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The prevalence of COVID-19 among healthcare professionals at primary healthcare centers

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ABSTRACT

Background: The SARS-CoV-2 infection typically triggers discernible immunological responses in most reported cases. Employing a serological test could identify prior asymptomatic infections and aid in evaluating an individual's immune status. Given that healthcare professionals face a higher risk of COVID-19 exposure, the utilization of personal protective equipment remains the foremost approach in averting disease transmission within healthcare facilities. **Objectives**: To ascertain the prevalence of COVID-19 among healthcare professionals working in primary healthcare centers located within the AL-Sader city district. **Method:** During the period between November 1st, 2020, and December 31st, 2020, a cross-sectional study was carried out in nine primary healthcare centers, chosen through a cluster random sampling method. **Result:** Out of the 470 participants included in the study, 101 (21.5%) had a documented history of COVID-19 infection, with 76 confirmed through polymerase chain reaction analysis. Notably, a notable correlation between a positive rapid immunological test result and a prior history of COVID-19 infection (p-value < 0.001). The rapid test showed a sensitivity of 56.6% and a specificity of 79.2%. Specifically, 125 participants (26.6%) tested positive using the rapid test, with 104 (83.2%) exhibiting IgG antibodies, 5 (4%) displaying IgM, and 16 (12.8%) showing both IgG and IgM antibodies. **Conclusion:** The prevalence of COVID-19 infection among participants exceeded the anticipated levels. Significantly, there was a discernible correlation between positive rapid test results and COVID-19 infection, as well as factors such as smoking, comorbidities, PPE training, and household infections.

Keywords: COVID-19, prevalence, Healthcare, Iraqi, professionals.

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INTRODUCTION

The novel coronavirus (SARS-CoV-2), responsible for causing coronavirus disease 2019 (COVID-19), initially surfaced in Wuhan, China, in December 2019. It subsequently spread swiftly across international borders and was officially characterized as a pandemic by the World Health Organization (WHO) on March 11, 2020. (Obaid et al., 2022) As of January 28, 2021, SARS-CoV-2 continues to spread worldwide, with a total of 100,200,107 confirmed cases of COVID-19, resulting in 2,158,761 reported deaths according to the World Health Organization (WHO) (Al Sa'ady et al., 2022).

The most prevalent symptoms of COVID-19 include fever, lethargy, cough, malaise, shortness of breath, and muscular pain. In severe cases, individuals may progress to develop acute respiratory distress syndrome (ARDS) and pneumonia.(WHO, 2021) While SARS-CoV-2 infection carries a less mortality in comparison to the Severe Acute Respiratory Syndrome (SARS) virus or the Middle East Respiratory Syndrome (MERS) virus, its extended incubation period led to a significant number of asymptomatic carriers (Shah et al., 2020; Suleman et al., 2023; Suleman et al., 2021; Suleman, Mohamed & Ahmmed, 2020).

The SARS-CoV-2 infection typically triggers discernible immune responses in the majority of reported cases; nevertheless, the level of protection against a second infection for previously infected individuals remains uncertain.(Fung et al., 2020) The T-cell responses directed against the SARS-CoV-2 spike protein have been studied and show a strong correlation with the levels of IgG and IgA antibodies in COVID-19 patients. This finding holds significant implications for the design of vaccines and understanding long-term immune responses. (Lumley et al., 2021; Suleman & Rahman, 2020; Suleman & Mohamed, 2019) When examining post-infection immunity, it's crucial to take into account several key considerations. These include pinpointing functional indicators of protection, identifying quantifiable surrogate markers, and establishing clear endpoints, such as preventing diseases, hospitalizations, fatalities, or onward transmission (Immune responses and immunity to SARS-CoV-2, 2021).

