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Impact of gender differences on lifestyle and glycemic control in Japanese patients with diabetes during COVID-19 lockdowns

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ABSTRACT

Aims: The COVID-19 pandemic has drastically changed global lifestyles. Some reports about lifestyle changes during this pandemic have been published. However, these studies have not assessed gender differences. Thus, we analyzed three lifestyle changes to determine gender differences.

Methods: We analyzed physical activity, snacking habits, and drinking habits in 323 patients with diabetes. Gender differences in lifestyle habits were analyzed using the χ^2 test, and comparisons of HbA1c between 2019 and 2020 were analyzed using the paired t-test. The factors that influenced the deterioration of HbA1c were determined using multivariate logistic regression analyses.

Results: Of the 323 patients, 212 were male and 111 were female. When examined by quarter, the HbA1c values increased significantly in 2020 compared with that in 2019 in the July–September period. In terms of gender differences in the changes of lifestyle habits, decreased physical activity was higher in women. The factors that affected deterioration in HbA1c were snacking habits for the overall and the male populations.

Conclusions: The lifestyle changes differed between the genders during the pandemic. A balanced diet is important for all patients with diabetes. Additionally, more attention should be paid to physical inactivity in women.

1. Introduction

Pneumonia of unknown pathogenesis was documented in Wuhan, Hubei Province, China, in December 2019 and was later identified as a new coronavirus infectious disease now-named coronavirus disease 2019 (COVID-19) [1]. The disease has since spread rapidly worldwide. On January 14, 2020, a patient with pneumonia who had stayed in Wuhan City was the first case reported in Japan [2]. In China and some Western countries, where the number of infected people had first spread rapidly, strong measures, such as city lockdowns, were imposed. In Japan, schools were temporarily closed from February 28, 2020, and teleworking was recommended for companies. Based on the Act on Special Measures Low for COVID-19, which was enacted on March 13, 2020, a state of emergency was issued in Japan on April 7. The Japanese people were requested to refrain from going out unnecessarily, and the declaration lasted until May 25. Such declarations were issued repeatedly thereafter, and this has changed the people's lifestyles drastically.

Diabetes is a typical lifestyle-related disease, and lifestyle habits greatly influence the management of such diseases. Changes in the lifestyles of patients with diabetes have due to the COVID-19 pandemic have been reported [3–7]. Some studies reported deterioration in lifestyle-related habits, such as dieting, snacking, exercise, and increased stress, and an association between glycemic control and weight gain. Other studies reported no changes in body weight or HbA1c but found an association between mental stress and lack of sleep with unhealthy eating habits, resulting in poor glycemic control in the study populations. However, these reports have not evaluated gender differences in lifestyle changes due to the COVID-19 pandemic. Considering gender differences in patients with diabetes, women may neglect their own health by prioritizing their household chores and family [8]. We therefore sought to investigate changes in three basic lifestyle habits during the COVID-19 pandemic retrospectively to determine whether any gender differences exist and whether they are related to glycemic control.

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2. Methods

We enrolled 323 patients with diabetes who were under regular follow-up and collected data by direct interview on changes in three subjective lifestyle habits (physical activity, snacking habits, and drinking habits) due to the COVID-19 pandemic during their visit to our hospital. Inclusion criteria were patients with diabetes who were visiting our hospital aged 20 years and above. Any type of diabetes was included. Exclusion criteria were patients who could not answer our interview independently. The three lifestyle habits (physical activity, snacking habits, and drinking habits) were analyzed according to three stages, namely, decrease, unchanged, and increase. The categorization was based on the patient's subjective evaluation. In addition to changes in the three lifestyle habits, data on gender, age, employment status, and HbA1c were extracted from the medical records. The HbA1c values obtained were the quarterly values for January–March, April–June, July–September, and October–December and the annual average values for 2019 and 2020. In calculating the rate of change in the annual average HbA1c (2020 average HbA1c to 2019 average HbA1c), 0% or less was defined as the improvement group, and 0.1% or more was defined as the deterioration group. As this study was a retrospective study, we did not need to obtain informed consent. Instead, we presented an opt-out on our website that explained the following: ① purpose of use and method of use of information, ② items of information to be used, ③ scope of users, ④ name of the person responsible for managing information ⑤ exclusion of information that identifies the research subject at the request of the research subject or his/her agent, and ⑥ process of accepting the request of the research subject or his/her agent. This study was conducted with the approval of the Medical Ethics Review Board of Tokyo Medical University (Approval Code T2020–0381).

2.1. Analysis 1

We assessed for gender differences the changes in three lifestyle habits caused by the COVID-19 pandemic.

2.2. Analysis 2

The factors that affected the deterioration of the average HbA1c value were analyzed by gender by multivariate logistic regression analyses.

