

RESEARCH ARTICLE

Correlation of meal timing and interval with glycemic control in patients with Type 2 diabetes

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ABSTRACT


Background: Eating is very essential for life. The timing of food can set all the organs and tissues in the body which relates to food digestion, absorption, and metabolism. Much research performed on many animals proves that food intake is very important which will integrate the peripheral clocks. Consequently, traditional eating habits with a good meal, timing, and interval should be ideal, and not skipping breakfast is very much important in maintaining glucose homeostasis. To make people aware of the meal timing, healthy portion of food components that have to be consumed and the time interval between food, and the importance of morning meals, this study helps to give the same. **Aims and Objectives:** The study of meal timing and the interval between the meals in Type 2 diabetes mellitus patients. **Materials and Methods:** Five hundred known cases of Type 2 diabetes patients were enrolled in the study. Reports necessary for glycemic status are collected. Diet history obtained from the patients. **Results:** Individuals who had their meals at an earlier time and the less time gap between their meals had good control of Diabetes when compared to the persons who had late meals and the increased time gap between the meals. **Conclusion:** Early or correct meal timings and fewer time intervals between meals will help in the control of Type 2 diabetes. Unhealthy timings of taking the food can lead to a severance in normal homeostasis which can result in unhealthy events. This study helps to be aware of the morbidity associated with their lifestyle habits. Further, it also helps in changing their lifestyle to a healthy eating habit which will help in reducing glycemic index and comorbidities.

KEY WORDS: Meal Timings; Interval between the Meals; Type 2 Diabetes Mellitus; Complications of Diabetes

INTRODUCTION

Diabetes is an emerging chronic disease that when not in control can cause life-threatening complications, and disability and even can reduce the life span. The global prevalence of diabetes reached 463 million adults in the year 2019^[1] say 9% and it is now 537 million by the year

2021^[1] say 12.9%. It is expected that by the year 2045, the prevalence of diabetes globally may reach 46%. Increased risk of diabetes is believed to be associated with advancing age, ethnicity, lifestyle, eating habits, family history of diabetes, and no physical activity. Complications related to diabetes include microvascular and macrovascular diseases such as neuropathy, retinopathy, cardiovascular diseases, and renal diseases. Hemoglobin A1C (HbA1C) mimics the glycemic status of an individual and acts as a biomarker for checking and monitoring diabetes. Increased value of HbA1C can be seen in patients with diabetes and poor control of diabetes. DM can be controlled through improvement in patient's dietary knowledge, attitudes, and practices. These are considered an integral part of comprehensive diabetes

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care. Researchers have said in their studies that patient's knowledge about dietary habits definitely has a positive effect on controlling diabetes. Studies have shown that assessing a patient's dietary attitude may have a considerable benefit toward treatment compliance and decrease the occurrence rate of complications as well.^[2] Studies also say that persons who are omitting breakfast and lunch are highly prone to get uncontrolled diabetes. A person who is skipping breakfast alone is also considered as one of the factors for eating disorder psychopathology.^[3] Recent large prospective studies seem to support that repeated snacking increases the risk of weight gain and Type 2 diabetes. Results from many RCT studies say that lifestyle modification can delay or prevent the onset of diabetes in high-risk individuals.^[4] Eating is very essential for life. The timing of food can set all the organs and tissues in the body which relates to food digestion, absorption, and metabolism. Much research performed on many animals proves that food intake is very important which will integrate the peripheral clocks. Consequently, traditional eating habits with a good meal and its timing and interval should be ideal, and not skipping breakfast is very much important in maintaining glucose homeostasis. Nowadays, for diabetes patients, diet pattern and diet portion sizes are given as a nutritional advice. Such advice gives them about good eating habits with personal nutritional needs. But till now, many are ignorant against the diet pattern and diet portions. Studies show that diet pattern and diet proportions will alone can reduce the risk of developing complications.^[5] Through many studies, it has been noted that definitely there was a positive outcome with patient's knowledge about the diet pattern. However, not much information is given to the patients about the meal frequency, exact time to be taken for the meals all throughout the day. This study will help the care takers and the diabetes patients to gain knowledge about how the meal timings and the interval between every meal will help in control of diabetes.

Aim

The aim of the study was to correlate the meal timings and interval with glycemic control in Type 2 diabetes mellitus patients.

Objective

Study of meal timing and the interval between the meals in Type 2 diabetes mellitus patients.

MATERIALS AND METHODS

A cross-sectional and observational study was carried out with a known case of Type 2 diabetes mellitus patients attending a diabetic clinic based on the inclusion and exclusion criteria. Institutional ethical clearance obtained for the study. Informed consent obtained from the selected subjects and

their demographic profiles and food habits with food timings and intervals are collected using a pre-designed and pre-validated questionnaire. The study subject's blood sample was collected by venous puncture using aseptic techniques. FBS, PPBS, and HbA1C was determined.

Statistical Analysis

All statistical analyses were performed using Statistical Package for the Social Science (version 17) for Microsoft windows. Descriptive statistics were presented as numbers and percentages. The data were expressed as Mean and SD. One-way analysis of variance with a *post hoc* Tukey HSD test was used for continuous data. A Pearson correlation coefficient analysis was used to examine the association of two related variables. A Chi-squared test was used for the comparison between the two attributes. A two-sided $P < 0.05$ was considered statistically significant.

RESULTS

In this study, we observed that those individuals who had their breakfast, lunch, and dinner at an earlier time had good control of HbA1C when compared to those individuals who had their food at a very late time. Moreover, those individuals who had less time gap between the meals had good control of HbA1c when compared to individuals who had more time gap between the meals.

We have taken the following HbA1C value for checking the control of diabetes.

The normal level of HbA1C- <6% (No Diabetes).

