

Different Characteristics of type 2 Diabetes Mellitus patients with and without COVID-19 at Dr. Soetomo General Hospital

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Abstract

Background: Diabetes is one of the most prevalent comorbidities in patients with COVID-19. People with diabetes are more likely to have more severe symptoms and complications when infected with any virus. The group of diabetic patients is a high risk patient during this pandemic who needs more attention. **Methods:** This is a retrospective descriptive study using data on patients with type two diabetes mellitus (T2DM) medical records in RSUD Dr. Soetomo for the period May 2020 – April 2022. The data includes characteristics including gender, age, religion, marital status, job type, length of hospitalization, hospital outcomes, and hypertension diagnosis. Each variable added in to tables divided into positive and negative COVID-19 T2DM patients characteristics. **Result:** T2DM without COVID-19 are 42 male patients and 58 female patients. T2DM without COVID19 aged 56-65 years were 40 patients (40%) and T2DM patients with COVID-19 aged 56-65 years were 37% patients. Most T2DM patients with and without COVID-19 are Housewife. T2DM patients with COVID-19 had length of hospitalization >7 days were 78% patients. T2DM patients with COVID-19 as many as 66 patients survived (66%) and 34 patients died (34%). T2DM with COVID-19 had hypertension are 45% patients and without hypertension are 55% patients. **Conclusion:** The number T2DM without COVID-19 of female patients is more than male patients. The number T2DM with COVID-19 of male patients is more than female patients. There was an increase in the number of hypertension and patients who die in T2DM patients with COVID-19 compared to T2DM without COVID-19.

Keywords : COVID-19; Diabetes Mellitus; Patient Characteristics

1. Introduction

Diabetes mellitus is a metabolic disorder based on hyperglycemia. Hyperglycemia in diabetes is caused by defects in insulin secretion, insulin action, or most often both. Hyperglycemia causes metabolic deregulation in diabetes mellitus and can be associated with damage to organ systems (Kumar, Abbas, and Aster 2016). Type 2 diabetes mellitus accounts for more than 90% of all diabetic population. The International Diabetes Federation (IDF) in 2015 revealed that there were 415 million people with DM and 98% of them were DMT2 sufferers (IDF 2015).

COVID-19 is a disease originating from animals which is then transmitted to humans or is called a zoonotic disease. COVID-19 came from bats. This is evidenced by the close phylogenetic relationship with the bat RaTG13 (Huang et al. 2020). Subsequent developments have shown that direct person-to-person

transmission can occur between close contacts, especially through respiratory droplets produced when an infected person coughs or sneezes. In addition, COVID-19 can also be transmitted indirectly. Sources of infection on the surface of objects such as plastic, aluminum, and glass that can last for 96 hours. It may also be a major source of COVID-19 transmission (Pastorino et al. 2020).

The number of people with diabetes mellitus in the world in 2017 has reached 425 million people from the world's population. Indonesia ranks sixth in the most cases of diabetes mellitus in the world with 10.3 million cases (IDF 2017). According to the Indonesian Ministry of Health, there was an increase in the prevalence of diabetes mellitus in Indonesia in the age group 15 years, namely 1.5% in 2013 to 2.0% in 2018. Data shows that East Java province ranks 3rd in diabetes mellitus cases in Indonesia by 2.6%. This is an increase from 2013 where previously East Java was ranked fifth with a diabetes prevalence of 2.1%. In addition, the prevalence of diabetes mellitus in Indonesia is higher in urban areas at 2.6% (Kemenkes 2019).

The chronic inflammation reported in DM patients with SARS-CoV-2 infection, results in an aggressive inflammatory response. Other studies conducted in COVID-19 patients with comorbid diabetes have observed decreased peripheral CD4+ and CD8+ T cell counts and increased cytokine levels (Guan et al. 2020; Yang and et al 2020; Wu et al. 2020; J. jin Zhang et al. 2020; Xu et al. 2020). A recent study revealed that COVID-19 patients with comorbid diabetes had significantly lower absolute lymphocyte counts in peripheral blood but had higher absolute neutrophil counts compared to non-diabetic patients (Geerlings and Hoepelman 1999). Among various markers of inflammation found to be elevated in COVID-19 cases with diabetes, IL-6 has been shown to be associated with lung injury and poorer prognosis (Le et al. 2014; C. Zhang et al. 2020). Serum IL-6 levels in diabetic patients without COVID-19 were significantly higher than in non-diabetic patients (Geerlings and Hoepelman 1999). This shows that COVID-19 patients with diabetes have a more severe disease severity than COVID-19 patients without diabetes (Azar et al. 2020).