Since the onset of this global pandemic in March 2020, numerous healthcare facilities have begun to document the prevalence of COVID-19 infection among healthcare workers (HCWs). (Plotkin, 2008) According to the World Health Organization (WHO), health workers encompass all individuals engaged in activities primarily aimed at improving health. This includes doctors,

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nurses, midwives, paramedical staff, hospital administrators, support staff, and community workers. These dedicated professionals now confront the occupational hazard of potentially contracting COVID-19, and in severe cases, even facing the risk of death.(Alserehi et al., 2021; Hossain et al., 2022; Alrobaie, 2022) Personal protective equipment (PPE) plays a crucial role in safeguarding healthcare workers (HCWs) from highly contagious diseases like COVID-19.

Nevertheless, hospitals have faced the peril of PPE shortages. This predicament arises from a combination of factors, including limited knowledge about pertinent technologies, inadequacies in the supply chain, and stringent regulatory mandates. (Bandyopadhyay et al., 2020) The World Health Organization (WHO) has provided guidelines regarding the judicious utilization of personal protective equipment (PPE) in both hospital and community settings. However, safeguarding healthcare workers (HCWs) continues to pose a significant challenge in many countries. The persistent shortage of sufficient and suitable PPE remains a pressing daily concern (Karim et al., 2020).

The vulnerability of healthcare workers (HCWs) to infection within the epidemic chain is a crucial concern, as HCWs play a pivotal role in managing the pandemic. Hence, every conceivable measure must be implemented to curtail the transmission of infection to HCWs. (Bandyopadhyay et al., 2020) This begins with identifying the risk factors for infection and subsequently implementing appropriate measures to mitigate these risks. It is widely recognized that disease transmission among healthcare workers (HCWs) is linked to factors such as overcrowding, inadequate isolation room facilities, and environmental contamination (Cassini et al., 2020).

In healthcare environments, apart from transmission through respiratory droplets or direct contact, there is also a potential for airborne transmission, especially during procedures that generate aerosols. Given the high contagiousness of SARS-CoV-2, healthcare workers (HCWs) have been operating under a notable risk of virus transmission while attending to patients suspected or confirmed with COVID-19.(Mhango et al., 2020) Nonetheless, the prevailing belief is that the majority of healthcare workers (HCWs) contracted the infection in their household environments rather than within healthcare settings. Nevertheless, early detection and screening are imperative in order to stave off potential virus transmission among HCWs and the broader community (Çelebi et al., 2020).

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The Iraqi health care system is divided into governmental and private sectors. Most governmental HCWs are also involved in private work at the same time (Beltrami et al., 2000).

The objective of this study was to determine the seroprevalence of COVID-19 among HCWs in primary healthcare centers in the AL-Sader city district.

METHODOLOGY

A descriptive cross-sectional study was conducted in several Primary Healthcare Centers (PHCs) in Al-Sader City. Al-Sader City district is located on the eastern side of the capital Baghdad and is considered the biggest district in Iraq with a catchment population of about 1.5 million. There are 21 PHCs and there are eight slums in this district. The data collection process was implemented during the period from 1st November 2020 to 31st December 2020.

Nine PHCs were randomly selected using a cluster random sampling technique and all HCWs in these PHCs who accepted to participate were included in the study. A questionnaire was devised to collect demographic information, assess potential factors contributing to disease contraction, and evaluate the utilization of essential personal protective equipment (PPE), The first part of the questionnaire is concerned with demographic variables included age, gender, job (physician, dentist, pharmacist, nurse, etc.), working unit in the PHCs, residence (within or outside the catchment area of PHC), and personal habits like smoking and alcohol use.

The second part is concerned with HCW's practices of using different PPEs, duration, training on PPE, and whether the HCW use PPEs at the private work. The third part is concerned with the history of having the disease, presence of comorbidities, (hypertensive, diabetes, CA, etc.), and history of contact with a confirmed case at the workplace or home. The questionnaire was distributed by visiting the PHCs and meeting the HCWs who filled the questionnaire themselves.

