(REVIEW ARTICLE)

Characteristics of COVID-19 patients with coronary artery disease comorbidity

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Abstract

Coronavirus disease 2019 (COVID-19) is an infectious respiratory disease which is caused by the SARS-CoV-2 virus. Coronary heart disease is a disease caused by plaque build-up in artery walls which supply blood to the heart and other body parts. Coronary heart disease is amongst the most severe COVID-19 comorbidities. Objective: To determine the patient profile of COVID-19 patients with coronary heart disease comorbidity Methods: Literature study with a systematic review that uses previous research as a reference to generate conclusions. Results: Based on the 24 journals used in this literature review, 11 journals discuss the topic of age, 9 journals discuss the topic of gender, and 8 journals discuss the topic of the prognosis of COVID-19 patients with coronary heart disease comorbidity. Conclusion: The mean age of COVID-19 patients with coronary heart disease comorbidity is 63,4 years old. The gender in this case is 64,7% males dan 34,3% females. The rates for prognosis are 47,6% of patients need to go to the ICU, 32,8% of patients died, 51,75% of patients recovered and 36,5% of patients need further treatment.

Keywords: Infectious disease; COVID-19; SARS-CoV-2 virus; Comorbidity; Coronary heart disease

1 Introduction

Coronavirus disease, also referred to as COVID-19 is a respiratory disease which is caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus [1]. The most common symptoms that infected patients suffer from are fatigue, weakness, loss the sense of smell and taste, difficulty breathing, dry coughs, and fever (usually 38°C or higher). This virus infects the patients' lungs, causing inflammation and shrinkage of the blood vessels (vasoconstriction) [2]. According to the WHO on the 18th of November 2022, there were 633,601,048 cases of confirmed COVID-19 infections, and from that number, 6.596.542 patients passed away [3]. In November 2022, COVID-19 cases in Indonesia reached 6.544.201 confirmed cases and a death count of 158.989, with the majority of the cases coming from Jakarta and West Java, which have 1,425,915 dan 1,179,690 confirmed cases respectively [4]. The SARS-CoV-2 Virus can spread through direct and indirect means, direct transmission of the virus can occur in several different ways, with the most common ways being human-to-human transmission and droplet transmission, and indirect transmission of the virus can happen through contaminated objects and also airborne transmission [5]. This virus has a high infection rate due to many people not following the established health protocols.

Many hospitalized patients who suffer from COVID-19 also show one or more accompanying diseases (comorbidity) which can worsen the condition of said patients. Comorbidities in COVID-19 can cause a plethora of complications for its patients, and according to the Indonesian Minister of Health in October 2020, these comorbidities can result in poor patient conditions and can even cause death. In 2020, the majority of COVID-19 patients who have comorbidities passed away, with the percentage of mortality almost reaching 97% [6]. A research study was done in Indonesia to do learn more about comorbidities and the mortality of COVID-19 patients. This research study was done by Djaharuddin et al and was done in Dr. Wahidin Sudirohusodo Hospital from March until September of 2020. This research consists of 454 COVID patients and of those 454 patients, the data shows that there are various comorbidities which those patients

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suffer from. The most common comorbidity in this research is high blood pressure (hypertension) which has a percentage of 42.31%, followed by cardiovascular disease at 30.77%, diabetes (28,21%), chronic kidney disease (23,08%), obesity (15,38%), etc. [7].

One of the most common comorbidities for COVID infections is cardiovascular disease which is ranked the third most prevalent comorbidity in COVID-19 patients in Indonesia [8]. The virus can interact with the cardiovascular system in several different ways. An example of an interaction between COVID-19 infection and the cardiovascular system is that the virus will increase the morbidity of patients who suffer from certain cardiovascular conditions, another example is that the virus can also cause myocardial injury and myocardial dysfunction [9]. A few examples of cardiovascular comorbidities in COVID-19 patients are coronary heart disease and congestive heart failure [10]. In a research study done by Loffi et al in the year 2020, 9.9% out of 1252 COVID patients suffer from coronary heart disease and said patients also have a very high mortality rate [11].

