

# The Relation between COVID-19 Severity and High Blood Pressure among Healthcare Workers at KAUH Jeddah, Saudi Arabia 2020-2021

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## ABSTRACT

**Background:** The World health organization declared that COVID 19 is a pandemic in March 2020. COVID 19 is presented with a variety of symptoms from mild to severe and even fatal presentation. Hypertension is a prevalent comorbidity all over the world. The connection between COVID 19 severity and presentation with high blood pressure is unknown. To our knowledge there is no published research in Saudi Arabia reported the presentation of high blood pressure in COVID 19 patients among health-care workers (HCW).

**Objective:** To assess the prevalence of presentation of high blood pressure among HCW and demonstrate its association with disease severity.

**Subjects and Methods:** This secondary data analysis was conducted in King Abdulaziz University hospital, (KAUH) in Jeddah city, Kingdom of Saudi Arabia (KSA). The study targeted all Saudi and Non-Saudi HCW and their families visiting ARI clinic for COVID-19 swab between March 2020 - March 2021. The complete records for HCW who reported blood pressure assessment were for 113 personnel. The included subjects were PCR COVID 19 positive cases.

**Results:** A total of 113 healthcare workers and/or their family members with blood pressure assessment were included in the current study. Most of them were females (56.6%) and the mean age was  $39.9 \pm 10.7$  years. Saudi patients were 22.1% of

the studied patients. Only 14.2% of them were presented with severe symptoms. The mean systolic and diastolic blood pressure were  $132.3 \pm 18.8$  and  $80.2 \pm 12.9$  mmHg and the prevalence of high blood pressure was 22.7%. The risk factors for presentation with high blood pressure were only older age and male sex by univariate and multivariable analysis irrelevant on disease severity.

**Conclusion:** The severity of COVID-19 among the healthcare workers was not associated with the elevation in blood pressure and is associated mainly with advancement of age and male gender.

**Keywords:** COVID-19, HCW, High Blood Pressure, Severity.

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## INTRODUCTION

The world health organization (WHO) has identified the current global pandemic known as COVID-19 as an international health problem that originated in Wuhan, China and spread to every country in the world.<sup>1</sup> Being coupled with COVID-19 infection may lead to further morbidities and worsen the course of the disease since high blood pressure affects various systems, can induce multiple organ failure, and can ultimately lead to death.<sup>2</sup>

Hypertension (HTN) is known to be one of the commonest non-communicable diseases worldwide with a prevalence of 31.1% in adults internationally in year 2010, with higher proportion of patients located in low and middle income countries (LMICs) in compared to high income countries (HICS).<sup>3</sup>

There are several researchers and studies confirmed that (SARS-CoV-2) uses the angiotensin converting enzyme 2 (ACE2) receptor to invade the human cell.<sup>4</sup> Knowing that ACE2 is highly abundant across body organs and expressed in many systems specially in the respiratory system, therefore there are many

speculations about the role of HTN in the pathogenesis of COVID-19.<sup>5</sup> A study conducted in China that investigated 1099 COVID-19 patients revealed they had a prevalence of HTN of 23.4% in severe cases.<sup>6</sup> Healthcare workers are the first line facing the pandemic and are the most exposed population of the society to COVID-19 infection and hypertension is the most prevalent comorbidity among adults in addition to our knowledge, the study was not conducted in Jeddah city so, this study was conducted to assess the relation between COVID-19 severity and High Blood Pressure among Healthcare Workers in KAUH.

## SUBJECTS AND METHODS

A retrospective cohort study was carried out at King Abdulaziz University hospital, (KAUH) in Jeddah city, Kingdom of Saudi Arabia (KSA). KAUH is one of the largest tertiary care and educational hospitals in Jeddah city. The study targeted all Saudi and Non-Saudi HCW and their families visiting ARI clinic for

COVID-19 swab between March 2020 -March 2021. All HCW at KAUH visiting the ARI clinic for the first time with a blood pressure reading taken at date of visit or day of admission or to be known as hypertension patient were included in the study. HCWs without a blood pressure reading or have an outdated reading were excluded from the study. The complete records for COVID 19 patients who underwent blood pressure assessment were 113 patients. Patients were classified based on their blood pressure measurements to high blood pressure and non-high blood pressure according to the WHO classification.<sup>7</sup>The data collection tools that were used in the study included the documents filled by ARI clinic nurses and written down by hand in ready templates as well as the hospital system (phoenix) to extract more data. The dependent variables included the severity of the illness, complaints of patients and the radiological findings. The independent variables included the age of the participants, their nationality, sex, swab of COVID-19, symptoms, severity of symptoms, oxygen saturation, CT chest, and CRP.

