Correlation between HbA1c Level and Glucose Level with Length of Stay of Diabetes Mellitus Patients Who Are Treated with COVID-19

Fathimatuz Zahro[1], Soebagijo Adi Soelistijo[2,*], Helmia Hasan[3]

*email : soebagijo.adi.s@fk.unair.ac.id
[1]Medical Program, Faculty of Medicine, Airlangga University, Surabaya, Indonesia
[2]Department of Internal Medicine, Dr. Soetomo General Hospital, Airlangga University, Surabaya, Indonesia
[3]Department of Pulmonology, Dr. Soetomo General Hospital, Airlangga University, Surabaya, Indonesia

Abstract

Background : Diabetes melitus was related to the risk of increased morbidity and mortality in patients that infected with SARS-CoV-2 virus. The treatment of COVID-19 patients were carried out with different treatment time intervals for each person. This is caused by a decrease in immune function in diabetes mellitus patients and is one of the factors that worsen the situation of COVID-19 patients. Some studies have found significant correlation between HbA1c level and COVID-19 progression or mortality since HbA1c reflects the average glycaemia over the preceding 2 to 3 months, whereas others have not. **Methods :** This study used a cross-sectional method with retrospective analytics design to determine the correlation between HbA1c level and length of stay of diabetes mellitus patient who are treated with COVID-19. This study used medical record files as the research instruments. **Results :** The results of this study indicate that the patient's gender are equal between male and female. The majority of patients age are in the range of 41 – 60 years old. The majority of patient's HbA1c level are ≥6,5%. The majority of patient's blood glucose level are >180 mg/dL. The majority of patient's length of stay are more than 21 days. The results of the multiple linear regression test showed that there is no correlation between the HbA1c level and the length of stay. **Conclusion :** This study shows that HbA1c is not related to the length of stay for patients with diabetes mellitus who are hospitalized with COVID-19.

Keywords **:** HbA1c, diabetes mellitus, length of stay, COVID-19

1. Introduction

It is known that both the history of diabetes melitus and hyperglycemia is closely related to the risk of increased morbidity and mortality in patients infected with the SARS-CoV-2 virus (Wallia *et al.,* 2020). Data in Italy supports the idea that patients with diabetes mellitus are particularly susceptible to COVID-19. In March 2020, 33.9% of patients who died from COVID-19 in Italy had diabetes mellitus as a comorbid (ECDC, 2020). COVID-19 patients are treated with different length for each individual in intensive care in hospitals. This is caused by a decrease in immune function in diabetes mellitus patients and is one of the factors that worsen the situation of COVID-19 patients. A previous study by Alkundi *et al.* (2020) states that COVID-19 patients with diabetes mellitus stay in the hospital with an average stay of 5 days longer than the length of stay of patients without diabetes who are hospitalized. HbA1c was a reflection of the average glycaemia over the preceding 2 to 3 months. Although it was improves the prognosis of COVID-19 patients with hyperglycemia with an increased risk of poor outcome, significance of HbA_{1c} level for the management of COVID-19 peoples remains unclear. Therefore, the initial aim of this study was tto determine the correlation between HbA_{1c} level and hospitalized duration for COVID-19.

2. Methods

2.1 Data Collecting

A retrospective analytics study with a cross-sectional design. This study used medical record files of diabetes mellitus patient who are treated with COVID-19 at RSUD Dr. Soetomo Surabaya in June 2020 – June 2021 as the research instruments. The minimum sample size of multiple linear regression test is 15 to 20 times of the total variables. There are 2 variable in this study, so the minimum sample is 40.

a. Inclusion criteria
   1 Patients aged 21 years old and over
   2 Alive discharged patients

b. Exclusion criteria
   1 Uncomplete data
   2 Pregnant patients
   3 Post-operation patients

2.2 Data Analysis

The correlation between HbA1c level with patient's length of stay was analyzed using a multivariate analysis of the multiple linear regression test, sig. <0.05 was considered significant and calculated using SPSS Software version 24 (SPSS Inc., Chicago, IL, USA). All categorical data were presented in numbers and percentages. Meanwhile, continuous data were presented in mean ± standard deviation (SD).

