Prevalence and clinical aspects of post COVID-19 infection complications among population of Jeddah, Saudi Arabia

Fathi El-Gamal¹*, Ahmed Jiman², Mohammed Aljabri², Hussam Aljuhani², Asem Fadel², Nawaf Aljedaani²

ABSTRACT

COVID-19 could lead to several extra-respiratory system specific manifestations and complications. This study aimed at exploring the occurrence and determinants of post COVID-19 infection complications among the population in Jeddah city. It was a cross section study where a convenient sample of 367 subjects from the population of Jeddah city was selected. They were asked a questionnaire which provided responses on personal and socio-demographic characteristics, as well as on clinical aspects and complications of post COVID-19 infection. The SPSS (IBM, P/C, ver 25) was used to analyze the data. Logistic regression and Chi square tests of significance were employed. The level of significance was 0.05. Although 96% of the subjects were vaccinated by COVID-19 vaccinations, 50% got the infection. Having chronic morbidity was significantly associated with catching the infection. Those with hypothyroidism were about 3 times more likely to catch COVID-19 infection (OR= 3.297; 95 CI: 1.062, 10.237 and p<0.039). Vaccination by Pfizer vaccine gave more protection than other vaccine types. Completion of vaccine doses was significantly associated with decreased occurrence of COVID-19 infection. The available vaccines do not confer solid protection against it.

Keywords: COVID-19, Saudi Arabia, Post infection complications

1. INTRODUCTION

The Corona virus spreads by droplet transmission and causes acute upper respiratory syndrome. It caused pandemic, which had started in China in the year 2019 (Mukherjee et al., 2021). It produces variable symptoms such as
cough, fever and difficulty of breathing. Less commonly, it is associated with body aches, sore throat and anorexia. However, COVID-19 infection can lead to extra-pulmonary effects on other organs such as the heart and the kidney (Nkire et al., 2022; Falco et al., 2021). Several personal factors such as gender, smoking habit, as well as the sociodemographic characteristics, increase the susceptibility of the subjects to COVID-19 infection and post infection morbidity and fatalities (Ahmed et al., 2020; Wien, 2021).

COVID-19 infection can be prevented by factors such as Vitamin D supplement (Dufour et al., 2022; Michienzi and Badowski, 2020). Several vaccines against COVID-19 infection were authorized globally (Edwards and Orenstein, 2023; MOH, 2020). Although, these vaccines were effective in preventing COVID-19 infection, however, few side effects following vaccination were reported globally such as fainting attacks, blood clots formation, body ache, headache, chills and swelling and redness at the site of injection (WHO, 2023; Canning et al., 2020; Syed-Khaja et al., 2022; Elsayed et al., 2023). Sever affection could lead to cognitive deterioration (Healthcare in Europe, 2022; Mohammadyari et al., 2021).

Need for temporary circulatory support and acute myocarditis were also reported in hospitalized patients with COVID-19 infection (Ashrafi et al., 2020). Post COVID-19 infection manifestations are significantly associated with the chronic morbidity state as well as the sociodemographic state of the subject (Idiaa et al., 2022; Hama-Amin et al., 2022). The occurrence of chronic renal affection is linked with increased age (Costa et al., 2021; Asadi-Pooya et al., 2021). Thus, the aim of the present study was to determine the occurrence and determinants of post COVID-19 complications among population of Jeddah city.

2. METHODOLOGY

It was a cross-sectional study; the sampling method was a non-probability convenient one. Data were collected on Jeddah population, through electronic platform using Google form during the period August 2022 to January 25th, 2023. Sample size was determined using G*power software, where $\alpha = 0.05$, Power $= 0.95$ effect size $= 0.3$ and degree of freedom$= 5$. The minimal sample size required was 277 subjects.

A predesigned questionnaire was used to collect the data on the subjects. It provided information on: 1-Socio-demographic and personal characteristics such as age, gender, educational level, occupation and smoking habit; 2- Clinical morbid history including diabetes mellitus, cardiovascular disease, asthma, autoimmune diseases and endocrine disorders; 3- COVID-19 vaccination history of type, nature, doses and place of vaccination, in addition to post vaccination side effects; 4- COVID-19 infection history including method of diagnosis, clinical picture, course of the infection, prognosis of the infection and hospital and ICU admission due to the infection; and 5- history of post COVID-19 infection manifestations such as fatigue, cough, loss of smell and taste, cardiovascular and pulmonary disorders as well mental disorders.

