Investigation of the prevalence of asthma in patients with COVID-19 and its relationship to asthma severity: A Cross-Sectional study

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Abstract

Background: On December 8, 2019, cases of pneumonia from an unknown disease were identified in Wuhan, China. Investigations showed that this disease was COVID-19, caused by the SARS-CoV-2 coronavirus. This study aimed to investigate the prevalence of asthma in patients with COVID-19 and its relationship to asthma severity.

Methods: In this cross-sectional study, we obtained patients' data from medical records, including their asthma history, severity, and COVID-19 outcomes (Mortality). Logistic regression was used to measure the association between asthma severity and COVID-19 mortality. The collected data were analyzed using SPSS software (Version 23).

Results: The study showed that asthma was present in 14.4% of the patients with COVID-19. Regarding asthma severity, 61.9%, 16.4%, and 21.6% of the patients had mild, moderate, and severe asthma, respectively. The overall mortality rate among the patients with COVID-19 was 21.42%. There was a significant association between asthma and COVID-19 mortality (p-value = 0.003). However, asthma severity was not related to COVID-19 mortality (p-value = 0.50).

Conclusion: The lower mortality rate in patients with severe asthma may be attributed to corticosteroid use, which is less common in patients with mild asthma. Inhaled corticosteroids may offer protection against severe COVID-19 in asthma patients and could potentially help treat COVID-19.

Highlights

What is current knowledge?

After the COVID-19 pandemic, there were concerns about whether asthma patients were more prone to infections and whether they might experience more severe cases compared to healthy individuals. Some studies suggest that asthma is not a risk factor for either. COVID-19 does not appear to aggravate asthma attacks. Later, some researchers suggested that inhaled corticosteroids might protect against infections and severe disease.

What is new here?

The low death rate among severe asthma patients may be attributed to corticosteroid use. Patients with mild asthma rarely use these medications. Some studies suggest that inhaled corticosteroids for asthma may protect against severe COVID-19 and could also aid in its treatment.

Introduction

On December 8, 2019, cases of pneumonia from an unknown disease were reported in Wuhan, China. Investigations showed that the disease was COVID-19, caused by the SARS-CoV-2 coronavirus. The disease presents with symptoms such as fever, dry cough, weakness, body pain, and shortness of breath. It reduces lymphocyte levels and can damage organs like the heart and kidneys. In severe cases, it may lead to ARDS, shock, and death (1).

Among the initial patients, fewer than half had diabetes, hypertension, or heart disease. Symptoms of the disease typically appear after an incubation period of approximately five days. The time from symptom onset to death ranges from 6 to 41 days, depending on a person's age and immune system. It is shorter in individuals over 70 years old (2,3). So far, no specific antiviral drug has been developed to treat coronavirus. The primary approach is supportive care, which includes maintaining vital signs, oxygen levels, and blood pressure, as well as addressing complications such as secondary infections and organ failure (4).

Of the drugs used to treat this disease, dexamethasone proved effective. It reduced mortality, particularly in patients on mechanical ventilation. In addition, remdesivir, an antiviral, helped hospitalized patients recover faster (5,6).

Asthma is a chronic lung condition that inflames the airways and causes acute airflow obstruction. This inflammation makes the airways overly responsive to stimuli. Over time, the obstruction may become permanent, and the airways may change shape. This chronic respiratory disease is common and negatively impacts people's quality of life and performance (7). Guidelines state that patients with moderate to severe asthma are at high risk for severe COVID-19 if infected (8).

Asthma sufferers are more susceptible to the common cold than healthy individuals. If asthma is not controlled, cold viruses can trigger severe asthma attacks. People with asthma have a slower immune response to viruses. In particular, their lung cells exhibit a delay in interferon function. Based on this knowledge, asthma seems to be a risk factor for more severe consequences of COVID-19 (9,10).

