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Seasonal changes in HbA1c values from young to elderly diabetic patients

Abstract

Background: Current research has focused on the seasonal changes in HbA1c at the age of 21-90 years old.

Subjects and methods: Subjects were 96 patients with type 2 diabetes mellitus (T2DM). Methods include the classification of group A, B, C by the age with 21-50, 51-70, 71-90 years old. HbA1c values in median were calculated for five consecutive seasons from December 2017 to February 2019.

Results: BMI value in 3 group A, B, C was 29.7, 24.7, 25.3, respectively. Basal HbA1c was 7.0%, 7.1%, 7.1%, in 3 groups, respectively. Seasonal changes in HbA1c are as follows: group A showed highest in the summer, group B showed highest in the spring and gradually decreased to the winter, and group C showed gradual decrease and lowest in autumn.

Discussion and conclusion: Seasonal changes would be probably from i) working generation with fatigue for persistent hot climate in group A, ii) rather stable daily life with balanced work and rest for the home in group B and C, iii) hot climate from spring to summer may be involved in the changes. Current investigation does not include multiple related factors. Further research will be expected for clarifying various factors.

Keywords: seasonal changes, HbA1c, type 2 diabetes mellitus, low carbohydrate diet

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Abbreviations: T2DM, type 2 diabetes mellitus; LCD, low carbohydrate diet; BMI, body mass index

Introduction

Diabetes has been one of the important health and medical problem in the world, and its adequate management for the patients would be crucial to maintain and develop the good control of the glucose variability.[1] As for the purpose of the treatment for type 2 diabetes mellitus (T2DM), it would be to decrease the prevalence of the microangiopathy and macroangiopathy, and to reduce the incidence of cardiovascular events on the brain and heart vessels.[2] Actually, it has been important to manage the values of blood glucose, blood pressure and lipid. It can bring the lower number of cardiovascular events and an improved prognosis. The control of the blood pressure has influenced the incidence of cardiovascular events from a randomized trial of intensive versus and standard treatment.[3]

From the diabetic management with some risk factors, there have been several guidelines for goal values. They include blood pressure,[4] lipids[5] and blood glucose.[6] Consequently, these statements have been useful for the target values in the medical practice. As regard to blood glucose and HbA1c, American College of Physicians (ACP) recommended in a guidance statement[7] with evidence-based medicine data. The comment was that the target HbA1c in T2DM would be about 7%–8% rather than 6.5%–7% that was previously recommended. There are some discrepancies of the results between cardiovascular outcome and mortality in diabetic patients achieved the same target values. One of those reason would be probably due to different time and frequencies in lots of large-scale clinical trials. Various differences may be from seasonal variations concerning diabetic situation.[8] It has been said that diabetic control has been worse in winter season because of more eating and less exercise habit.[9,10]

In the past, a standard nutritional treatment for diabetes was calorie restriction (CR). Since then, Atkins have introduced low carbohydrate diet (LCD) and it has become gradually prevalent.[11,12] From several research concerning CR and LCD, the superiority of LCD has been reported in DIRECT study and other studies.[13,14] On the other hand, in Japan, the author and co-workers have been engaged in clinical research such as CR and LCD.[15,16] Especially, we continued various research on comparative study of CR and LCD, research on ketone bodies, and carbohydrate food loading test.[17–19]

We have continued to treat a large number of diabetic patients and have published various reports.[20,21] Among them, some staffs of our diabetes team had noticed that there were several cases where diabetes control becomes worse from the spring to the summer, 2019. It was speculated that the climate had been extremely hot for several months. We have accumulated much data of diabetic patients, then we have tried to investigate the seasonal changes in HbA1c values. In this article, obtained data and the related discussion would be reported.