3. Result

Table 1. Characteristics distribution of diabetes mellitus patient who are treated with COVID-19

Variable	Category	Subject (n = 186)	*Mean* ± SD	Percentage
Age (years old)	21 – 40	23	34,65 ± 3,94	12,4%
	41 – 60	114	49,11 ± 4,64	61,3%
	> 60	49	65,78 ± 5,1	26,3%
Gender	Male	93		50%
	Female	93		50%

Table 1 shows that the most subjects are at the age of 41 – 60 years old (61,3%). The youngest is 27 years old and the oldest is 80 years old. It also shows that the gender distribution of this study both are equal between male and female.

Table 2. Distribution of HbA1c level of diabetes mellitus patient who are treated with COVID-19

HbA1c level (%)	Subject (n=186)	Percentage
< 6,5	17	9,2%
≥ 6,5	169	90,8%

Table 2 shows that the most subjects are experience at ≥ 6,5% of HbA1c level (90,8%).

Table 3. Distribution of glucose level of diabetes mellitus patient who are treated with COVID-19

Glucose level (mg/dL)	Subject (n=186)	*Mean* ± SD	Persentase
< 140	34	111,6 ± 19,69	18,3%
140 – 180	26	163,1 ± 10,27	14,0%
> 180	126	295,75 ± 83,37	67,7%

Table 3 shows that the most subjects are experience at 180 mg/dL of glucose level (67,7%).

Table 4. Distribution of subject's length of stay

Length of stay	Subject (n=186)	*Mean* ± SD	Percentage
< 7 days	5	4,8 ± 1,30	2,7%
7 – 14 days	45	10,82 ± 2,15	24,2%
15 – 21 days	66	17,48 ± 1,98	35,5%
> 21 days	70	29,89 ± 10,42	37,6%

Table 4 shows that the most subjects were stay in hospital for more than 21 days (37,6%).

Table 5. Correlation test between HbA1c level and length of stay of diabetes mellitus patient who are treated with COVID-19

Model		F	*Sig.*
1	Regression	0,183	0,908[b]
	Residual		
	Total		

Table 5 shows the results of the *multiple linear regression* test between HbA1c levels and glucose levels with length of stay has a significancy = 0.908 (Sig. >0.05), it means that there is no correlation between this variables.

4. Discussion

In this study, the entire sample was divided into 3 age ranges, 21 – 40, 41 – 60, and over 60 years old. The results of this study show that people with diabetes mellitus who experience COVID-19 and discharged alive were most in the age range of 41 – 60 years old with an average age of 49.11 years old. This result were similar with previous research by Triyono et al. (2021) which states that most COVID-19 patients with diabetes mellitus who are hospitalized in East Java, Indonesia are in the age group of 41-60 years (76.1%).

The results of multiple linear regression analysis showed that there was no affection of HbA1c levels to the relationship between initial blood sugar levels and the length of treatment of people with diabetes mellitus treated with COVID-19. The results obtained from this study are in accordance with the research conducted by Schlesinger *et al.* (2021) which states that there is no correlation and affection of HbA1c levels on the severity of COVID-19 or the risk of COVID-19 mortality. Another study conducted by Lippi *et al.* (2020) which states that COVID-19 patients with high initial blood sugar levels when admitted to the hospital without a history of diabetes mellitus have a worse prognosis than patients who have a history of DM. Meanwhile, in diabetes mellitus patients, high initial blood sugar levels are a more significant risk factor than HbA1c which only reflects glucose homeostasis for the previous 2 – 3 months. Previous study by Klein et al. (2021) prove that they still did not find a strong correlation between HbA1c and COVID-19 severity and mortality, but in the subgroup of patients requiring mechanical ventilation, mortality was significantly increased in patients with HbA1c ≥ 6.5% which in line with other cohorts of COVID-19 patients, showing that admission blood glucose may be a more relevant predictor for mortality because it may be interpreted as a biomarker of systemic inflammation on admission.

