International Journal of Frontiers in
Chemistry and Pharmacy Research
Journal homepage: https://frontiersrj.com/journals/ijfcpr/
ISSN: 2783-0462 (Online)

(RESEARCH ARTICLE)

Check for updates

Blood glucose levels in patients not hospitalized vaccinated against SARS-CoV-2 viral infection as risk factor for severe Covid-19

Andressa de Farias Fehlberg [1], Lorena Gonçalves da Silva Salles [1, 2], Yasmin Lima de Oliveira [1, 3], Andreza Mendes da Silva [1, 4], Cintia de Oliveira Correa [1, 4], Joelma Lessa da Silva [1] and Rachel Siqueira de Queiroz Simões [1, 5, 6, *]

[1] *Department of Sciences Medicine, All Lab World Medical Clinic, Presidente Vargas, 529 - Centro, Rio de Janeiro, Brazil.*
[2] *Department of Pharmacy, Celso Lisboa University Centre, Rio de Janeiro, Brazil.*
[3] *Department of Biomedicine, Celso Lisboa University Centre, Rio de Janeiro, Brazil.*
[4] *Department of Nursing, Celso Lisboa University Centre, Rio de Janeiro, Brazil.*
[5] *Department of Health and Agricultural Sciences, Santa Úrsula University, Fernando Ferrari, 75 – Botafogo, Rio de Janeiro, Brazil.*
[6] *Vector Medical Malacology lato sensu postgraduate, Oswaldo Cruz Institute, Oswaldo Cruz Foundation, Avenida Brazil 4.365 – Manguinhos, Rio de Janeiro, Brazil.*

International Journal of Frontiers in Chemistry and Pharmacy Research, 2024, 05(01), 001–006

Publication history: Received on 16 July 2024; revised on 04 September 2024; accepted on 06 September 2024

Article DOI: https://doi.org/10.53294/ijfcpr.2024.5.1.0025

Abstract

Hyperglycemia or diabetic people has been suggested as a risk factor for developing severe illness from coronavirus disease 2019 (COVID-19). The aim of our study was to detect the presence of glucose levels in blood samples of the patients without known pre-existing diabetes collected in the post-pandemic period. Patients with severe COVID-19 pneumonia requiring hospitalization between January 2023 and December 2023 were not enrolled in this retrospective observational study. This is a retrospective epidemiology study involving patients categorized into three groups according to admission Blood Glucose (BG) levels: < 70 mg/dL; 77 – 90 mg/dL; > 99 mg/dL collected in 2023y according to standard glycaemia targets. Throughout 2023y, a total of 13,246 blood samples were collected from 11,425 non-diabetic patients vaccinated against Covid, which 10,478 male and 947 female. Furthermore, we detected that nondiabetic patients with good glycemic control (86.77%). Moreover, we detected highest percentage of samples collected from men (91,71%) and lowest percentage from women (8,28%). These data upon the references resulted as hyperglycaemia were compared to COVID-19 vaccinated patients with normoglycemia blood glucose measures. So, our study dataset was a backward-looking study which the glucose parameter listed in the electronic medical records could be analyzed as focuses the predictor factor on vaccinated patients against SARS-CoV-2. We concluded that new insulin therapy could be applied in future studies including diabetic patients vaccinated against COVID-19. It is also added that comorbidities were not considered in the analysis of controlled glucose levels and/or considered within the normal reference standard.

Keywords: SARS-Cov-2; COVID-19; Diabetes; Blood Glucose; Hyperglycaemia**.**

1. Introduction

Coronavirus disease 2019 (COVID-19) is a pandemic illness which started in China in December 2019 and rapidly spread across the world [1]. COVID-19 ‘‘cytokine storm’’ have been linked with higher levels of the proinflammatory cytokines as tumor necrosis factor-α (TNF-a), interleukin (IL)-1β, and IL-6 and higher levels of IFN a, b, and l expressed by Monocytes infected with CoV-2 [2]. SARS-CoV-2-Induced Metabolic Reprogramming of Monocytes Directly Affects T

* Corresponding author: Rachel Siqueira de Queiroz Simões; Email: rachelsqsimoes@gmail.com

Cell Response and Lung Epithelial Cell Death [3]. Hyperglycaemia may contribute to development of cytokine storm by promoting proinflammatory glycosylation [4].