Subjects and methods

Enrolled subjects are 96 patients who have been treated for medical treatment in Kanaiso Hospital, Tokushima Japan, where the authors are working as clinicians. The diagnosis for the patients would be T2DM with the age of 21-90 years old (Table 1). The age range in each group was 21-50, 51-70, 71-90 years, respectively. As for the diagnosis, type 1 diabetes mellitus and special types of diabetes were excluded in the criteria of this study. As to the method, we have accumulated lots of data from diabetic patients for years. Data of HbA1c values from five seasons were calculated every three months. The seasons were defined as follows: i) winter includes December 2017, January and February, 2018, ii) spring is from March to May, 2018, iii) summer is from June to August, 2018, iv) autumn is from

September to November, 2018, and v) winter is from December 2018, January and February, 2019. Regarding to the HbA1c value in each season, three consecutive HbA1c values were calculated into the average level. The data of weight, height and body mass index (BMI) were measured in the spring, 2018, which is the start of the new fiscal year in Japan.

Table 1 Subjects of 3 groups

Grouping	age (yr)	n	M/F	BMI
Group 1	21 - 50	28	18/10	29.8 [23.9–31.5]
Group 2	51 - 70	33	14/19	24.7 [22.5–27.1]
Group 3	71 - 90	35	18/17	25.3 [22.8–27.4]

BMI: Body Mass Index

Data of BMI: Median and Quartile of 25% and 75%

Statistical analysis

The results of the data in this study were statistically calculated.[22] The results were shown as the median value and the quartiles of 25% and 75%.[23] It means that 50% of the subjects are situated around the median value.[24] Data of Body mass index (BMI) were expressed by median value and 25% and 75% of the quartiles, which were shown in Table 1. Furthermore, HbA1c values in three groups were also calculated by median value. The data was shown in the Figure 1.

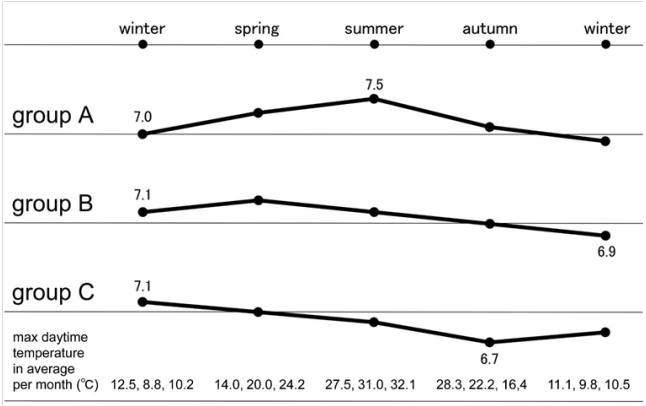

Figure 1 Seasonal changes in HbA1c values with 3 groups, Horizontal line shows the level of 7%.The data of the max daytime temperature in average per month (°C) are shown from December 2017 to February 2019.

Ethical considerations

This study was fundamentally conducted in compliance with the adequate ethical principles, which was based on the Declaration of Helsinki. Moreover, there was some commentary for the Ethical Guidelines for Research in the medical field for Human beings and in the conduction of the Good Clinical Practice (GCP). Regarding the protection of human rights, there were some ongoing considerations. Furthermore, "Ethical Guidelines for Epidemiology Research" was applied according to the related guideline. These principles were originated from Japan by the Ministry of Education, Culture, Sports, Science and Technology and also by the Ministry of Health, Labor and Welfare.

As to current investigation, authors have explained the detail of the research and obtained the informed consent from the subjects. Furthermore, we have established the ethical committee for the clinical research in Kanaiso Hospital. It included the president, the vice-president, director of the Pharmaceutical department, the head-nurse of the nursing department, director of the administration and expert in the medical and legal specialty professionals. We have discussed and made confirmation that this investigation has been adequate and agreed with all members with no problems.

Results

Fundamental data

The subjects were 96 patients with type 2 diabetes mellitus (T2DM). BMI value in 3 group A, B, C was 29.7, 24.7, 25.3, respectively (Table 1). The value of median of BMI in group 1 was higher than those of other groups.

