

Original Research Article

Effect of eating frequency on prediabetes status: a self-controlled preventive trial

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ABSTRACT

Background: National diabetes data group (NDDG) first introduced the concept of a metabolic state intermediate between normal glucose homeostasis and diabetes, called glucose intolerance. The expert committee on the diagnosis and classification of diabetes mellitus extended the concept in 1997 to include patients with impaired fasting glucose (IFG) and those with impaired glucose intolerance (IGT) and referred it as prediabetes. The rationale of the study is that if a person will eat only twice in the day, the insulin secretion will be less which will reduce the fasting insulin levels which are a proxy for prediabetes status.

Methods: This is a self-controlled preventive trial. The study was conducted from 1st July 2016 to 30th June 2017. Prediabetes was diagnosed when person had HbA1C from 5.7 to 6.4. The participants with HbA1C level from 5.7 to 6.4 were included in the study. The participants were advised to eat twice in the day and walk 4.5 km in 45 minutes every day, at least 5 days a week. They were asked to repeat HbA1C and fasting insulin after 3 months. Sample size calculated was 38. The parameters used for evaluation were HbA1C and fasting insulin.

Results: There were 33 males and 15 females in the study population. It was seen that there was significant reduction in HbA1C and fasting insulin levels of prediabetes patients. This difference was statistically significant with p value less than 0.01. All prediabetics converted to non-diabetic state in three months period.

Conclusions: Eating twice a day and walking 4.5 km in 45 minutes every day causes statistically significant reduction in HbA1C and fasting insulin levels in patients with prediabetes. It was seen that all 48 participants converted to non-diabetic state within a period of 3 months.

Keywords: Effect, Eating frequency, Prediabetes

INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both.¹ Cut-off glycemic levels defining diabetes are based on the observed association between certain glucose levels and a dramatic increase in the prevalence of micro vascular complications considered specific for hyperglycemia (retinopathy and nephropathy). In 1979, the National diabetes data group (NDDG) first introduced the concept

of a metabolic state intermediate between normal glucose homeostasis and diabetes, called glucose intolerance. The expert committee on the diagnosis and classification of diabetes mellitus extended the concept in 1997 by recognizing patients with impaired fasting glucose (IFG) in addition to those with impaired glucose intolerance (IGT).¹ Both categories were referred to as prediabetes and are considered substantial risk factors for progression to diabetes. Moreover, micro vascular complications, including retinopathy, chronic kidney disease, and

neuropathy, and cardiovascular disease have been associated with prediabetes.

India has the unfortunate privilege of being the “Diabetes capital” of the world. The prevalence rates have been estimated to be 12% in urban areas and 4% in rural areas. More concerning is the fact that diabetes prevalence over the past four decades has increased fourfold.²

It is observed in patients with prediabetes that there are also raised levels of fasting insulin. Fasting insulin levels should normally be below 10 units.

Hyperinsulinemia is associated with many problems such as obesity, insulin resistance and high levels of triglycerides and increased sodium retention by renal tubules which induce hypertension. High levels of insulin can stimulate endothelial proliferation to initiate atherosclerosis.

Insulin secretion in the body is of two types. There is a baseline secretion of 18 to 32 units per day.³ The other type is insulin secreted due to every episode of eating. It is observed that food containing carbohydrates is a powerful stimulus for insulin secretion. Proteins have a weak stimulant effect and fats have almost no effect in this regard. It is also observed that consumption of breakfast or complete meal results in secretion of more or less similar amounts of insulin. The rationale of the study is that if a person will eat only twice in the day, the insulin secretion will be less. Hence the person will get the benefits of lowered level of insulin which facilitates use of fats for energy purpose. It will also reduce the fasting insulin levels which are a proxy for prediabetes status. This finding was published as a case report by the first author.⁴

Insulin is the hormone responsible for utilization of carbohydrates for energy in the body. In its absence or when its levels are low, the body switches over to fats as a source of energy. Insulin is secreted in large quantities if one consumes food item that contains carbohydrates. Proteins and fats have minimal effect on insulin secretion. The “carbo-insulin connection” theory was popularized by late Dr. Shrikant Jichkar from 1997 to 2004. He advocated the idea of eating only twice a day to lose weight and prevent obesity.⁵ This self-controlled preventive trial was conducted to find out the effect of reducing eating frequency to twice a day on prediabetes status.

