ECRONICON OPEN ACCESS

EC PULMONOLOGY AND RESPIRATORY MEDICINE

Literature Review

Distribution of COVID-19 among King Abdul-Aziz International Airport Employees during a Period from March to August 2020

Heba Ahmed Shalabi[1]* and Eman Elsayed Abd-Ellatif[2,3]

[1]Department of Epidemiology, King Saud University, Saudi Arabia

[2]Ministry of health, Saudi Arabia

[3]Department of Public Health and Community Medicine, Faculty of Medicine, Mansoura University, Egypt

***Corresponding Author**: Heba Ahmed Shalabi, Department of Epidemiology, King Saud University, Saudi Arabia.

Received: July 21, 2021; **Published:** July 31, 2021

Abstract

Background: Since the beginning of COVID-19 pandemic, many sectors are at high risk of catching the infection. Airport workers are in direct contact with travelers from all over the world and the possibility of catching the infection is high. Hence, the main objective of this study is to determine the prevalence of COVID-19 among King Abdul-Aziz airport workers from March to August 2020 and asses the burden and the prognosis of the diseases among these workers.

Methodology: We conducted a cross-sectional study. Socio-demographic data were retrieved from the Health Electronic Surveillance Network (HSEN) in addition to the airport's database about the employees. Clinical data about the disease, complication, and comorbidities were retrieved personally from the patient via a telephone-based interview. Data were analyzed using SPSS and statistical significance was set at $p < 0.05$.

Results: We identified 767 patients with a mean age of 40 years (SD ± 7). 737 (96.1%) of the participants were males and 29 (3.9%) were females. 79 workers were Saudi (10.3) and the remaining (89.7%) were non-Saudi. The majority of the participants (52.2%) worked at Ground Services. The prevalence of COVID-19 among King Abdula-Aziz airport workers was 74.8% (573/767). Most of the cases were infected between May (21.8%), August (19.0%), and March (18.5%). Out of the 142 patients who were admitted to the hospital, 10 patients entered the ICU and 3 deaths were reported with a cases fatality rate = 0.52%. (4.4%), (5.6), and (3.8%) reported cardiac, respiratory, and renal complications, respectively. There was a statistically significant relationship between the age, and the sex of the participants and the possibility of catching an infection ($P = 0.027$), ($P = 0.049$), respectively. Also, there was a statistically significant correlation between hypertension, diabetes, and asthma and the development of cardiac, respiratory and renal complications in COVID-19 patients.

Conclusion: Airport workers were highly exposed to the infection, and strict procedures should have been executed to contain the pandemic and decrease its distribution. Patients that were older with a history of chronic diseases were at higher risk. Hence, they should have paid much more attention to decrease their chance of having the infection.

Keywords: *COVID-19; King Abdul-Aziz Airport Workers; Health Electronic Surveillance Network (HSEN)*

Introduction and Literature Review

In December 2019, Wuhan city, Hubei province, China. Several patients presented to the local hospitals of the city with symptoms of pneumonia of unknown origin. Many of the confirmed cases gave a history of direct contact with live animals in the seafood market of the city. It took about a month until China notified the World Health Organization (WHO) of an outbreak of an unknown virus causing pneumonia. A week later, the virus was isolated from the samples and identified as a new species that belong to the coronavirus's family. Later, it was called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. The Coronaviruses family is a family of single-stranded positive-sense RNA characterized by the presence of an envelope carrying certain spikes which give the characteristic crown-like appearance of the virus under the electron microscope hence its name [2]. The family is subdivided into four main subclasses, alpha, beta, gamma and delta groups. The beta group contains the viruses isolated from the bats which act as their natural hosts. The SARS-CoV-2 carries almost 90% genetic similarity to the beta species isolated from the bats this supporting the hypothesis that SARS-CoV2 is a mutated form of bat coronaviruses [3,4].

Transmission of SARS-CoV2

According to the genetic similarity between SRAS-CoV2 and other viruses from the same family like SARS-CoV1 and MRES CoV (Middle East Respiratory Syndrome Coronavirus), Many researchers suppose that SARS-COV2 is transmitted to human via an intermediate host like the other members of the family. In case of MERS-CoV the intermediate host was identified as the camels and palm civets for SARS-CoV1. However, it was suggested that pangolins are the intermediate hosts for the new SARS-CoV2 [1,5]. The WHO identified three main classes of transmission. Scattered transmission which includes involvement of a small number of cases identified locally. Cluster transmission include population that belong to the same geographic distribution or experienced the same exposure, and community transmission which refers to the places with higher rates of outbreaks [6]. Human-to-human transmission has been established and several methods have been described. The most important methods are direct transmission of the organisms from an infected person and direct contact with surfaces harboring the virus. In the first condition, the patient releases several droplets contaminated with the virus via coughing or sneezing. The virus particles can stay in the air for a long period of time and transmit for a distance exceeding 1m [7]. Furthermore, the virus can survive for long time on the surfaces. Hence, it can be transmitted via direct contact with contaminated surfaces like beds, devices, tables or even during shaking contaminated hands [8]. Other studies pointed to the susceptibility of water transmission. Heever, there is no solid evidence about the claim. In addition, intestinal manifestations like nausea, vomiting, diarrhea and acute hepatitis have all been reported with SARS-CoV2. However, there was also no solid evidence of fecal-oral transmission [8,9].