After the COVID-19 pandemic, concerns arose about whether asthma patients were more prone to infections and whether they might experience more severe cases than healthy individuals. Some studies suggest that asthma is not a risk factor for either. Among hospitalized COVID-19 patients, those with asthma had similar rates of severity as others. Apparently, COVID-19 does not aggravate asthma attacks. Later, some suggested that inhaled corticosteroids might protect against infections and severe disease by reducing the ACE2 enzyme in the lungs (11). This study aimed to investigate the prevalence of asthma in patients with COVID-19 and its relationship to asthma severity.

Methods

Study design

This cross-sectional study used a census. It included all COVID-19 patients with a history of asthma or common asthma treatments. The

data was extracted as an Excel file through the health information software. An investigation of COVID-19 patients referred to health centers across the province identified nearly 27,000 patients, of whom approximately 1,500 had asthma.

Data collection

The study included COVID-19 patients with acute respiratory symptoms and shortness of breath. Their infections were confirmed by CT scans and RT-PCR tests. We obtained information from patients' records and calls, including age, gender, and asthma history. We also noted asthma severity (Mild, moderate, severe) and COVID-19 outcomes (Mortality).

Statistical analysis

The collected data were analyzed using SPSS (Version 23) software. We described quantitative variables with mean and standard deviation. A frequency distribution table was used for qualitative variables. Logistic regression was applied to measure the association between the severity of asthma and death from COVID-19. We tested correlations of qualitative variables with a chi-square or Fisher's exact test. A significance level of 0.05 was considered.

Results

This study was conducted by sampling 929 COVID-19 patients hospitalized at Taleghani hospitals. Among them, 134 patients (14.4%) had asthma, while 795 patients (85.6%) did not. A total of 199 patients (21.42%) died due to COVID-19.

The severity of asthma among those with asthma: 83 (61.9%) individuals had mild asthma, 22 (16.4%) had moderate asthma, and 29 (21.6%) had severe asthma. The frequency and severity of asthma, categorized by age, are reported in Table 1. Among male participants, 52 (11.9%) had asthma, with 30 (57.7%) having mild asthma, 12 (23.1%) having moderate asthma, and 10 (19.2%) having severe asthma.

Table 1. The frequency of asthma and the severity of asthma reported by age

Variables		Gender	
		Male (N, %)	Female (N, %)
Asthma	Yes	52 (11.9)	82 (16.7)
	No	385 (88.1)	410 (83.3)
Severity of asthma	Mild	30 (57.7)	53 (64.6)
	Moderate	12 (23.1)	10 (12.2)
	Severe	10 (19.2)	19 (23.2)

Regarding deaths caused by COVID-19 by gender, there were 91 deaths among males (20.9%) and 108 deaths among females (22%). Deaths due to COVID-19 among asthmatic patients by gender were as follows: eight male patients (15.4%) and seven female patients (8.5%).

Among the 134 people with asthma, 15 (11.2%) died, and 119 (88.8%) survived. Among the 795 non-asthmatic people, 184 (23.1%) died due to COVID-19, and 611 (76.9%) survived. Statistical analysis showed a significant relationship between asthma and death caused by COVID-19 (P-value = 0.003). The relationship between the severity of asthma among the patients and mortality due to COVID-19 was also investigated. The severity of asthma was classified into three groups: mild, moderate, and severe. Of the 83 people with mild asthma, 10 died, and 73 survived; among the 22 people with moderate asthma, three died, and 19 survived; and among the 29 people with severe asthma, two died, and 27 survived. The results showed that asthma severity was not related to COVID-19 mortality (P-value = 0.5; Table 2).

Table 2. Relationship between asthma and severity of asthma with death in patients

Variables		Death		P-value
		Yes (N, %)	No (N, %)	
Asthma	Yes	15 (11.2)	119 (88.8)	0.003
	No	184 (23.1)	611 (76.9)	
Severity of asthma	Mild	10 (12.0)	73 (88.0)	0.52
	Moderate	3 (13.6)	19 (86.4)	
	Severe	2 (6.9)	27 (93.1)	

Table 3 illustrates the associations between the study variables and death from COVID-19. For each one-unit increase in the age of patients with asthma, the risk of death from COVID-19 increases by 8%.