Currently there is limited knowledge on medical comorbidities corelated glucose and COVID-19 so the main of this study is to detect the presence of glucose levels in the post-pandemic period, since diabetes are among the main risk factors for severe COVID-19 symptoms. The presence of Diabetes Mellitus (DM) has a significant impact on mortality rate in COVID-19 patients [4,5]. Meta-analysis study had been performed on retrospective cohort study linked demographics data prevalence of several comorbidity associated with hospitalized COVID-19 patients at China [5]. Previous reports have demonstrated that hyperglycemia at admission was associated with poor outcomes in COVID-19 patients [6]. Novel Biotechnological Strategies and Genomic Variants had been studied using classical and next-generation vaccine platforms to SARS-CoV-2 testing several populations included different comorbidities such as diabetes mellitus (DM) or high glucose levels [7]. In addition, docking molecular had been applied for drug design and computational modeling in SARS-Cov-2 virus infection [8].

2. Methodology

Patients with severe COVID-19 pneumonia requiring hospitalization between January 2023 and December 2023 were not enrolled in this retrospective observational study. We obtained clinical and outcome data were obtained from electronic medical records of the lab. The data set was divided into normal, low and high glucose blood collection groups. Data regarding comorbidities found to be associated with COVID-19 were not including in our study. The clinical manifestations of COVID-19 were not considered when self-reported by patients at the time of blood collection in the clinical laboratory. Statically the T test was performed to the association between categorical variables and 95% confidence interval were considered. The hexokinase enzymatic method is the reference method for determining blood glucose in serum or plasma. Sample involves the separation of the fluid part (serum) from the formed elements (red blood cells, leukocytes and other cells) and is carried out immediately, so that there is no consumption of this analyte. Adenosine triphosphate promotes the phosphorylation of glucose in a reaction catalyzed by hexokinase (HK), according to the following chemical reaction [9]:

$$\text{Glucose} + \text{ATP} \xrightarrow{\text{HK}} \text{Glucose-6-phosphate} + \text{ADP}$$

$$\text{Glucose-6-Phosphate} + \text{ADP} \xrightarrow{\text{G-6-PDH}} \text{6-phosphoglucanato} + \text{NADH}$$

Hexokinase is an enzyme that catalyzes the transfer of phosphate from ATP to glucose. The chemical reaction catalyzed by the enzyme glucose 6-phosphate dehydrogenase (G-6-PDH) has high specificity for glucose 6 phosphate and therefore other hexoses or phosphorylated pentose esters do not participate in the reaction [9].

3. Results

Throughout 2023y, a total of 13,246 blood samples were collected from 11,425 non-diabetic patients vaccinated against Covid-19, which 10,478 male and 947 female. Of these samples, a small portion of 11 presented between > 70mg/gL; the highest percentage was 9914 in the rate between 77 - 90 70 mg/gL and 1500 samples at the level above >90 mg/gL (Figure 1).

Normal glucose values follow reference standards between 70- 99 mg/dL. All changed findings were confirmed by recollected sample (1.821 new samples), as reference internal quality control. Therefore, lower values are suggestive of hypoglycemia and higher values are indicative of pre-diabetes. In this study, only glucose was investigated as predictor factor to comorbidity in vaccinated patients against SARS-CoV-2.

Furthermore, we detected that nondiabetic patients with good glycemic control (86.77%) and values within the expected range had high percentage rates compared with those with poorer control or values above the expected range 13.12% (Table 1). The median blood glucose was 0,9 (<70 mg/dL) considering values below the expected range; 826 (77 – 90 mg/dL) considering values within the expected range and 125 (>99 mg/dL) considering values above the expected range. So, analysis of means, standard deviation and coefficient of variation of all patients collected in the 2023 year can be found in the table 2 and showed in figure 2.