Pathogenesis and immune response

Because of the molecular mimicry between SARS-CoV1 and SARS-CoV2, the two viruses share similar surface proteins called S1 and S2. The S1 protein is responsible for binding to certain surface receptors called Angiotensin-Converting Enzyme 2 (ACE2) which present on the cell membrane of respiratory epithelium, pneumocytes, alveolar cells, and the pulmonary cells responsible for production of the surfactant. The S2 protein allows the virus envelope to fuse with the cell membrane and facilitates the entry of the viral particles to the cells [10,11]. Upon entering the cytoplasmic environment, the virus produces certain proteins which inhibit Type I interferon (The main inhibitor of intraocular antiviral activity), thus escaping the innate immune response of the human body and facilitate the viral replication cycle [12]. Studies reported a significant increase in the level of proinflammatory cytokines especially Interleukin 1, 6 and 12 (IL1, IL6, IL12), Interferon γ (INF- γ), Monocyte Chemoattractant Protein-1 (MCP-1), and Macrophage Inflammatory Proteins-1 (MIP-1). These cytokines mediate most of the reported complications associated with SARS-CoV2 especially Acute Respiratory Distress Syndrome (ARDS) and septic shock [13].

Upon replication of the virus into the cells, certain incubation period passes and symptoms start to appear to producing a disease called Corona Virus Diseases-2019 (COVID-19) [14].

Clinical manifestations and complications

A wide spectrum of manifestations has been reported starting from asymptomatic patients to the level of ARDS. However, the most frequently reported symptoms are dry cough, sore throat, fever, dyspnea, myalgia and chest pain [15]. Moreover, gastrointestinal manifestations have also been described in COVID-19. Some of the most common intestinal manifestations are vomiting, diarrhea, GIT upset and acute viral hepatitis [16]. The previously mentioned respiratory symptoms are often associated with mild cases. However, respiratory symptoms can complicate with interstitial and alveolar pneumonia, ARDS and respiratory failure [17].

Several studies discussed the extra-pulmonary complications of COVID-19. Goldriach., *et al*. studied 400 patients diagnosed with CODVID-19. He found out that the diseases induces a severe inflammatory process within the cardiac muscle causing a dysregulation of the heart rate and impermanent of cardiac function of car, the net result of myocarditis are arrythmia and heart failure [18]. Zhu., *et al*. also reported similar results about the effect of CODVID-19 on the cardiac muscle. They discussed the mechanisms by which the virus causes cardiac damages and identified several mechanisms including direct viral entry via ACE-2, cytokine-mediated injury and hypoxia-induced injury of the myocytes [19]. Moreover, vascular complications are also reported in the literature. Kollias., *et al*. reported an increased susceptibility to Venous Thromboembolisms (VTEs) and higher D-dimer levels in patients with severe COVID-19. They are also more susceptible to develop Disseminated Intra-vascular Coagulopathy (DIC) Hence, administration of anticoagulant therapy is a mandatory step in the management of severe cases [20]. Neurological manifestations have also been described in COVID-19 patients. The spectrum of manifestations ranges from loss of the main special sense like smell, taste or vision to the level of seizures, strokes and encephalopathy [21,22]. Studies also discussed the effect of the virus of the kidney. Almost 30% of hospitalized individuals because of COVID-19 are on dialysis and their laboratory results showing different degree of hematuria and/ or proteinuria suggesting a degree or renal failure [23,24]. The virus also precipitate thrombocytopenia by three mechanisms: A- direct impairment of the hematopoietic stem cells, B-damage of the megakaryocytes as a complication of alveolar damage, and C-endothelial damage and platelet aggregation which complicates by clotting and formation of multiple VTEs [25].

Diagnosis

According to the WHO [26], the case definition basically classifies the conditions into three main levels:

- A-suspected cases includes three conditions. 1- Patients with severe cough, fever and hospital admission suggesting severe acute respiratory diseases. 2- No etiology fully explains the condition. 3- Previous history of direct contract with infected patient or traveling back from an endemic country like China or working in a health-care facility like hospitals or clinics.
- Probable case: Tested positive using Pan-coronavirus assay without laboratory findings.
- Confirmed case: A patient with confirmed laboratory and radiological findings irrespective to the clinical signs or symptoms.

For the previously mentioned patients who mee the diagnostic criteria, oropharyngeal or nasopharyngeal swab must be taken and Real Time PCR (RT-PCR) is used to determine the presence and the quantity of the viral load [27].

Although PCR is considered the gold standard method, laboratory investigation can be useful in determining the diagnosis and the prognosis of the condition. Patients with mild symptoms are usually associated with lymphopenia, elevated lactate dehydrogenase and prolonged prothrombin time. Also, they may have elevated C-reactive protein (CRP), Erythrocyte sedimentation Rate (ESR), and elevated level of proinflammatory cytokines [27]. Radiological findings are more reliable and the most often used technique to diagnose the condition because of the high costs of PCR tests. Computed Tomography (CT) usually shows bilateral infiltrates with ground-glass opacities and sub-segmental consolidation of the lung tissue [28]. All of these test are adopted in the diagnosis of COVID-19 patients. However, not all of these tests must give conclusive results separately but the approach of diagnosis depends on combining all of the available data to support one another in order to reach the final diagnosis.

Treatment

Management of the condition is mainly symptomatic and supportive and depends on the level of affection. Mild cases are usually treated with Antipyretic and antitussive agents, together with antibiotics for secondary bacterial infections in addition to maintaining a state of adequate nutrition, fluid replacement and complete isolation of the patient. Hypoxic patients should be managed with O_2 administration via nasal prongs or mask or even mechanical ventilation in severe cases [2]. Adjuvant therapy is also recommended. It consists of zinc, vitamin D, and C, azithromycin and corticosteroids [17]. Detailed clinical guiltiness for the management of critical cases have been published by the WHO [29].

Risk factors

Zheng., *et al*. performed a systematic review to identify the main predisposing factors that worsen the prognosis of the condition and increase its complications. They concluded that complications are more likely to happen among males than females, older people (Above 65 years) than younger one and more likely to develop among smokers or people with chronic diseases like hypertension, diabetes, obesity, chronic renal failure, cardiac disorders or chronic respiratory conditions like asthma [30]. Their findings also came consistent with the findings reported by Wolff et who discussed similar risk factors [31].

