Impact on Diabetes Management Due to Social Participation Restrictions Associated with the COVID-19 Pandemic

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Objective: To elucidate the impact of activity restrictions associated with the pandemic on diabetes management.

Materials: This study evaluated all patients visiting our facility who were determined to have diabetes during the observation periods. To determine the impacts of the emergency declared on April 7, 2020, we examined 345, 1109, and 752 patients whose hemoglobin A1c (HbA1c) levels were measured in March and April, May, or in June, respectively. Patients were compared to data from other subjects evaluated in 2019 under the same conditions. The 2019 subjects included 469, 1315, and 783 patients whose HbA1c levels were measured in March and April, May, or June, respectively.

Methods: Comparison of the HbA1c levels in April, May, and June minus the HbA1c levels in March of both 2019 and 2020 were used to assess the impact of pandemic-related activity restrictions on diabetes management. HbA1c levels greater than 0 were defined as patients who “worsened”, while differences in HbA1c levels ≤0 were defined as patients who conditions were “not worsened”. Comparisons of the deterioration/improvement rates for the HbA1c levels in 2019 and 2020 were then performed.

Results: Compared to 2019, the number of patients exhibiting a worsened diabetes management increased from March to April 2020 [122 (26.0%) vs. 137 (39.7%), p<0.01], while the number of patients with worsened diabetes management decreased from March to June 2020 [305 (39.0%) vs. 240 (31.9%), p<0.01].

Conclusions: When compared to 2019, there was no sustained increase in patients with worsening diabetes management during the 2020 observation period.

Key words: coronavirus disease 2019, diabetes management, activity limitations, social participation restrictions

1. Introduction

In order to ensure good diabetes management, it has been reported that proper exercise is beneficial in these patients1. Due to the worldwide spread of coronavirus disease 2019 (COVID-19), many countries have put into place lockdowns and quarantines of both cities and regional locations. Japan first declared a state of emergency from April 7, 2020 to May 25, 2020, during which time stricter restrictions on activities were placed. During this state of emergency, there was a decrease in the mobility of the Japanese population, which caused many patients with lifestyle-related diseases having to subsequently change their lifestyles2. However, the impact of these nationwide activity restrictions on diabetes management remains unclear. This study aimed to elucidate the impact of activity restrictions associated with the pandemic on diabetes management.
restrictions on diabetes management remains unclear. This preliminary investigation was designed to evaluate the impact of activity restrictions associated with COVID-19 on diabetes management. Diabetic patients being treated at Juntendo University Hospital were examined by using data collected from electronic medical records, along with information on the changes in the hemoglobin A1c (HbA1c) levels.

2. Materials and Methods

This retrospective, observational study evaluated data collected from all patients who visited the Diabetes and Endocrine Clinics of Juntendo University Hospital and who were prescribed antidiabetic drugs and/or were diagnosed with diabetes mellitus from March to June 2019 and/or from March to June 2020. Juntendo University Hospital is located in Tokyo, the capital of Japan, with most of the patients living in metropolitan areas. HbA1c levels measured during above observation period in the eligible patients were anonymized and extracted through the Data Warehouse attached to the electronic medical record system in collaboration with the Center for Promotion of Data Science. The facility’s website published the research plan. Prior to enrollment, all subjects were informed that any clinical data obtained during their medical treatment would be retrospectively analyzed and published. The study protocol was approved by the Ethics Review Board of Juntendo University (No. 20-152).