METHODS

This is a self-controlled preventive trial. The study was conducted from 1st July 2016 to 30th June 2017.

The prediabetes is diagnosed with following criteria.⁶

Fasting plasma glucose (FPG) 100 mg/dl to 125 mg/dl (or) 2 hour plasma glucose in the 75 g OGTT 140 mg/dl to 199 mg/dl (or) HbA1C 5.7 to 6.4.

In the present study, the criteria of HbA1C, was considered.

Study population and selection criteria

The enrollment was done from 1st July 2016 to 31st December 2016. First author is engaged in a public health campaign since last four years known as “obesity and diabetes free India”. The subjects were provisionally enrolled in the study after taking their informed consent during the author’s lectures on weight loss and diabetes prevention arranged in various cities and towns of India. The author got pretested questionnaires filled from the audience who attended his lectures. The questionnaires included demographic information and detailed diet history with special emphasis on frequency of eating, the quantity and types of food items consumed. During lecture, the author used to guide the participants to find out how many times they are secreting insulin and then deciding upon the timings of lunch and dinner. He used to collect the questionnaires from the willing participants. The participants were enrolled in Whatsapp groups specially developed for the campaign. The participants were advised to get their HbA1C and fasting insulin level done at the beginning and send reports to author. The participants with initial HbA1C level from 5.7 to 6.4 were included in the study. After receiving first report each participant was informed telephonically about the diet plan. Every month the participant was asked about his/her progress as regards weight, waist circumference and any problems faced. He/she was asked to repeat HbA1C and fasting insulin after 3 months. A reminder message was sent if report was not received within one week of expected date.

Sample size

Sample size was calculated by using statistical software Open EPI version 2 with following information:

Expected cure rate difference - 50%; Alpha error - 5%; Beta error - 20%.

The calculated sample size was 38. Considering the loss to follow up of about 20% we planned to include 46 participants. We included those participants for data analysis who sent their reports of HbA1C and fasting insulin at the beginning and at the end of 3 months within the stipulated period. The parameters used for evaluation were HbA1C and fasting insulin level. The data was analysed by calculating mean, standard deviation. Paired ‘t’ test was used to test the significance before and after the intervention.

The theory in nutshell

This theory is based on a very simple principle. Every time we consume any food item containing carbohydrates we secrete insulin. If we eat breakfast or complete lunch or dinner, the quantity of insulin secreted is almost the same.⁷ Insulin secretion is of two types. There is a baseline secretion 18 to 32 unit per 24 hours which is beyond our control.⁸ Secondly with each episode of eating, we secrete insulin. As our blood always has high level of insulin, the body uses carbohydrates as a source of energy and fats remain untouched. Insulin being the saving hormone, tries to store energy in the form of fats. When we treat a diabetic patient with injectable insulin, one of the side effects is weight gain. When we are fasting say 3 to 4 hours after lunch or dinner, our insulin level goes down. The lowered level of insulin stimulates the body to use firstly liver glycogen and then fats for the purpose of energy. Hence when a person eats only twice in the day, s/he loses weight. Reduced eating frequency also caused reduction in fasting insulin level.

Advice in the campaign

- Identify the time of the day when you are really hungry; usually a person is truly hungry twice in the day. Some people have a pattern of 9 am, 6 pm and others have a pattern of 1 pm and 9 pm.
- Eat whatever you are eating presently at these two times; you have to just divide the quantity in to two.

- More quantity (say 60 to 70%) should be at the time of lunch and remaining at dinner.
- You can eat any food item; avoid sweets.
- You should not take tea/coffee with sugar, fruits, dry fruits or any other eatables in between the two meals.
- You should also not use sugar substitutes as the sweet taste stimulates the secretion of insulin.
- If at all you feel hungry in between two meals, you can take water, green tea/black tea/tea with 25% milk and 75% water (all without sugar/sugar free), buttermilk or coconut water.
- Check your weight and waist circumference every month.
- Repeat HbA1C and fasting insulin level after 3 months.
- Walk 4.5 km in 45 minutes every day at least five days in a week.

RESULTS

At the beginning 55 patients were included in the study on the basis of their HbA1C reports. Out of them 48 patients gave regular feedback and sent HbA1C and fasting insulin reports after 3 months of following diet plan within stipulated period of one week. The sample size required was 38. There were 33 males and 15 females in the study population. The age and sex wise distribution of participants is shown in Table 1.