In spite of the previously mentioned findings, no literature, to the best of our knowledge, discussed the risk factors of catching the infection and the role of chronic diseases in increasing the susceptibility of the patient to get infected. Hence, the main objective of this thesis is to determine the role of chronic diseases and its effect of the rate of infection. We will also determine the effect of chronic disease of the prognosis of the condition as a secondary objective.

Epidemiology of COVID-19 worldwide and in KSA.

Up until this moment (December 29th, 2020), the World Health Organization (WHO) estimates that the total number of infected cases worldwide is 79,673,754 including 1,761,381 deaths. United States of America (USA)comes as first country with the highest number of cases (18,827,300). The total number of confirmed cases in KSA is 362.220 with 6185 deaths. The country comes in third place after Iraq and Morocco in the number of infected cases [32]. The highest cumulative numbers were recorded in Riyadh, Mecca, Jeddah, and Al Madinah Al Munawwarah [33]. Studies showed that the condition is more prevalent among males than females and also among adults than children [34]. Al Mutair., *et al*. studied the condition at the beginning of the pandemic and reported that males are four times infected than females. He also reported that the mean age of the infected patients is 38.6 years old [35]. Al tawfiq., *et al*. in an early stage of the pandemic, also discussed the number of returning travelers in quarantine facilities who tested positive and reported that 1.2% (23 cases out of 1928) tested positive after two successive swabs [36]. Several papers discussed the precautionary measures that need to be achieved by the kingdom to decrease the rate of infection and prevent the widespread of the condition. Al-Rasheed., *et al*. developed a mathematical model that assesses the effect of certain factors on the development of the condition. They concluded that social distancing, schools and mosques closures, domestic flight shutdown and curfews are the decisive factors that can decrease the spread of the condition [37]. Perveen., *et al*. [38] have discussed detailed measurement followed by all sectors in the kingdom to prevent the widespread of the condition. A- A wide collaboration between all the ministries of the kingdom to follow the guideline published by the Saudi Center of Diseases Control (CDC) Mistry of Health. An important initiative is "TAWAKALNA" app developed by the National Information Center to give an updated idea about the current number of cases and the most infected regions. Also, it allows the citizens to request permission in cases of curfew. Another pillar in the management of the pandemic is the Saudi CDC which is responsible for spreading awareness among the citizens, informing the current number of infected cases, preventing the spread of the diseases, and management of the diagnosed cases. Further guidelines that discuss the measures to follow in every sector and place (For example houses, hospitals, workplaces, community gatherings, schools, and mosques) were also detailed in the study. As previously mentioned, there is a good number of papers that discussed the epidemiology of COVID-19 in KSA [34,39,40]. However, none of these papers discussed the burden of the condition in certain sectors like the airport workers.

Objectives of the Study

Our main objective is to:

- Determine the distribution of COVID-19 among King Abdul-Aziz international airport employees.
- Define the risk factors for catching the infection.
- Assess the prognosis and the complications of COVID-19 among the airport workers especially those with chronic comorbidities.

Methodology

Study participants and setting

A Surveillance-based cross-sectional study was conducted including the total number of employees at King Abdul-Aziz International airport during a period from March to August 2020, Jeddah, KSA. A number of 765 employees were enrolled in the study.

Data collection

Data were collected using Health Electronic Surveillance Network (HESN), which is a comprehensive and flexible online-based platform aiming at accommodating Saudi programs for public health to facilitate date collection and allow public health professional to collect data, predict the distribution of the diseases, and prevent and control the distribution of the diseases and providing decision makers with evidence-based results [41].

The sociodemographic characteristics and the information about the airport workers, their residencies, and the sectors of works were available on HESN and the airport's excel sheet database retrieved from the airport's database. However, the other information about the comorbidities, complications of COVID-19 and the prognosis of the cases were collected personally from each participant via a telephone-based interview.

Ethical Approval

The study procedures were reviewed and approved by the Research Ethics Committee (REC), the unit of Biomedical ethics- KAUH. The objectives and procedures of the study were explained to the precipitants and they were told that their participation was completely voluntarily.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0.

Categorical variables were described using frequencies and percentages, continuous variables were described using mean and standard deviation (SD).

Inferential statistics were performed. P-value was considered statistically significant at $P < 0.05$.

Results

Descriptive statistics

Demographics and baseline characteristics

A total number of 767 workers participated in the study. Among these participants 96.1% (n = 737) were male and 3.9% (n = 29) were female. The mean age of the percipients was 40 (SD = 7.8) years. 206 (26.9) aged between 25 - 35 years, 282 (36.8%) aged between 35:45 years, and 279 (36.4%) aged 45:55 years. 79Workers (10.3%) were Saudi and the remaining workers were non-Saudi (89.7%). Most of them were Indian (272 Worker, 35.5%), Filipino (124 Worker = 16.2%), Bangladesh (115 Worker = 15%), and Nepali (86 Worker = 11.2) (Table 1).

Feature		Frequency	Percentage
Sex	Male	737	96.1%
	Female	30	3.9%
Age	25:35 Years	206	26.9%
	35:45 Years	282	36.8%
	45:55 Years	279	36.4%
Nationality	Indian	272	35.5%
	Filipino	124	16.2%
	Bangladesh	115	15.0%
	Nepali	86	11.2%
	Saudi	79	10.3%
	Pakistani	38	5.0%
	Rai-Lankan	28	3.7%
	Egyptian	12	1.6%
	Other	11	1.4%
	Sudanese	2	.3%