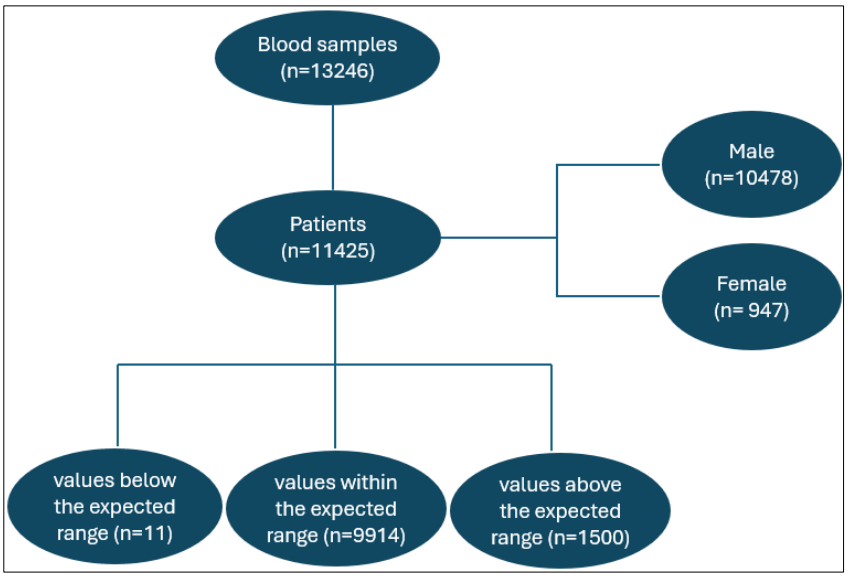

Figure 1 Flowchart of the blood glucose population.

Table 1 Comparative analysis of percentage of values of blood glucose samples collected among months/year.

Months	values below the expected range	values within the expected range	values above the expected range	Patients
January	0	88.11%	11.88%	1.010
February	0	85.83%	14.16%	706
March	0.09%	82.24%	17.65%	1.042
April	0	87.41%	12.58%	874
May	0.09%	86.39%	13.51%	1.110
June	0.3%	86.2%	13.5%	1.000
July	0.10%	89.00%	10.89%	955
August	0	84.61%	15.38%	1.170
September	0.10%	88.65%	11.23%	961
October	0.27%	86.21%	13.51%	1.110
November	0.10%	87.81%	12.07%	911
December	0	91.49%	8.50%	576
Total	0.096%	86.77%	13.12%	11.425

Table 2 Analysis of means, standard deviation and coefficient of variation of all patients collected in the 2023 year.

Year	values below expected range	values within expected range	values above expected range	Patients	Samples
2023	0.9166 ± 1.0836	826.1666 ± 138.7187	125 ± 37.4918	952 ± 170.8180	1.104 ± 247.6408
	(CV = 1.182136)	(CV = 0.167906)	(CV = 0.299934)	(CV = 0.17943)	(CV = 0.2243)

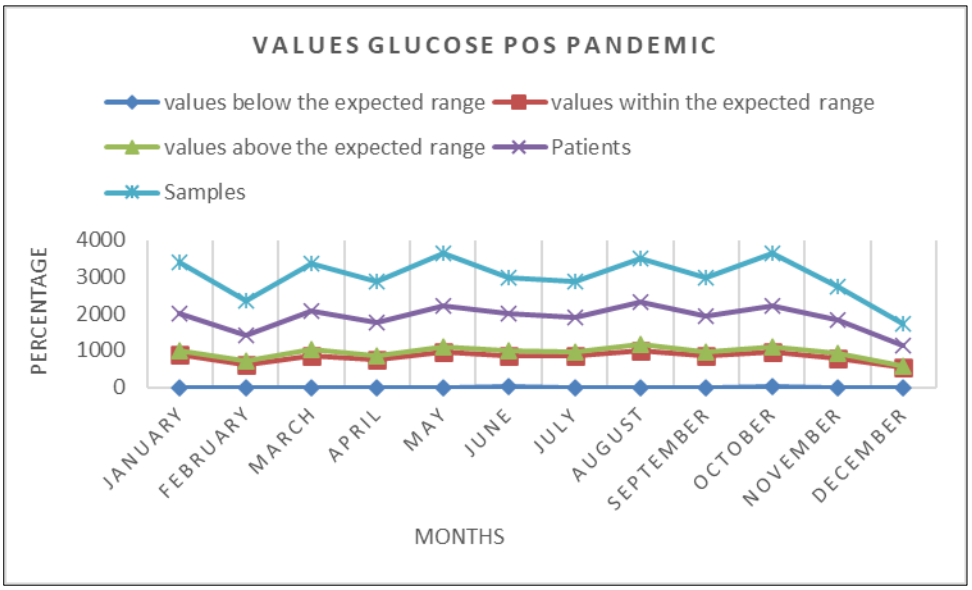

Figure 2 Analysis of blood glucose levels collected in the 2023 y.

