

## **DIET THERAPY IN DIABETES**

In the treatment of diabetes, diet is recognized to have a pivotal role. The importance of food consumed and energy conservation in relation to glucose homeostasis has been physiologically studied for last 5 decades and even though individual nutrients have been studied in laboratories in great detail, there are still ever increasing controversies on food items that are promotive for stabilization of diabetic control and in securing an eumetabolic status<sup>1</sup>: This subject is discussed under the following headings :

1. Goals of diet therapy in diabetes mellitus.
2. Principles of diet in different types of diabetes mellitus.
3. Present recommendation of diet constituents and their rationale.
4. Food energy intake-calculations.
5. Diet planning-exchanges
6. Modifications of diets :
  - (i) Caloric alternatives
  - (ii) Nutritive upgrading
  - (iii) Net change in energy balance-augmenting expenditure.
7. Diet counselling-Practise of art.  
Behaviour modification.  
Causes of failure of diet therapy.
8. Side effects of diet therapy :  
Hypoglycaemia.  
Cyclic rebound.

### **1. Goals of diet therapy**

The goals of diet therapy in diabetics are now universally accepted and are applicable to all types of diabetics<sup>2</sup>. These can be enumerated as follows :

- I. Diet for diabetics should be nutritiously adequate.
- II. The caloric content of the diet for all diabetics should be at a level which will permit them to achieve and maintain optimum or standard weight, lean diabetics to receive extra calories while overweight diabetics to reckon with reduced calories.

---

Based on lecture delivered by Prof MMS Ahuja., Rekha Sharma and Pratiba Kaushik on Sept. 16, 1983 at J.L. Auditorium, AIIMS, New Delhi.

III. Diet should aim to restore altered metabolism as much as possible and maintain blood glucose as near physiological range as possible.

IV. Dietary modifications are to be so planned as to prevent or delay the development and the progress of cardiovascular, renal, retinal, neurological and other complications associated with diabetes. Hypertension and hyperlipidaemia can be quite effectively contained by diet therapy.

A historical perspective<sup>3</sup> to connote various trials and errors and extreme variations in diet at different times will be of interest and permit the scope for further discussion on this subject.

Greeks recommended diet of honey, autumn fruits and sweet wines to alleviate the severe wasting caused by the disease. In Sushrutta, we find nourishing diets recommended for the lean diabetics, while purging and fasting was the regime for the obese diabetics. John Rollo in 18th century indicated rotten meat and rancid fat as anti-diabetic and animal foods were expected to alleviate diabetes. In nineteenth century, in vogue were the high carbohydrate diet of oat meal and skimmed milk and later low carbohydrate diets of vegetables, thrice boiled to dissolve out their sugar. Allen in U.S.A. (1919) followed the starvation diets. In insulin era, West has followed relatively high fat diets in diabetics, proportion of constituents being fats 45%, CH<sub>2</sub>O 40%, proteins 15%.

East and West differ on the amount of carbohydrate to be permitted, on the merits and demerits of vegetarian and non-vegetarian diets, or the permissible content of fat in the diet acknowledging that more than 30% proportion of calories from fats are related to high blood cholesterol and which in turn is implied with large vessel disease, e.g. coronary, cerebral or limb vessels.

## 2. Principles of diet in different types of diabetes

*Diabetes is a heterogenous syndrome* and while recognizing two main clinical types of diabetes, IDDM or NIDDM-major differences in the diet approach in these two types should be fully appreciated.

IDDM (Insulin dependent, exogenous insulin is required for survival)

NIDDM (There is sufficient endogenous insulin for survival. The treatment aims to increase efficacy of this endogenous insulin).

(1) For Children, underweight individuals, and pregnancy, sufficient calories are required for growth/weight gain, or fetal growth, so added calories to basal meals are to be planned.

Usually obese, so reduction in excess of energy intake or low calorie diet is to be followed.

(2) Caloric break up in divided meals is organised to cover insulin injection, so timing of meals is important.

The absorption of nutrients may be slowed with fibre or bitter. This provides uniform blood glucose pattern through out the day.

