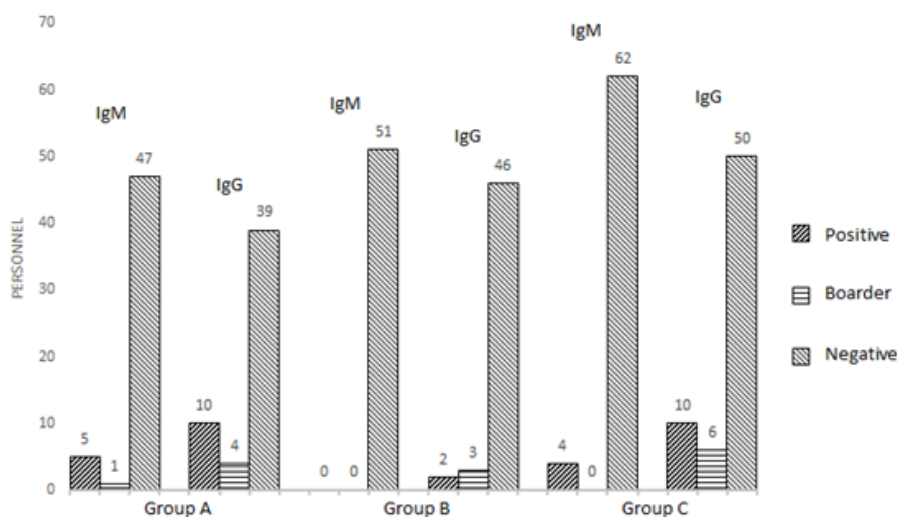

Figure 1. Frequency of personnel based on the Covid19- antibodies status in each group

The presence of common Covid-19 symptoms such as fever, cough, sore throat, chills, shortness of breath, olfactory dysfunction, and digestive symptoms in the participants and their families had a significant relationship with the studied groups.

Moreover, the symptoms of fever, cough, sore throat, chills, shortness of breath, and olfactory dysfunction were found to be significantly correlated to the IgG levels, while only cough and shortness of breath were significantly correlated with IgM levels, as observed in Table 2.

Table2. Data of symptoms

	P-Value	Group C	Group B	Group A
Fever	<0.05	12 (18.2%)	3 (5.9%)	28 (52.8%)
Cough	<0.05	10 (15.2%)	2 (3.9%)	30 (56.6%)
Sore throat	<0.05	15 (22.7%)	1 (2%)	21 (39.6%)
Chill	<0.05	11 (16.7%)	1 (2%)	24 (45.5%)
Shortness of breath	<0.05	16 (24.2%)	3 (5.9%)	24 (45.5%)
Olfactory disorder	<0.05	3 (4.5%)	0	10 (18.9%)
Digestive symptoms	<0.05	1 (1.5%)	0	10 (18.9%)
Symptoms in the family	<0.05	11 (16.7%)	3 (5.9%)	11 (16.7%)

Discussion

In this study, the levels of anti-Covid-19 IgG and IgM antibodies were evaluated among personnel of the Shahid Hasheminezhad hospital. This hospital had become a Corona center after the pandemic hit, and a large portion of Covid-19 infected patients from the north-east of Iran had been referred to this hospital; thus, the personnel had a high chance of infection with Covid-19.

The aim of this study was to assess the symptoms connected with IgG and IgM antibodies related to

Covid-19, as well as investigate the relationship between IgM and IgG antibodies and the ward personnel who were working there. Out of 170 personnel who entered the study, 22 (12.9%) tested positive for IgG, and 9 (5.2%) tested positive for IgM. The most IgG- and IgM-positive personnel belonged to the first group, who had the highest chance of contacting Covid-19 patients. This was unusual, compared to results of other studies.

In Italy, Armando De Carlo and his colleagues conducted a study on the IgG serum level of 3,242

asymptomatic employees of the Policlinico Riuniti Hospital. The high-risk group, which had more contact, revealed a prevalence of serum antibody of 1.4%, while in contrast, the medium-risk group had 2%. (10). A study conducted by Johannes Korth and his team was conducted on 316 Health Care Workers (HCWs) of the Essen teaching hospital in Germany to examine Covid-19 IgG antibodies. Similar to our study, the participants were classified into three groups: high-risk (n= 244), intermediate-risk (n=37), and low-risk (n=35).