Good control of Diabetes – 6–8% and Poor control of Diabetes – >8%.

Table 1 explains the demographic details of the participants. Table 2 explains about control of diabetes at different breakfast timings. Earlier the breakfast timings high is the control of HbA1C. Late breakfast timings lead to a high value of HbA1C and it is statistically significant. Table 3

Table 1: Participant characteristics

Characteristics	Number – 500
Men (in %)	69
Women (in %)	31
Age in years	22–79
Height in m ²	1.34–1.89
Weight in kgs	45–96
BMI kg/m ²	17–42
FBS (mg/dL)	72–496
PPBS (mg/dL)	82–567
HbA1C (%)	4.8–15.1

explains about control of diabetes at different lunch timings. Earlier the lunch timing, high is the control of HbA1C. Late the lunch timings, high the value of HbA1C and it is statistically significant. Table 4 explains about control of diabetes at different dinner timings. Earlier the lunch timings high the control of HbA1C. Late the dinner timings, high the value of HbA1C and it is statistically significant. Table 5 explains about control of diabetes at different time gaps between meals. Lessor the time gap between the meals, high the control of HbA1C. The higher the time gap between the meals, high the value of HbA1C and it is statistically significant.

Table 2: Control of diabetes in different breakfast timings

Breakfast time	Normal (%)	Good control of diabetes (%)	Poor control of diabetes (%)	P-value
8–9 am	28.5	54.8	16.7	<0.001
9–10 am	3.4	46.9	49.7	<0.001
10–11 am	0.0	7.3	92.7	<0.001

P<0.005 – Significant

Table 3: Control of diabetes in different lunch timings

Lunch time	Normal (%)	Good control of diabetes (%)	Poor control of diabetes (%)	P-value
12–1 pm	34.1	39.0	26.8	<0.001
1–2 pm	13.5	53.4	33.2	<0.001
2–3 pm	2.0	31.8	66.2	<0.001
>3 pm	11.8	39.0	49.2	<0.001

P<0.005 – Significant

Table 4: Control of diabetes in different dinner timings

Dinner time	Normal (%)	Good control of diabetes (%)	Poor control of diabetes (%)	P-value
7–8 pm	29.0	48.4	22.6	<0.001
8–9 pm	25.5	53.3	21.2	<0.001
9–10 pm	4.7	45.3	50.0	<0.001
10–11 pm	0.0	10.6	89.4	<0.001

P<0.005 – Significant

Table 5: Control of diabetes with a time gap between the meals

The time gap between meals	Hours	Normal (%)	Good control of diabetes (%)	Poor control of diabetes (%)	P-value
The time gap between breakfast and lunch	<5 h	18.3	59.3	22.4	<0.001
	>5 h	0.5	3.8	95.6	<0.001
The time gap between lunch and dinner	<7 h	18.3	59.3	22.4	<0.001
	>7 h	0.5	3.8	95.6	<0.001
The time gap between dinner and the next day's breakfast	<12 h	18.3	59.3	22.4	<0.001
	>12 h	0.5	3.8	95.6	<0.001

P<0.005 – Significant

DISCUSSION

In this study, we were able to observe that eating at a very late time can reduce the control of diabetes and an increased time gap between every meal will reduce the effect of insulin on blood sugar and thereby decrease glycemic control. With the above-mentioned results, we can come to the conclusion that individuals can be given the advice to take breakfast before 9 am, lunch before 2 pm, and dinner before 9 pm, which can reduce the risk of developing complications and can control high blood sugar also.

Lopez-Minguez *et al.*,^[6] said in their study that eating meals other than the recommended time can lead to a severe disturbance in their circadian system that may lead to unhealthy events which was again proved by this study that eating at very late time other than recommended time have reduced the control of HbA1C. Many researchers had studied the effect of breakfast skipping on developing Type 2 diabetes mellitus.^[7,8] Sami *et al.*^[9] delivered that improper dietary practice and a sedentary environment are the major risk factors for the rapidly increasing incidence of DM among countries. Nakajima and Suwa,^[10] in their study said that increased sugars are seen in late-night eaters alone but not in persons who are skipping breakfast alone. Morgan *et al.*,^[11] in their study explained that habit of eating late at night will have a higher impact on the glycemic index which was equal to this study where person who are eating late will have less control of diabetes. Paoli *et al.*,^[12] said in their study that, a regular meal pattern with breakfast, lunch, and dinner, not skipping breakfast, consuming a higher portion of food early in the day, limited meal frequency (i.e., 2–3 meals) may give good physiological benefits such as decreased inflammation, good circadian rhythmicity, stress resistance, and modulation of the gut microbiota. The possible mechanism behind the increased sugars and high HbA1C for the subjects who are eating the meals at a very late time and increased time interval between the meals in our study can be due to increased insulin resistance. Diabetes is a disorder that is going to continue for a lifetime, proper therapy methods with special attention on diet should be given by the persons who are giving the healthcare. The patients should also be given good knowledge about the disease and diet, for this purpose, the health-care providers must inform the patients to make

changes in their nutritional habits and food preparations and timings to take their food.

Strength of the Study

Many researchers found that a regular meal pattern (3 times a day) and timing of the meals early in the day and not skipping breakfast can reduce the onset of diabetes. In our study, we correlated meal timing and interval with glycemic control in patients with Type 2 diabetes.

Limitation of the Study

We listed out only the timing of the meal and the interval between the meals. The proportion of the food consumed and its nutritional value was not done, which can be taken up for the future research.

CONCLUSION

Active and effective dietary education may prevent the onset of diabetes and its complications. To make people aware of meal timing, a healthy portion of food components that have to be consumed and the time interval between food, and the importance of morning meals, this study helps to give the same.

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