

## Risk Factors Associated with Nurses' Infection with COVID-19

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### Abstract

Nurses represent the largest number of health care providers and they are an essential part of the healthcare workforce working on the frontline during the COVID 19 pandemic. They are in direct contact with patients, providing high levels of care to promote patient safety and positive care outcomes while at the same time placing their own health and well-being at considerable risk.

**The Aim:** To investigate the cause of COVID 19 infection amongst nurses.

**Methods:** A self-administered online questionnaire was administered to the targeted sample who participated on a voluntarily basis.

**Result:** 123 surveys were completed. The majority of the participants were compliant with infection precaution protocols. More than half of them were aware of the source of infection.

**Conclusion:** Nurses are well oriented in dealing with Covid 19 crisis. However, more awareness is needed regarding infection precaution and reducing level of anxiety.

### Introduction

Coronavirus not only poses a critical threat to healthcare providers but is also considered a challenge to the healthcare system worldwide. Healthcare providers especially staff on the frontline such as nurses are at high risk of infection [1]. Several countries have identified high numbers of healthcare providers who were infected. In China, for instance, figures show the prevalence of 3300 cases in March 2020 while Italy reported 20% of healthcare workers were infected [2]. Nurses are more vulnerable to being infected and are at high risk of exposure due to direct contact with patients [3].

The aim of this study is to identify and evaluate the common risk factors associated with Covid-19 infection among nurses' staff. It is hoped that it may provide information about Covid-19 that can be used to further develop infection control guidelines and regulations in relation to covid-19 that can be used to promote nurse safety in the future

### Literature Review

The Saudi center for disease prevention and control (SCDC) stat-

ed that fever, respiratory symptoms such as shortness of breath, cough and, pneumonia are associated with Covid-19 infection [4].

The world health organization recommends health care providers maintain safe practice and follow infection control protocols [5]. It classifies workplace exposure as close or frequent contact with people infected with Covid-19 (less than 1 meter). Health care is considered the highest risk area where workers require protection and must be competent in the use of personal protective equipment (PPE) such as a masks, gowns and especially face shields when dealing with aerosol generating procedures. Additionally, frequent hand hygiene is required before and after performing any procedures dealing with body secretions as in the case of Covid-19 [4].

The SCDC encourages raising the health awareness among health care providers by providing a designated hotline for medical consultation, and several infection control initiatives placed to enhance the safety of the health care workers, in addition to infection prevention and control training for workers and a proper assignment considering comorbidities, age and pregnancy [6].

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Nagesh, 2020, proposes several recommendations to promote safe standards such as testing frontline health care workers specifically for those with comorbidities, both self, and social isolation, applying measures such as the use of PPEs with proper disposal methods, and training with local language protocols [7].

Jin, 2020 study investigated the cause of the COVID 19 infection among health care workers, infection control practice, symptoms and treatment. He found that approximately 42% experienced fever followed by lethargy and muscle pain. The main factor affecting the infection was close contact and inadequate distance between the infected people [8]. Another study [9] found that there was an association between the health care worker exposure and the close contact history with a positive case of Covid-19. Protection behaviors and the proper usage of personal protective equipment (PPEs) are the baseline for avoiding an infection during work [9].

There is a limited body of literature which identifies risk factors for healthcare workers in relation to COVID-19 as it is a new phenomenon. As health care workers are at high risk of COVID-19 infection this study seeks to provide valuable information and promote awareness about risk factors, and steps that can be taken to mitigate risk, to promote safety and well- in this nurse population which is currently empirically under researched.

### Materials and Methods

The study used a Cross sectional descriptive research design to identify risk factors for COVID-19 infection amongst nurses working in Saudi Arabia so that variables could be compared at the same time in this population.

The study took place in EHC which consists of 22 hospitals: 5 Specialist, 5 Health Network and 12 Rural Health Network and 137 Primary Health Care centres that provide primary, secondary and tertiary level care to Saudi Nationals and citizens of the Gulf States, which is situated in the Eastern Province of Saudi Arabia.