The research protocol was approved by the local Research and Ethics committee at KAUH, Jeddah, KSA. Individual consent is a prerequisite for data collection. Data was kept confidential and not be disclosed except for the study purpose. At the end of the study, the results and recommendations were submitted to the institute.

The data was collected and verified by hand then coded before entry to personal computer and checked again for outliers. Data then analyzed using SPSS statistical software package version 25. For qualitative variables, data were presented using descriptive statistics as frequencies and percentages, Chi square (or fisher's exact) was used to compare qualitative variables when possible. Quantitative variables were presented as means and standard deviations for parametric data and median (IQR) for non-parametric data and compared using independent sample t-test and Mann Whitney U test to compare 2 independent quantitative subgroups. Binary logistic regression analysis was used to predict the high blood pressure among the admitted patients. Statistical significance was considered at P-value <0.05.

**Table 1: Sociodemographic characteristics among the studied patients:**

Items	Value (no=113)	
<b>Age</b>		
Mean±SD	39.9±10.7	
Median (min-max)	38(22-69)	
<b>Sex</b>	<b>No.</b>	<b>%</b>
Male	49	43.4
Female	64	56.6
<b>Nationality</b>	<b>No.</b>	<b>%</b>
Non-Saudi	88	77.9
Saudi	25	22.1

**Table 2: Symptoms and examination of COVID-19 among the studied patients:**

Items	Value (no=113)	
<b>Symptoms</b>	<b>No.</b>	<b>%</b>
Loss of taste	3	2.7
Loss of smell	2	1.8
Cough	35	30.9
Fever	44	38.9
Shortness of breath	12	10.6
Sore throat	79	69.9
Running nose	50	44.2
Headache	44	38.9
Diarrhea	10	8.8
Nausea/vomiting	12	10.6
Abdominal pain	11	9.7
Fatiguability	74	65.5
Body ache	80	70.8
Chest pain	3	2.7
<b>Severity of symptoms</b>		
Mild	97	85.8
Moderate to Severe	16	14.2
<b>EXAMINATION</b>		
<b>Oxygen saturation (no=112)</b>		
≤95%	8	7.1
96-99%	68	60.2
100%	36	31.9
<b>Temperature at presentation (n=112)</b>		
Mean±SD	37.2±0.9	
Median (min-max)	37(36-39.7)	

**Table 3: CRP and radiological findings of COVID 19 among the studied patients:**

Items	Value (no=113)	
<b>CRP ® (no=54)</b>		
Median (IQR)	7.1(0,72.1)	
<b>CT chest (no=25)</b>	<b>No.</b>	<b>%</b>
Clear	19	76
Right side lung infiltrate	2	8
Bilateral lung infiltrate	4	16

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**Table 4: Blood pressure assessment among the studied COVID 19 patients:**

Items	Value (no=113)	
<b>Systolic blood pressure</b>		
Mean±SD	132.3±18.8	
Median (min-max)	132 (88-184)	
<b>Diastolic blood pressure</b>		
Mean±SD	80.2±12.9	
Median (min-max)	79(45-118)	
<b>Prevalence of high blood pressure</b>	<b>No.</b>	<b>%</b>
Non high blood pressure	82	72.6
High blood pressure	31	27.4

**Table 5: Association between Sociodemographic characteristics and high blood pressure among the studied COVID 19 patients:**

Items	Non hypertensive (no=82)	Hypertensive (no=31)	P-value
<b>Age</b>			0.007*
Mean±SD	35.2±8.2	41.3±10.3	
<b>Sex</b>	<b>No.(%)</b>	<b>No.(%)</b>	0.018*(X <sup>2</sup> )
Male	30(61.2%)	19(38.8%)	
Female	52(81.3%)	12(18.8%)	
<b>Nationality</b>	<b>No.(%)</b>	<b>No.(%)</b>	0.943 (X <sup>2</sup> )
Non-Saudi	64(72.7%)	24(27.3%)	
Saudi	18(72.0%)	7(28.0%)	