The SPSS software (IBM version 25) was used. Data were typed onto SPSS files and were checked for typing errors. Different tests of significance were used to study the association between the variables such as the Chi square test of significance. Logistic regression was also used and 95% CI, as well as OR were used. The level of significance for this study was 0.05.

3. RESULTS

This study enrolled 367 subjects (17.8% males and 82.2% were females). Those who had COVID-19 infection were 50.5% of the studied subjects. COVID-19 infection was reported among different sociodemographic groups ($p > 0.05$). On the other hand, COVID-19 infection was significantly more common among unemployed subjects where $p< 0.000$ (Table 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>COVID 19 Infection</th>
<th>Total</th>
<th>X2</th>
</tr>
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<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
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<td>Male</td>
<td>32</td>
<td>1.1%</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>120</td>
<td>78.9%</td>
<td>181</td>
</tr>
<tr>
<td>Education</td>
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<td>166</td>
</tr>
<tr>
<td>level</td>
<td>&lt; University</td>
<td>34</td>
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<td>48</td>
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<tr>
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<td>Student</td>
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<td>122</td>
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<tr>
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<td>Unemployed</td>
<td>36</td>
<td>23.7%</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Manual worker</td>
<td>36</td>
<td>23.7%</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Clerical</td>
<td>16</td>
<td>10.5%</td>
<td>24</td>
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COVID-19 infection was 1.2 times more common in younger subjects compared to older ones where the p value was <0.039. Those with hypothyroidism were about 4 times more likely to catch COVID-19 infection compared to the healthy ones where OR = 3.297; 95 CI: 1.062, 10.237 and p<0.039 (Table 2).

Table 2 Logistic regression relationship between socio-demographic and morbidity variables and COVID-19 infection

<table>
<thead>
<tr>
<th>COVID-19 infection</th>
<th>B</th>
<th>Sig. (p-value)</th>
<th>Exp (B)</th>
<th>95% Confidence Interval for Exp(B)</th>
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<tr>
<td></td>
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<td>.328</td>
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<td>1.163</td>
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<td>Age</td>
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<td>.037</td>
<td>.956</td>
<td>.916</td>
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<tr>
<td>Gender</td>
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<td></td>
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<tr>
<td>Male</td>
<td>.398</td>
<td>.223</td>
<td>1.490</td>
<td>.785</td>
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<tr>
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<td>.602</td>
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<td>University of higher</td>
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<td>.482</td>
<td>.158</td>
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<td>1.505</td>
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<tr>
<td>Marital status</td>
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<td></td>
</tr>
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<td>Bachelor/bachelorette</td>
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<td>.210</td>
<td>.034</td>
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<tr>
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<td>.403</td>
<td>.084</td>
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<td>.196</td>
<td>.018</td>
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<td>.341</td>
<td>1.556</td>
<td>.627</td>
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<td>1.929</td>
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<td>Non-smoker</td>
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</table>
No significant association was found between having chronic diseases such as Diabetes, vitamin D deficiency, hyperthyroidism, heart diseases, CKD, taking multivitamins and COVID-19 infection (p >0.05). On the other hand, COVID-19 infection was significantly more associated with autoimmune disease, asthma, liver disease or chronic allergy (Tables 3).

Majority of the enrolled subjects received COVID-19 vaccination (95.9%). COVID-19 infection was significantly more common among non-vaccinated subjects (p<0.002). Pfizer vaccine gave significantly more protection than other types (p <0.05). Completion of vaccine doses was significantly associated with decreased infection with COVID-19 virus. Greater proportion of the subjects had got the vaccine after they got infected with COVID-19. Side effects after vaccination were discomfort at the site of inoculation (91.6%), fever (48.7%), muscle aches (55.9%) and Joint pain (43.5%) (Table 4).

