

Diet in Diabetes Mellitus

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Introduction

Diet is one of the basic factors that govern the proper management of Diabetes Mellitus. The other two factors being drug and discipline. Of these three factors diet plays a major role because a vast majority of diabetic patient can be treated by diet therapy alone. Cases needing drugs (Insulin/tablet) also need some form of diet adjustment.

Diet therapy is perhaps the oldest form of treatment for diabetes mellitus. There is evidence that as early as 3500 BC. diet was used in the treatment of diabetes mellitus in Egypt (1).

Diet therapy has gone through drastic modification over the years as our understanding of the pathophysiology of diabetes mellitus has improved. A positive advance was made in 1979 when John Rollo a Surgeon General of British Royal Artillery introduced Rollo diet (2). The principle of Rollo diet was to avoid Carbohydrate in favour of protein. The diet would consist animal food principally. Diabetic diet of the past used to be a semi starvation diet. Modern diet however aims at giving a near normal diet.

Most medical graduates are not well informed about the Modern therapy, In this paper an attempt will be made to give an idea about the target of diet therapy in diabetes mellitus, the method of the determination of calorie requirement, distribution of the calorie between carbohydrate, protein, fat, and the method of prescription of diet using exchanges or portions. A brief out-line of dietetic goal for population in general and diabetics in particular will also be given.

Targets of diet therapy in diabetes Mellitus

Diet is a prescribed course of food which is essential for normal growth and maintenance of life. However one must not lose sight of the fact that appetite for food and the act of eating is a joy and satisfaction of life. Therefore as far as possible, we must not deprive

a person from the joy and pleasure of eating. One of the aims of the diet therapy will be to keep the weight of the individual within his desirable weight range; this will mean that an underweight insulin dependent diabetes mellitus (IDDM) case should gain weight and an overweight non-insulin dependent diabetes mellitus (NIDDM) should lose weight. The prescribed diet should be such that would maintain proper nourishment which is a balanced diet. One of the targets of diet therapy is to prevent complications of diabetes mellitus by normalising blood sugar and by correcting other metabolic abnormalities. The principal target is to prepare a ground for optimum utilisation of insulin (endogenous and exogenous).

The practical problem of achieving the targets of diet therapy in developing countries is the fact that for economic reason there are people who can hardly afford meat or milk even-once in a month. There are people who can just manage rice with chilli and salt. To these people to talk about costly diet is to throw away learned advice in wilderness. However a doctor must be able to advice to these few who can afford a costly diet.

Calculation of Calorie Requirement

Calorie requirement can be calculated from the ideal body weight of the individual. There are a number of different methods of knowing the ideal body weight. Data from metropolitan insurance company showing the maximum longevity of people of different weights is one source of a chart made available in most text books. This is somewhat cumbersome as it is grouped according to the build of the individual, small frame, medium frame and large frame. To determine ideal body weight from body mass index (3) was conveniently taken at BIRDEM. Body Mass index $BMI = \frac{\text{Weight in kg.}}{\text{Height in meter}^2}$. Normal BMI for male is 20-25 (ideal 22.1) for female is 19-23 (ideal 20.6). From the formula mentioned above ideal body weight of an individual can be obtained if we find his height in meter. Ideal body weight in kg = height in meter square X BMI. Ideal weight of a man having height of 1.6 meter is calculated as follows :—

$$\text{Ideal weight} = (1.6)^2 \times 22.1 = 56.58 \text{ kg}$$

$$\text{Minimum acceptable weight} = (1.6)^2 \times 20 = 51 \text{ kg}$$

$$\text{Maximum acceptable weight} = (1.6)^2 \times 25 = 64 \text{ kg}$$

Similarly a female with a height of 1.45 meter will have—

$$\text{Ideal weight} = (1.45)^2 \times 20.6 = 43.3 \text{ kg}$$

$$\text{Minimum acceptable weight} = (1.45)^2 \times 19 = 40 \text{ kg}$$

$$\text{Maximum acceptable weight} = (1.45)^2 \times 23 = 48.3 \text{ kg}$$

The weight can also be directly read from a nomogram, Once the ideal body weight is known the calorie requirement can be calculated from the formula suggested by Dr. Pombo in the World Book of Diabetes (4). For persons doing light job calorie requirement will be 30 kcal/kg/per 24 hours. For moderate job calorie requirement is 35 kcal/kg/day. For heavy job 40 kcal/kg/per day or more. To give an example a person with ideal body weight of 65 kg who is performing heavy job will require $40 \times 65 = 2600$ kcal per day.