Table 1: *The main sociodemographic characteristics of the participants.*

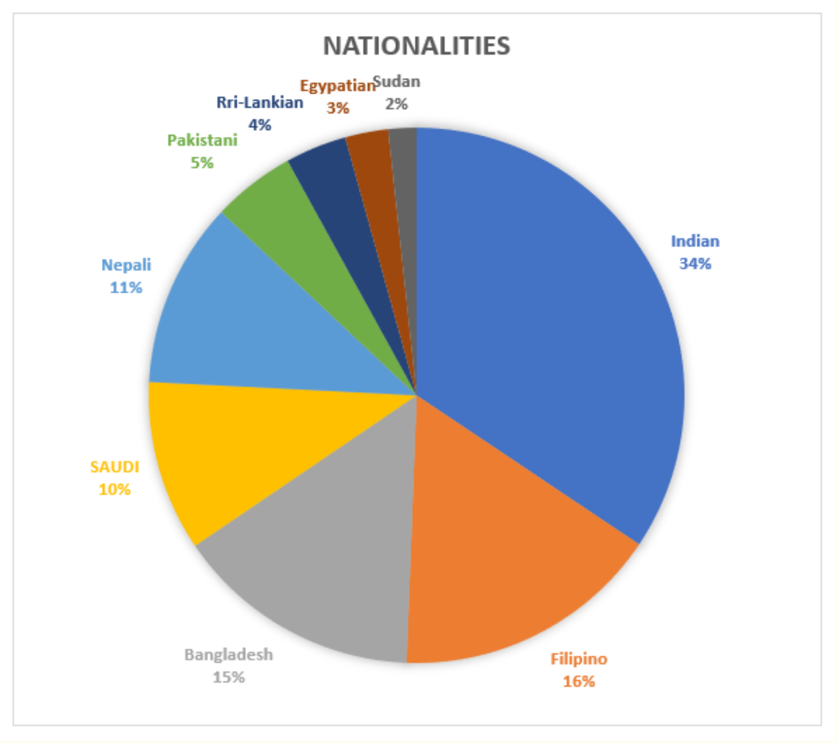

Figure 1: *Illustrating the nationalities of the employees.*

The majority of the participants (52.2%) worked at the ground services, construction (19.7%), and airport supplies (6.9%). While other workers belonged to the private aviation (4.0%), transportation services (3.9%), and engineering industry (3.0%) (Table 2).

Sector of work	Positive	Negative	Total percentage
SGS	303	97	52.2%
Construction	97	54	19.7%
Supplies	53	0	6.9%
Private Aviation	10	21	4.0%
Transportation Services	29	1	3.9%
Engineering industry	17	6	3.0%
Airport Public Health	21	0	2.7%
Air fuel	20		2.6%
Restaurant	8	0	1.1%
Other	27	3	3.9%

Table 2: *The mains sectors of the airport workers.*

In addition, most of the participants lived in Al-Hamadanyah District (20.2%), RAWSEL Hotel (173%), and IWAA- camp (15.1%) (Table 3).

Residency	Number	Percentage
Al-Hamadanyah District	155	20.2%
RAWSEL-hotel	133	17.3%
IWAA-camp	116	15.1%
Other places.	56	7.3%
Heraa Street	55	7.2%
Alsaad Palace	49	6.4%
Al-Ajaweed	39	5.1%
Bani-Malek	31	4.0%
Al-Rayan District	28	3.7%
Al-Hamraa	27	3.5%
Al-Atyaf hotel	20	2.6%
Al-Nozha	14	1.8%
Al-Samir District	14	1.8%
Recovery Area	11	1.4%
Alnoaima	10	1.3%
Al-Safa district	9	1.2%

Table 3: *The main residencies of the participants.*

Prevalence and complications of COVID-19 among airport workers

Out of the total 767 workers who participated in the study, 459 (59.8%) infected and 114 (14.8%) suspected workers gave positive results upon taking their samples. The total prevalence of COVID-19 among King Abdul-Aziz airport workers was 74.8% (Table 4).

Status	Sample confirmation	Frequency	Percentage	Total
Infected (Primary)	Positive	459	59.8%	74.8%
Suspected (Secondary)	Positive	114	14.8%	
	Negative	194	25.2%	25.2%

Table 4: *Prevalence of COVID-19 among King Abdul-Aziz airport workers.*

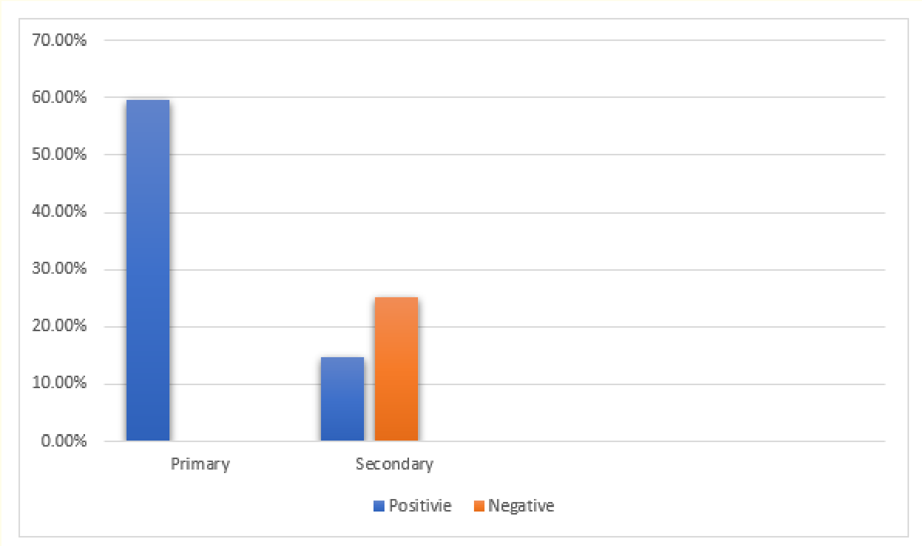

Figure 2: *The Prevalence of COVID-19 among King Abdul-Aziz airport workers.*

Number of positive cases per month

At the first month of collecting the sample, March, there was 142 positive cases, followed by 112 in April, 167 in May,66 in June, 134 in July, and 146 cases in August (Table 5).

