Review Article

Prevalence of COPD Concerning Severity of COVID-19 Infection: A Short Systematic Review and Meta-analysis

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Abstract

Background: Concerning COVID-19, levels of angiotensin-converting enzyme 2 (ACE2), the said host receptor of the virus responsible for COVID-19 (intense acute respiratory syndrome coronavirus 2; SARS-CoV-2), were located to be elevated in patients with COPD. But, early character COVID-19 studies have not always pronounced a drastically better fee of severe disease in COPD sufferers. **Aim:** This work aims to determine the prevalence of COPD concerning the severity of COVID-19 infection. **Materials and Methods:** A systematic search was performed over different medical databases to identify Internal Medicine studies, which studied the outcome of the COPD group versus the Non-COPD group of COVID-19 patients. Using the meta-analysis process, either with fixed or random-effects models, we conducted a meta-analysis on the prevalence of severe cases as a primary outcome, and on mortality rate as a secondary outcome. **Results:** Eleven studies were identified involving 146666 patients, 2764 in the COPD group, and 143902 in the Non-COPD group. The meta-analysis process revealed that the pooled prevalence of severity among COVID-19 patients was (28.7%), and there is a significant increase in COVID-19 severe cases in the COPD group (OR=3.46, P=0.042). The pooled mortality rate among COVID-19 patients was (16.7%), and there is a highly significant increase in mortality in COPD group (OR=3.75, P<0.001). **Conclusion:** To conclude, COVID-19 is an emerging disease all over the world and spreading at an unpredicted rate, resulting in significant influences on global economies and public health. The present review assessed the risk factors related to the outcomes of SARS-CoV-2 infections which were included old age, male gender, and obesity, associated co-morbidities in COPD, which increase the mortality and severity of COVID-19.

Keywords: COPD; Severity COVID-19; Mortality

Introduction

The coronavirus disorder 2019 (COVID-19) outbreak is now pandemic, straining medical infrastructure, personnel, and resources in much of Europe, the center East, and North the USA, with significant results for clinical control, including rationing of care. Current facts suggest that 14% of COVID-19eassociated pneumonia instances are severe, and five% of inflamed patients require intensive care. Mortality rates in severe and critically ill sufferers are staggering, with the disorder being fatal in approximately two thirds. [1]

The COVID-19 pandemic has continued to spread globally, and even though the majority is asymptomatic or only display a mild, flu-like illness, a significant percentage develops an excessive response. Intense COVID-19 can result in fatal complications, which include acute respiration distress syndrome, multi-organ failure, and death. The question as to why a few individuals become severely ill, whilst others do no longer, remains a puzzle to be solved. it's far therefore of great importance to discover risk factors or comorbidities associated with severe COVID-19 to protect the susceptible and allow for prudent resource allocation. [2]

Although the overall fatality rate of COVID-19 is low older adults and patients with comorbidities are much more likely to have an extreme disease and subsequent mortality. The most typically reported non-communicable sicknesses that have been

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proven to predict bad prognosis in patients with COVID-19 include diabetes mellitus (DM), hypertension, cerebrovascular disease, coronary artery disease (CAD), and chronic obstructive pulmonary disease (COPD). [3]

Chronic Obstructive Pulmonary Disease (COPD) is related to an increased threat of morbidity and mortality in network-acquired pneumonia (CAP). Changes in local/systemic inflammatory reaction, impaired host immunity, microbiome imbalance, persistent mucus production, structural damage, and use of inhaled corticosteroids have been hypothesized to make contributions to such hazards. Concerning COVID-19, levels of angiotensin-converting enzyme 2 (ACE2), the said host receptor of the virus responsible for COVID-19 (intense acute respiratory syndrome coronavirus 2; SARS-CoV-2), were located to be elevated in patients with COPD. But, early character COVID-19 studies have not always pronounced a drastically better fee of severe disease in COPD sufferers. [4]

This work aims to determine the prevalence of COPD concerning the severity of COVID-19 infection.

Literature Review

Our review came following the (PRISMA) statement guidelines. [5]

Study eligibility

The included studies should be in English, a journal published article, and a human study describing COVID-19 patients. The excluded studies were non-English or animal studies.