Hypertension and type 2 diabetes mellitus are common co-occurring diseases. The main cause of morbidity and mortality in diabetes is cardiovascular disease, which is exacerbated by hypertension (Azar et al. 2020). Hypertension occurs twice as often in patients with diabetes as in patients without diabetes (Messerli and Grossman 2001). Hypertension and diabetes are closely related because they share common risk factors such as arterial remodeling, dyslipidemia, atherosclerosis, endothelial dysfunction, vascular inflammation, and obesity (Messerli and Grossman 2001). Patients with high blood pressure often develop insulin resistance and have a higher risk of developing diabetes than individuals who are not hypertensive (Messerli and Grossman 2001). There is also an overlapping incidence of cardiovascular complications of diabetes and hypertension mainly associated with microvascular and macrovascular disease (Petrie, Guzik, and Touyz 2018). Diabetes is associated with an increased risk of CVD, especially if the patient also has concomitant hypertension (Petrie, Guzik, and Touyz 2018). It is no coincidence that hypertension and diabetes often coexist in the same individual (Chen et al. 2021), as they share common mechanisms, such as upregulation of the renin-angiotensin system, oxidative stress, inflammation, and pathological activation of the immune system (Sinha and Haque 2022; Visca et al. 2018).

Complications of diabetes can be divided into acute and chronic. Acute complications include hypoglycemia, diabetic ketoacidosis, and hyperosmolar hyperglycemic syndrome. Chronic complications include microvascular and macrovascular disease. Complications of diabetes can be categorized as macrovascular, namely those involving large and medium blood vessels and microvascular complications involving small blood vessels such as small arterioles (Bagher and Jo 2013). Microvascular damage causes complications of diabetic retinopathy, diabetic nephropathy, and diabetic neuropathy. Macrovascular complications include atherosclerosis leading to increased coronary artery disease, increased cerebrovascular disease and stroke, and increased peripheral arterial disease contributing to limb ischemia (Heydari et al. 2010).

The mechanism of infection of SARS-CoV-2 is by binding to Angiotensin converting enzyme 2 (ACE2). ACE2 is an important enzymatic component of the renin-angiotensin-aldosterone system (RAAS). ACE2 is an enzyme that attaches to the outer surface (membrane) of cells in some organs. ACE2 is widely expressed in tissues in the lungs, intestines, heart, and kidneys. ACE2 is a counterregulation of the RAAS system (Vaduganathan et al. 2020). ACE2 converts Angiotensin (Ang) II to Angiotensin 1-7 so that it can limit the noxious substrate at the ACE/Ang II/AT1 receptor (Wang, Gheblawi, and Oudit 2020; Chappell et al. 2014). The antihypertensive properties of ACE2 may be due to the degradation of angiotensin II (Chen et al. 2021). RAAS laboratory results show that Ang II levels are elevated in most COVID-19 patients. A possible mechanism is the binding of SARS-CoV-2 to ACE2 thereby inhibiting the degradation of angiotensin II which causes an increase in blood pressure (Chen et al. 2021). Controlling comorbidities, especially hypertension, and targeting strategies to promote vascular health, may be especially important in reducing the microvascular and macrovascular complications of diabetes.

2. Methods

2.1. Data Collecting

The data used in this study is secondary data. This type of study is a descriptive retrospective, cross-sectional study of T2DM patients at RSUD Dr. Soetomo General Hospital. The data is sample of the population of patients with type two diabetes mellitus in RSUD dr. Soetomo for the period May 2020 – April 2022. The sampling technique in this study was carried out using a purposive sampling technique. This technique is done by taking samples with certain considerations made by researchers based on characteristics or characteristics of the population that have been known previously and carried out at a certain time (Notoatmodjo, 2008). The sample size used in this study used a cross section with unpaired categorical analytical research methods (Dahlan 2013) using the following formula:

$$n1 = n2 = \left(\frac{Z_{\alpha} \sqrt{2PQ} + Z_{\beta} \sqrt{P_1Q_1 + P_2Q_2}}{P_1 - P_2} \right)^2$$

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$$n1 = n2 = \left(\frac{1,96 \sqrt{2(0,568)(0,432)} + 0,84 \sqrt{(0,668)(0,332) + (0,468)(0,532)}}{0,668 - 0,468} \right)^2$$

n1 = n2 = 95 samples

Based on the results of the calculation that the minimum sample size was 95, the total number of samples used was 200 people with details of 100 people with DM-COVID-19 and 100 people with DM-without COVID-19.