- |  |   |
|--|---|
| (3) Consistency of eating pattern and meal composition is very important.  | Fasting or exercise is beneficial, timing is not so crucial.  |
| (4) Greater consideration is to be given to carbohydrates content of diet. | Diet should be lower in fat and cholesterol content so as to obviate the risk of atherosclerotic disease. |

### 3. Present Recommendations of diet constituents

Present recommendation on diet constituents<sup>4-9</sup> and their rationale are presented as follows :

*Carbohydrate*, mostly from cereals, form staple diet in our country (cheapest of all diet constituent).

- (a) High vrs. low carbohydrate diets do not bring variations in diabetic control. In India, diabetics are permitted carbohydrates upto 65-75% of total calories. Higher amounts carbohydrates in daily diet increase insulin sensitivity and as well lower blood lipids.
- (b) Simple carbohydrates (glucose, sucrose containing) rapidly elevate blood glucose and so are not recommended.
- (c) Complex carbohydrates such as from coarse cereals, grain starches, dextrans, and legumes in equal amounts do not induce abrupt rise of blood glucose and should form the bulk source.

*Fibre content* modifies glucose tolerance, fibre enriched meals decrease glycaemia, effect the transit time and tend to gel formation that sequester glucose and insulate carbohydrates from digestive enzymes. The content of fibre recommended is approximately 30 g/day.

*Fats*, usually form the cooking media, and are most calorogenic. (Cost is 6 times more than CH<sub>2</sub>O.)

- (a) Ratio of saturated fats as from animal fats, hydrogenated fat, e.g. meat, ghee : polyunsaturated fats e.g. vegetable oils, sunflower, gingely, maize or til oil and monosaturated fats as olive oil, poultry and certain fat oils should be in order of-1 : 1 : 1. Saturated fats are atherogenic and epidemiologically diets with high proportion of fats and relatively low proportion of carbohydrates can be related to cardiovascular mortality<sup>9</sup>.
- (b) Total calories from fat sources should not exceed 30% of calories.
- (c) Cholesterol intake should be reduced to 300 mg day (HDL should be elevated, low value having a direct relationship to CAD).

*Proteins* consist of nutrients that provide for tissue growth and repair, (most costly dietary item).

- (a) Proteins are good stabilizers, daily requirement is 0.9 g/kg b.w. and should form 15-20% of total calories. Proteins affect gut hormones and insulin secretion and in this manner glucose tolerance. At level of central nervous system, protein diet lower serotonin level, that modulates chemical signals for satiety.

- (b) Children/pregnant diabetics require more proteins than proportion recommended for adult/Kg.
- (c) Formulation proteins are not recommended, they have lower biological value and certain side effects.

*Supplement foods recommended* consists of micronutrients, as vitamins and minerals.

*Vitamin B complex* : IDDM patients with uncontrolled diabetes loose water soluble vitamins, need replenishment. Obese diabetics on weight reducing diet also benefit from vitamin supplement.

*Iron* : Pregnant diabetics need additional iron as others.

*Zinc* : Zinc is of no value, and its intake does not modify glucose metabolism. Few comments are included on other dietary items :-

*Sweetners* : Non-nutritive sweeteners include saccharin and cyclamates. These are banned in some countries though in the amount consumed seem safe. Nutritive sweeteners consist of sorbital, xylitol, aspartame, i.e. yields 4 calories and these items are expensive.

*Alcohol* : This is best avoided. However 35 ml/day can be allowed with- out upset of glycaemic control. Caloric content of alcohol is 7 K cal/g and so one helping will be 135 C and this should be borne in calculation of total calorie intake. Alcohol has antabuse like effect with sulphonylureas. In an alcoholic, coma can be mistaken and diagnosis of hypoglycaemia missed completely. Use of alcohol may as well provoke hypertriglyceridaemia.