Study identification

Basic searching was done over the PubMed, Cochrane library, and Google scholar using the following keywords: COPD, severity COVID-19, mortality.

Data extraction and synthesis

RCTs, clinical trials, and comparative studies, which studied the outcome of the COPD group versus the Non-COPD group of COVID-19 patients, will be reviewed. Outcome measures included the prevalence of severe cases (as a primary outcome), and mortality rate (as a secondary outcome).

Study selection

We found 94 records, 34 excluded based on title and abstract review; 60 articles are searched for eligibility by full-text review; 22 articles cannot be accessed; 16 studies were reviews and case reports; 11 were not describing functional outcome; leaving 11 studies that met all inclusion criteria.

Statistical methodology

The pooling of data, Proportions (%), Odds Ratios (ORs), with 95% confidence intervals (CI) were done, using MedCalc ver. 18.11.3 (MedCalc, Belgium). According to heterogeneity across trials using the I^2-statistics; a fixed-effects model or random-effects model were used in the meta-analysis process.

Results

The included studies were published in 2020. Regarding the type of included studies, all studies were retrospective [Table 1]. Regarding patients' characteristics, the total number of patients in all the included studies was 146666 patients, 2764 in the COPD group, and 143902 in the Non-COPD group [Table 1].

The mean age of all patients was (54.2 years), with 81237 (55.4%) male patients [Table 1]. [6-16]

A meta-analysis study was done on 11 studies that described and compared the 2 different groups of patients; with an overall number of patients (N=146666) [Table 2]. [6-16]

Each outcome was measured by:

Odds Ratio (OR)

- For COVID-19 severity and COPD.
- For mortality and COPD.

Concerning the primary outcome measure, we found 7 studies reported COVID-19 severity with a total number of patients (N=1892). I^2 (inconsistency) was 97.6% with a highly significant Q test for heterogeneity ($p<0.0001$), so the random-effects model was carried out. Using the random-effects model, the pooled prevalence of severity among COVID-19 patients was (28.7%) [Figure 1].

Table 1: Patients and study characteristics.

N	Author	Type of study	Number of patients			Age (average years)	Male patients
			Total	COPD group	Non-COPD group		
1	L. Chen et al. [6]	Retrospective	1859	61	1798	59	934
2	M. Chen et al. [7]	Retrospective	123	6	117	62.5	61
3	Gao et al. [8]	Retrospective	43	8	35	44	26
4	Guan et al. [9]	Retrospective	1099	12	1087	46.7	459
5	Li et al. [10]	Retrospective	102	2	100	62	59
6	Liu et al. [11]	Retrospective	78	2	76	42.7	39
7	Parra-Bracamonte et al. [12]	Retrospective	142690	2655	140035	50	79280
8	Yang et al. [13]	Retrospective	52	4	48	59.7	35
9	Zhang, Cao, et al. [14]	Retrospective	289	6	283	57	154
10	Zhang, Dong, et al. [15]	Retrospective	140	2	138	56.3	71
11	Zhou et al. [16]	Retrospective	191	6	185	56.3	119

#Studies arranged alphabetically.

Table 2: Summary of outcome measures in all studies.

N	Author	Primary outcome Severe COVID-19 cases		Secondary outcome Mortality rate	
		COPD group	Non-COPD group	COPD group	Non-COPD group
1	L. Chen et al. [6]	---	---	12	196
2	M. Chen et al. [7]	---	---	3	28
3	Gao et al. [8]	3	12	---	---
4	Guan et al. [9]	7	60	---	---
5	Li et al. [10]	---	---	1	14
6	Liu et al. [11]	1	10	---	---
7	Parra-Bracamonte et al. [12]	---	---	871	16001
8	Yang et al. [13]	2	30	---	---
9	Zhang, Cao, et al. [14]	2	76	3	46
10	Zhang, Dong, et al. [15]	2	56	---	---
11	Zhou et al. [16]	4	50	4	50

