BRIEF REPORT

Quantifying Worsened Glycemic Control During the COVID-19 Pandemic

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Aims: **We hypothesized that glycemic control in outpatients, measured by HbA1c, was worse during the early months of the COVID-19 pandemic than in 2019. We sought to quantify how much worse and to determine if social determinants of health were associated with these differences.**

Materials and Methods: **Data were extracted from the electronic medical records of 2 cohorts of patients seen in the family medicine clinic of a southeastern academic health center. Three hundred patients with baseline HbA1c results as well as HbA1c results in May 2019 or May 2020 were evaluated.**

Results: **The groups had similar mean baseline HbA1c (7.65, SD = 1.50 for 2019; 7.61, SD = 1.71 for 2020; P = .85). Mean May HbA1c decreased from baseline in 2019 (7.19, SD = 1.45) but rose in 2020 (7.63, SD = 1.73), a statistically significant difference (P < .01). Controlling for age, gender, race, and insurance status, HbA1c in May 2020 ($mean_{adj}$ = 7.73) was significantly higher than in May 2019 ($mean_{adj}$ = 7.16).**

Conclusions: **During the early months of the COVID-19 pandemic, glycemic control in our patient population was significantly worse than during the same period in 2019 (mean HbA1c difference = 0.57). Contrary to our expectations, we did not find associations between patient demographic variables and glycemic control, including race. (J Am Board Fam Med 2021;34:S192–S195.)**

Keywords: **COVID-19, Family Medicine, Hb A1c, Pandemics, Population Health, Social Determinants of Health**

Introduction

Although the COVID-19 pandemic presents the immediate health risk of viral infection, the pandemic, along with the local and national governmental response to it, potentially increases short- and long-term health risks for patients living with chronic disease. Reports of COVID-19 in the United States began in late January 2020.[1] As a pandemic response strategy, in Georgia, the governor declared a state of emergency March 14, 2020, which was followed by a shelter-in-place order issued March 23, 2020, continuing through April 2020.[2] Pandemic response strategies may limit (1) patients' ability to adhere to nutritional or physical activity guidelines and (2) patients' access to health care.[3] Stay-at-home and social distancing policies may also contribute to social isolation, which can negatively impact mental health. These effects of pandemic response strategies can inhibit patients' disease self-management.[4] For patients living with type 2 diabetes or prediabetes, it is not clear how significantly pandemic response strategies impact glycemic control.

The social determinants of health framework suggests that the social responses to the pandemic, such as shelter-in-place orders, closure of businesses, and loss of some public services, may have had a disproportionate effect on racial and ethnic minority groups.[5] Minority groups have less financial capacity to enact healthy nutritional decisions

This article was externally peer reviewed.

Submitted 24 August 2020; revised 19 October 2020; accepted 20 October 2020.

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Disclaimer: Views expressed within this publication represent those of the authors and do not reflect the official position of the Uniformed Services University of the Health Sciences, or the US Government, the Department of Defense at large.

Funding: None.

Conflicts of interest: Dr. Seehusen is the Deputy Editor of *JABFM*.

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in the midst of the financial hardships that have emerged following pandemic response strategies.[6] Pandemic response strategies, which encouraged the public to stay at home and close to home, likely amplified the effect of "place" on patients' ability to manage chronic conditions. Predominately Black American communities have less access to healthy foods and higher access to fast food,[7,8] each of which makes chronic disease management more difficult. Similarly, African American women list neighborhood safety concerns and lack of sidewalks as barriers to physical activity close to home.[9]

The purpose of this study was to investigate the impact of local pandemic response strategies on glycemic control. Our hypothesis was that glycemic control in our patient population was significantly worse in the early months of the pandemic as compared with the same months in 2019. A secondary hypothesis was that race, payment model, and median household income would be associated with differences in mean HbA1c.

Materials and Methods

After receiving an exemption from the Augusta University Institutional Review Board, all adult (aged 18 years and older) outpatient HbA1c results of 5.5 or higher from May 2019 and May 2020 were identified in our electronic medical record (EMR) (Cerner). The range of 5.5 or higher was applied to include patients at the upper ends of normoglycemia, prediabetes, and diabetes. We anticipated that the glycemic control of all of these populations may have been negatively impacted by the pandemic. Data extraction included the May HbA1c plus an appropriate comparison HbA1c for a baseline. The May HbA1c was used to measure glycemic control during the first 3 months of the US pandemic response. The baseline time frame was defined as the preceding October through February and reflected a recent measure of glycemic control before the influence of US and local pandemic response strategies.

All patients were enrolled in the outpatient family medicine clinic of an academic health center within the diabetes belt in the southeastern United States. Patients in this clinic receive care from faculty and resident family physicians as well as nurse practitioners.[10] A total of 335 records were retrieved that had an outpatient laboratory HbA1c result in May and a baseline outpatient laboratory HbA1c result in the preceding October to February. The May glycemic value represents a patient's glycemic control during the implementation of the strictest pandemic response strategies (from March through May) in Georgia. We chose to compare HbA1c change in 2020 to 2019 instead of a simple pre-, postpandemic analysis as a control for any seasonal variation of HbA1c levels that might exist in this patient population.