a. Inclusion criteria

1. DMT2 patients have COVID-19 and DMT2 patients are not exposed to COVID-19
2. Patient medical records (name, age, gender, and date of birth), COVID-19 diagnosis status, T2DM diagnosis status, and hypertension diagnosis status.

b. Exclusion criteria

1. The patient has a history of adrenal disease, kidney disease, hypothyroidism, coarctation of the aorta, hyperthyroidism, sleep apnea, and consumption of certain drugs (Non-Steroid Anti-Inflammatory Drugs

(NSAIDs), oral contraceptives, antidepressants, corticosteroids, decongestants, and drugs) in the long term.

The total number of medical record data that were screened was 4,692 data consisting of 2,279 DMT2 patients who did not suffer from COVID-19 and 2,413 DMT2+COVID-19 patients, a lot of data were excluded because patients had other diseases that allowed secondary hypertension to occur. The final data studied were 200 people, with details of 100 data on DMT2-COVID+19 patients and 100 data on DMT2-without COVID19 patients.

2.2. Data Analysis

The data will be analyzed univariately on each variable resulting from data collection. Univariate analysis was used for the distribution and percentage of each variable (Notoatmodjo, 2008). Each characteristic will be count for the quantity and then entered into tables to see the difference between positive and negative COVID-19 DMT2 patients at Dr. Soetomo General Hospital.

2.3. Conclusion

The conclusions drawn from this study are in the form of characteristics of positive and negative COVID-19 DMT2 patients at Dr. Soetomo General Hospital.

3. Result

Based on the results of data collection, 200 samples of type 2 Diabetes mellitus patients were obtained, with details of 100 DMT2 patients confirmed COVID-19 and 100 DMT2 patients not confirmed COVID-19.

3.1. Characteristics of T2DM and T2DM+ COVID-19 patients based on gender frequency

Based on the descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo General Hospital for the period of May 2020 – April 2022, the data on gender characteristics is obtained in Table 1.

Table 1. Patient Characteristics by Gender

Gender	T2DM		T2DM + COVID-19	
	Frequency	Percentage	Frequency	Percentage
Male	42	42%	53	53%
Female	58	58%	47	47%

Based on the analysis of gender characteristics in Table 1, Type 2 Diabetes Mellitus patients without COVID-19 are 42 male patients (42%) and 58 female patients (58%). The number type 2 Diabetes mellitus without COVID-19 of female patients is more than male patients. Type 2 Diabetes Mellitus patients with COVID-19 are 53 male patients (53%) and 47 female patients (47%). The number type 2 Diabetes mellitus with COVID-19 of male patients is more than female patients.

3.2. Characteristics of T2DM and T2DM+ COVID-19 patients based on Age frequency

Based on the descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo General Hospital for the period of May 2020 – April 2022, data on age characteristics is obtained in Table 2.

Table 2. Patient Characteristics by Age

Age	T2DM		T2DM + COVID-19	
	Frequency	Percentage	Frequency	Percentage
17 – 25	1	1%	0	0%
26 – 35	2	2%	6	6%
36 – 45	12	12%	13	13%
46 – 55	25	25%	34	34%
56 – 65	40	40%	37	37%
> 65	20	20%	10	10%

Based on the analysis of age characteristics in Table 2, Type 2 Diabetes Mellitus patients without COVID-19 aged 17-25 years were 1 patient (1%), aged 26-35 years were 2 patients (2%), aged 36-45 years as many as 12 patients (12%), age 46-55 years were 25 patients (25%), age 56-65 years were 40 patients (40%) and age > 65 years were 20 patients (20%). Type 2 Diabetes Mellitus patients with COVID-19 aged 26-35 years were 6 patients (6%), age 36-45 years were 13 patients (13%), age 46-55 years were 34 patients (34%), age 56-65 years were 37 patients (37%) and age > 65 years as many as 10 patients (10%). Most patients with Type 2 Diabetes Mellitus patients with and without COVID-19 are at the age of 56-65 years.

3.3. Characteristics of T2DM and T2DM+ COVID-19 patients based on Religion frequency

Based on the descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo General Hospital for the period of May 2020 – April 2022, the data on the characteristics of religion is obtained in Table 3.