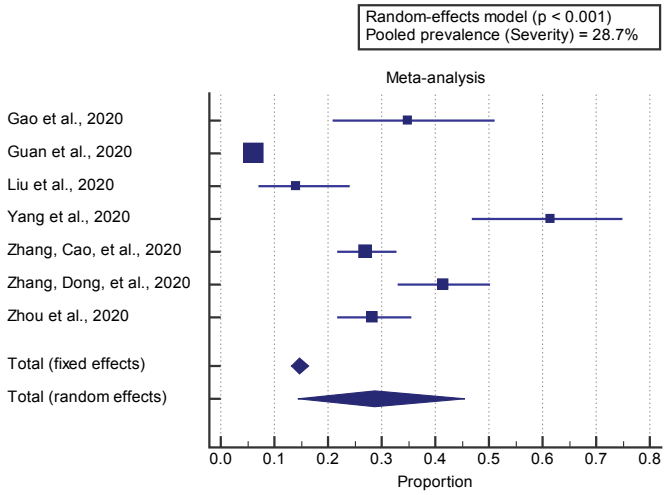

Figure 1: Forest plot for pooled prevalence of severity.

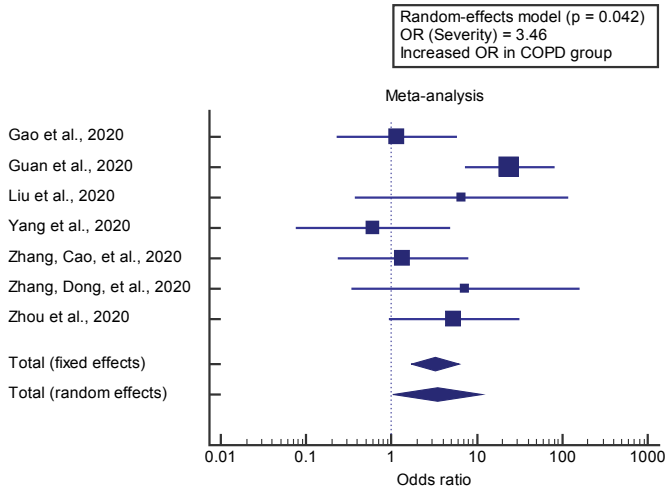

Figure 2: Forest plot for severe COVID-19 cases.

Using the random-effects model, the meta-analysis process revealed a significant increase in COVID-19 severe cases in the COPD group compared to the Non-COPD group (OR=3.46, P=0.042) [Figure 2].

Concerning the secondary outcome measures, we found 6 studies reported mortality rates with a total number of patients (N=145254). I^2 (inconsistency) was 91.3% with a highly significant Q test for heterogeneity (p<0.0001), so the random-effects model was carried out.

Using the random-effects model, the pooled mortality rate among COVID-19 patients was (16.7%) [Figure 3].

Using the random-effects model, the meta-analysis process revealed a highly significant increase in mortality in COPD group compared to Non-COPD group (OR=3.75, P<0.001) [Figure 4].

Discussion

This work aims to determine the prevalence of COPD concerning the severity of COVID-19 infection.

The included studies were published in 2020. Regarding the type of included studies, all studies were retrospective.

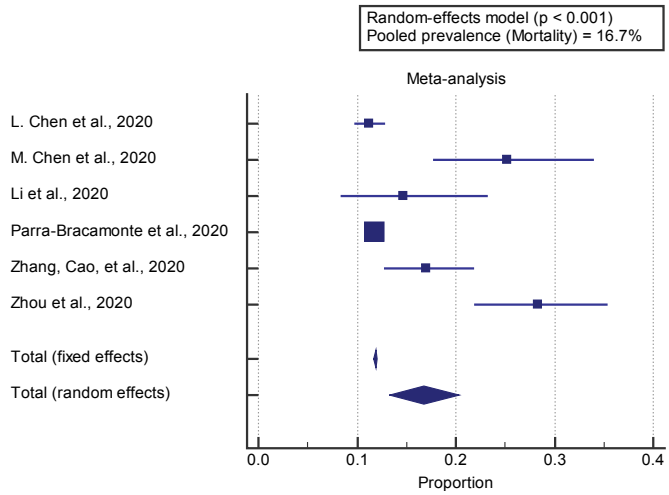

Figure 3: Forest plot for pooled prevalence of mortality.