Patient records were excluded for other diagnosis (type 1 diabetes) (n = 1), race other than Black or White (n = 16), or nonspecific HbA1c value in chart (listed as greater than 15) (n = 1). All cases with baseline HbA1c outliers (greater than 2 standard deviations) were also removed (n = 17). Thus, 300 patients are included in the analysis.

Results

Table 1 shows demographic characteristics of the 2019 and 2020 groups. The group demographic variables were not statistically different. The groups

Table 1. Demographic Variables and HbA1c Results for May 2019 and May 2020 Patients

	2019 (n = 156)	2020 (n = 144)	p-Value
Age (mean, SD)	61.0 (11.7)	60.4 (13.4)	NS
Women (%)	111 (71.2)	89 (61.8)	NS
White (%)	53 (34.0)	45 (31.1)	NS
Insurance status (%)			NS
Medicaid	85 (54.5)	68 (47.2)	
Medicare	14 (9.0)	22 (15.3)	
Insurance	52 (33.3)	47 (32.6)	
Self-pay	5 (3.2)	7 (4.9)	
Antidiabetic medication (%)			NS
None	25 (16.0)	32 (22.2)	
Only noninsulin medications	87 (55.8)	66 (45.8)	
Insulin	44 (28.2)	46 (31.9)	
Median household income (mean, SD)	$38,529 (15,732)	$40,399 (13,707)	NS
Baseline HbA1c (mean, SD)	7.65 (1.50)	7.61(1.71)	NS
May HbA1c (mean, SD)	7.19 (1.45)	7.63 (1.73)	<0.01

SD, standard deviation.

had similar mean baseline HbA1c (7.65, SD = 1.50 for 2019; 7.61, SD = 1.71 for 2020; $P = .85$).

Mean May HbA1c decreased from baseline in 2019 (7.19, SD = 1.45) but rose in 2020 (7.63, SD = 1.73), a statistically significant difference ($P < .01$). In univariate analysis, age, gender, race, and insurance status were not statistically associated with mean May HbA1c results. Medication regimen was significantly associated with May HbA1c levels (no antidiabetic medications: mean = 6.17, SD = 0.65; noninsulin medications only: mean 7.18, SD = 1.44; regimen included insulin: mean = 8.63, SD = 1.60 [$P < .001$]).

For hypothesis testing, a full factorial model of covariance (ANCOVA)—including the fixed factors of year (2019 or 2020) and race (Black American or White American) and covariates baseline HbA1c, patient age, and estimated household income—was tested onto the dependent variable May HbA1c. In the model, the baseline HbA1c had a significant association with the dependent variable, $F(1, 295) = 347.7$, $P < .001$. Controlling for covariates, year was significantly associated with HbA1c, $F(1, 295) = 18.85$, $P < .001$. Patient HbA1c in May 2020 ($mean_{adj}$ = 7.73) was significantly higher than patient HbA1c in May 2019 ($mean_{adj}$ = 7.16). No main effect was detected for race. No interaction effect for year by race was detected.

Discussion

It has been previously reported that COVID-19 infection can lead to dramatic worsening of existing or new onset diabetes, perhaps by alteration of glucose metabolism.[11] Glycemic control during the pandemic has already been shown to be worse in patients with type 1 diabetes.[12] Theoretical concerns about glycemic control among outpatients with type 2 diabetes has been expressed in the medical literature.[13] In addition, some potential mitigation strategies have been suggested.[14]

Our findings suggest that the COVID-19 pandemic indeed worsened glucose control in the short term among our patient population. Comparing adjusted mean HbA1c between the 2 years, the COVID-19 pandemic, and the sociopolitical response to it resulted in a mean HbA1c 0.57 higher in May 2020 than May 2019. During spring 2020, as compared with spring 2019, patients probably were more likely to experience financial and social stress, to struggle with changes in the food supply that reduced healthy nutritional choices, to encounter obstacles to established exercise patterns, to have limited access to health care, and to experience heightened barriers to medication adherence.

This elevated HbA1c may put patients at a greater risk for long-term diabetes complications because higher HbA1c levels are associated with higher risk for cardiovascular and other complications.[15,16] Recent evidence also suggests that significant swings in HbA1c may also be associated with long-term cardiac outcomes.[17]

Contrary to our secondary hypothesis, we did not find associations between patient sociodemographic variables and glycemic control, including race. In fact, although both White and Black patients had worse glycemic control in 2020 compared with 2019, White patients had a greater rise in year-over-year HbA1c than Black patients did, although this was not statistically significant. The reasons for this are unclear, but one intriguing possibility is that Black patients with diabetes may have developed strong resiliency and were therefore more capable of dealing with the shifting landscape of the pandemic.[18]

Findings are limited by study design. The study compares 2 separate cohorts, rather than a single patient population. In this clinic, we did not have access to a large number of patients that had HbA1c data available in both years. However, the 2 cohorts belong to the same general patient population and were followed in the same clinic, mostly by the same primary care clinicians. That, combined with the fact that their mean baseline HbA1c numbers were so similar, indicates that direct comparison of these 2 cohorts is reasonable.