COVID-19 has remained a very prevalent topic in these past few years, and many studies have been done to help contain this pandemic, whether by prevention or by medication. Prevention of this disease can be done by taking the vaccine and adopting a healthier lifestyle that integrates the health protocols to cut off the infectious chain. This literature review is done to find out the characteristics of COVID-19 patients with coronary artery disease comorbidity gather data about the patients analyze useful/important information and use said information to help with the treatment of COVID-19 with coronary artery disease comorbidity and lower its mortality rate.

2 Material and methods

2.1 Research Method

The research method used to conduct this literature review is through using previous studies in the 2020-2023 period and using systematic review.
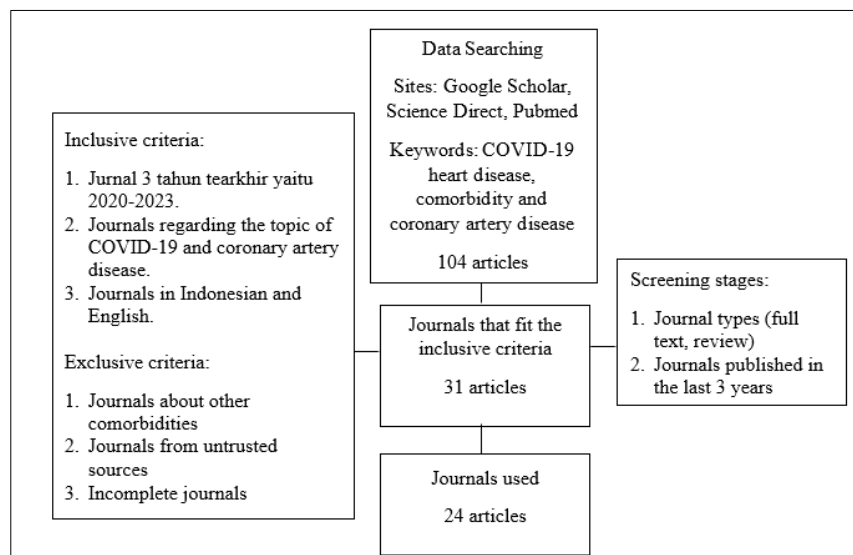

**Figure 1** Literature review stages

3 Results and discussion

In this study, 24 articles which fit the 2020-2023 period criteria were used, these articles were obtained from websites such as Google scholar, Pubmed and Science Direct.

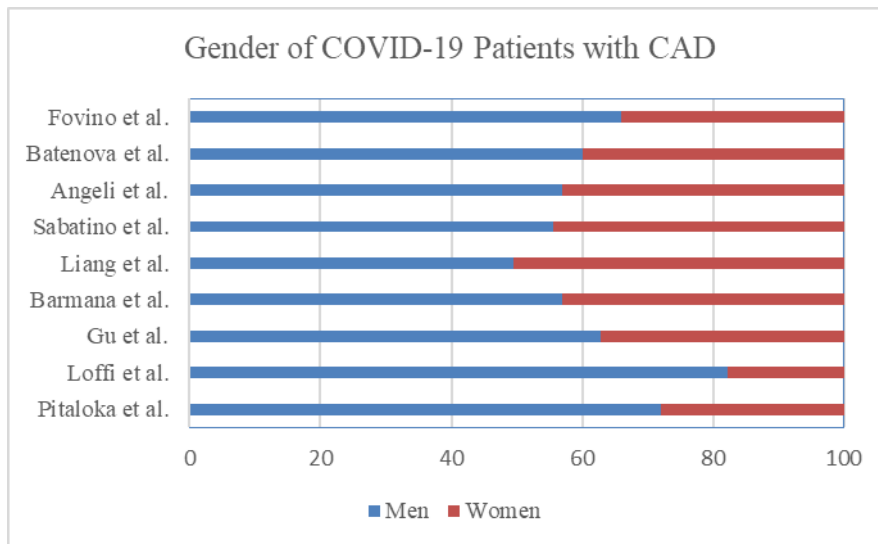### 3.1 Age of COVID-19 patients with CAD comorbidity