The HCWs had the Participants undergo a COVID-19 rapid antibody test (specifically the IgM-IgG Rapid test) after providing their verbal consent. The test cassettes were equipped with a colored conjugate pad that contained SARS-CoV-2 recombinant antigens coupled with colloidal gold (referred to as SARS-CoV-2 conjugates). Additionally, a nitrocellulose membrane strip featured an IgG line, an IgM line, and a control line, The test was done following the standard procedure (add 20 microliters of the blood sample into the sample well, then add 2-3 drop of

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buffer and start the timer 10-15 minutes and wait for the colored lines to appear). This data were obtained by researcher's communication.

Statistical Analysis

The gathered data was input and assessed using both descriptive and inferential statistics with SPSS, with a p-value below 0.05 denoting statistical significance to achieve current study objectives.

Ethical considerations

Verbal approval was obtained from each participant before filling the questionnaire and having the rapid test. Participants' data was kept confidential. Official approval was obtained from the medical research committee at the Public Health Directorate, Iraq Ministry of Health.

RESULTS

Table1: *Distribution of positive history COVID-19 according to the type of examination.*

Types of examination	*HCWs with positive Covid-19	
	Frequency	%
*PCR	76	75.2
*CT scan	35	34.7
Rapid test	12	11.9
Blood test(D-dimer)	2	2.0

This table shows that 75% of participants were diagnosed with polymerase chain reaction (PCR), 34 %by CT scan, 11.9% by rapid test, and 2% by a blood test.

Table 2: *Distribution of positive IgM, IgG, and both*

		HCWs with a positive rapid test N (125)	
		F	%
Immunoglobulins type	IgG	104	83.2
	IgM	5	4.0
	Both	16	12.8

This table shows that 83.2% of cases had positive IgG, 4% had positive IgM, and 12.8% had positive IgG and IgM.

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Table 3: *Association of COVID-19 according to the result of rapid test*

		COVID-19						P. Value
		Yes		No		Total		
		N	%	N	%	N	%	
Rapid test result	Positive	60	48.0	65	52.0	125	26.6	<0.001
	Negative	41	11.9	304	88.1	345	73.4	
	Total	101	21.5	369	78.5	470	100.0	

There was a significant association between the result of the rapid test and the state of COVID-19 (P-value <0.001).

Table 4: *Distribution of PCR positive according to the result of rapid test*

		PCR positive						**P. Value**
		Yes		No		Total		
		N	%	N	%	N	%	
Rapid test result	Positive	43	34.4	82	65.6	125	26.6	<0.001
	Negative	33	9.6	312	90.4	345	73.4	
	Total	76	16.2	394	83.8	470	100.0	

The above table record significant association between the result of the rapid test and the state of PCR positive (p-value<0.001), sensitivity (SN)=56.6%, specificity (SP)=79.2%.

Table 5: *Association of COVID-19 according to the result of IgG and IgM test*

		COVID-19						P. Value
		Yes		No		Total		
		N	%	N	%	N	%	
IgG	Yes	58	48.3	62	51.7	120	25.5	<0.001
	No	43	12.3	307	87.7	350	74.3	
IgM	Yes	13	61.9%	8	38.1%	21	4.5%	<0.001
	No	88	19.6%	361	80.4%	449	95.3%	
Total		101	21.4%	369	78.3%	470	100.0%	

The table declare that there is a significant association between the result of IgG and IgM with the state of COVID-19 (P-value <0.001)

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Table 6: Distribution of COVID-19 and rapid test result according to sociodemographic characteristic and risk factor