**Table 6: Association between severity of symptoms and oxygen saturation at admission and high blood pressure among the studied COVID 19 patients:**

Items	Non hypertensive (no=82)	Hypertensive (no=31)	P-value
<b>Severity of symptoms</b>	<b>No.(%)</b>	<b>No.(%)</b>	0.369 (FET)
Mild	72(74.2%)	25(25.8%)	
Moderate to Severe	10(62.5%)	6(37.5%)	
<b>Oxygen saturation (no=112)</b>	<b>No.(%)</b>	<b>No.(%)</b>	0.767 (X <sup>2</sup> )
≤95%	5(62.5%)	3(37.5%)	
96-99%	50(73.5%)	18(26.5%)	
100%	27(75.0%)	9(25.0%)	
<b>Oxygen saturation (no=112)</b>			0.858 (X <sup>2</sup> )
Mean±SD	98.2±2.4	98.1±1.7	
<b>Temperature at presentation (n=112)</b>			0.651 (X <sup>2</sup> )
Mean±SD	37.1±0.8	37.2±0.9	

**Table 7: Association between CRP & radiological findings and high blood pressure among the studied COVID-19 patients:**

Items	Non hypertensive (no=82)	Hypertensive (no=31)	P-value
<b>CRP ® (no=54)</b>	4.9(0,50.4)	9.3(2.7,139.3)	0.246 (MW)
Median (IQR)			
<b>CT chest (no=25)</b>	<b>No.(%)</b>	<b>No.(%)</b>	0.999 (FET)
Clear	15(78.9%)	4(21.1%)	
Right side lung infiltrate	2(100.0%)	0(0.0%)	
Bilateral lung infiltrate	3(75.0%)	1(25.0%)	

MW: Mann Whitney U non parametric test

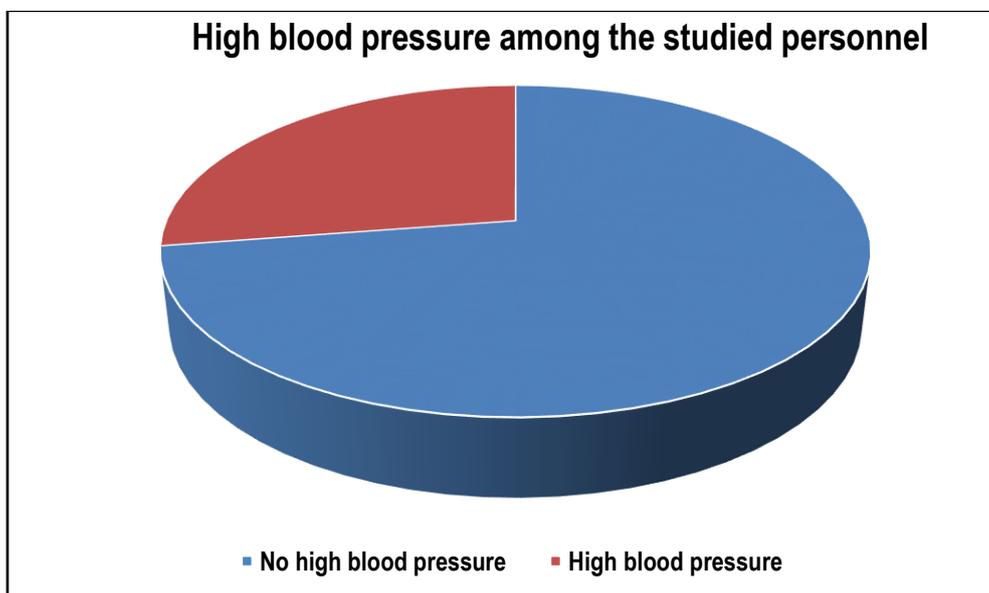
FET: Fisher's Exact test

**Table 8: Binary logistic regression analysis for prediction of high blood pressure in the studied patients presented with COVID 19 from baseline characteristics (age, sex) and disease severity of symptoms:**

Independent variables	P-value	OR	95% C.I. for OR	
			Lower	Upper
Female gender	0.014*	0.314	0.126	0.788
Age (years)	0.004*	1.074	1.023	1.127
Moderate to severe symptoms	0.829	1.146	.333	3.940

OR: Odds ratio; CI: Confidence interval; \*P-value is significant

NB: the independent variables were selected based on the statistically significant predictors detected by the univariate analysis (age & sex) and the clinically significant outcome (despite the insignificant statistically relation) in the form of severity of symptoms.