Based on a study by Pitaloka et al, the average age of COVID-19 patients with coronary heart disease is 60 years, a research done by Loffi et al shows 75.9 years as the average age, Gu et al, shows an average age of 66.4 years, Barman et al shows an average age of 68.5 years, Liang et al, which shows an average age of 61.2 years, and a study done by Szarpak et al shows an average age of 55.6 years. Of the 21 studies examined in a meta-analysis compiled by Sabatino

et al, the mean age was 55.5 years, from the study done by Angeli et al, the mean age was 72 years. The meta-analysis of Batenova et al which consists of 4 studies found that the mean age of 66.9 years. Khidoyatova's research showed that the mean age of 60.2 years and lastly, Fovino et al's study showed an average age of 65.3 years in COVID-19 patients with coronary heart disease comorbidity. [11]–[21]
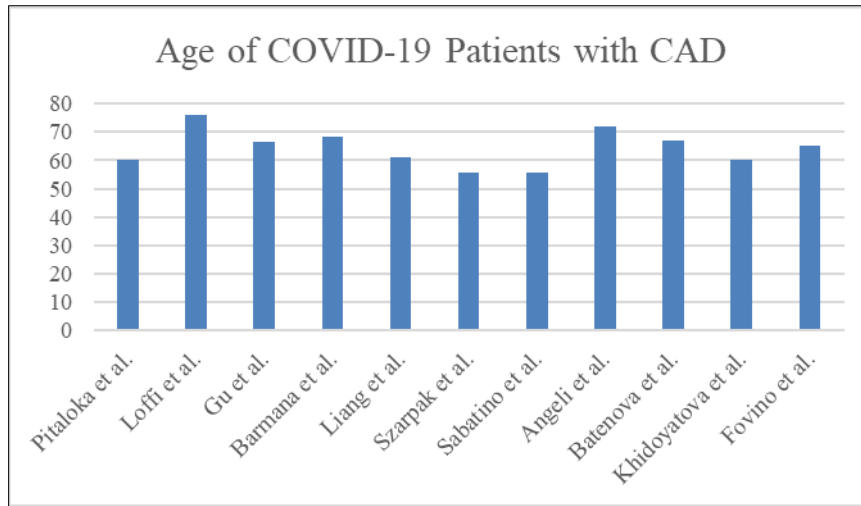
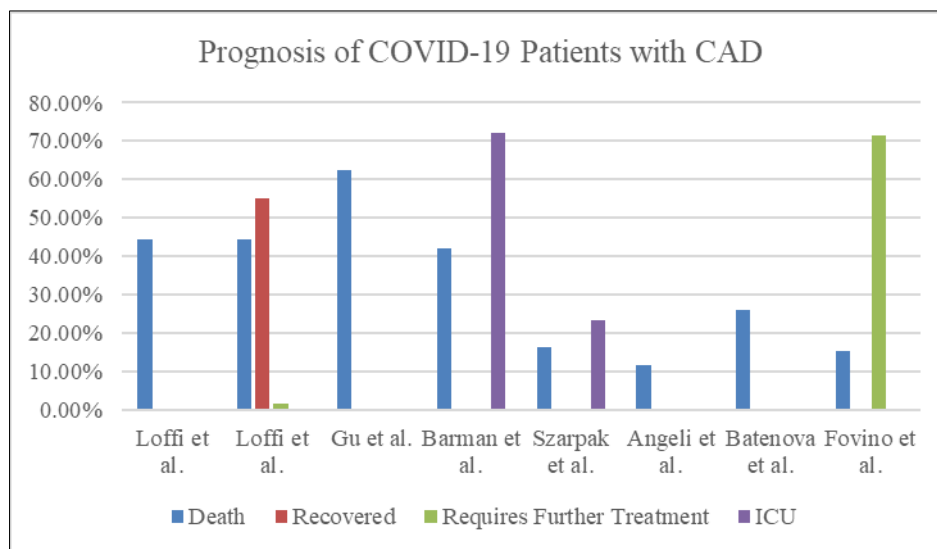**Figure 2** Age of COVID-19 patients with CAD comorbidity