Moreover, we detected highest percentage of samples collected from men (91,71%) and lowest percentage from women (8,28%) (Table 3). The mean and standard deviation for the female samples were 78.9166 ± 24.3738 (CV = 0.30885), and for male were 873.1666±156.9527 (Table 4). Blood Glucose samples collected among female and male investigated in the 2023 year were showed in figure 3.

Table 3 Percentage of glucose samples collected by gender among months/year.

Year	Female	Male	Patients	Samples
2023	78.9166 ± 24.3738	873.1666±156.9527	952 ±170.8180	1.104±247.6408
	(CV = 0.308855)	(CV = 0.179751)	(CV = 0.17943)	(CV = 0.224312)

Table 4 Analysis of means, standard deviation and coefficient of variation of glucose pos pandemic period (2023 y)

Months	Female	Male	Patients
January	7.52%	92.47%	1.010
February	10.05%	89.94%	706
March	12.47%	87.52%	1.042
April	7.89%	92.10%	874
May	6.93%	93.06%	1.110
June	10.9%	89.1%	1.000
July	8.79%	91.20%	955
August	7.26%	92.73%	1.170
September	8.42%	91.57%	961
October	6.93%	93.06%	1.110
November	6.25%	93.74%	911
December	5.38%	94.61%	576
Total	8.28%	91.71%	11.425

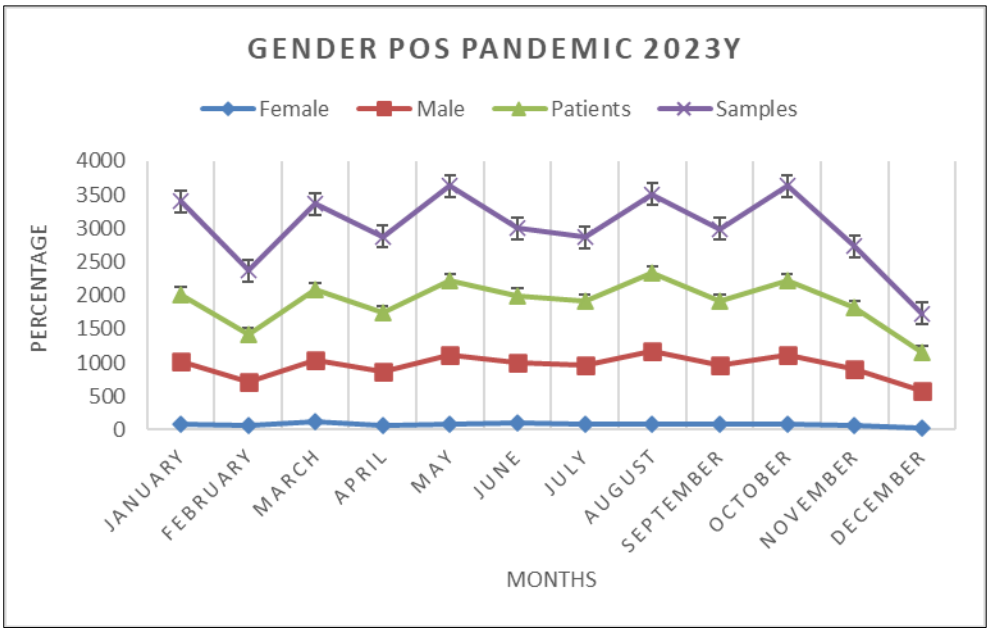

Figure 3 Blood glucose samples collected among female, and male investigated in the 2023 y.

4. Discussion

It has been demonstrated that hyperglycemia in patients with COVID-19 is associated with a higher risk of mortality. So, our study focused on the possibility of vaccinated patients against COVID-19 showed controlled glucose blood levels. And the emergence and reemergence of viral diseases may be accompanied for the genomic and epidemiology surveillance to mitigate any risk of propagation of the novel possible variant viral [10]. Concerning our results, glycemic testing should be recommended since high glucose levels was associated in COVID-19 patients [6;7].