		COVID-19 (101)				P. Value	Rapid test result(125)						P. Value
		Yes		**No**			**Positive**		**Negative**		**Total**		
		N	**%**	**N**	**%**		**N**	**%**	**N**	**%**	**N**	**%**	
Gender	**Male**	**60**	**20.9**	**227**	**79.1**	**0.700**	**84**	**29.3**	**203**	**70.7**	**287**	**100.0**	**0.101**
	Female	**41**	**22.4**	**142**	**77.6**		**41**	**22.4**	**142**	**77.6**	**183**	**100.0**	
Age group	**< 30**	**27**	**23.7**	**87**	**76.3**	**0.764**	**22**	**19.3**	**92**	**80.7**	**114**	**100.0**	**0.127**
	30-39	**19**	**20.0**	**76**	**80.0**		**24**	**25.3**	**71**	**74.7**	**95**	**100.0**	
	40-49	**21**	**18.6**	**92**	**81.4**		**29**	**25.7**	**84**	**74.3**	**113**	**100.0**	
	50-59	**34**	**23.4**	**111**	**76.6**		**49**	**33.8**	**96**	**66.2**	**145**	**100.0**	
	≥ 60	**0**	**0.0**	**3**	**100.0**		**1**	**33.3**	**2**	**66.7**	**3**	**100.0**	
Occupation	**Doctor**	**6**	**23.1**	**20**	**76.9**	**0.193**	**6**	**23.1**	**20**	**76.9**	**26**	**100.0**	**0.536**
	Dentist	**3**	**13.0**	**20**	**87.0**		**4**	**17.4**	**19**	**82.6**	**23**	**100.0**	
	Pharmacist	**11**	**26.2**	**31**	**73.8**		**8**	**19.0**	**34**	**81.0**	**42**	**100.0**	
	medical laboratory	**16**	**27.6**	**42**	**72.4**		**13**	**22.4**	**45**	**77.6**	**58**	**100.0**	
	Nursing & Paramedical	**48**	**24.5**	**148**	**75.5**		**61**	**31.1**	**135**	**68.9**	**196**	**100.0**	
	Administrative	**9**	**12.3**	**64**	**87.7**		**20**	**27.4**	**53**	**72.6**	**73**	**100.0**	
	Others	**8**	**15.4**	**44**	**84.6**		**13**	**25.0**	**39**	**75.0**	**52**	**100.0**	
Contact with	**Yes**	**73**	**33.8**	**143**	**66.2**	**0.000**	**64**	**29.6**	**152**	**70.4**	**216**	**100.0**	**0.170**
	No	**28**	**11.0**	**226**	**89.0**		**61**	**24.0**	**193**	**76.0**	**254**	**100.0**	

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a confirmed case													
Smoking	Yes	11	12.9	74	87.1	0.037	13	15.3	72	84.7	85	100.0	0.010
	No	89	23.2	295	76.8		111	28.9	273	71.1	384	100.0	
Comorbidity	Yes	32	25.4	94	74.6	0.213	43	34.1	83	65.9	126	100.0	0.025
	No	69	20.1	275	79.9		82	23.8	262	76.2	344	100.0	
Residence in the PHC catchment area	Yes	21	20.4	82	79.6	0.758	26	25.2	77	74.8	103	100.0	0.725
	No	80	21.8	287	78.2		99	27.0	268	73.0	367	100.0	
	Yes	60	50.0	60	50.0	0.189	44	36.7	76	63.3	120	100.0	0.020

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PPE Training	**No**	**41**	**11.7**	**309**	**88.3**		**81**	**23.1**	**269**	**76.9**	**350**	**100.0**	
Households Infection	**Yes**	**89**	**22.6**	**305**	**77.4**	**0.000**	**113**	**28.7**	**281**	**71.3**	**394**	**100.0**	**0.004**
	No	**12**	**15.8**	**64**	**84.2**		**12**	**15.8**	**64**	**84.2**	**76**	**100.0**	
Coworker infection	**Yes**	**41**	**27.0**	**111**	**73.0**	**0.046**	**41**	**27.0**	**111**	**73.0**	**152**	**100.0**	**0.898**
	No	**60**	**18.9**	**258**	**81.1**		**84**	**26.4**	**234**	**73.6**	**318**	**100.0**	
Having Private work	**Yes**	**23**	**28.4**	**58**	**71.6**	**0.098**	**19**	**23.5**	**62**	**76.5**	**81**	**100.0**	**0.482**
	No	**78**	**20.1**	**311**	**79.9**		**106**	**27.2**	**283**	**72.8**	**389**	**100.0**	

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DISCUSSION

In this study table 1, a total of 470 healthcare workers (HCWs) participated. The key findings included a significant correlation between COVID-19 infection and the rapid results of the immunological test. Interestingly, most of those affected did not have a history of smoking.