### Table 3 Association between COVID-19 infection and having chronic diseases

<table>
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<tr>
<th>Variable</th>
<th>Categories</th>
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<th>X2 (p)</th>
</tr>
</thead>
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<td></td>
<td></td>
<td>Yes %</td>
<td>No %</td>
<td>No %</td>
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<td>Yes</td>
<td>-.415</td>
<td>.499</td>
<td>.660</td>
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<td>No</td>
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<td></td>
<td></td>
</tr>
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<td>Diagnosed with Hypertension</td>
<td>Yes</td>
<td>.099</td>
<td>.859</td>
<td>1.104</td>
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<td></td>
<td>No</td>
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<td></td>
</tr>
<tr>
<td>Diagnosed with Vitamin D deficiency</td>
<td>Yes</td>
<td>-.015</td>
<td>.954</td>
<td>.985</td>
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<tr>
<td></td>
<td>No</td>
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<td></td>
</tr>
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<td>Yes</td>
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<td>.773</td>
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</tr>
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<td>No</td>
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<td>1.193</td>
<td>.039</td>
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<td></td>
</tr>
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<td>.876</td>
<td>.901</td>
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<td>.650</td>
<td>.574</td>
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</tr>
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<td>.294</td>
<td>.734</td>
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<td>No</td>
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<td></td>
</tr>
<tr>
<td>Take Vitamin D</td>
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<td>.139</td>
<td>.625</td>
<td>1.149</td>
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<td>Take multi-vitamins</td>
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<td>Total</td>
<td>X2 (p-value)</td>
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<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
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<td>8</td>
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<td>Heart diseases</td>
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<td>3</td>
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</tr>
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<td>211</td>
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Table 4 Relationship between Covid-19 infection and Vaccination
Fever after vaccination

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<td>69</td>
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<td>109</td>
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Nausea after vaccination

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<th>101</th>
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<th>259</th>
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<th>(0.379)</th>
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<td>7.9%</td>
<td>7</td>
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<td>200</td>
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Vomiting after vaccination

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<td>7</td>
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<td>96.6%</td>
<td>329</td>
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Muscle ache after vaccination

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<td>44.3%</td>
<td>91</td>
<td>44.0%</td>
<td>153</td>
<td>44.1%</td>
<td>(0.952)</td>
<td></td>
</tr>
</tbody>
</table>

Joint pain after vaccination

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>101</th>
<th>72.1%</th>
<th>158</th>
<th>76.3%</th>
<th>259</th>
<th>74.6%</th>
<th>(0.379)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>64</td>
<td>45.7%</td>
<td>87</td>
<td>42.0%</td>
<td>151</td>
<td>43.5</td>
<td>0.461</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>76</td>
<td>54.3%</td>
<td>120</td>
<td>58.0%</td>
<td>196</td>
<td>56.5%</td>
<td>(0.497)</td>
<td></td>
</tr>
</tbody>
</table>

Majority of the COVID-19 cases were diagnosed by PCR analysis (57.4%), particularly among those who were less than 40 years of age (p<0.05). A small proportion of the infected subjects (9.6%) needed admission to hospital, mainly those over 40 years or those less than 20 years of age (p <0.05). A very small proportion of the studied subjects mainly among those aged 40 years or more needed admission to ICU (Table 5).

Table 5 Association between age in years and method of diagnosis and fate of the infection

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>Age in years</th>
<th>Total</th>
<th>X2 (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt; 21</td>
<td>21-40</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Method of diagnosis</td>
<td>Self-diagnosis</td>
<td>12</td>
<td>27.9%</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Clinical diagnosis</td>
<td>6</td>
<td>14.0%</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>PCR</td>
<td>25</td>
<td>58.1%</td>
<td>44</td>
</tr>
<tr>
<td>Cured from COVID-19</td>
<td>Yes</td>
<td>39</td>
<td>90.7%</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>4</td>
<td>9.3%</td>
<td>3</td>
</tr>
<tr>
<td>Admission to Health center</td>
<td>Yes</td>
<td>7</td>
<td>16.7%</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>35</td>
<td>83.3%</td>
<td>68</td>
</tr>
<tr>
<td>Admission to ICU</td>
<td>Yes</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>8</td>
<td>100.0%</td>
<td>8</td>
</tr>
</tbody>
</table>

Persistent fatigue (55.9%), arthritis (47.6%); headache and loss of smell (42.8% and 42.1% respectively) were some of the post COVID-19 infection complications. These symptoms were similar among all age groups except for headache which was significantly more in those younger than 20 years old (p <0.05). Loss of taste (30.3%) was also present in all groups of age (p> 0.05).