The study was conducted over a three months The Study used a purposive sampling technique to identify characteristics of the COVID 19 virus and risk factors whereby all nurses and midwives working in EHC facilities that were infected with the virus were invited to participate in the study. The aim of recruiting this population was to ensure that rich information was gathered about COVID 19 to provide insight into what the risk factors may be for nurses.

### Research Instrument

The study used a self-administered questionnaire available online which was distributed by the researchers to nursing staff infect-

ed with Covid-19. A question was created at the beginning of the survey for participants to confirm that they were infected with the COVID -19 virus. The questionnaire consists of two sections: one section requesting socio-demographic data and a further section comprising of questions adapted from the Saudi Arabia CDC COVID-19 investigation form. These are questions that relate to exposure to infection, signs and symptoms, history of comorbidities, utilization of PPEs, and infection control measures.

### Pilot / Data Collection

The quality of the questionnaire was evaluated by a panel of expert nurse leaders who assessed construct validity to ensure that it met its objectives in investigating the risk factors associated with COVID-19 infection amongst nurses. Additionally, a pilot study was tested on ten program participants to confirm reliability through the clarity of questions and effectiveness of instructions

After completion of the pilot study, the questionnaires were distributed to nurses infected with Covid-19 with a deadline for completion after xx days. It was accompanied by a letter explaining the purpose of the study and outlining any potential risks to subjects. Staff were requested to participate in the study on a voluntary basis with waiver of consent, as it was perceived that the research involved minimal risk.

### Data Analysis / Findings

A total population sample of 200 nurses were invited to participate in the research; One hundred and twenty three (123) nurses agreed to participate which is representative of 61.5% of the total population. Although a sample size of 130 participants would have provided a more representative sample, the sample of 123 nurses provided a 5.39% margin of error at the 95% confidence level which is acceptable. The questionnaire was returned completed in most categories. Statistical analysis was conducted using Statistical Product and Services Solutions (SPSS version 23.0. Demographic data analysis was performed using frequency count, percentage, mean and standard deviation to describe the research sample. Inferential statistics were analysed using the Chi square test to examine the relationship between the nurses characteristics , statistical significance was set at  $p \leq 0.05$ .

### Sociodemographic Characteristics.

The analysis showed that the majority of the participants were female married and non-pregnant 121 (98.4%) 95 (77.2%) and 115 (93.5%) respectively, aged group of 26 – 45 years old constitutes 88 (71.5%), 87 (70.8%) were working as front line nurse, 78 (63.4%) were in Covid-19 centers and of that 52.0% were in Covid-19 critical units (table number1).

**Table 1: Sociodemographic characteristic count and percentages, Chi-square value, significance level. Note asterisk means statistically significant differences parentheses Cramer's test for effect size.**

Participant's characteristics	N	(%)	Mild	Moderate	Sever	X <sup>2</sup>	Sig.
<b>Age</b>							
18-25	3	2.4	1(0.8)	1(0.8)	1(0.8)	4.4	0.81
26-35	88	71.5	48(39.0)	29(23.6)	11(8.9)		
36-45	24	19.5	13(10.6)	9(7.3)	2(1.6)		
46-55	6	4.9	5(4.1)	1(0.8)	0(0.00)		
Above 55	2	1.6	1(0.8)	1(0.8)	0(0.00)		
<b>Gender</b>							
Male	2	1.6	1 (0.8)	0(0.00)	1 (0.8)	3.35	0.18
Female	121	98.4					
<b>Working position</b>							
Administrative work	36	29.3	19(16.0)	14(11.8)	3(2.5)	0.97	0.61
Front line nurse	87	70.8	46(54.6)	26(21.8)	11(9.2)		
<b>Marital status</b>							
Single	28	22.8	10(8.2)	13(10.7)	4(3.3)	5.0	0.08
Married	95	77.2	58(47.5)	27(22.1)	10(8.2)		
<b>Are you pregnant</b>							
Yes	5	4.1	2(1.8)	2(1.8)	1(0.9)	12.7	0.13
No	115	93.5	63(55.8)	34(30.1)	8(7.1)		
Maybe	3	2.4	1(0.9)	0(0.00)	2(1.8)		
<b>Working area</b>							
Covid-19 Centre (Dammam, Qatif, and Cardiac centre)	78	63.4	43(36.4)	26(22.0)	9(7.6)	0.41	0.98
Non Covid-19	32	26.0	19(16.1)	9(7.6)	4(3.4)		
Other	13	10.6	4(3.4)	3(2.5)	1(0.8)		
<b>Working unit</b>							
Critical unit	64	52.0	34(27.6)	22 (17.9)	8(6.5)	2.6	0.84
Non critical unit	32	26.0	16(13.0)	12 (9.8)	2(1.6)		
Outpatient; 1°and ,2°	5	4.1	3(2.4)	2 (1.6)	0(0.00)		
Other	21	17.1	15(12.2)	5(4.1)	2(1.6)		