Distribution of calories among various components of food staff

Modern trend is to allow more carbohydrate than that was practiced in the past. Based on the recommendation of American, British and Japanese Diabetic Association (6) the food staff can be distributed as follows :

Protein	—15% of total calories (12-25%)
Fat	—30% of total calories (25-35%)
Carbohydrate	—55% of total calories (50-60%)

In developing countries calories from fat should be recommended the minimum acceptable i.e. 25% and from carbohydrate at the maximum i.e. 60% of total calories.

The 60 kg moderately active man who will have his food with 2100 calories distributed as follows :

Protein	—15% of 2100 = 315 kcal = 76.8 g of protein
Fat	—24% of 2100 = 525 kcal = 58.0 g of fat
Carbohydrate	—60% of 2100 = 1260 kcal = 315 g CHO

Therefore the diet description will be as follows:

Calories	—2100
Protein	—76.8 g
Fat	—58.0 g
Carbohydrate	—315.0 g

It is difficult for the patient to comply with the order that he should take 76 g of Protein, 315 g of Carbohydrate etc. To make it practicable for the patient and to understand what he is to take a system of exchange or portion has been proposed (7).

Carbohydrate Exchange

One carbohydrate (CHO) exchange is that amount of food which will contain 15 g CHO, 2 g protein and 5 g of fat and 75 calories. This is present in 30 g of bread or chapati; 2 ounce of boiled rice etc. detailed chart is available in Diabetic Guide Book (II).

Some authorities however consider one carbohydrate exchange to be that amount which contains 10 g of CHO, 1.5 g protein and 0.3 g fat contributing to 50 calories. A thin piece of bread weighing 20 g or its equivalent other items of diet, are included in the exchanges chart. We are adopting the former i.e. CHO. Exchange containing 15 g.

Meat Exchanging (Meat Portion)

One Meat Exchange contains 6 g of protein, 1.5 g of fat and 40 calories; 30 g of meat, fish or its equivalent.

Fat Exchange (Butter Portion)

Fifteen gramme of fat (135 calories) comprises one fat exchange Half ounce of butter or 15 g of edible oil or its equivalent constitute one fat exchange.

Translation of Diet Prescription into food stuff (7)

At the outset it should be determined how much milk be allowed to the patient in 24 hours. Let us say whole milk (for tea, pudding etc.) required is 4 ounce (120 ml.). This will have 6 g of carbohydrate, 4 g of fat and 4 g of protein.

Carbohydrate Requirement

Of the total 315 g of CHO requirement 6 g has been provided from milk. The remaining 309 g will be supplied by 20 CHO exchanges.

Protein Requirement

Already supplied by milk and CHO = 4 g + 40 g = 44 g (one CHO exchange contains 2.0 g of Protein). Therefore protein to be supplied is 77 - 44 = 33 g. This can be supplied in 5.5 meat exchange.

Fat Requirement

Milk and Carbohydrate exchange supplied 34 g of fat; meat exchange supplied 8.2 g. Therefore a total of 42 g has been supplied, remaining 16 g (58 - 42) will be supplied by one fat exchange.

Diet prescription may be written as follows :

		Kcal
Milk	120 ml	76
CHO Exchange	20	1500
Meat Exchange	5.5	220
Fat Exchange	1	135
Dal	159	50
Vegetable	2 exch.	100
Total Calorie	2081	

If the patient cannot afford milk the prescription will be as follows :

		Kcal
Egg	One	40
CHO Exchange	20	1500
Meat Exchange	5.5	220
Fat Exchange	1	135
Dal	22 g (raw)	75
Vegetables	2 exch.	100
Fruits	1 exch.	25
Total Calorie		

Distribution of Exchanges

Exchange	Breakfast	Mid Morning	Lunch	Afternoon	Dinner	Bedtime
CHO	3	2	6	2	6	1
Meat	1	0.5	2	-	2	-

Daily Diet Menu

Calorie 2095, Meat 5.5 exchange, Carbohydrate 20 exchange, Fat exchange 1.