2.3. Statistical analysis

The comparison of HbA1c values in 2019 and 2020 was analyzed by paired t-test. Gender differences in the changes in the three lifestyle habits were analyzed using the χ^2 test. Multivariate logistic regression analyses were used to analyze the data of the HbA1c improvement and deterioration groups. The outcome was the improvement/deterioration of the average HbA1c value, and the explanatory variables were employment status, and changes in the three lifestyle habits. A p-value of < 0.05 was considered statistically significant.

3. Results

Of the 323 patients with diabetes, 212 were male (65.6%) and 111 were female (34.4%). Twenty-four patients had type 1 diabetes (7.4%), 291 patients had type 2 diabetes (90.1%), and 8 patients had another type of diabetes (2.5%). The average age was 63.1 ± 13.1 years (male, 62.7 ± 11.8 years; female, 63.8 ± 15.3 years) (Table 1). The annual average HbA1c value in 2019 was 7.6 ± 1.1% (male, 7.6% ± 1.1%; female, 7.5% ± 1.6%), whereas the annual average HbA1c value in 2020 was 7.6 ± 1.0% (male, 7.6% ± 1.0%; female 7.6% ± 1.0%). No significant differences in the variables were found between the two years. When examined by quarter, the HbA1c levels increased significantly in 2020 compared with 2019 in the July–September period (July–September HbA1c 2019 vs. 2020: 7.4% ± 1.0% vs. 7.6% ± 1.1%; p = 0.000058). This tendency was observed in both genders (Male: 7.4 ± 1.0 vs. 7.6 ± 1.1, p = 0.001; Female: 7.4 ± 1.1 vs. 7.7 ± 1.1, p = 0.006) (Fig. 1).

Table 1
Patients' characteristics.

Subjects (n)	323	
Average age (years)	63.1 ± 13.1	
	Number	%
Male (n)	212	65.6
Female (n)	111	34.4
Type 1 diabetes	24	7.4
Type 2 diabetes	291	90.1
Other type of diabetes	8	2.5
Diabetes medication		
Biguanide	192	59.4
Thiazolidine	2	0.6
α-Glucosidase inhibitor	20	6.2
SGLT2 inhibitor	111	34.4
DPP4 inhibitor	180	55.7
GLP-1 receptor agonist	34	10.5
Sulfonylurea	47	14.6
Glinide	22	6.8
Insulin	93	28.8

3.1. Analysis 1: Gender differences in changes in three lifestyle habits

Overall, for physical activity, the frequency of decrease was 47%, unchanged was 41%, and increase was 12%. Gender differences were observed in the frequency of changes in physical activity (χ^2 (2) = 13.6; p = 0.001 (Male vs. Female, Decreased/Unchanged/Increased: 40% /44%/16% vs. 60%/35%/5%; p = 0.001). The frequency of increased physical activity was significantly higher in men, and the frequency of decreased physical activity was significantly higher in women. Overall, for snacking habits, frequency of decreased was 6%, unchanged was 62%, and increase was 32%. Gender differences were observed in the frequency of changes in snacking habits (χ^2 (2) = 7.67; p = 0.022) (Male vs. Female, Decreased/Unchanged/Increased: 5%/67%/28% vs. 10%/52%/38%; p = 0.001). Only the frequency of unchanged snacking habits was significantly higher in men. Overall, for drinking habits, the frequency of decrease was 14%, unchanged was 80%, and increase was 6%. Gender differences were observed in the frequency of changes in drinking habits (χ^2 (2) = 14.8; p = 0.001) (Male vs. Female, Decreased/Unchanged/Increased: 17%/74%/9% vs. 6%/92%/2%; p = 0.001). The frequency of increase and decrease in drinking habits were significantly higher in men. The frequency of unchanged was significantly higher in women (Fig. 2).

3.2. Analysis 2: Factors affecting the deterioration of the average HbA1c value

No significant associations were observed in drinking habits, physical activity, and the deterioration of the average HbA1c value. Snacking habits were significantly associated with the deterioration of the average HbA1c value in the overall analysis (odds ratio [OR] 1.707, 95% confidence interval [CI] 1.128–2.584) and with the male gender (OR 1.864, 95% CI 1.056–3.292) in multivariate analysis. Employment status was also significantly associated with the male gender (OR 2.771, 95% CI 1.536–4.999) analysis. On the other hand, in the female population, although no factors were significantly associated with changes in HbA1c values, employment status showed an opposite trend to that in males (OR 0.480, 95% CI 0.220–1.051; p = 0.066). Interestingly, the opposite trend was observed between genders (Table 2).