Table 1: Age and sex wise distribution of participants.

Age/Sex	Males	Females	Total
Up to 40 years	14	4	18
41 years and above	19	11	30
Total	33	15	48

Table 2: Mean, standard deviation and standard error of mean of HbA1C and fasting insulin before and after the intervention.

Paired samples statistics					
		Mean	N	SD	SEM
Pair 1	HbA1C(1)	6.0310	48	0.20569	0.02969
	HbA1C(2)	5.2269	48	0.34234	0.04941
Pair 2	FI(1)	15.6348	48	6.69823	0.96681
	FI(2)	8.6202	48	4.33039	0.62504

Table 3: Results of paired 't' test.

Paired samples test									
		Paired differences			95% confidence interval of the difference		T	df	P value
		Mean	SD	SEM	Lower	Upper			
Pair 1	HbA1C(1) - HbA1C(2)	0.80417	0.37167	0.05365	0.69625	0.91209	14.990	47	0.000
Pair 2	FI(1) - FI(2)	7.01458	5.41730	0.78192	5.44156	8.58760	8.971	47	0.000

It was seen that there was significant reduction in HbA1C and fasting insulin levels of prediabetes patients due to the intervention. This difference was statistically significant with p value less than 0.01.

All prediabetics converted to nondiabetic state in three months period.

DISCUSSION

Diabetes mellitus is a lifestyle disease. The prevalence of diabetes in India and world is on rise in last few decades. Same is true for obesity. There have been attempts to find out ways by which the possibility of diabetes mellitus can be delayed or prevented by lifestyle modifications or by medicines. Role of diet is discussed a lot. If we look at the traditional dietary composition of different in the world, it reveals that people have adapted to different extremes of diets under different ecological settings. There are examples of tribes taking over 85% carbohydrates, 70% animal fats, or almost 100% dependence on meat and fish with practically no carbohydrate intake. Today the macronutrient composition of the diets in America, where the prevalence of obesity is the highest, or India that has highest number of diabetics is much more “balanced” than these extreme diet communities. But interestingly, the extreme diet communities traditionally had negligibly small prevalence of diabetes, hypertension or high cholesterol.⁹ This view reduces the importance given to dietary modifications suggested as a means to prevent diabetes. In our intervention the diet plan advised had no restriction on any food item. The participants were allowed to eat all food items in quantity and variety which they used to eat before starting this diet plan. And it has shown good improvement as regards HbA1C and fasting insulin levels.

The diabetes prevention program (DPP) was a major multicenter clinical research study aimed at discovering whether modest weight loss through dietary changes and increased physical activity or treatment with the oral diabetes drug metformin (Glucophage) could prevent or delay the onset of type 2 diabetes in study participants. At the beginning of the DPP, participants were all overweight and had blood glucose, also called blood sugar, levels higher than normal but not high enough for a diagnosis of diabetes—a condition called prediabetes. The DPP found that participants who lost a modest amount of weight through dietary changes and increased physical activity sharply reduced their chances of developing diabetes. Taking metformin also reduced risk, although less dramatically.¹⁰

In a large prospective study conducted on health professionals at Boston, it was found that breakfast consumption was inversely associated with T2D risk in men. Eating frequency and snack consumption were both directly associated with T2D risk and mediated by BMI, which indicated that the adverse effect of increased eating

frequency or snacks on T2D risk was partially mediated through its effect on body weight. Eating frequency only 1 or 2 times/day was also associated with an increased T2D risk compared with eating 3 meals/d.¹¹ In our study there was no question of omitting breakfast as the advice was to eat twice when the person feels really hungry. Boston study suggests thrice a day eating pattern to reduce the risk of diabetes but we got encouraging results with twice a day eating.

It is clear that a lifestyle disease should have a solution in lifestyle modification! The results of our study are quite promising in this context. In a resource poor country like India it is almost impossible to treat millions of diabetics and the complications of diabetes. The simple lifestyle modification suggested in this study can prove appropriate for our country. Further studies are needed to gather more evidence in this regard.

Limitations

The study is based on self-reporting by the participant. Though the reports of HbA1C and fasting insulin could be objectively assessed other information regarding diet and exercise was accepted as reported by the participants. It is likely that some effect could be due to reduction in calories consumed due to reduced eating frequency, and increased calorie expended due to walking. Other conditions responsible for reduction in HbA1C level were not studied.

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