**Lifestyle for hygiene and prevention types of infection.**

In general, participants, reported that 96.7% were always and 3.3% sometimes washing their hands. All participants were wearing a mask during work however, almost 62.6% of participants were wearing a surgical mask at non-critical areas, and almost 37.4% were wearing N95 mask at the critical area. Participants were wearing PPE, according to the workplace besides washing their hands at the minimum required way if not more (table number 2).

Normal eight hours working time were 60% whereas, 25% working 12 hours and the rest work more than 12 hours. Only (28) 22.8% of the grand total were having medical problems, 7 (25%) out of those suffered from an immune disease, 6 (21.4%) suffered from respiratory problems, 6 (21.4%) suffer from diabetes and hypertension, and the rest 9 (32.1%), suffer from other non-chronic diseases.

**Table 2: Lifestyle for hygiene and prevention types of infection, count and percentages, Chi-square value, significance level. Note asterisk means statistically significant differences parentheses Cramer's test for effective size.**

Participant's characteristics	N	(%)	Mild	Moderate	Sever	X <sup>2</sup>	Sig.
<b>Frequently of washing hands</b>							
Sometimes	4	3.3	0(0.00)	4(3.3)	0(0.00)	8.2	0.01
Always	119	96.7	68(55.3)	37(30.1)	14(11.4)		
<b>Frequently wearing PPE</b>							
When needed	67	54.5	38(31.1)	22(18.0)	7(5.7)	0.69	0.95
Sometimes	4	3.2	2(1.6)	1(0.8)	0(0.00)		
Always	52	42.3	28(23.0)	7(5.7)	52(42.6)		
<b>If working in a critical area (use of mask)</b>							
Surgical	77	62.6	28(25.0)	21(18.8)	11(9.8)	7.4	0.02
N95	46	37.4	35(31.3)	15(13.4)	2(1.8)		
<b>Hours spent at work</b>							
8 hour	75	61.0	44(35.8)	25(20.8)	6(4.9)	19.1	0.001
12 hours	30	24.4	20(16.3)	9(7.3)	1(0.8)		
More than 12 hours	18	14.6	4(3.3)	7(5.7)	7(5.7)		
<b>If having medical problems</b>							
Yes	28	22.8	13(10.6)	7(5.7)	8(6.5)	10.6	0.001
No	95	77.2	56(45.5)	34(27.6)	6(4.9)		
<b>Medical problems</b>							
Immune disease	7	25.0	5(10.2)	2(4.1)	0(0.00)	37.6	0.001
Respiratory	6	21.4	0(0.00)	3(6.1)	3(6.1)		
Diabetes	4	14.3	0(0.00)	0(0.00)	4(8.2)		
Hypertension	2	7.1	2(4.1)	0(0.00)	2(4.1)		
Other	9	32.1	18(36.7)	10(20.4)	1(2.0)		
<b>Traveling to an infected country</b>							
Yes	1	0.8	0(0.00)	1(0.8)	0(0.0)	NA	NA
No	122	99.2	66(55.0)	39(32.5)	14(11.7)		

### Participant's characteristics related to COVID-19

#### Signs and Symptoms

The analysis showed that the most common sign and symptom of COVID-19 was fever (31.7%) followed no symptoms (19.5%), headache (14.6%), cough (9.8%), other (9.7%), pain (7.3%), (diarrhea 4.1%) and that shortness of breath was the least common sign and symptom (3.3%) amongst nurses.