Month	Frequency of positive cases	Percentage
March	142	18.5%
April	112	14.6%
May	167	21.8%
June	66	8.6%
July	134	17.5%
August	146	19.0%

Table 5: *The number of cases per month.*

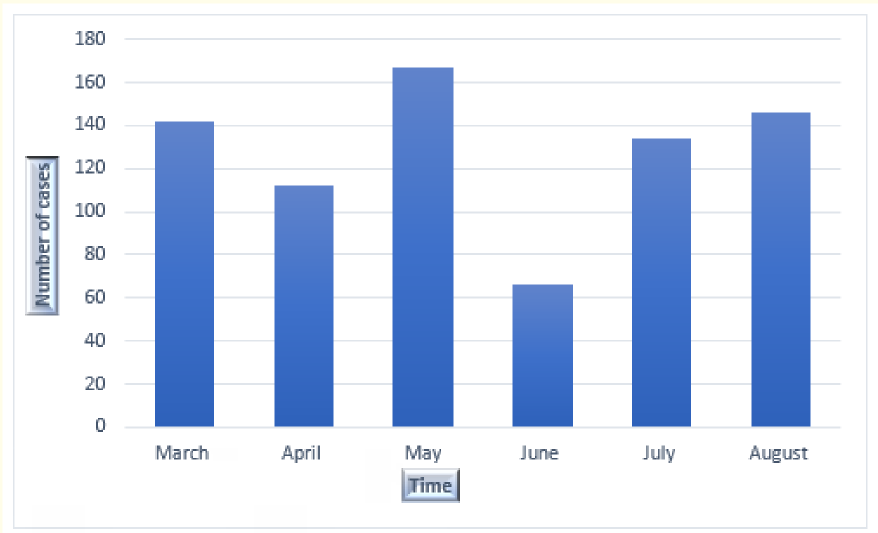

Figure 3: *Epidemiological curve on the number of cases per month.*

34 (4.4%) Workers gave a history of cardiac complications, 43 (5.6%) reported some respiratory complications, and 29 (3.8%) had renal complications (Table 6).

Feature	COVID-19 Positive	Negative	Total Percentage
Cardiac complications	24	10	4.4%
Respiratory Complications	42	1	5.6%
Renal Complications	26	3	3.8%

Table 6: *Prevalence of comorbidities among King Abdul-Aziz airport workers.*

Site of isolation and outcome of cases

76% (583) of the workers were isolated in the company, 42 (5.5%) were isolated at home, and 142 (18.5%) were hospitalized. Out of the total 142 patients who went to the hospital, 132 patients were isolated in specialized wards for COVID-19 patients and the remaining 10 patients entered the Intensive Care Unit (ICU) because of their critical conditions (Table 7).

<table>
<tr><th>Site of isolation</th><th colspan="2">Number</th><th colspan="4">Percentage</th></tr>
<tr><td>Company</td><td colspan="2">583</td><td colspan="4">76.0%</td></tr>
<tr><td rowspan="3">Hospital</td><td rowspan="3">142</td><td>Ward</td><td colspan="3">132</td><td rowspan="3">18.5</td></tr>
<tr><td rowspan="2">ICU</td><td rowspan="2">10</td><td>Cured</td><td>7</td></tr>
<tr><td>Died</td><td>3</td></tr>
<tr><td>Home</td><td>42</td><td>42</td><td colspan="4">5.5%</td></tr>
<tr><td>Total</td><td>767</td><td>767</td><td colspan="4">100.0</td></tr>
</table>

Table 7: *The site of isolation of the workers.*

The total number of positive cases was 573; 570 patients completed their course of treatment and their samples turned negative and 3 cases died. The cases fatality rate was 0.52% (Table 8).

Positive cases	Completely cured	Died	Case-fatality rate
573	570	3	0.52%

Table 8: *The final outcome of the positive cases.*

Inferential statistics

Relationship between Sociodemographic parameters and the possibility of catching the infection

The numbers of positive cases were 140,212,221 among the age groups (25:35, 35:45, and 45:55, respectively. Chi-square test shows a statistically significant correlation between the age of the participants and the possibility of catching an infection (P = 0.027). Furthermore, among the airport workers, 546 males and 27 females tested positive for COVID-19. There was also a statistically significant correlation between the sex and the positively of catching an infection (P = 0.049). On the other hand, there was no statistically significant correlation between the Saudi and Non-Saudi participants in the possibility of catching the infection (0.409). Finally, upon comparing the relationship certain sectors of work and the possibility of catching an infection. There was no statistically significant relationship between working in the ground services and the rate of infection. (P = 0.781). However, there was a statically significant relationship between working in the construction and the infectivity rate (P = 0.001).

Feature	COVID-10 Positive	COVID-10 Negative	P-value
Age • 25:35 • 35:45 • 45:55	140 212 221	66 67 61	0.027
Sex • Male • Female	546 27	191 3	0.049
Nationality • Saudi • Non-Saudi	56 517	23 171	0.409
Sector • SGS	303	97	0.781

Table 9: *The effect of sociodemographic standards on the possibility of catching the infection.*

The effect of comorbidities on the development of complications

562 workers reported positive history of comorbidities. 278 Workers had hypertension (212 among positive cases and 66 among negative cases), 219 had diabetes (167 among positive cases and 52 among negative cases), and 65 workers had a history of asthma (57 were positive for COVID-19 and 8 were negative). Chi-Square test revealed a statistically significant effect of hypertension on developing cardiac (P = 0.001), respiratory (P = 0.001), and renal (P = 0.031) complications in patients with positive COVID-19. In addition, there was also a statistically significant effect of diabetes on cardiac (P = 0.001), respiratory (P = 0.001), and renal (P = 0.005) complications among positive patients. Upon using the Chi-square test to assess the relationship between asthma and respiratory, cardiac and renal complication, the expected count was less than 5 at 25%, 50% and 25% of the cells, respectively. Hence, Fischer Exact test was adopted to assess the relationship. The results of Fischer Exact test suggest a statistically significant effect of asthma on the development of cardiac (P = 0.001), respiratory (P = 0.001), and renal (P = 0.029) complications among patients with positive COVID-19 (Table 10).