Table 3. Patient Characteristics by Religion

Religion	T2DM		T2DM + COVID-19	
	Frequency	Percentage	Frequency	Percentage
Muslims	94	94%	90	90%
Christians	3	3%	5	5%
Catholic	2	2%	2	2%
Hindus	0	0%	0	0%
Buddhists	1	1%	1	1%
Confucianism	0	0%	2	2%

Based on the analysis of religious characteristics in Table 3, Type 2 Diabetes Mellitus patients without COVID-19 are Muslim as many as 94 patients (94%), Christians as many as 3 patients (3%), Catholic as many as 2 patients (2%), and Buddhists as many as 1 patients (1%). Type 2 Diabetes Mellitus patients with COVID-19 are Muslim as many as 90 patients (90%), Christians as many as 5 patients (5%), Catholic as

many as 2 patients (2%), Buddhists as many as 1 patients (1%), and Confucianism as many as 2 patients (2%). Most patients with Type 2 Diabetes Mellitus patients with and without COVID-19 are Muslim.

3.4. Characteristics of T2DM and T2DM+ COVID-19 patients based on Marital Status frequency

Based on a descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo General Hospital for the period May 2020 – April 2022, data on the characteristics of marital status are obtained in Table 4.

Table 4. Patient Characteristics by Marital Status

Marital Status	T2DM		T2DM + COVID-19	
	Frequency	Percentage	Frequency	Percentage
Never-married	4	4%	4	4%
Married	75	75%	82	82%
Divorced	21	21%	14	14%

Based on the analysis of Marital Status characteristics in Table 3, Type 2 Diabetes Mellitus patients without COVID-19 are never-married as many as 4 patients (4%), married as many as 75 patients (75%), and divorced as many as 21 patients (21%). Type 2 Diabetes Mellitus patients with COVID-19 are never-married as many as 4 patients (4%), married as many as 82 patients (82%), and divorced as many as 14 patients (14%). Most patients with Type 2 Diabetes Mellitus patients with and without COVID-19 are Married.

3.5. Characteristics of T2DM and T2DM+ COVID-19 patients based on job Type frequency

Based on the descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo General Hospital for the period May 2020 – April 2022, the data on the characteristics of Job Type are obtained in Table 5.

Table 5. Patient Characteristics by Job Type

Job Type	T2DM		T2DM + COVID-19	
	Frequency	Percentage	Frequency	Percentage
Housewife	42	42%	38	38%
Entrepreneur	12	12%	9	9%
Civil Servant	5	5%	5	5%
Private employees	26	26%	27	27%
Doesn't Work	3	3%	2	2%
Retired	4	4%	5	5%
Etc	8	8%	14	14%

Based on the analysis of Job Type characteristics in Table 5, Type 2 Diabetes Mellitus patients without COVID-19 are Housewife as many as 42 patients (42%), Entrepreneur as many as 12 patients (12%), civil servant as many as 5 patients (5%), private employees as many as 26 patients (26%), Doesn't work as many as 3 patients (3%), retired as many as 4 patients (4%) and other as many as 8 patients (8%). Type 2 Diabetes Mellitus patients with COVID-19 are Housewife as many as 38 patients (38%), Entrepreneur as many as 9

patients (9%), civil servant as many as 5 patients (5%), private employees as many as 27 patients (27%), Doesn't work as many as 2 patients (2%), retired as many as 5 patients (5%) and other as many as 14 patients (14%). Most patients with Type 2 Diabetes Mellitus patients with and without COVID-19 are Housewife.

3.6. Characteristics of T2DM and T2DM+ COVID-19 patients based on Length of Hospitalization frequency

Based on the descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo for the period of May 2020 – April 2022, data on the characteristics of the length of hospitalization are obtained in Table 6.

Table 6. Patient Characteristics by Length of Hospitalization

Length of Hospitalization	T2DM		T2DM + COVID-19	
	Frequency	Percentage	Frequency	Percentage
< 4 Days	32	32%	12	12%
4 - 7 Days	42	42%	10	10%
>7 Days	26	26%	78	78%

Based on the analysis of length of hospitalization characteristics in Table 6, Type 2 Diabetes Mellitus patients without COVID-19 had length of hospitalization <4 days were 32 patients (32%), 4-7 days were 42 patients (42%), and >7 days were 26 patients (26%). Most Type 2 Diabetes Mellitus patients without COVID-19 had length of hospitalization are 4-7 days. Type 2 Diabetes Mellitus patients with COVID-19 had length of hospitalization <4 days were 12 patients (12%), 4-7 days were 10 patients (10%), and >7 days were 78 patients (78%). Most Type 2 Diabetes Mellitus patients with COVID-19 had length of hospitalization are >7 days.