Regarding patients' characteristics, the total number of patients in all the included studies was 146666 patients, 2764 in the COPD group, and 143902 in the Non-COPD group. The mean age of all patients was (54.2 years), with 81237 (55.4%) male patients. A meta-analysis study was done on 11 studies that described and compared the 2 different groups of patients; with an overall number of patients (N=14666). Concerning

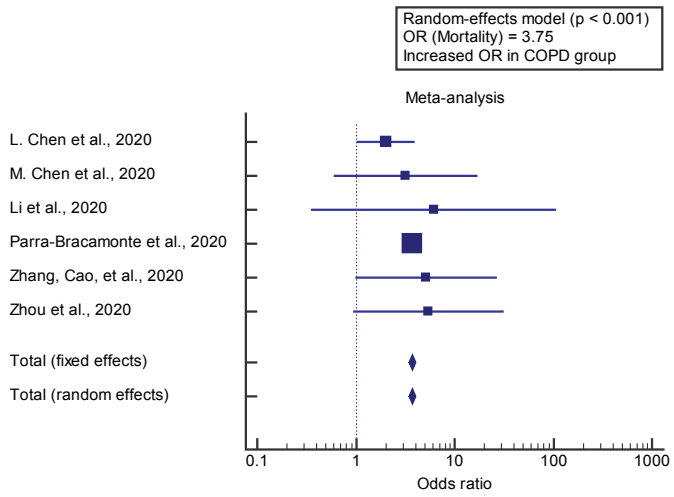

Figure 4: Forest plot for mortality rate.

the primary outcome measure, we found 7 studies reported COVID-19 severity with a total number of patients (N=1892).

Using the random-effects model, the pooled prevalence of severity among COVID-19 patients was (28.7%). Using the random-effects model, the meta-analysis process revealed a significant increase in COVID-19 severe cases in the COPD group compared to the Non-COPD group (OR=3.46, P=0.042, which came in agreement with Alqahtani et al., [17] Zhao et al., [18] Pranata et al., [2] Cox et al., [19] and Pal & Bhadada. [3]

Alqahtani et al., reported that, overall, 123 abstracts were screened and 61 full-text manuscripts have been reviewed. A total of 15 studies met the inclusion standards, which included a total of 2473 confirmed COVID-19 patients. All studies had been included within the meta-analysis. The crude case fatality rate of COVID-19 became 7.4%. The pooled occurrence rates of COPD patients and smokers in COVID-19 cases had been 2% and 9% respectively. COPD sufferers were at a better hazard of more severe disorder (risk of severity=63%, (22/35). [17]

Zhao et al., reported that a total of 10 studies were included inside the evaluation to decide the effect of pre-present COPD on the severity of COVID-19, as 1 of the research did not record on the prevalence of COPD of their patient population. The pooled odds ratio (OR) of COPD for the development of severe COVID-19 is which suggests that the presence of COPD is associated with an almost fourfold better risk of growing extreme COVID-19 (fixed-effects version; OR=4.38; heterogeneity among the different studies being mild (I2=41%; P=0.08). Sensitivity analysis showed that the results had been not affected by any individual study. [18]

Pranata et al., reported that, COPD showed higher risk for composite poor outcome (OR 5.01, P<0.001; I2 0%, P=0.98) [Figure 1]. Subgroup analysis of COPD patients showed a higher mortality (OR 4.36, P=0.009; I2 0%, P=0.88), greater likelihood of having severe COVID-19 (OR 4.62, P<0.001; I2 0%, P=0.78), ICU care (OR 8.33, P=0.03; I2 0%, P=0.89) and disease progression (OR 8.42, P=0.01; I2 0%, P=0.84). [2]

Cox et al., reported that chronic obstructive pulmonary sickness (COPD) is a hazard factor for severe COVID-19 disorder and many patients with COPD may have underlying chronic bacterial infections before severe acute respiration syndrome coronavirus 2 (SARS-CoV-2) infections, however, this important fact isn't always being pronounced. More statistics on co-infections are urgently required to establish their importance in COVID-19 severity and mortality. [19]