	Cardiac complications		p-value	Respiratory Complications		p-value	Renal Complications		p-value
	Yes	No		Yes	**No**		**Yes**	**No**	
Hypertension									
Yes	34	244	0.001	29	249	0.001	16	262	0.031
No	0	489		14	475		13	476	
Diabetes									
Yes	34	185	0.001	27	192	0.001	15	204	0.005
No	0	548		16	532		14	534	
Asthma									
Yes	11	54	Fischer Exact test = 0.001	35	30	Fischer exact test = 0.001	6	59	Fischer exact test = 0.029
No	23	678		8	694		23	679	

Table 10: *The prevalence of comorbidities and the effect of each one on the development of complications among patients with positive COVID-19.*

Discussion

In the past few decades, the process of globalization has increased the rates of worldwide travelling and passengers' mobilization. According to the passengers' air traffic - Statista, the number of worldwide travelers was 4.7 billion per 2020 (before the COVID-pandemic) [42]. This high number of travelers can increase the risk of transmission of infectious diseases among the travelers themselves and the airport workers. To the best of our knowledge, this the first sturdy carried out to assess the effect of COVID-19 on the airport workers in Saudi Arabia. We found that the prevalence COVID-19 among airport workers was 74.8% from March to August. Our results were consistent with a prospective cohort study conducted by Rojas., *et al.* who identified that the incidence rate of COVID-19 among airport workers in Colombia is 7.9%. The authors used a self-reported questionnaire to assess the sociodemographic characteristics of the workers, Polymerase Chain Reaction (PCR) to identify the positive cases, and Automated Chemiluminescent Immunoassay (ACI) for the detection of seroconversion by examining the IgM and IgG antibodies. They concluded that most of the cases were asymptomatic and the main risk factor for the development of the infection was the duration of daily commutes [43]. In our study, the high prevalence of COVID-19 can be explained by several factors. First of all, at this time, the world was facing a new pandemic with little information about the proper methods of investigation, rapid diagnosis and management. Many passengers acted as asymptomatic carriers of the disease that helped in the widespread of the condition among the airport workers. Secondly, the WHO declared COVID-19 as a pandemic at the 11th of march 2020. before this time the world's air traffic and aviation were not totally suspended in many countries. These procedures increased the possibility of the travelers harboring the disease to infect many other persons and increase the infectivity rates. On the other hand, several factors were associated with an increased susceptibility to the infection. Liu., *et al*. reported that the infectivity rate is increased among elder persons, people with close contact to the cases, and multiple comorbidities [44]. His findings were consistent with our results as the mean age of the airport workers was 40 years (± 7.8SD) and 36.8%, 36.4 belonged the age group between 35:45 years and 45:55 years, respectively. This could be explained by the fact that immune system is weaker among older people, together with the associated immune-related disorders in COVID-19 patients like hypercoagulability and endotheliopathy [45]. In addition, chronic comorbidities like diabetes and hypertension can play a significant role in lowering the immune mechanisms of the body and increase the vulnerability of the person to catch the infection [46,47]. There was also a higher prevalence of the disease among males than females. Our results were consistent with Alyami., *et al*. who reported a higher prevalence of COVID-19 among Saudi males [34]. This could be explained by the different life-styles of males as they are more commonly smokers, hypertensive, diabetic, and more susceptible to cardiovascular and cerebrovascular disorders [48]. On the other hand, we found that the proportion of positive cases among females (27/30) is higher than males (564/737), this can be explained by nature of female work in the airport as most of the females work with close contacts to the travelers (for example: flight attendants) which make them more susceptible to catch an infection [44]. However, this result needs further evaluation as the low number of female airport workers cannot be representative to the whole population. We also reported that the major number of positive cases belonged to the SGS sector which is responsible for the ground services (Saudi Ground Services SGS) like transport services, baggage handling, fleeting services and ramping services. These services make the workers in closer contacts with the travelers and increase the possibility of catching the infection. Our results were consistent with Jing., *et al*. who reported a higher prevalence of the diseases among people with close contacts to the infected persons [49]. However, this increase with not statistically significant when comparing SGS with other services on the susceptibility of catching an infection. Despite the high prevalence of the condition, we reported three deaths with a cases fatality rate = 0.52%. This high rate of recovery with consistent with Alyami., *et al*. who reported similar results in KSA [34]. This could be explained by the increased adherence of the workers to the instruction of self-isolation together with the proper health care system in KSA that provided an health care services for the complicated cases to lower the possibility of life-threating complications and increased the survival rate of the workers. Chronic diseases have been linked with increased complications and worse outcome of COVID-19 patients. We studied the effect of chronic diseases on the development of cardiac, respiratory and renal complications. Our results suggested a statistically significant relationship between hypertension, and the development of cardiac (P = 0.001), respiratory (P = 0.001), and renal (P = 0.031) complications. Our results were consistent with Richardson., *et al*. who reported that hypertensive patients are more liable to admit to ICU, receive mechanical ventilation, and treated with kidney replacement therapy [50]. Reilev., *et al*. also reported that hypertension, Ischemic Heart Diseases (IHDs) and Heart Failure (HF) are all associated with increased complication of COVID-19 and fatal outcomes of the condition [51]. We also found a statistically significant effect of diabetes on the development of cardiac (P = 0.001), respiratory (P = 0.001), and renal (P = 0.005) complications among patients with COVID-19. Similar results were reported by Williamson., *et al*. about the effect of uncontrolled diabetes and on the prognosis of the condition and the worsening of the complications [52]. Zhou., *et al*. and Mason el, also reported higher mortality rates of COVID-19 among Chinses patients with uncontrolled diabetes and hypertension [53,54]. Finally, we reported a statistically significant associated between asthmatic patients and the development of cardiac (P = 0.001), respiratory (P = 0.001), and renal (P = 0.029) complications. Izquierdo studied the effect of COVID-19 on asthmatic patients and concluded that asthmatic patients with COVID-19 are more liable to develop life-threatening complications and admitted to the hospital and ICU [55]. These all findings indicates a strong associated between multiple comorbidities and poorer outcome of COVID-19.