3.2 Gender of COVID-19 patients with CAD comorbidity

Figure 3 Gender of COVID-19 patients with CAD comorbidity

Based on a research done by Pitaloka et al, the gender that is more often affected by COVID-19 with CAD is male with a percentage of 72%, in a literature review done by Loffi et al, it showed that the male gender is more prevalent in the case of COVID-19 and CAD comorbidity, with a percentage of 82.3%, a research by Gu et al states that males are more likeliy to have this disease with a percentage of 62.9%, a research from Barman et al shows that 57% of patients are male, but in a Meta-analysis study conducted by Liang et al states that 51.5% of patients are female. Sabatino et al stated that 55.6% of patients were male. In Angeli et al's study, the majority of COVID-19 patients with CAD comorbidity were male, with 57% of the patients being male, data from the Batenova et al meta-analysis showed that 80.1% of COVID-19 patients with CAD were male. Lastly, in Fovino et al's study, it was found that 35 out of 53 patients (66.1%) were male. [11]–[15], [17]–[20]

3.3 Prognosis of COVID-19 Patients with CAD

Figure 4 Prognosis of COVID-19 Patients with CAD

For the prognosis of COVID-19 patients with CAD comorbidity, Loffi et al's study stated that out of 124 patients, 44% of patients died, and from another study Loffi et al showed that 55% of patients recovered, 13% died after being discharged from the hospital, and 1.5% needed to be re-hospitalized, the rest (31.5%) died. In Gu et al's study, 25 out of 40 patients (62.5%) died, Barman et al's study, 72% of patients needed to go to the ICU and the total death in this study was 42%, In a meta-analysis done by Szarpak et al showed a fairly low rate compared to other studies, with a mortality rate of 16.4% (10.8% severe COVID infection and 5.6% ordinary COVID infection) and this study also showed that 23.2% of COVID-19 patients with CAD comorbidity needs to be go to the ICU. The mortality rate from Angeli et al was 11.6%. Batenova et al showed a mortality rate of 26%, and in the study done by Fovino et al, 38 (71.6%) patients required further treatment and 8 (15.1%) patients died. [11], [13], [14], [16], [18]–[20]

4 Discussion

In this literature review, 11 articles discussing the age of COVID-19 patients with coronary heart disease were used, with 10 articles using the non-probability sampling method and 1 article using the stratified sampling method. The age data in this study is quite diverse, the age range of COVID-19 patients with comorbid coronary heart disease starts from 35 to 83 years old. Based on the data in Figure 2, the average age is 64.3 years. Although the age range in these case patients is quite large, most of the COVID-19 patients with CAD are ± 60 years old. Riset Kesehatan Dasar (RIKESDAS) 2018 [22] noted that heart disease is spread across all age groups. The highest rates are at the age of 75 and over and 65-74 years with a prevalence of 4.7 and 4.6% respectively. Men aged 45 years or more and women aged 55 years or more have a greater risk of developing heart disease than those who are younger. Increasing age will cause changes and decreased bodily functions, the heart muscle and blood vessels can also undergo numerous changes, resulting in reduced blood pumping efficiency. The heart cannot pump blood as effectively as at a young age, which can cause potential complications. Reduced elasticity in the arteries, the arteries tend to lose some of their elasticity with age, resulting in increased stiffness. This makes it difficult for the arteries to expand and contract properly, which can cause people of old ages to suffer from hypertension (high blood pressure) and strain on the heart. In addition, there is atherosclerosis which is a buildup of plaque in the arteries, this causes the arteries to be narrow and restrict blood flow to the heart, this generally occurs in older individuals. In people with older ages, there is a decrease in physical activity, as they get older, they may become less physically active, which can lead to weight gain and accumulation of risk factors of heart disease, such as high blood pressure, high cholesterol levels, diabetes, obesity, and a sedentary lifestyle [23]–[25]. For coronary artery disease specifically, the majority of affected patients are quite old, this is because as the patient's age increases, the patient's hormones also undergo a significant decrease, especially the hormones estrogen and testosterone [26]. COVID-19 with coronary heart disease is more common in patients aged 60 years because these patients have risk factors that make them more susceptible to developing COVID and coronary heart disease, primarily people of older age.