3.7. Characteristics of T2DM and T2DM+ COVID-19 patients based on Hospital Outcomes frequency

Based on the descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo General Hospital for the period May 2020 – April 2022, data on the characteristics of hospital outcomes are obtained in Table 7.

Table 7. Patient Characteristics by Hospital Outcomes

Hospital Outcomes	T2DM		T2DM + COVID-19	
	Frequency	Percentage	Frequency	Percentage
Survive	91	91%	66	66%
Dead	9	9%	34	34%

Based on the analysis of hospital outcome characteristics in Table 7, Type 2 Diabetes Mellitus patients without COVID-19 as many as 91 patients survived (91%) and 32 patients died (9%). Type 2 Diabetes Mellitus patients with COVID-19 as many as 66 patients survived (66%) and 34 patients died (34%). Most patients with Type 2 Diabetes Mellitus patients with and without COVID-19 are survive, but there is an increase in the number of patients who die in Type 2 Diabetes Mellitus patients with COVID-19 compared to Type 2 Diabetes Mellitus patients without COVID-19.

3.8. Characteristics of T2DM and T2DM+ COVID-19 patients based on hypertension diagnosis frequency

Based on the descriptive analysis of the medical records of patients with Type 2 Diabetes mellitus at Dr. Soetomo General Hospital for the period of May 2020 – April 2022, data on the characteristics of the diagnosis of hypertension are obtained in Table 8.

Table 8. Patient Characteristics by Hypertension Diagnosis

Hypertension Diagnosis	T2DM		T2DM+COVID-19	
	Frequency	Percentage	Frequency	Percentage
Hypertension	30	30%	45	45%
Without Hypertension	70	70%	55	55%

Based on the analysis of Hypertension Diagnosis characteristics in Table 8, Type 2 Diabetes Mellitus patients without COVID-19 had hypertension are 30 patients (30%) and without hypertension are 70 patients (70%). Type 2 Diabetes Mellitus patients with COVID-19 had hypertension are 45 patients (45%) and without hypertension are 55 patients (55%). Most patients with Type 2 Diabetes Mellitus patients with and without COVID-19 are without hypertension.

4. Discussion

DMT2 patients, both with and without COVID-19, were recorded as having a majority Muslim religion, marital status, and housewife occupation. This is in accordance with Indonesian population statistics recorded at the Central Statistics Agency (BPS 2020). Based on gender, the majority of the 200 patients were female, namely in the group of T2DM patients without COVID-19. This is in line with previous research which showed that most DMT2 patients were female (68%) and the rest were male, which was 32% (Mukhyarjon, Wahid, and Manaf 2020). The KRS condition of the majority of patients is alive where the group is DMT2 patients without COVID-19. This is in accordance with other studies which revealed that the majority of patients with DMT2 returned home alive (according to indications or at the patient's wish) as many as 93.9% (Agustina and Rosfiati 2018).

Based on the length of stay, the majority of patients need more than 7 days, namely in the group of DMT2 patients with COVID-19. This is in line with previous research which stated that the majority of COVID-19 patients with comorbidities required a length of hospitalization of 14-21 days (83%) (Wardani, Bistara, and Septianingrum 2022). Based on age, the most patients aged 56-65 years were in the group of DMT2 patients without COVID-19 who did not suffer from hypertension. This is different from previous research which stated that the majority of DMT2 patients were in the early elderly age (46-55 years) as many as 45 people (45.5%) (Agustina and Rosfiati 2018).

5. Conclusion

Based on the results of the analysis, the conclusion of the study is that patients with type 2 diabetes mellitus are dominated by patients aged 56-65 years, are Muslim, have married marital status, and work as housewives. This happened to T2DM patients both with and without COVID-19. Although from all groups it was known that the majority of patients did not have hypertension, it was known that there was an increase in the number of hypertension in Type 2 Diabetes Mellitus patients with COVID-19 compared to Type 2 Diabetes Mellitus patients without COVID-19. Patients with type 2 diabetes mellitus without COVID-19 were dominated by female patients. In contrast, T2DM patients with COVID-19 were dominated by male patients.

Most Type 2 Diabetes Mellitus patients with and without COVID-19 survive, but there is an increase in the number of patients dying in Type 2 Diabetes Mellitus patients with COVID-19 compared to Type 2 Diabetes Mellitus patients without COVID-19.

6. Recommendations

Furthermore, researchers are expected to be able to carry out further research with a larger number of samples so that they better describe the condition of the population and pay more attention to other related variables.

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