Limitation of the Study

Out study has two main limitations. First of all, we did not manage to collect accurate investigations and full history of the participants about their comorbidities and complications via hospital medical records. Instead, all of the information were collected through self-reported telephone-based interview. Hence, this could affect the accuracy of the diagnosis and available information about the comorbidities and the associated complications with COVID-19. Secondly, out of the 767 participants in the study, there were only 30 females who were tested for COVID-19 and enrolled in the study. This number does not represent the total number of females working in the airport and may serve as a non-representative sample and compromise the statistical accuracy about the gender difference and its effect on catching the diseases and developing complications.

Conclusion

Based on the previous findings we can conclude that there was a high prevalence of COVID-19 among airport workers in KSA and further instructions need to be followed in order to decrease this high prevalence. In addition, old-aged males who work in direct contact with travelers are more susceptible to catch the infection than females and young-aged workers. Also, chronic diseases like diabetes, hypertension and asthma can significantly increase the risk of cardiac, renal and respiratory complication of COVID-19. Finally, according to the number of healed cases and the case-fatality rate we can also conclude that Saudi health care system was efficient in containing the problem and dealing with positive cases to minimize the number of deaths.

Recommendation

Further studies need to be conducted to assess the recent prevalence of the condition among airport workers after applying the air traffic restriction worldwide and compare it with our findings to determine the efficacy of air travel restriction on decreasing the number of cases. A larger number of females must be included to report representative results about the gender difference and the vulnerability to catch a disease. Finally, further studies need to focus on the effect of other comorbidities like ischemic heart diseases, hepatic diseases and obesity on the outcome of COVID-19 among airport workers.

Bibliography

1. Yuen KS., *et al*. "SARS-CoV-2 and COVID-19: The most important research questions". *Cell and Bioscience* 10.1 (2020): 1-5.
2. Singhal T. "A Review of Coronavirus Disease-2019 (COVID-19)". *Indian Journal of Pediatrics* 87.4 (2020): 281-286.
3. Velavan TP and Meyer CG. "The COVID-19 epidemic". *Tropical Medicine and International Health* 25.3 (2020): 278-280.
4. Li H., *et al*. "Coronavirus disease 2019 (COVID-19): current status and future perspectives". *International Journal of Antimicrobial Agents* 55.5 (2020): 105951.
5. Zhang T., *et al*. "Probable Pangolin Origin of SARS-CoV-2 Associated with the COVID-19 Outbreak". *Current Biology* 30.7 (2020): 1346-1351.
6. Spiteri G., *et al*. "First cases of coronavirus disease 2019 (COVID-19) in the WHO European Region, 24 January to 21 February 2020". *Eurosurveillance* 25.9 (2020).
7. Dancer SJ., *et al*. "Putting a balance on the aerosolization debate around SARS-CoV-2". *Journal of Hospital Infection* (2020).
8. Lotfi M., *et al*. "COVID-19: Transmission, prevention, and potential therapeutic opportunities". *Clinica Chimica Acta* (2020).
9. La Rosa G., *et al*. "Coronavirus in water environments: Occurrence, persistence and concentration methods - A scoping review". *Water Research* (2020).
10. Lu R., *et al*. "Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding". *Lancet* 395.10224 (2020): 565-574.

11. Li W., *et al*. "Angiotensin-converting enzyme 2 is a functional receptor for the SARS coronavirus". *Nature* (2003).

12. Totura AL and Baric RS. "SARS coronavirus pathogenesis: Host innate immune responses and viral antagonism of interferon". *Current Opinion in Virology* 2.3 (2012): 264-275.

13. Wong CK., *et al*. "Plasma inflammatory cytokines and chemokines in severe acute respiratory syndrome". *Clinical and Experimental Immunology* 136.1 (2004): 95-103.

14. Trougakos IP., *et al*. "Insights to SARS-CoV-2 life cycle, pathophysiology, and rationalized treatments that target COVID-19 clinical complications". *Journal of Biomedical Science* 28.1 (2021): 1-18.

15. Chen N., *et al*. "Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study". *Lancet* 395.10223 (2020): 507-513.

16. Gu J., *et al*. "COVID-19: Gastrointestinal Manifestations and Potential Fecal-Oral Transmission". *Gastroenterology* (2020).

17. Esakandari H., *et al*. "A comprehensive review of COVID-19 characteristics 2 (2020): 1-10.

18. Goldraich LA., *et al*. "Emerging Topics in Heart Failure: COVID-19 and Heart Failure (2020): 942-944.

19. Zhu H., *et al*. "Cardiovascular Complications in Patients with COVID-19: Consequences of Viral Toxicities and Host Immune Response". *Current Cardiology Reports* 22.5 (2020).

20. Kollias A., *et al*. "Thromboembolic risk and anticoagulant therapy in COVID-19 patients: emerging evidence and call for action". *British Journal of Haematology* 189.5 (2020): 846-847.

21. Wu Y., *et al*. "Nervous system involvement after infection with COVID-19 and other coronaviruses". *Brain, Behavior, and Immunity* 87 (2020): 18-22.