#### Own Anxiety level evaluation

The majority of nurses evaluated their own anxiety level as mild (52.8%), compared the number of nurses that evaluated their own anxiety level as moderate (33.3%), severe (11.4%) or other (5.6%).

#### Knowing the source of infection

The majority of nurses knew the source of infection (60.2%) compared to those that did not know (22.0%). However, some nurses (17.9%) failed to answer the question which may have

provided further insight.

#### Requiring Hospitalization

A small percentage of nurses required hospitalization (17.9%) compared to those that were not in need of admission (82.1%).

#### Close contact with positive ones

The majority of nurses were in close contact with positive cases (52.8%) compared to those that were not (39%). However, 10 nurses (8.1%) failed to answer.

#### Working in a health facility with confirmed patients.

The majority of nurses were working in facilities where there were confirmed cases of COVID-19 (67.5%) compared to those where there were no confirmed cases (32.5%).

#### Distance kept when dealing with others

The majority of nurses with COVID-19 (54.4%) were within one meter when dealing with others compared to those that kept a distance of two meters (43.9%) or three meters (1.6%).

**Table 3: Participants characteristics related to Covid-19, count, and percentages.**

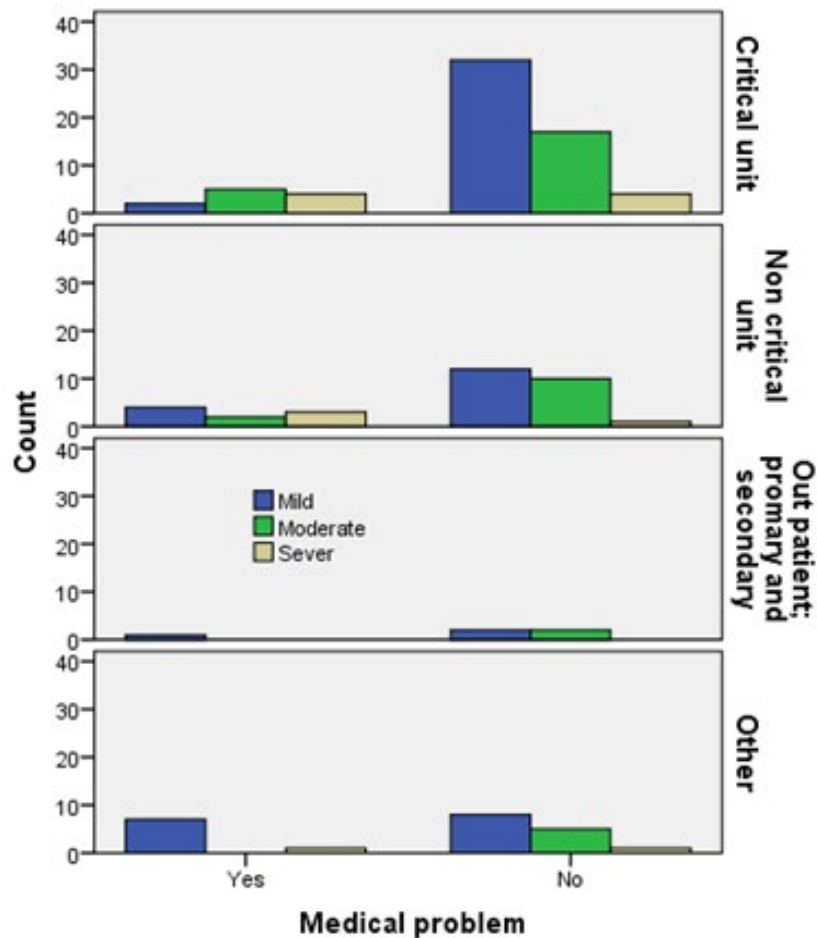
<b>Participant's characteristics of COVID-19</b>	<b>N</b>	<b>(%)</b>
	<b>123</b>	<b>100</b>
<b><i>Signs and symptoms</i></b>		
Cough	12	9.8
Fever	39	31.7
SOB	4	3.3
Diarrhea	5	4.1
Headache	18	14.6
Pain	9	7.3
No symptoms	24	19.5
Other	12	9.7
<b><i>Own anxiety level evaluation</i></b>		
Mild	65	52.8
Moderate	41	33.3
Severe	14	11.4
Others	12	5.6
<b><i>Knowing the source of infection</i></b>		
Yes	74	60.2
No	27	22.0
Not answering	22	17.9
<b><i>Requiring hospitalization</i></b>		
Yes	22	17.9
No	101	82.1
<b><i>Close contact with positive ones</i></b>		
Yes	65	52.8
No	48	39.0
Missing	10	8.1
<b><i>Working in a health facility confirmed pts.</i></b>		
Yes	83	67.5
No	40	32.5
<b><i>Distance kept when dealing with others</i></b>		
One-meter	67	54.4
Two-meter	54	43.9
Three-meter	2	1.6