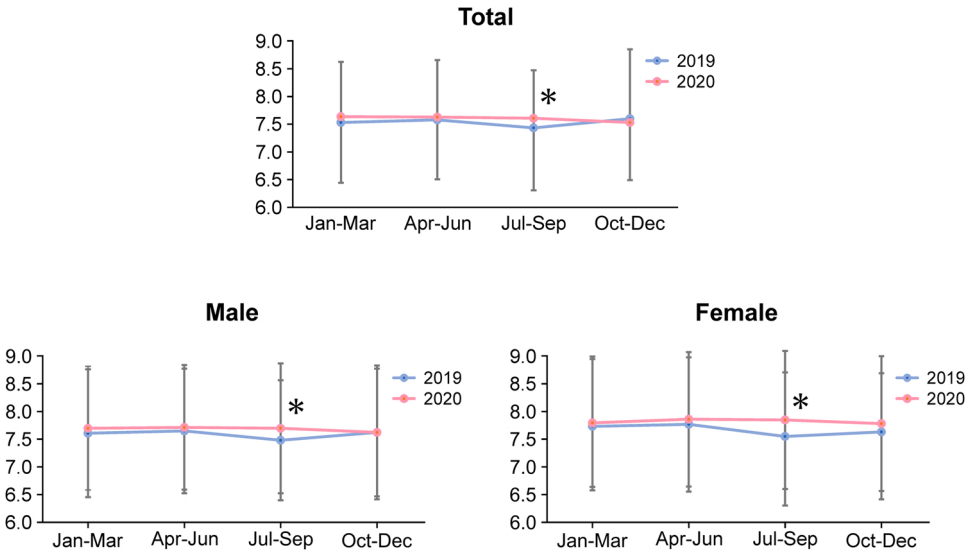

Fig. 1. Quarterly obtained HbA1c values in 2019 and 2020. The blue line shows the value of HbA1c in 2019, and the red line shows the value in 2020. In all three analyses of total, male and female, HbA1c values increase significantly in 2020 compared with 2019 in the July–September period.

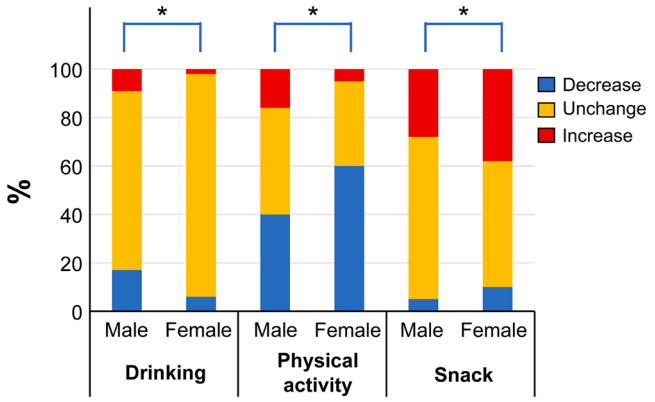

Fig. 2. Gender differences in changes in three lifestyle habits. Gender differences are observed in the frequency of changes in physical activity and snacking and drinking habits.

Table 2
Multivariate logistic regression analysis of deterioration of mean HbA1c.

	Deterioration of mean HbA1c	
	Multivariate significant variables ($p < 0.05$)	
Overall	OR (95% CI)	p-value
Employment status	1.470 (0.932–2.319)	0.10
Drinking	1.153 (0.684–1.944)	0.59
Physical activity	0.859 (0.613–1.203)	0.38
Snack	1.707 (1.128–2.584)	0.01
Male		
Employment status	2.771 (1.536–4.999)	< 0.01
Drinking	1.063 (0.593–1.907)	0.84
Physical activity	0.813 (0.536–1.232)	0.33
Snack	1.864 (1.056–3.292)	0.03
Female		
Employment status	0.480 (0.220–1.051)	0.07
Drinking	2.018 (0.489–8.326)	0.33
Physical activity	0.923 (0.471–1.808)	0.82
Snack	1.676 (0.873–3.216)	0.12

4. Discussion

We retrospectively investigated the changes of the three lifestyle habits during the COVID-19 pandemic to determine whether there is any gender difference and whether it is associated with glycemic control. We found gender differences in the changes of three lifestyle habits. In particular, there were strong gender differences in physical activity. Snacking habits and employment status were associated with glycemic control in male population, whereas in case of the employment status, the opposite trend was observed in the female population.

Many reports have been published on how these lockdowns affect lifestyle habits. An online survey of 1033 Chinese people showed that 70% of participants increased their screen time, whereas 30% of participants increased in the frequency of their vegetable and fruit intake [9]. An analysis of 995 Indian people revealed that physical activity decreased, whereas sitting time and screen time increased. Improvement in dietary habits was seen in younger people. Body weights increased in one-third of participants. Quarantine-induced stress and anxiety increased in nearly one-fourth of the participants [10]. According to a survey conducted at 35 research institutes in West Asia, North Africa, Europe, and the United States, which used the Internet to evaluate the psychological and lifestyle-related effects of home confinement due to COVID-19, the period of home confinement had a negative effect on mental health and emotions, and these were associated with unhealthy lifestyle (lack of physical activity + 15.2%; decreased social activity + 71.2%; deterioration of sleep quality + 12.8%; unhealthy eating habits + 10% compared with the period before confinement) [11]. In the general population, physical inactivity has been identified in many reports, although dietary habits varied. Many reports showed that increased stress leads to unhealthy eating habits.