Breakfast :		Kcal
Chapati 2 or bread 2 piece or any other item	≈ 2 CHO Exchnge	≈ 150
Potato 66 g or carot 150 g or any other vegetable	≈ 1 CHO Exchange	≈ 75
Egg (one),		≈ 30
Meat 1 Oz or any other meat product	≈ 1 Meat Exchange	≈ 40
Tea without sugar	≈	≈
		<hr/> ≈ 305

Mid Morning 11 a.m.

Biscuit 30 g or bread 4 pieces (small)	≈ 2 CHO Exchange	≈ 150
Meat/fish, 15 g = 1 piece (small)	≈ 0.5 Exchange Meat	≈ 20
		<hr/> ≈ 170

Lunch

		Kcal
Rice 4 cups or chapati 6 (1≈20 g)	≈ 6 CHO Exchange	≈ 450
Vegetable	≈ 1 Exchange vegetable	≈ 50
Fish/Meat 60 g	≈ 2 Meat Exchange	≈ 80
Dal 11g (raw)≈1/2 cup cooked (medium concentration)		≈ 37.5
		<hr/> ≈ 617.5

Afternoon

Biscuit, 30 g or muri 44 g (3 cups) or chira 1 cup or khai 4 cup	≈ 2 CHO Exchange	≈ 150
Tea without sugar		≈
		<hr/> ≈ 150

Dinner

Chapati 6/Bread 6 piece	= 6 CHO Exchange	= 450
Vagetable	= 1 Vagetable Exchange	= 50
Meat/fish 60 g	= 2 Meat Exchange	= 80
Dal, 11 g (raw)=1/2 cup cooked (medium concentration)		= 37,5
		<hr/> 617,5

Supper

Toast/Rolles/Biscuit	= 6 CHO Exchange	= 75
Fruit (one orange or one apple or one guava etc)	= 1 Exchange fruit	= 25
		<hr/> 100
Oil, 15 g, to be used during cooking	= 1 Exchange oil	= 135 Kcal

There are some vegetable and fruit which have no significant calories e.g. Jambura, Kam-ranga, Cauliflower, Shasha, Khaira, Bhindi, Cucumber, Raddish etc. Detailed list available in diet book, (II) these can be eaten freely.

Some special points about diet in general and diabetic diet in particular

Some ten years ago American Senate constituted a committee to formulate the dietary goal for the people of that country (8). Of the six goals they recommended that first two which do not apply to the people of developing countries as they are already taking low fat and high carbohydrate diet. Of the others, we may benefit from taking less than 3 g salt per day (but not in hot weather). One should restrict the cholesterol intake to 300 g per day, As far as possible only unsaturated fats should be taken. The intake of refined sugar should be restricted.

Of late emphasis is being laid on the intake of fiber containing diet. This is applicable to all but is particularly applicable to diabetic patients. There is a little confusion as to what should include in the definition of fiber. We may consider fiber to include product derived from a wide variety of plants whose storage

carbohydrate and structural components are resistant to human digestive enzymes (1). Vegetables, fruits particularly skin of the vegetables and fruits, bran of wheat, legumes, viscoious gums in fruit keja manna, guar, leafy vegetables, cabbage, cauliflower, etc. are some of the examples of fiber containing diet. Though this definition excludes gums, mucilages, synthetic disaccaride e.g. lactulose they are also known to have similar effect of fiber, containing diet. (9). The fiber intake should be at least 30 g daily (10).

The fiber containing diet has the property of slowing the absorption rate of glucose from the intestine and thus maintain the steady level of blood glucose.

The effect is mediated through delayed (not diminished) gastric emptying, slowing carbohydrate digestion and absorption, and may induce variable response from gastrointestinal hormones.

Summary

Egyptians used diet therapy for diabetes mellitus about 3500 years ago. Still today diet therapy remains the mainstay for treatment of diabetes mellitus. To prescribe proper diet one has to find out the patient's actual weight, his ideal weight and his calorie requirement. From the formula of Body Mass Index, it is possible to know the ideal weight of an individual if his height in meter is known. Once the ideal weight is known his calorie requirement can be obtained by multiplying it by 30, 35 or 40 according to the nature of the job the individual performs. Required calorie has to be distributed among carbohydrate, Protein and fat in such a way that carbohydrate provides 60% of calories, protein 15% and fat 25% of calories. For practical purpose a menu is prepared by adopting a system of exchanges or portions. Dietary goal for population in general is emphasised with special reference to diabetes. The fiber content of the diet is very important for diabetic control.

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