5. Conclusion

Based on the results of research on diabetes mellitus patient who are treated with COVID-19 at RSUD Dr. Soetomo Surabaya, it can be concluded that there is no correlation between the HbA1c level and glucose level with length of stay for people with diabetes mellitus who are treated with COVID-19. The high level of HbA1c does not affect the increase of patient's length of stay in hospital.

6. Recommendations

Future studies are expected to add other variables such as COVID-19 severity, patient's commorbidity, and the patient's status (referral or not).

Acknowledgements

The author would like to thanks parents, lecturers, friends, and all staff of Faculty of Medicine Airlangga University and RSUD Dr. Soetomo.

References

Alkundi, A, Mahmoud, I, Musa, A, Naveed, S, & Alshawwaf, M, 2020, 'Clinical characteristics and outcomes of COVID-19 hospitalized patients with diabetes in the United Kingdom: A retrospective single centre study.', ***Diabetes Research and Clinical Practice***, vol. 165, p. 108263, doi: 10.1016/j.diabres.2020.108263.

European Centre for Disease Prevention and Control, 2020, 'European Center for Disease Prevention and Control. Coronavirus disease 2019 (COVID-19) pandemic: increased transmission in the EU/EEA and the UK – seventh update', ***European Center for Disease Prevention and Control***, vol. 2019, no. March, p. 31, Retrieved from https://www.ecdc.europa.eu/sites/default/files/documents/RRA-seventh-update-Outbreak-of-coronavirus-disease-COVID-19.pdf.

Hair *et al.,* 1998, *Multivariate Data Analysis,* Fifth Edition, Prentice Hall, Upper Saddle River : New Jersey.

Klein, S.J., Mayerhöfer, T., Fries, D. *et al.* 2021. Elevated HbA1c remains a predominant finding in severe COVID-19 and may be associated with increased mortality in patients requiring mechanical ventilation. *Crit Care* **25**, 300. https://doi.org/10.1186/s13054-021-03730-2

Lippi, G, South, AM, & Henry, BM, 2020, 'Electrolyte imbalances in patients with severe coronavirus disease 2019 (COVID-19).', ***Annals of Clinical Biochemistry***, vol. 57, no. 3, pp. 262–265, doi: 10.1177/0004563220922255.

Schlesinger, S, Neuenschwander, M, Lang, A, Pafili, K, Kuss, O, Herder, C, & Roden, M, 2021, 'Risk phenotypes of diabetes and association with COVID-19 severity and death: a living systematic review and meta-analysis', ***Diabetologia***, vol. 64, no. 7, pp. 1480–1491, doi: 10.1007/s00125-021-05458-8.

Triyono EA, Wahyuhadi J, Prajitno JH, Novida H, Siagian N, Cahyani C, Putri AT, Lusida MAP, Hidayat AA, Idamusaga KS, Intansari NI, Asmara J, Hadi A, Bandem IKMP. *Clinical characteristics and outcomes of hospitalized COVID-19 patients with diabetes mellitus in East Java, Indonesia: A cross-sectional study*. F1000Res. 2022 Jun 21;11:684. doi: 10.12688/f1000research.111047.1.

Vallea A, Javier Rodriguez, FélixCamiña, Miguel AMartínez-Olmos, Juan B. Ortola, Santiago Rodriguez-Segadea. 2022. *At-admission hba1c levels in hospitalized COVID-19 participants with and without known diabetes*, *Clinica Chimica Acta*. Elsevier. Available at: https://www.sciencedirect.com/science/article/pii/S0009898122011809

Wallia, A, Prince, G, Touma, E, El Muayed, M, & Seley, JJ, 2020, 'Caring for Hospitalized Patients with Diabetes Mellitus, Hyperglycemia, and COVID-19: Bridging the Remaining Knowledge Gaps', ***Current Diabetes Reports***, vol. 20, no. 12, p. 77, doi: 10.1007/s11892-020-01366-0