5. Conclusion

Our study dataset was a backward-looking study which the glucose parameter listed in the electronic medical records could be analyzed as focuses the predictor factor on vaccinated patients against SARS-CoV-2. In this study population, we concluded that new insulin therapy could be applied in future studies including diabetic patients vaccinated against COVID-19. It is also added that comorbidities were not considered in the analysis of controlled glucose levels and/or considered within the normal reference standard.

Compliance with ethical standards

Acknowledgments

This research was supported by All Lab World Medical Clinic. The authors thank the hematology laboratory staff and collaborators in data processing.

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

Statement of ethical approval

All research was performed in accordance with the relevant guidelines and regulations. Medical record numbers were used for data collection and no personal identifiers were collected or used in the research report. Ethical clearance was obtained from the ethical review committee of Department of Sciences Medicine University in accordance with ethical principles for the guidance of physicians in medical research.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

Funding source

There was no funding source for this study.

References

[1] World Health Organization. Coronavirus disease (COVID-19) outbreak (https://www.who.int)

[2] Codo et al., 2020. Elevated Glucose Levels Favor SARS-CoV-2 Infection and Monocyte Response through a HIF-1a/Glycolysis-Dependent Axis. Cell Metabolism 32, 437–446 September 1, 2020. 2020 Elsevier Inc. https://doi.org/10.1016/j.cmet.2020.07.007

[3] Sakai et al. 2023. Combining blood glucose and SpO2/FiO2 ratio facilitates prediction of imminent ventilatory needs in emergency room COVID-19 patients. Scientifc Reports | (2023) 13:22718 | https://doi.org/10.1038/s41598-023-50075-7

[4] Mamtani, A.M., Athavale, M., Abraham et al. 2020. Association of hyperglycaemia with hospital mortality in nondiabetic COVID-19 patients: A cohort study. Diabetes & Metabolism 47 (2020) 101254. https://doi.org/10.1016/j.diabet.2021.101254

[5] Nandy et al., 2020. Coronavirus disease (COVID-19): A systematic review and meta-analysis to evaluate the impact of various comorbidities on serious events. Diabetes & Metabolic Syndrome: Clinical Research & Reviews 14 (2020) 1017-1025, https://doi.org/10.1016/j.dsx.2020.06.064 1871

[6] Barbosa, M., Marques-Sá, J., Carvalho, C., Fernandes, V. Is elevated blood glucose at admission associated with poor outcomes in hospitalized COVID-19 patients? Arch Endocrinol Metab, 2023, v.67(6), 1-12, e000649. doi: 10.20945/2359-3997000000649

[7] Simões, R.S.Q et al. Classical and Next-Generation Vaccine Platforms to SARS-CoV-2: Biotechnological Strategies and Genomic Variants. International Journal of Environmental Research and Public Health, v. 19, p. 1-22, 2022. doi10.3390/ijerph19042392

[8] de Queiroz Simões, R.S., Ferreira, M.S., Dumas de Paula, N., Machado, T.R., Pascutti, P.G. (2020). Computational Modeling in Virus Infections and Virtual Screening, Docking, and Molecular Dynamics in Drug Design. In: da Silva, F.A.B., Carels, N., Trindade dos Santos, M., Lopes, F.J.P. (eds) Networks in Systems Biology. Computational Biology, vol 32. Springer, Cham. https://doi.org/10.1007/978-3-030-51862-2_12

[9] Fehlberg, A. F. et al. Clinical screening on nondiabetic vaccinated against COVID-19 patients and blood glucose dysregulation levels associated with SARS-CoV-2 in the post-pandemic period. International Journal of Frontiers in Biology and Pharmacy Research, 2024, 06(01), 001–006. doi: https://doi.org/10.53294/ijfbpr.2024.6.1.0036

[10] Barth, O.M., Simões, R, S.Q. Emerging and reemerging viruses. In: Human and Veterinary Virology. 1. ed. Rio de Janeiro: Thieme Revinter, ISBN: 978-85-5465-034-6, v.1 p: 317: 324, 2019