Table 3. Associations between severity of asthma and death of COVID-19

Variables	OR*	95% CI**	P-value
Severity of asthma			
Mild	1	-	-
Moderate	0.92	0.189-4.5	0.924
Severe	0.275	0.047-1.5	0.147
Sex			
Male	1	-	-
Female	0.406	0.118-1.39	0.151
Age	1.08	1.03-1.39	0.001

*OR: Odds Ratio; ** CI: Confidence Interval

Discussion

This study examined 929 hospitalized COVID-19 patients in Taleghani hospitals. The frequency of asthma was 14.4% among those with asthma and 85.6% among those without asthma. Similarly, a study conducted by Lovinsky et al. in 2020 investigated asthma among hospitalized COVID-19 patients. It found a prevalence of 12.6% among all patients and a prevalence of 23.6% in a subgroup of 55 patients under 21 years old (12).

The severity of asthma among those with asthma was as follows: 61.9% had mild asthma, 16.4% had moderate asthma, and 21.6% had severe asthma. In a 2020 study by Lee et al., involving 686 COVID-19 patients with asthma, 89% had mild asthma, 9% had moderate asthma, and only 1% had severe asthma (13). Among the male patients, 11.9% had asthma, with 57.7% having mild asthma, 23.1% having moderate asthma, and 19.2% having severe asthma. Among the female patients, 16.7% had asthma, with 64.6% having mild asthma, 12.2% having moderate asthma, and 23.2% having severe asthma.

The outcome of COVID-19 disease (Death) showed that a total of 21.42% of individuals died due to COVID-19. Regarding deaths caused by COVID-19 by gender, 20.9% were male, and 22% were female. In Shah et al.'s 2020 study on COVID-19 patients, 17.6% of the patients died, while 82.4% were discharged from the hospital. In that study, male mortality was 23%, which was higher than female mortality at 13.8% (14).

Death due to COVID-19 among asthmatic patients by gender was 15.4% in males and 8.5% in females. In the study conducted in 2020 by Lee et al., among asthmatic patients, the male gender was associated with a higher rate of death due to COVID-19 (p-value = 0.021) (13).

In terms of age distribution, the average age of the participants in this study was 52.55 ± 19.27 years. The youngest participant was one year old, and the oldest was 93 years old. The patients were divided into three age groups: under 40 years old (251 participants, 27%), 40 to 69 years old (484 participants, 52.1%), and 70 years old and above (194 participants, 20.9%). Among those under 40 years old, 30 (12%) had asthma, while 76 (15.7%) in the 40 to 69 age group and 28 (14.4%) in the 70 and above age group were asthmatic. In Shah et al.'s 2020 study on COVID-19 patients, 58.2% of the patients were female, and 41.8% were male (14). A retrospective cohort study conducted by Almazeedi et al. (2020) in Kuwait on COVID-19 patients reported an average patient age of 41 years, with 81% of the participants being male (15).

Regarding the frequency of different severities of asthma by age: among 30 asthmatics under 40 years old, 18 (60%) had mild asthma, five (16.7%) had moderate asthma, and seven (23.3%) had severe asthma. Among 76 individuals aged 40 to 69 years, 49 (64.5%) had mild asthma, 14 (18.4%) had moderate asthma, and 13 (17.1%) had severe asthma. In the age group of 70 years and above, there were 28 individuals, of whom 16 (57.1%) had mild asthma, three (10.7%) had moderate asthma, and nine (32.1%) had severe asthma.

A study was conducted on the relationship between asthma and mortality due to COVID-19. It was observed that among 134 individuals with asthma, 11.2% died, and 88.8% survived. Among 792 non-asthmatic individuals, 23.1% died due to COVID-19, while 76.9% survived. Statistical analysis revealed a significant relationship between asthma and death caused by COVID-19. However, a study conducted in 2020 by Lieberman et al. found that having asthma is not associated with a higher risk of mortality (16).