As a single institution study, findings here are interpreted in accordance with the pandemic response strategies of this local area. The severity of the COVID-19 pandemic, and the aggressiveness of the local response to it, are local effects. The impact on population glycemic control may be sensitive to these factors, limiting generalizability of these findings. Data retrieved from an EMR, such as race, are subject to error. Lastly, the mean household income was estimated based on the patients' zip code. In some cases, this method may have overestimated or underestimated an individual patient's income.

Future research should look at other patient populations to determine if our findings are representative or unique. Patients living in regions that experienced more significant, and longer, impacts from the COVID-19 pandemic may observe greater changes in glycemic control. Additional research

could also evaluate how local COVID-19 infection rates and governmental responses influenced glycemic control. Qualitative inquiry should also evaluate individual patient factors and strategies that mitigated the influence of pandemic response strategies on glycemic control.

To see this article online, please go to: http://jabfm.org/content/34/Supplement/S192.full.

References

1. Hartmann-Boyce J, Morris E, Goyder C, et al. Diabetes and COVID-19: risks, management, and learnings from other national disasters. Diabetes Care 2020;43:1695–703.
2. Nedelman M. New report on first US case of novel coronavirus details mild symptoms followed by pneumonia. 2020. Available from: https://www.cnn.com/2020/01/31/health/washington-coronavirus-study-nejm/index.html. Accessed July 30, 2020.
3. ACLU Georgia. Timeline of Georgia government actions regarding COVID-19. 2020. Available from: https://www.acluga.org/en/timeline-georgia-government-actions-regarding-covid-19. Accessed July 24, 2020.
4. Usher K, Bhullar N, Jackson D. Life in the pandemic: social isolation and mental health. J Clin Nurs 2020;29:2756–7.
5. Turner-Musa J, Ajayi O, Kemp L. Examining social determinants of health, stigma, and COVID-19 disparities. Healthcare (Basel) 2020;8:168.
6. Tai DBG, Shah A, Doubeni CA, Sia IG, Wieland ML. The disproportionate impact of COVID-19 on racial and ethnic minorities in the United States. Clin Infect Dis 2020;ciaa815. Available from: https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa815/5860249.
7. Baker EA, Schootman M, Barnidge E, Kelly C. The role of race and poverty in access to foods that enable individuals to adhere to dietary guidelines. Prev Chronic Dis 2006;3:A76.
8. James P, Arcaya MC, Parker DM, Tucker-Seeley RD, Subramanian SV. Do minority and poor neighborhoods have higher access to fast-food restaurants in the United States? Health & Place 2014;29:10–7.
9. Joseph RP, Ainsworth BE, Keller C, Dodgson JE. Barriers to physical activity among African American women: an integrative review of the literature. Women Health 2015;55:679–99.
10. Barker LE, Kirtland KA, Gregg EW, Geiss LS, Thompson TJ. Geographic distribution of diagnosed diabetes in the U.S.: a diabetes belt. Am J Prev Med 2011;40:434–9.
11. Rubino F, Amiel SA, Zimmet P, et al. New-onset diabetes in Covid-19. N Engl J Med 2020;383:789–90.
12. Verma A, Rajput R, Verma S, Balania VKB, Jangra B. Impact of lockdown in COVID 19 on glycemic control in patients with type 1 diabetes mellitus. Diabetes Metab Syndr 2020;14:1213–6.
13. Koliaki C, Tentolouris A, Eleftheriadou I, Melidonis A, Dimitriadis G, Tentolouris N. Clinical management of diabetes mellitus in the era of COVID-19: practical issues, peculiarities and concerns. JCM 2020;9:2288.
14. Gujral UP, Johnson L, Nielsen J, et al. Preparedness cycle to address transitions in diabetes care during the COVID-19 pandemic and future outbreaks. BMJ Open Diab Res Care 2020;8:e001520.
15. Wan EYF, Yu EYT, Chen JY, Wong ICK, Chan EWY, Lam CLK. Associations between usual glycated haemoglobin A1c and cardiovascular disease in patients with type 2 diabetes mellitus: a 10-year diabetes cohort study. Diabetes Obes Metab 2020;22:2325–34.
16. Kelly TN, Bazzano LA, Fonseca VA, Thethi TK, Reynolds K, He J. Systematic review: glucose control and cardiovascular disease in type 2 diabetes. Ann Intern Med 2009;151:394–403.
17. Segar MW, Patel KV, Vaduganathan M, et al. Association of long-term change and variability in glycemia with risk of incident heart failure among patients with type 2 diabetes: a secondary analysis of the ACCORD trial. Dia Care 2020;43:1920–8.
18. Kim JH, Islam SJ, Topel ML, et al. Individual psychosocial resilience, neighborhood context, and cardiovascular health in Black adults: a multilevel investigation from the Morehouse-Emory Cardiovascular Center for Health Equity Study. Circ Cardiovasc Qual Outcomes 2020;13:e006638.