Seasonal HbA1c changes

Seasonal changes in HbA1c values in 3 groups are revealed in Figure 1. As regard to the basal HbA1c at the winter 2017-2018, it was 7.0%, 7.1%, 7.1% in 3 groups, respectively. Group A showed the HbA1c value for increasing from the spring and summer, and the highest in the summer. Group B showed HbA1c value for highest in the spring and gradually decreased to the winter. Group C showed gradual decrease from spring to autumn and the lowest in autumn. As reference data, the max daytime temperature from December 2017 to February 2019 were included in Figure 1. The average max temperature data were from 27.5 to 32.1°C in 3 months in summer 2018.

Discussion

Authors have continued clinical research on diabetes, such as low carbohydrate diet, comparison of glucose variability between LCD and calorie restriction (CR), meal tolerance test (MTT) for standard breakfast, and others.[19,25] We have continued managing many diabetic patients for long years. The reason for initiating this study was the specific climate from spring to summer, 2018. It has so high temperature and humidity that were not ever experienced in Japan. During that period, several diabetic patients were found with rather bad glucose control. Our co-medical staffs and physicians have been impressed with the tendency. Consequently, we try to start the project of seasonal changes of HbA1c.

Regarding the seasonal change, HbA1c values in groups A increased from spring to summer. This results may be from working for a long time in various stressful jobs in the hot circumstances, leading to fatigue. The age range of group A is from 21 to 50, which may be compatible for the daily working in so severe climate condition. There is a report related to diabetes and temperature.[26] There seems to be an increase in the risk of having HbA1c level more than 7%, for every 1 C decrement in temperature. This paper would be compatible for the elevated HbA1c in group A. Group B and Group C showed the gradual decrease of HbA1c from winter to summer. These age range means middle to aged people. Among them, some ratio of them are full-working or part-time working, and others are not working spending their lives in the home. In these cases, hot climate or weather does not seem to influence their daily lives, because they can stay in rather cooler circumstance than that of young people. According to the previous report, diabetic patients had higher risk of HbA1c > 7% in the winter and spring than those in the summer.[26] This tendency would be probably due to less exercise and more eating in winter season.

There are some limitations of our current study. From previous

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related papers, several factors were found influencing HbA1c value. They include age difference, sex difference, socio-economic status and sociodemographic factors.[27] Elder healthy adults with few coexisting chronic illnesses and intact cognitive function have to maintain lower glycemic goals (HbA1c 7.5%).[28,29] In contrast, those with multiple coexisting chronic illnesses, cognitive impairment have to maintain less stringent glycemic control goals.[29]

It would suggest that glycemic control target could be individualized according to each functional states, comorbidities, such as the existence of microvascular complications, macrovascular complications, cardiovascular disease (CVD) and episodes of hypoglycemia.[30] Furthermore, seasonal variations have been observed in lifestyle, food intake and physical activity. There were varied seasonality in glycemic control, total physical activity, and food intake.[31] HbA1c of every 3 months in five seasons (summer, autumn, winter, spring, summer) showed 7.0%, 6.9%, 7.2%, 7.4%, 7.2%, respectively.[31]

For the references, seasonal changes were investigated in 2678 patients with T2DM.[32] The biomarkers were HbA1c, Blood Pressure, and LDL-cholesterol, which stand for ABC. The target levels of these were defined as HbA1c <7%, BP <130/80 mmHg, and LDL cholesterol <100 mg/dL. As a result, the achievement rates of all ABC were lowest in winter.[32] From above, current study does not analyze enough related factors. Consequently, further additional study will be necessary for future research of seasonal changes of HbA1c and other biomarkers.

Conclusion

In current study, we examined seasonal Hb1c changes in diabetic patients. As a result, HbA1c were higher in summer with 21-50 years old, decreasing from winter to autumn with 51-90 years old. Hot climate from spring to summer may be involved in the changes. These results suggest that it would be necessary to consider the adequate diabetic management and to develop the detail study concerning various biomarkers in the future.

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None.

Conflicts of interest

The authors declare there is no conflict of interest.

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