The relationship between the severity of asthma among patients and mortality due to COVID-19 was investigated. Asthma severity was classified into three groups: mild, moderate, and severe. A total of 83 people had mild asthma, of whom 10 died and 73 survived; 22 people had moderate asthma, of whom three died and 19 survived; and 29 people had severe asthma, of whom two died and 27 survived. Statistical analysis showed that the severity of asthma is not related to the outcome (Mortality) of COVID-19. Although two deaths among patients with severe asthma, compared to 10 deaths among those with mild asthma, suggest a protective effect of higher asthma severity against the outcome of COVID-19, this may be due to the continuous use of corticosteroids in patients with severe asthma, while those with mild asthma rarely use corticosteroids.

In a study by Ramakrishnan et al. in 2021 on the use of inhaled budesonide in COVID-19, early administration of budesonide reduced the likelihood of requiring urgent care and treatment, and it shortened the duration of recovery from COVID-19. In this study, the improvement in clinical symptoms in the budesonide group was one day faster than in the other group. The average number of fever days in the first 14 days was lower in the budesonide group than in the control group (17).

In a study conducted in 2020 by Yamaya et al. on the effect of formoterol and budesonide on the coronavirus, it was observed that the improvement in clinical symptoms in the budesonide group was one day faster than in the other group. The average number of fever days in the first 14 days was lower in the budesonide group than in the control group, and it was shown that these drugs moderate the inflammation caused by the infection in the airways. A study by Schultze et al. found that asthma patients on high doses of corticosteroids have a higher mortality risk than those on only SABA (Short-acting beta agonist) (Adjusted HR = 1.52, 95% CI = 1.08-2.14) (18).

In a study conducted in 2020 in Spain by Izquierdo et al., the effect of COVID-19 on asthmatic patients was investigated. In this study, the use of inhaled corticosteroids in hospitalized patients was lower than in non-hospitalized patients, and it was concluded that inhaled corticosteroids and biological drugs are generally safe and may have a protective effect against severe COVID-19 infection (19).

In a study conducted in 2021 by So et al., regarding the relationship between the use of inhaled corticosteroids before hospitalization and the survival rate in COVID-19, more than 6095 hospitalized patients were reviewed retrospectively. Of these, 5.5% had recently used inhaled corticosteroids. D-dimer levels were significantly lower in ICS users (0.48 [0.88, 2.76] versus 1.66 [0.88, 3.51], p-value = 0.043), and the need for intubation was lower in ICS users. In this study, there was no clear association between ICS use and mortality due to COVID-19 (p-value = 0.63) (20).

Conclusion

The results of this study showed that there is a significant relationship between asthma and the outcome (Death) of COVID-19. Asthma sufferers were classified into three groups: mild, moderate, and severe. Among mild asthma sufferers, the death rate was 12%. Among moderate asthma sufferers, it was 13.6%. Among severe asthma sufferers, it was 6.9% due to COVID. The low death rate among patients with severe asthma may be due to the use of corticosteroids, as patients with mild asthma rarely use them. Some studies suggest that inhaled corticosteroids for asthma may protect against severe COVID-19 and might help treat it.

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Ethical statement
The research followed the tenets of the Declaration of Helsinki. The Ethics Committee of Golestan University of Medical Sciences approved this study (Ethical code: IR.GOUMS.REC.2020.332). Accordingly, written informed consent was obtained from all participants before any intervention. This study was extracted from Maryam Nafisi's thesis (Thesis #111580) in Medical Medicine at this university. Additionally, ethical issues (Including plagiarism, data fabrication, and duplicate publication) were fully observed by the authors.

Conflicts of interest
The authors declare no conflicts of interest.

Author contributions
ME: Conceptualization, project administration, writing. MGG: Conceptualization, methodology, investigation, software, visualization. MN: Investigation, writing. SAA: Conceptualization, validation. All authors read and approved the final manuscript.

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