Some reports in Japan observed a relationship between lifestyle changes and glycemic control due to the COVID-19 pandemic. Munekawa et al. [3] investigated stress levels and lifestyle-related changes in 203 patients with type 2 diabetes using a questionnaire and found that 40% of the study population felt increased stress, and 50% had decreased physical activity. Increased stress was associated with decreased physical activity and increased dietary intake. Tanaka et al. [4] conducted a self-administered questionnaire survey of 463 patients with diabetes. They found an increase in snacking habits in 21%, a decrease in physical activity in 51.2%, and an increase in alcohol intake in 8.7%. People under the age of 65 years with increased snacking exhibited worsening HbA1c and weight gain, whereas in those over the

age of 65 years, physical inactivity was a factor of weight gain. A difference depending on the age has been reported. Kishimoto et al. [6] surveyed 168 diabetic patients. Patients with reduced exercise due to teleworking or gym closure had worse glycemic control, but patients with improved diet, regardless of exercise, reported improved glycemic control. In the present study, 32% showed increased snacking, whereas 47% showed decreased physical activity. In the overall analysis, the factor statistically associated with worsening glycemic control was increased snacking, indicating the importance of diet management during the COVID-19 pandemic, as demonstrated by Kishimoto et al. Several reports revealed the association between the COVID-19 pandemic and lifestyle changes. However, in these studies, gender differences have not been investigated.

Much research has been done on gender differences in normal conditions, but not during the COVID-19 pandemic. According to demographic and behavioral data from a cohort study in 20 countries, the "PURE-Saudi" study, women were more likely to experience some form of stress [12]. In real life, women may neglect their own health by prioritizing their household chores and family [8]. This might be the reason why an opposite trend was observed between the genders while studying the effect of employment status on glycemic control. Since ancient times, men have been hunting, and women have been collecting to secure food. Men and women in that period were said to vary in their dietary behaviors. The Handza tribe of Tanzania still maintains these traditional, gender-based hunter-gatherer roles. Reports on the differences in dietary behaviors between the men and women of the Handza stated that males consumed a higher proportion of meat in total calories, whereas females consumed a higher proportion of tubers (plant roots). Women were also reported to eat more often than men [13].

In addition, while women are highly interested in healthy eating and form their own weight and eating habits, men tend to eat fatty foods because they prioritize the joy of eating [14]. These gender differences in eating behavior are influenced by gender hormones. Estrogen, a female hormone, is said to have anti-obesity and anti-feeding properties. Chronic increased stress is known to cause a bias toward a high-energy diet (rich in sugars and lipids), which is said to be more pronounced in men [15]. The cortisol-secreting response to stress may increase food intake and sweets [16]. Unproductive time or spells of boredom also affects eating behavior. Boredom is known to increase the desire for snacking, which is considered an avoidance behavior from self-loathing caused by boredom [17]. Chronic psychological stress and boredom as a result of lockdowns during the COVID-19 pandemic, therefore, increase the tendency for a high-energy dietary intake and snacking, and the effects can be significant, especially in men. The present study also indicates that snacking contributes to the deterioration of HbA1c in men.

We demonstrated that there are gender differences in lifestyle changes, especially physical activity, in Japanese patients with diabetes during the current pandemic. The effects of lifestyle-related changes on HbA1c were associated with an increase in snacking habits in the overall and male analysis. Through diet and exercise therapy is important for all patients with diabetes in this pandemic period, but based on our findings, diet in men should be emphasized for glycemic control. We found that women are more likely to be physically inactive than men. It was suggested that it may be a target of treatment in this condition.

4.1. Limitations

The data obtained on the changes in lifestyle habits were not quantitative evaluations but were subjective responses of the subjects. No dietary intake or nutritional survey other than snacking was investigated. Patient information such as complications and duration of diabetes were not sufficiently investigated. In addition, because this study is a retrospective medical record survey, the medications were administered at the discretion of the attending physician and thus varied among the patients. These limitations must be thoroughly addressed in future studies to obtain more conclusive results.

This study found gender differences in lifestyle changes in patients with diabetes during the COVID-19 pandemic. The findings suggest that treatment for diabetes should be tailored in consideration of gender differences.

Ethics approval and consent to participate

This retrospective study was approved by the Medical Ethics Review Board of Tokyo Medical University (Approval Code: T2020–0381). As this study was a retrospective study, we did not need to obtain informed consent.

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Declaration of Competing Interest

None.

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