In order to determine the impact of the state of emergency that was declared on April 7, 2020, this study enrolled 345 patients whose HbA1c levels were measured in both March and April, 1,109 patients whose HbA1c levels were measured in both March and May, and 752 patients whose HbA1c levels were measured in both March and June. Additional subjects enrolled for the purpose of comparison were selected from the 2019 data utilizing the same conditions. The subjects selected for the 2019 comparison group included 469 patients whose HbA1c levels were measured in both March and April, 1,315 patients whose HbA1c levels were measured in both March and May, and 783 patients whose HbA1c levels were measured in both March and June. If the same subject was seen more than once within one month and HbA1c levels were measured multiple times, the mean values of the measurements were calculated and then used. To assess the impact of the restricted activity during the state of emergency on the diabetes management, the HbA1c levels in April, May, and June minus HbA1c levels in March were compared between 2019 and 2020. A Wilcoxon rank-sum test was used to analyze the differences in the HbA1c levels. It has been previously reported that the risk of “adverse outcome” caused by diabetes increases linearly with increasing HbA1c. In addition, a 1 kg weight loss has been estimated to reduce HbA1c by 0.1%. Therefore, during this comparison, subjects exhibiting a difference in the HbA1c levels greater than 0 were defined as “worsened”, while subjects exhibiting a difference in the HbA1c levels ≤0 were defined as “not worsened”. A chi-squared test was used to analyze the deterioration rate of HbA1c levels in 2019 and 2020. All statistical analyses were performed using SAS 9.4 for Windows (SAS Institute Inc., Cary, NC, USA).

3. Results

Table 1 presents the comparison of the changes in the HbA1c levels, while Table 2 presents the changes in the diabetes management between 2019 and 2020. Continuous variables are described as the median, (minimum, maximum). Changes in HbA1c levels from March to April were worse in 2020 as compared to 2019, with an HbA1c difference of -0.1 (-4.6, 3.2) in 2019 vs. a difference of 0.0 (-3.7, 1.8) in 2020 (p<0.01). In addition, worsening HbA1c levels were observed in a greater number of patients from March to April in 2020 as compared to 2019, with an HbA1c difference of -0.1 (-4.6, 3.2) in 2019 vs. 39.0% (39.7%) in 2020 (p<0.01). In 2020, there was an improvement trend in the changes in HbA1c levels from March to June as compared to 2019, with an HbA1c difference of 0.0 (-7.5, 3.7) in 2019 vs. a difference of -0.1 (-6.3, 3.1) in 2020 (p=0.07). Furthermore, there were fewer patients exhibiting worsened HbA1c levels from March to June in 2020 as compared to 2019, 305 (39.0%) in 2019 vs. 240 (31.9%) in 2020 (p<0.01). There was no significant difference between 2020 and 2019 for the HbA1c levels from March to May, with an HbA1c difference of 0.0 (-4.9, 3.6) in 2019 vs. a difference of 0.0 (-5.5, 2.3) in 2020 (p=0.93). Moreover, there was also no significant difference between 2020 and 2019 for patients
exhibiting worsened HbA1c levels from March to May, [501 (38.1%) in 2019 vs. 396 (35.7%) in 2020 (p=0.23)].

4. Discussion

There was no persistent deterioration of the short-term changes in the HbA1c levels noted during the state of emergency that was declared in Japan, and our results did not appear to show any profound changes. However, the results did show that patients with worsening HbA1c exhibited a slight decrease after a temporary increase. Thus, some diabetic patients may have been affected by the COVID-19 pandemic and the various related restrictions on social activities.

Reports of changes in diabetes management before and after the state of emergency lockdowns remain controversial, with studies indicating both worsening and improvement in these patients5-8. A simulation model was reported that predicted worsening diabetes management in conjunction with lockdowns, while another study reported that a lack of access to insulin/glucostrips led to a worsening of the management of type 1 diabetes mellitus5,6. In contrast, Fernández et al. and Bonora et al. examined lockdowns in Spain and Italy, respectively, and reported finding improved diabetes control in patients with type 1 diabetes mellitus7,8. They suggested that patients could spend more time on self-management due to a reduction in daily routine activities during the lockdowns, and thus, this may have been responsible for improving the diabetes control.

Although our present results suggest that there was no persistent deterioration in the overall diabetes management, it is possible that some of the diabetic patients may have had either worse or better diabetes control. In Japan, social participation restrictions led to a temporary decrease in daily workloads in addition to a decrease in alcohol intake amounts. Furthermore, as these diabetic patients had more time to spend on diabetes management,
this might be responsible for the improvement in HbA1c levels that were observed in June 2020. In addition, government, social demands, or anxiety and stress caused by the pandemic could have also led to behavioral changes\textsuperscript{9,10}. However, one study has reported that the use of lockdowns can have adverse effects on health indicators\textsuperscript{11}. Thus, anxiety and stress associated with COVID-19 could have led to a worsening of the diabetes management in some Japanese patients.