In the study, it was found that IgG antibodies were detectable in 5 (1.6%) people. Furthermore, the prevalence of serum IgG was found to be higher in the intermediate-risk group (5.4%) than in the high-risk group (1.2%) (11). Both studies obtained similar results to ours and detected no association between IgG levels and presence in high-risk wards. In our study, the highest number of positive antibodies were found in the high-risk group. This discrepancy could be due to the lack of adherence to safety protocols among staff in different regions. The variance between Covid-19-related antibody titers in the high-risk group of our study and other studies reflects the greater compliance with safety protocols in other countries than those used in Iran. Thus, health care settings should focus on improving standards in order to save more lives and limit transmission chains.

In July 2020, Giovanni Sotgiu and his colleagues conducted a study in Italy to assess the prevalence of IgG and IgM antibodies against COVID-19. The aim of this study was to investigate the serological prevalence of SARS-CoV-2 antibodies in a group of HCWs exposed to the disease. A total of 202 individuals, with an average age of 45, were examined retrospectively. 14.4% of the HCWs tested positive for IgM, with 7.4% testing positive for IgG. While IgM was observed more commonly in men (3.4%), the highest prevalence of IgM positivity was seen in individuals aged 20-29 (9.25%). However, no association was observed between exposure to COVID-19 patients and IgG and IgM positivity (12).

A study involving 474 HCWs in New York revealed similar results. Out of all the participants, 80 (16.9%) had Covid-19 IgM or IgG antibodies. Interestingly, there was no significant difference in antibody prevalence between different exposure groups (13).

The non-observed difference in the prevalence of IgM and IgG Covid-19 antibodies among high-risk personnel who had the most contact with Covid-19 patients suggests that working in the Covid-19 related wards is not more likely to lead to infection with the virus. However, the lack of use of personal protective equipment, as well as protracted shift hours and pressure on health care workers, are among the factors that increase the chance of infection (14). In our study, we discovered a potential relation between antibodies and certain symptoms in individuals. However, other studies presented conflicting results. Nopsopon et al., in their study of 844 hospital staff in Thailand, found that only 7 (0.8%) tested positive for SARS-COV-2-IgM and none tested positive for IgG, and moreover, they concluded that there was no correlation between IgM and symptoms (15).

However, A study conducted by Ganz-Lord et al. in the U.S. identified a possible association between symptoms such as fever, cough, sore throat, anosmia, and ageusia, and having IgG antibodies (16). Although the production of Covid-19 IgM starts 4-6 days after the onset of symptoms and reaches its peak on the early stages, IgG begins to form 5-10 days after the onset of clinical manifestations, reaches its peak 21-25 days after onset of the disease, and then decreases after 31-41 days. This suggests that IgM is better for diagnosis in the early stages and IgG levels should be used to diagnose later stages of the disease (17). Most people with high Covid-19 antibody titers are considered to be carriers of the disease and have the ability to transmit it. This serves as a good means of controlling the pandemic. As long as they are IgM positive, they should be quarantined, and the presence of IgG, indicative of recovery, shows they have relative immunity against Covid-19, though it may only be for a limited time.

Our study had some limitations that should be taken into consideration for future studies. Personnel were not tested for PCR, leaving their status of infection with Covid-19 unknown. This study was conducted in a single center, with a relatively small sample size; a larger sample size would be preferable.

Additionally, the kit used in this study might not be capable of detecting antibodies with low titers. Medications used by personnel as prophylaxis should be considered in future studies as they might affect their symptoms. Also, investigation of the time between the first contact with an infected person and onset of symptoms, as well as the time between sampling would be suggested for future studies.

Conclusion
The findings of this research demonstrated that both activities in wards associated with Covid-19 patients and direct interaction with these patients had no significant impact on the rise in IgG and IgM levels. However, being in the wards with more frequent interaction with Covid-19 patients led to an increase in the symptoms of digestive issues, olfactory disorder, fever, cough, sore throat, chills, and shortness of breath.

Ultimately, we concluded that a majority of the clinical symptoms experienced by staff, including

fever, cough, sore throat, chills, and shortness of breath.. Ultimately, we concluded that a majority of the clinical symptoms experienced by staff, including fever, cough, sore throat, chills, shortness of breath, and smell disorder, had a significant relationship to IgG. Additionally, two symptoms--cough and shortness of breath--had a significant relationship to IgM.

Statement of Ethics

The procedures have done in this study was approved by Mashhad University of Medical Sciences (MUMS) with project no 990562.

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Conflict of Interest

The authors declare that they have no competing interests.

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