Pal & Bhadada, reported that even though the overall fatality charge of COVID-19 is low older adults and patients with comorbidities are much more likely to have a severe ailment and next mortality. The most normally reported non-communicable diseases which have been proven to predict poor prognosis in patients with COVID-19 to include diabetes mellitus (DM), hypertension, cerebrovascular disease, coronary artery disease (CAD) and chronic obstructive pulmonary disease (COPD). [3] Our result came in disagreement with Zhang et al. [14]

Zhang et al., reported that, because of these results, smoking should not be considered a preventive measure for COVID-19 and as a public health issue should be discouraged at all times. Although smoking is a major cause of the chronic obstructive pulmonary disease (COPD), a recent study reported that COPD did not increase the risk of COVID-19 patients requiring admission to the intensive care unit (ICU). [14]

Concerning the secondary outcome measures, we found 6 studies reported mortality rates with a total number of patients (N=145254).

Using the random-effects model, the pooled mortality rate among COVID-19 patients was (16.7%). Using the random-effects model, the meta-analysis process revealed a highly significant increase in mortality in COPD group compared to Non-COPD group (OR=3.75, P<0.001), which came in agreement with Alqahtani et al., [17] Aly et al., [20] Lippi & Henry, [4] Zhao et al., [18] Leung et al., [21] and Grasselli et al. [22]

Alqahtani et al., reported that COPD patients were at a higher risk of more severe disease (risk of severity=63%, (22/35) compared to patients without COPD 33.4% (409/1224) [calculated RR, 1.88]. This was associated with higher mortality (60%). [17]

Aly et al., reported that clinical characteristics of 25 cases died with COVID-19. The clinical profile of these patients showed that the most important risk factors for death in these patients represented in, age, and underlying diseases. Regarding the underlying illnesses associated with death, the most recorded one was chronic hypertension than diabetes mellitus, chronic cardiac diseases, cerebral infarction, kidney disease, chronic obstructive pulmonary disease. [20]

Lippi & Henry, reported that Chronic Obstructive Pulmonary Disease (COPD) is associated with an increased risk of morbidity and mortality in community-acquired pneumonia (CAP). Alterations in local/systemic inflammatory response, impaired host immunity, microbiome imbalance, persistent mucus production, structural damage, and use of inhaled corticosteroids have been hypothesized to contribute to such risk. [4]

Zhao et al., reported that only two of the included studies reported the association between death and pre-existing COPD. Death was reported in 6 of 10 (60%) of patients with COPD and 80 of 233 (34.3%) of non-COPD patients. The pooled OR of COPD for death was 1.93 however, the heterogeneity in this analysis (I2=61%; P=.11) was quite high. [18]

Leung et al., reported that there is a global outbreak of COVID-19 coronavirus. Although most patients inflamed and identified with CVOID-19 sickness have moderate signs and symptoms, approximately 20% of people have established extreme or severely severe sickness including signs and symptoms of pneumonia, breathing failure, septic shock, and multi-organ failure. The estimated case-fatality fee is 1-2%. Importantly, almost all deaths have taken place in those with significant underlying continual sicknesses such as COPD and cardiovascular sicknesses. The reason for this observation is largely unknown. [21]

Grasselli et al., reported that, at multivariable analysis, a 10-year increase in age (HR, 1.75) and male sex (HR, 1.57) were significantly associated with mortality. Among comorbidities, history of chronic obstructive pulmonary disease (HR, 1.68), hypercholesterolemia (HR, 1.25), and diabetes (HR, 1.18) was significantly associated with mortality. [22]

Conclusion

To conclude, COVID-19 is an emerging disease all over the world and spreading at an unpredicted rate, resulting in significant influences on global economies and public health. The present review assessed the risk factors related to the outcomes of SARS-CoV-2 infections which were included old age, male gender, and obesity, associated co-morbidities in COPD, which increase the mortality and severity of COVID-19.

Competing Interests

The authors declare that they have no competing interests. All the listed authors contributed significantly to the conception and design of study, acquisition, analysis, and interpretation of data and drafting of the manuscript, to justify authorship.

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