**Figure 1: Prevalence of high blood pressure among the studied COVID 19 patients**

**RESULTS**

A total of 113 healthcare workers and/or their family members with blood pressure assessment were included in the current study. Most of them were females (56.6%) and the mean age was 39.9±10.7 years. Saudi patients were 22.1% of the studied patients (Table 1). Symptoms were described in (Table 2) and 14.2% of them presented with severe symptoms. Among 25 patients who had records for CT chest, 76% had clear CT chest. The mean systolic and diastolic blood pressure were 132.3±18.8 and 80.2±12.9 mmHg (Table 4) and the prevalence of high blood pressure was 22.7% (Figure 1).

Older age was significantly associated with COVID 19 patients presented with high blood pressure (P-value=0.007). Males were significantly liable to be presented with high blood pressure in the studied patients (P-value=0.018) (Table 5).

There was insignificant difference between COVID 19 patients presented with high blood pressure and patients presented without high blood pressure regarding their severity of symptoms, oxygen saturation, CRP, CT findings (Table 6,7).

After adjustment for age, sex, and severity of symptoms for prediction of presentation with high blood pressure, it was illustrated that age and sex of the patient are the only factors affecting their presentation with high blood pressure (Table 8).

**DISCUSSION**

The epidemiological and clinical characteristics of COVID-19 have been widely described. It's interesting to note that certain

comorbidities have been linked to worse results, including increased mortality and a higher chance of infection. Hypertension is one of the most typical co-morbid conditions. It is unknown whether the intensity of symptoms or uncontrolled blood pressure are risk factors for contracting COVID-19. Even if it has no impact on susceptibility to the SARS-CoV-2 viral infection, various organizations have already emphasized that blood pressure control is still a crucial factor to take into account in order to limit disease burden.<sup>8</sup>

This study was performed on healthcare workers at Jeddah, Saudi Arabia to investigate the relation between hypertension and the severity of symptoms of COVID-19. This study revealed that the mean systolic and diastolic blood pressure were 132.3±18.8 and 80.2±12.9 mmHg and the prevalence of high blood pressure was 22.7%.

Several studies about COVID-19 infection assessed the prevalence of hypertension as a main co-morbidity to COVID-19 infection and revealed the same prevalence of elevated blood pressure. Like the study of Guan et al. about the clinical characteristics of corona virus disease in china that found the prevalence of hypertension was recorded in (15%) of cases. Also, the study of Wu et al. that studied the risk factors linked with acute respiratory distress and death in patients with coronavirus Wuhan, China reported that about (19.4%) of cases presented with elevated blood pressure. Similarly, the study of Zhou et al. and Wang et al. about the clinical characteristics of hospitalized patients admitted with coronavirus disease showed that the

prevalence of hypertension was (30.4% and 31.2%) respectively.<sup>6,9,10,11</sup>

The most common clinical presentation of COVID-19 in this study was generalized bony aches (70.8%), sore throat (69.9%), fatigability (65.5%), running nose (44.2%), fever (38.9%) and cough (30.9%). About 14.2% of them presented with severe symptoms.

The manifestations of COVID-19 infection vary from person to other and according to the strain causing infection. In France, Cough, myalgia, and fever were the most common symptoms, with 92 and 84 percent of individuals reporting at least one of these, according to the study by Jary et al.<sup>12</sup> In China the study of Wan et al. revealed that the most common symptoms and signs at the onset of illness were fever (88.9%), cough (76.5%), myalgia or fatigue (32.5%), and headache (17.7%). Less common symptoms were pharyngalgia (25.2%), dyspnea (13.3%) and diarrhea (13.3%). They also found that (29.6%) of cases showed severe symptoms.<sup>13</sup> Huang et al. compared with non-hypertensive and hypertensive patients and showed a higher severity of cases among hypertensive (24.8% vs 15.2%). Fever was the most typical symptom among all patients (81.9 percent). Cough (63.2 percent), dyspnea (52.3 percent), expectoration (19.4 percent), muscle discomfort (7.7 percent), and diarrhea (12.9 percent) were the other symptoms with the highest frequency, but headache occurred in just 12.3 percent of cases (1.0 percent).<sup>5</sup>