There are 9 journals that discuss the gender of COVID-19 patients with coronary artery disease. All journals used in this study use the non-probability sampling method. Based on the gender data of this study in Figure 3, the more prevalent gender is male, with 64.7% of the patients being male and 34.3% of the patients being female. The male gender is more likely to get coronary artery disease and COVID-19 because men have more risk factors than women, some of these risk factors are that more men smoke and drink alcohol [27], [28]. Traditionally, men tend to engage in lifestyle choices that increase the risk of CAD, such as smoking, excessive alcohol consumption, and unhealthy eating habits. In addition, there are underlying genetic and biological differences that make men more susceptible to CAD, such as cholesterol metabolism and blood pressure regulation. Men tend to experience CAD at a younger age than women because they are protected by estrogen until menopause. The hormone estrogen, found in higher levels in pre-menopausal women, has been shown to have a protective effect on the cardiovascular system. Estrogen helps maintain healthy blood vessel function, promotes a favorable cholesterol profile, and reduces inflammation. After menopause, when estrogen levels decrease, the risk of CHD in women begins to increase and approaches that of men [16], [27], [28].

There are 7 journals that discuss the prognosis of COVID-19 patients with coronary artery disease comorbidity. Based on the data in this study (Figure 4), the data gathered about COVID-19 patients with coronary artery disease comorbidity showed that 32.8% died, 51.75% recovered, 36.5% needs further treatment, and 47.6% needed to go to the ICU. COVID patients with coronary artery disease comorbidity are more prone to be treated in the usual ward, but some patients who have more severe complications such as kidney failure and heart failure are treated in the ICU [18]. The prognosis in COVID-19 patients with coronary artery disease comorbidity is generally quite poor, especially in elderly patients. In a study conducted by Liang et al, most of the COVID-19 patients with coronary artery disease comorbidity had poor prognoses, namely treatment in the ICU (Intensive Case Unit), critical condition and also death [15]. The prognosis for cases of this disease will also be more severe if the patient has a history of other diseases, for example, in a study conducted by Angeli et al, the mortality rate in COVID patients with coronary heart disease was 47.2%, with 35.6% of these being coronary heart disease patients who had a history of heart failure [18].

The SARS-CoV-2 virus enters the human body by binding to angiotensin converting enzyme 2 (ACE-2). The binding of this virus will cause changes in the ACE-2 signaling pathway. The SARS-CoV-2 virus can cause several symptoms in the patient's body, the common symptoms of COVID-19 infection are shortness of breath, fever, coughing and headaches. This viral infection can generally heal within 10-14 days, but if the patient's immune system is weak, the virus will easily replicate and will cause further complications, because the virus can migrate from the conducting airways to the lower respiratory tract and cause alveolar epithelial cell infection resulting in Acute Respiratory Distress Syndrome. This systemic inflammation is characterized by an acute systemic inflammatory response and a cytokine storm (the release of too many cytokines over a short period of time), and both of these factors can lead to organ dysfunction or failure. COVID-19 infection will also cause an imbalance in the demand and supply of oxygen to the myocardium, this factor is exacerbated by the presence of coronary artery disease, because coronary artery disease also reduces the supply of oxygen to the myocardium. Several studies have also shown that coronary arterial disease exacerbates COVID-19 infection by intensifying hypoxemia and hypoxia, both of which will lead to acute myocardial injury. In addition, atherosclerotic plaques are known to be a source of immune system dysregulation and chronic inflammatory states, which when combined with endothelitis can lead to multiple organ damage during COVID-19 disease. Other severe conditions that can happen because of this comorbidity include plaque rupture and coronary thrombosis. Systemic inflammation, as well as increased pressure due to increased coronary blood flow, can accelerate plaque rupture, leading to acute myocardial infarction [13], [21].

5 Conclusion

COVID-19 patients with coronary artery disease comorbidity had an average age of 64.3 years with the gender data showing that the patients are 64.7% male and 34.3% female, with the prognosis data showing that 47.6% of the patients were admitted to the ICU, 32.8% of the patients died, 51.75% of the patients recovered and 36.5% of the patients requiring further treatment.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare there is no conflict of interest in this article.

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