In terms of rapid test outcomes as recorded in table 2, 101 participants, less than quarter of participants had previously experienced a COVID-19 infection. Some HCWs had a history of COVID-19 but tested negative on the rapid test less than quarter of respondents, which may suggest either a lower immunity level or waning immunity. Conversely, of 65 participants, more than half of respondents displayed higher immunity or were potentially asymptomatic cases.

In table 3, 4 there was significant association was observed between the rapid test and polymerase reaction chain (p-value <0.001), with a sensitivity of more than half of cases and specificity of majority of cases; some studies advise against relying solely on rapid tests for initial diagnoses due to their lower sensitivity (BioMedomics, 2021; Mehmood et al., 2021). A meta-analysis study demonstrated encouraging accuracy in using IgG detection for diagnosing SARS-CoV-2.

Current study displays in table 5 that more than quarter of respondents tested positive with rapid tests. The diagnostic value of the IgM test was found to be less useful compared to IgG. Moreover, combining IgG and IgM tests did not yield a superior diagnostic accuracy when compared to using IgG alone (Nagura-Ikeda et al., 2020).

There was a notable correlation found as illustrated in table 6 between positive rapid test results and factors such as smoking, comorbidities, PPE training, and household infections. Another study indicated that individuals who reported not consistently wearing personal protective equipment (PPE) during all encounters showed a higher likelihood of seropositivity in comparison to those who reported better commitment wearing their PPE (Zahang et al., 2021).

Table 6 documented a significant relationship was found between contact with confirmed cases and risk of COVID-19 infection Improper or inadequate use of PPE poses a significant risk of virus exposure to healthcare workers (HCWs) and heightens the potential for cross infection within hospitals. Research have identified that a low awareness and discomfort with the equipment may serve as obstacles to its effective utilization. (Stubblefield et al., 2020Lai et al., 2020) Utilizing personal protective equipment (PPE) along with receiving proper infection control training has

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been linked to a reduced risk of infection. Additionally, specific types of exposures have been associated with an elevated risk of contracting infections. (Chan and Lee., 2004)

Smoking has a significant association with COVID-19 infection (P-value< 0.037**)** as mentioned in table 6**,** the reliability and precision of the documented smoking status remain uncertain. Given the urgency of the pandemic, it is plausible that patients may not have accurately reported their smoking habits. Additionally, there's a possibility that some patients may quit smoking shortly after contracting the disease, categorizing them as former smokers. (Chou et al., 2020)

Current epidemiological research indicates in table 6 that active smoking is linked to heightened severity of the disease and an increased risk of death in hospitalized COVID-19 patients. This is attributed to smoking's potential to upregulate the angiotensin-converting enzyme-2 (ACE-2) receptor, which the SARS-CoV-2 virus uses to establish entrance to the host. Additionally, smoking can trigger a 'cytokine storm', further exacerbating outcomes for COVID-19 patients.(Farsalinos et al., 2020) An additional study discovered a counterintuitive trend—a negative correlation between smoking and the occurrence of COVID-19 at the population level across 38 European countries. Considering this, and in light of numerous other studies revealing a potential underreporting of smoking prevalence among hospitalized cases, it may be prudent to investigate further through laboratory experiments and controlled human trials (Kashyap et al., 2020).

CONCLUSION

The prevalence of COVID-19 infection among participants exceeded the anticipated levels. Notably, a significant association was observed between rapid tests and COVID-19 infection, as well as factors such as smoking, PPE training, comorbidities, and household infections.

RECOMMENDATIONS

Strong strategies are needed to improve infection control and prevention measures including PPE proper training and use, give the priority for HCWs to receive the vaccine when it is available.

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