It is yet unknown what specific hypertension etiology could result in more severe COVID-19. The relationship between severe hypertension and cytokine imbalance could be explained by COVID-19. A growing body of clinical evidence has linked cytokine storms, such as those characterized by high levels of IL-6, interleukin-7, granulocyte-macrophage colony-stimulating factor, and tumor necrosis factor alpha, to the worsening of COVID-19.<sup>14</sup>

After adjustment for age, sex, and severity of symptoms for prediction of presentation with high blood pressure, it was illustrated that age and sex of the patient are the only factors affecting their presentation with high blood pressure. Older age was significantly associated with COVID 19 patients presented with high blood pressure. Males were significantly liable to be presented with high blood pressure in the studied patients. There was insignificant difference between COVID 19 patients presented with high blood pressure and patients presented without high blood pressure regarding their severity of symptoms, oxygen saturation, CRP, CT findings.

In accordance with our results was the Italian cross-sectional study of Iaccarino et al. who did not find hypertension as an independent factor affecting the severity and outcome of COVID-19.<sup>15</sup> Also, the study of Tadic and Cuspidi did not reveal independent effect of hypertension on severity and mortality of COVID-19.<sup>16</sup>

Unlike our results, several studies demonstrated a significant association between the severity of symptoms of COVID-19 and hypertension. Liang et al. in their meta-analysis revealed that hypertension was significantly associated with the increased risk of adverse outcomes and severity of symptoms in COVID-19 patients.<sup>17</sup> Also, the study of Bauer et al. found that in COVID-19 patients younger than 65 years of age, with diabetes, hypertension, congestive heart failure, and cancer were even more strongly associated with high risk of severe COVID-19.<sup>18</sup> In

the review performed by Peng et al. about the role of hypertension in the severity of COVID-19, they concluded that hypertension is strongly associated with elevated mortality in patients with COVID-19.<sup>19</sup>

The difference with our study could be explained as the mean age of their studies was older than 60 years which is alone considered to be a risk factor for the severity of COVID-19. In addition, some studies evaluated combined co-morbidities like DM, smoking, cancer and congestive heart diseases.

According to the age as a risk factor Huang et al. agreed with our results and revealed that compared with non-hypertensive patients, hypertensive patients were older and had a higher proportion of severe cases, and ICU admission.<sup>5</sup>

Pranata et al. demonstrated in their study that the meta-regression analysis showed that the association between hypertension and increased composite poor outcome and severity of the disease was influenced by gender revealing that males commonly influenced than females.<sup>2</sup>

Also, Escobedo-de la Peña et al. in their study reported that age and sex were major independent risk factors for the severity of the disease and the mortality associated with pneumonia caused by COVID-19.<sup>20</sup>

The connection between hypertension, gender and Renin-angiotensin-system (RAS) may be the explanation of the result. Angiotensin II type 2 receptor (AT2R) activity is higher in hypertensive females than type I receptor (AT1R), which results in a lessening of the negative effects of AT1R activation.<sup>21</sup> Male hypertension patients had higher levels of AT1R expression and activation, which is thought to contribute to vasoconstriction, a pro-inflammatory response, increased oxidative stress, and ARDS in severe COVID-19 cases. This condition provides an explanation for the higher occurrence of severe COVID-19 in males compared to females. It is hypothesized that estrogen causes the propensity for "good." Females' renin-angiotensin systems.<sup>22</sup>

In conclusion, the severity of COVID-19 among the healthcare workers was not associated with the elevation in blood pressure and is associated mainly with advancement of age and male gender. However, the study of combined associated co-morbidities to hypertension is recommended to be evaluated in further studies.

## LIMITATIONS

Shortage of documenting the full history of the patients as to be known hypertensive or not. This study can't determine the causality between severity of COVID 19 and presentation with high blood pressure but it can only report the association.

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