There were several limitations for the present study. First, this study is based on data from only one medical institution. Since this facility is a university hospital located in a metropolitan area in Japan, this could have led to bias in the subject selection. A larger number of medical institutions will need to be included in order to obtain more representative results. Second, we did not directly observe the activity of the individual subjects. Thus, changes in the behaviors of diabetic patients after activity restrictions remain unclear. In order to clarify what kind of behavioral changes might have potentially occurred in these diabetic patients, a direct questionnaire survey should have been utilized. In addition, this study does not describe the background of diabetic patients. Backgrounds such as diabetes type, age, gender and complications are also associated with lifestyle habits, and thus, patient background information will be needed for future studies. Finally, the results reported in the current study only present the short-term changes that occurred during the diabetes management. In Japan, the declaration of the first state of emergency was from April 7, 2020 until May 25, 2020. Thus, since June of 2020, the Japanese social activity level appears to have recovered\textsuperscript{2}. Even so, continuation of the COVID-19 pandemic continues to be responsible for various social changes. In order to clarify the impact of the COVID-19 pandemic social changes on diabetes management, larger scale observational studies conducted over a longer period of time, with a wider variety of information collected will need to be undertaken.

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Authors’ contributions
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Conflicts of interest statement
The following authors have financial relationships to disclose.
NF is an employee of 4DIN Ltd.
AT is an employee of 4DIN Ltd., and has a leadership role in a private company.
None of the other authors have any financial relationships to disclose.

References
1) Pai LW, Li TC, Hwu YJ, Chang SC, Chen LL, Chang PY: The effectiveness of regular leisure-time physical activities on long-term glycemic control in people with type 2 diabetes: A systematic review and meta-analysis. Diabetes Res Clin Pract, 2016; 113: 77-85.
2) Apple “COVID-19 – Mobility Trends Reports” https://covid19.apple.com/mobility. Accessed 19 February 2021.
3) Stratton IM, Adler AI, Neil HA, \textit{et al}: Association of glycaemia with macrovascular and microvascular...
complications of type 2 diabetes (UKPDS 35): prospective observational study. BMJ, 2000; 321: 405–412.
4) Gummesson A, Nyman E, Knutsson M, Karpefors M: Effect of weight reduction on glycated haemoglobin in weight loss trials in patients with type 2 diabetes. Diabetes Obes Metab, 2017; 19: 1295–1305.
5) Ghosal S, Sinha B, Majumder M, Misra A: Estimation of effects of nationwide lockdown for containing coronavirus infection on worsening of glycosylated haemoglobin and increase in diabetes-related complications: A simulation model using multivariate regression analysis. Diabetes Metab Syndr, 2020 Jul-Aug; 14(4): 319–323.
6) 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: 1213–1216.
7) Fernández E, Cortazar A, Bellido V: Impact of COVID–19 lockdown on glycemic control in patients with type 1 diabetes. Diabetes Res Clin Pract, 2020; 166: 108348.
8) Bonora BM, Boscarì F, Avogaro A, Bruttomesso D, Fadini GP: Glycaemic control among people with type 1 diabetes during lockdown for the SARS-CoV-2 outbreak in Italy. Diabetes Ther, 2020; 11: 1–11.
9) Curtis V, Dreibelbis R, Sidibe M, et al: How to set up government–led national hygiene communication campaigns to combat COVID–19: a strategic blueprint. BMJ Glob Health, 2020; 5: e002780.
10) Salari N, Hosseinian–Far A, Jalali R, et al: Prevalence of stress, anxiety, depression among the general population during the COVID–19 pandemic: a systematic review and meta-analysis. Global Health, 2020;16: 57.
11) Clemmensen C, Petersen MB, Sørensen TIA: Will the COVID–19 pandemic worsen the obesity epidemic? Nat Rev Endocrinol, 2020 Sep; 16: 469–470.