### **Relationship Between Nurses' Characteristics**

A positive correlation was found amongst nurses with medical problems and their own level of anxiety which was most likely because nurses perceived that they were at risk of developing complications as a result of the COVID-19 virus. There was also an association found between the number of hours spent in work and their own level of anxiety as nurses .

**Table 4: Association among some of the thought important research factors, Chi-square value, significance level, and effect size. Note asterisk means statistically significant differences parentheses Cramer’s test for effective size.**

Association of among some of the variables	X <sup>2</sup> value	Sig. Cramer’s test
Having medical problems and hospitalization.	3.06	0.22
Having medical problems and own anxiety Level.	11.04	0.03* (0.30)
Working position and distance kept with infected pts.	0.42	0.8
Hours spent in work and own anxiety Level.	18.3	0.001* (0.4)
Hours spent at work and frequently hand washing.	2.65	0.27
Age group and level of anxiety.	4.47	0.81
Age group and wearing mask at work.	6.84	0.14
Age group and washing hands at work.	2.60	0.62
Age group and frequently wearing PPE.	5.92	0.65
Age group knowing the source of Covid-19.	4.42	0.35
Age group close contact with positive Covid-19.	4.97	0.29



**Figure 1: Level of anxiety in different working places for healthy nurses and those having medical problems.**

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## Discussion

Exposure to the Covid-19 of healthcare providers is one of the main issues that has been bothersome during the outbreak, especially for nurses staff who are at great numbers of health providers and also are placed at the front line of the health care services, which may necessitate spending more time at their different health bodies, they are dealing with patients in direct and indirect contact, that may let them be easily susceptible to infection. Even though, the regulations state that not only the health care bodies but also the other governmental and private amenities to have at least the minimum requirements of protection, like wearing a mask and self-hygiene before entering those places that are beside the guidelines to avoid crowded areas.

This study is trying to provide a way of how the virus is being transmitted to the nurse's community at different health care bodies, where the possible causes of infection will be put under investigation to reveal the actual or the potential causes and see whether this was due to lack of protection at work, or due to the interaction with other people outside the work; the community or/ household.

The regulation of the nursing quality audit and cross-training to make sure the staff is following at least the minimum level of the standard precaution, the study willing to show the common ways of infection, thereafter revisiting the quality of precaution and cross-training requirements for implication in the future [10, 11].