Depression and anxiety (35.2% and 26.2% respectively), as well as post-traumatic stress (11%) were found among all age groups. Dyspnea and cough (25.5% and 22.8% respectively) and fever (11%), were also reported by all age groups. Dysrhythmia was reported by 12% of the subjects mainly those older than 40 years of age. Lung fibrosis was reported by 1.4% of the subjects mainly among those who were over 40 years of age (Figure 1). Coughing, blurring of vision and lung fibrosis was significantly more encountered among older subjects where the p value was less than 0.05 (Table 6).
Figure 1 Post COVID-19 infection complications

Table 6 Relationship between Post- COVID complications and age groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>Age in years</th>
<th>Total</th>
<th>X2 (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&gt;21</td>
<td>21- 40</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Yes</td>
<td>24</td>
<td>58</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>17</td>
<td>41.5</td>
<td>31</td>
</tr>
<tr>
<td>Arthritis</td>
<td>Yes</td>
<td>20</td>
<td>48.8</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>21</td>
<td>51.2</td>
<td>39</td>
</tr>
<tr>
<td>Headache</td>
<td>Yes</td>
<td>23</td>
<td>56.1</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>18</td>
<td>43.9</td>
<td>44</td>
</tr>
<tr>
<td>Fever</td>
<td>Yes</td>
<td>7</td>
<td>17.1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>34</td>
<td>82.9</td>
<td>63</td>
</tr>
<tr>
<td>Coughing</td>
<td>Yes</td>
<td>4</td>
<td>9.8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>37</td>
<td>90.2</td>
<td>48</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>Yes</td>
<td>12</td>
<td>29.3</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>29</td>
<td>70.7</td>
<td>52</td>
</tr>
<tr>
<td>Blurry vision</td>
<td>Yes</td>
<td>6</td>
<td>14.6</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>35</td>
<td>85.4</td>
<td>62</td>
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<tr>
<td>Brain fog</td>
<td>Yes</td>
<td>9</td>
<td>22.0</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>32</td>
<td>78.0</td>
<td>55</td>
</tr>
<tr>
<td>Loss of smell</td>
<td>Yes</td>
<td>18</td>
<td>43.9</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>23</td>
<td>56.1</td>
<td>43</td>
</tr>
<tr>
<td>Loss of taste</td>
<td>Yes</td>
<td>12</td>
<td>29.3</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>29</td>
<td>70.7</td>
<td>50</td>
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<tr>
<td>Anxiety</td>
<td>Yes</td>
<td>11</td>
<td>26.8</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>30</td>
<td>73.2</td>
<td>54</td>
</tr>
<tr>
<td>Depression</td>
<td>Yes</td>
<td>17</td>
<td>41.5</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>24</td>
<td>58.5</td>
<td>46</td>
</tr>
<tr>
<td>Post Traumatic Stress</td>
<td>Yes</td>
<td>5</td>
<td>12.2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>36</td>
<td>87.8</td>
<td>61</td>
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<tr>
<td>Dyssrhythmia</td>
<td>Yes</td>
<td>3</td>
<td>7.3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>38</td>
<td>92.7</td>
<td>60</td>
</tr>
<tr>
<td>Heart</td>
<td>Yes</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
</tbody>
</table>
Inflammation | No | 41 | 100.0 | 69 | 100.0 | 34 | 97.1 | 144 | 99.3 | (0.205) 
Lung Fibrosis | Yes | 0 | 0.0 | 0 | 0.0 | 2 | 5.7 | 2 | 1.4 | 6.374 | (0.041) 
 | No | 41 | 100.0 | 69 | 100.0 | 33 | 94.3 | 143 | 98.6 | 
Diabetes | Yes | 0 | 0.0 | 0 | 0.0 | 1 | 2.9 | 1 | 0.7 | 3.136 | 
 | No | 41 | 100.0 | 58 | 100.0 | 34 | 97.1 | 143 | 99.3 | 

4. DISCUSSION

The aim of the present research was to explore the burden of COVID-19 infection among the population of Jeddah city, SA. COVID-19 infection is more common in males than in females (Mukherjee et al., 2021). This is not in line with findings from the present study. Low economic status has been highlighted as a factor affecting vulnerability to COVID-19 infection. Patients with a low economic status are more likely to reside in unhealthy environments with poor hygiene. However, in the present study we found no such an association. In the present study unemployed subjects were more vulnerable to infection (Nkire et al., 2022).