22. Wu X., *et al*. "Acute necrotizing encephalopathy: An underrecognized clinicoradiologic disorder". *Mediators of Inflammation* (2015): 9-13.

23. Ahmadipour E., *et al*. "Understanding kidney injury in COVID-19 a pressing priority 10.2 (2021).

24. Cheng Y., *et al*. "Kidney disease is associated with in-hospital death of patients with COVID-19". *Kidney International* 97.5 (2020): 829-838.

25. Kordzadeh-Kermani E., *et al*. "Pathogenesis, clinical manifestations and complications of coronavirus disease 2019 (COVID-19)". *Future Microbiology* 15.13 (2020): 1287-1305.

26. WHO. Global Surveillance for human infection with novel coronavirus (2019-nCoV) Interim guidance Who (2020).

27. Harapan H., *et al*. "Review article on Coronavirus". *Journal of Infection and Public Health* 13.5 (2020): 667-673.

28. Huang P., *et al*. "Use of chest CT in combination with negative RT-PCR assay for the 2019 novel coronavirus but high clinical suspicion". *Radiology* (2020).

29. Clinical WHO, Who W. WHO-nCoV-Clinical-2020.3-eng (2020): 1-10.

30. Zheng Z., *et al*. "Risk factors of critical and mortal COVID-19 cases: A systematic literature review and meta-analysis". *Journal of Infection* (2020).

31. Wolff D., *et al*. "Risk factors for Covid-19 severity and fatality: a structured literature review". *Infection* (2020).

32. WHO Coronavirus Disease (COVID-19) Dashboard". *Bangladesh Physiotherapy Journal* (2020).

33. COVID 19 Dashboard: Saudi Arabia (2020).

34. Alyami MH., *et al*. "Epidemiology of COVID-19 in the Kingdom of Saudi Arabia: An Ecological Study". *Frontiers in Public Health* 8 (2020): 1-9.

35. Al Mutair A., *et al*. "Clinical, epidemiological, and laboratory characteristics of mild-to-moderate COVID-19 patients in Saudi Arabia: an observational cohort study". *European Journal of Medical Research* 25.1 (2020): 1-8.

36. Al-tawfiq JA., *et al*. "Incidence of COVID-19 among returning travelers in quarantine facilities: A longitudinal study and lessons learned (2020).

37. Alrasheed H., *et al*. "COVID-19 spread in Saudi Arabia: Modeling, simulation and analysis". *International Journal of Environmental Research and Public Health* 17.21 (2020): 1-24.

38. Perveen S., *et al*. "Coronavirus nCOVID-19: A pandemic disease and the Saudi precautions". *The Saudi Pharmaceutical Journal* 28.7 (2020): 888-897.

39. Alboaneen D., *et al*. "Predicting the epidemiological outbreak of the coronavirus disease 2019 (COVID-19) in Saudi Arabia". *International Journal of Environmental Research and Public Health* 17.12 (2020): 1-10.

40. Ameen F., *et al*. "Covid-19 pandemic outburst in Saudi Arabia: A glimpse". *Saudi Journal of Biological Sciences* 27.12 (2020): 3547-352.

41. What is HESN? - HESN Portal (2021).

42. • Passenger air traffic each year | Statista (2021).

43. Malagón-Rojas JN., *et al*. "SARs-CoV-2 and work-related transmission: Results of a prospective cohort of airport workers, 2020". *A Revista Brasileira de Medicina do Trabalho* 18.4 (2021): 371-380.

44. Liu T., *et al*. "Risk factors associated with COVID-19 infection: a retrospective cohort study based on contacts tracing". *Emerging Microbes and Infections* 9 (2020): 1-31.

45. Joly BS., *et al*. "Understanding pathophysiology of hemostasis disorders in critically ill patients with COVID-19". *Intensive Care Medicine* 46 (2020): 1603-1606.

46. Bi Q., *et al*. "Epidemiology and transmission of COVID-19 in 391 cases and 1286 of their close contacts in Shenzhen, China: a retrospective cohort study". *The Lancet Infectious Diseases* 20.8 (2020): 911-919.

47. Chen TL., *et al*. "Clinical Characteristics and Outcomes of Older Patients with Coronavirus Disease 2019 (COVID-19) in Wuhan, China: A Single-Centered, Retrospective Study". *The Journal of Gerontology: Biological Sciences and The Journal of Gerontology* 75.9 (2020): 1788-1795.

48. Regitz-Zagrosek V., *et al*. "Gender in cardiovascular diseases: Impact on clinical manifestations, management, and outcomes". *European Heart Journal* 37.1 (2016): 24-34.

49. Jing QL., *et al*. "Household secondary attack rate of COVID-19 and associated determinants in Guangzhou, China: a retrospective cohort study". *The Lancet Infectious Diseases* 20.10 (2020): 1141-1150.

50. Richardson S., *et al*. "Presenting Characteristics, Comorbidities, and Outcomes among 5700 Patients Hospitalized with COVID-19 in the New York City Area". *The Journal of the American Medical Association* 323.20 (2020): 2052-2059.

51. Reilev M., *et al*. "Characteristics and predictors of hospitalization and death in the first 9,519 cases with a positive RT-PCR test for SARS-CoV-2 in Denmark: A nationwide cohort". *Med Rxiv* (2020): 1-24.

52. Williamson E., *et al*. "OpenSAFELY: Factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients". *Med Rxiv* (2020).

53. Zhou F., *et al*. "Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study". *Lancet* 395.10229 (2020): 1054-1062.

54. Mason KE., *et al*. "Age-adjusted associations between comorbidity and outcomes of COVID-19: A review of the evidence". *Med Rxiv* (2020): 1-19.

55. Izquierdo JL., *et al*. "The impact of COVID-19 on patients with asthma". *European Respiratory Journal* 57.3 (2021).

Volume 10 Issue 8 August 2021