As expected as with continual education and quality assurance audit, the participants showed a very good level of standardization of personal hygiene, precaution level, and making sure of the optimum services required especially, at the unit of Covid-19 centers. Female nursing staff were the majority in this study similar to others, they are also the ones who deal with the hospitalized confirmed positive of Covid-19 patients, and they showed that they are always wearing either the surgical mask or the N95 mask [1], and always keep using the PPE depending of working place, beside the routine hand washing, and using gel disinfectant. Due to the lockdown and travel ban, it is expected that all participants were inside the country, except one [11].

### Knowing the Source of Infection

Even though it was a very difficult period where the health care was exhausted and worked hard, however, this study tries to evaluate the possible causes of covid-19 transmission among them, to minimize the effect if possible in the future, and improve the quality of nursing services.

Significantly 60% of the participants know the source of infection and only 22% did not know the exact cause, whereas 18% were not quite sure of whether it was from work, or from outside, even though the actual answer of those were not fully knowing, however, more emphasis is needed to stress on knowing the source of infection and location (table number 3).

## Level of Anxiety

Even with the high level of protection, safety and wearing the N95 mask, infection could occur. The level of anxiety were interestingly similar for both nurses working more than the normal eight hours and also for those who suffer from medical problems (table 2). Those who are working in critical places and healthy participant were more worried. 11.4% nurses reported server anxiety, and 33.3% reported moderate anxiety with statistical significance difference  $X^2$  18.3, Cramer's test 0.4  $p < 0.05$ , (shown in figure1). Level of anxiety, 6.5% work > 12 hours and 0.8 work 12 hours. Large number of participants who have medical problems are worried about their health, this is coincide with what reported in other studies [12] [11], working time for nurses with medical problems, even though this is a normal behavior however, need to have more investigation especially during or at crises of infection. For those who work more than 8 hours and who are at front line.

As the majority >75% of participants were at the two age groups of youth up to 45 years of old, those who were having medical problems constitute about 25% the level of anxiety were ranged from >40 mild to 27% moderate with statistically significant  $X^2$  11.04, Cramer's test 0.30  $p < 0.05$ , again staff with medical problems need to evaluate and investigate so as making sure not affect the quality of work [12].

Age was not associated with level anxiety ( $X^2$ ;4.47)  $p > 0.05$ , spending hours at work, wearing mask, washing hands, wearing PPE and close contact with positive Covid-19.

Youth usually have low level of anxiety and can tolerate extra work easily. Those who got Covid-19 symptoms (about 80% ) the symptoms were common as headache 15% and fever around 31%, which is similar to Covid-19 patients [4].

### Physical Distances at Work

In general, the health staff have who are dealing with patients need to work closely with patients that may differ from location other; Covid-19 testing, center of confirmed Covid-19, and/or hospitalized confirmed Covid-19 patients, 50% of the participants shows they keep at least one meter away from patients, >40% two-meter that depends on location and patients under investigation. However, The rest may need closer distance should have closer distance as the requirement of patients care, in this study there were no association between working distance and the place of work of either front line, or Covid-19 centers [1][2]. those who were working in front line the distance were ranged from around 35% at one-meter and 30% two-meter according to the medical procedure needed, there as majority of the participants were youth up to 45 years of old then were was also no association  $p > 0.05$  between age and level of anxiety[11] It appears that youth usually have more encouragement and low level of anxiety, and they can tolerate stressed work (table 4).

### Required Hospitalization

Out of the total for those who got Covid-19 symptoms, only 18% required hospitalization and 22.0% had medical problems which



means at least almost 28% of health staff required hospitalization. There was no association  $p>0.05$  of whether having medical problems or not, which can lead to that regardless of staff health and age Covid-19 infection could hospitalize any patient even with if healthy, there were no association and could affect healthy even with the protection level [13].

### Conclusion

As nurses are in direct contact with patients, they are placing their own health and well-being at considerable risk. The study found that majority of the participants were compliant with infection precaution protocols and more than half of them were aware of the source of infection. However, nurses must be more accountable to protect their health and must be compliant in the standards and regulations. More awareness is needed regarding infection precaution and reducing level of anxiety.

### Conflict of Interest Statement

There is no conflict of interest.

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