This is not in line with previous study. Smoking tobacco produces exhaled smoke, coughing or sneezing, aerosols containing SARS-CoV-2 in the surroundings and contaminating surfaces (Falco et al., 2021). However, in the present study smoking was not associated with COVID-19 infection. The prevalence of DM is high among hospitalized COVID-19 (Healthcare in Europe, 2022). This is not in line with the present study. COVID-19 exaggerates cardiovascular complications by promoting arterial and venous thrombosis through inducing inflammation, activating platelets and causing vascular dysfunction and blockade (Ashrafi et al., 2020).

In the present study hypertension was not associated with increased COVID-19 infection. Vitamin D is important for increasing the immunity of the body for COVID-19 infection (Ahmed et al., 2020). There is no scientific evidence that patients with poorly controlled thyroid disorders are more likely to contract COVID-19. However, those with uncontrolled thyroid dysfunction and particularly those with thyrotoxicosis are likely to be at higher risk of infection-related comorbidities, for example, a cytokine storm (Wien, 2021).

This is in line with findings from the present study. Several bodily systems are under the control of the thyroid gland hormones, so viral infection could adversely affect its functions and hence function of many human cells, such as the receptors of the olfactory nerve (Dufour et al., 2022). Hypothyroidism was significantly associated with COVID-19 infection. The impact of acute COVID-19 on people with asthma appears complex, being moderated by multiple interacting disease-specific, demographic and environmental factors. Research regarding longer-term effects in this group is limited (Michienzi and Badowski, 2020).

Asthma in the present study predisposed to infection with COVID-19. Majority of the subjects in our study received COVID-19 vaccine. The WHO, (2023), Edwards and Orenstein, (2023) and MOH, (2020) maintains an updated list of vaccine candidates under evaluation. The common reported adverse effects of COVID-19 vaccination consist of the injection site’s local reaction followed by several non-specific vague symptoms. However, cerebral venous sinus thrombosis and immune thrombotic thrombocytopenia after vaccination were reported (WHO, 2023; Canning et al., 2020). This is in line with findings from the present study.

In the present study fatigue, arthritis and headache, fever and coughing were commonly encountered among the patients. This is in line with other studies (Healthcare in Europe, 2022; Jdiaa et al., 2022). Poor mental health such as depression, anxiety, post-traumatic stress, low motivation, fatigue, low mood and disturbed sleep usually accompany having severe COVID-19 infection (Mohammadyari et al., 2021). This is in line with findings from the present study.

Blurry vision, dysrhythmia and dyspnea and lung fibrosis were found in post COVID-19 infection. This is in line with other studies (Ashrafi et al., 2020; Jdiaa et al., 2022). Previous studies revealed that COVID-19 infection was associated with loss of taste and/or smell. This is in line with other studies (Costa et al., 2021; Asadi-Pooya et al., 2021).

Limitations

There are some limitations to this study: As this study is cross-sectional, the causal relationship remains unknown and we do not know if the effects of these variables on post COVID-19 infection during the COVID-19 pandemic will persist in the long term. It is also a nonprobability convenient sample and its generalization to the population may be defective; however, it is an exploratory study.
5. CONCLUSION AND RECOMMENDATIONS

COVID-19 is characterized by post infection both pulmonary and extra-pulmonary complications. Although there are several vaccines developed against it; these vaccines do not give solid protection; therefore, personal hygiene and measures to prevent airborne transmission are mandatory to be adopted.

Acknowledgments
We thank all the participants for their cooperation throughout the study.

Author Contributions
FG contributed to study design, analyzing data and writing the first original draft. AJ, MA, HA, AF and NA contributed to collecting data and writing the draft.

Institutional Review Board Statement
The study was approved by the Institutional Review Board of Ibnsina National College for medical studies (No.: H-07-09062021, approval date: 9 – 6- 2021).

Informed Consent Statement
All enrolled subjects gave their consent to participate in the study.

Funding
This study has not received any external funding.

Conflict of interest
The authors declare that there is no conflict of interests.

Data and materials availability
All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES AND NOTES