Of all diabetics in our country, blood glucose can be controlled only on diets modification in about one quarter. It is our policy to prescribe diet to all NIDDM patients in the first instance. In those where blood glucose cannot be stabilized by diet alone, supplementation with oral drugs is undertaken. Recently some data from U.S.A. has become available, where in the last two decades following a national nutritional policy, with a decline in consumption per capita of dairy products, creams, animal fats and oils and the campaign of media against tobacco smoking and increasing awareness of usefulness of exercise, incidence of mortality from cardiovascular disease seem to have declined by 25%<sup>8</sup>.

#### **4. Food energy intake-calculations**

Calculation of caloric needs depends on many variables, e.g. environment, physical activity, but these should ensure normal growth, development in children and, as well be sufficient during pregnancy and lactation.

Average caloric needs worked out for Indians will be 30-35 calories/kg of the body weight. These should be adjusted if overweight, reduce by 10 calories/kg; if sedentary reduce by 5 calories/kg, if underweight increase by 10 calories/kg, if doing strenuous job increase by 5-15 calories/kg depending on physical endurance required.

Once the calorie needs have been assessed, the selections of food items i.e. diet composition is to be planned. Food items are divided into different groups according to their nutritive value. The common denominators of food groups are as follows :

1. Cereals and cereal products.
2. Milk and milk products.
3. Meat and meat products.
4. Legumes and grams
5. Oils and fats.
6. Leafy and other vegetables
7. Fruits

Cereal and cereal products contain mainly carbohydrates and starches and therefore can be taken in supplementation with pulses and grams to improve the nutritive value in terms of proteins and fibre. Soya bean is a good example. Milk and milk products have a good quality protein and use of low fat milk is recommended for diabetics to bring down the fat and caloric content.

Meat and its products are a rich source of proteins and should be taken in the grilled or tandoori form to avoid the extra cooking fat commonly used in their preparation in the Indian manner.

Green and leafy vegetables are rich source of vitamins and minerals.

In fats and oils, vegetable oils like safflower, corn oil, or gingelly are recommended, these being the unsaturated fats. Oils, like coconut, palm, desi ghee or vanaspathi are rich in saturated fats.

### **5. Diet Planning-.Exchanges**

The foods can be further categorized into groups, based on similarities of nutrient and caloric content and portion size. Their grouping provides the basis for food exchanges and foods within each group can be substituted or exchanged with other foods in the same group. It is thus grouping of foods in which specified amounts of all the foods are approximately equal in carbohydrates, proteins and fats and foods within each group can be substituted or exchanged with other foods in the same group. For example, *cereal exchange* has 70 calories (15 g. carbohydrates and 2 g. proteins), one chapati can be exchanged for cooked rice 75 g, or one medium idli or potato (1 small) 75 g. or bread 1 large slice.

*Milk exchange* has 145 calories, 12 g. carbohydrates, 8 g. proteins and 7 g. fats. One glass (240 ml) of milk (3% fat) can be exchanged for 60 g. of paneer or 3 cups of curd (skimmed milk). *Meat exchange* has 75 calories (7 g protein and 5g fat), one oz of lamb, mutton, chicken can be exchanged with 1 egg. or 1 oz. of processed cheese.

The exchange list give greater flexibility in the diet and patient has a free hand in calculating his own meal from a normal family meal or while eating out. This also help the patient in self-education and with the help of competent nutritionist understand nutritive values of diet and its relation to control of glucose in the diabetic.

Meal planning has certain practical aspects, such as social status, economics, purchasing capacity of food items, cultural pattern, joint family, etc. and eating habits of individual in reference to preference for certain foods.

It will be in accordance with the type of treatment being followed by the patient, e.g. insulin or oral drugs. Again, distribution of meals (breakfast, lunch, tea, dinner) depend on the personal habits of the individual diabetic.

## 6. Modification of Diets

Knowledge of “alternatives” at this stage can be of real great value for providing wider choice of low calorie but nutritive diets for the diabetics.

### (a) Caloric alternatives

Some of alternatives in caloric value would be as follows :

Prantha (200 calories)	Chappati (80 calories).
Pulao/fried rice, biryani 75 g cooked (170 calories)	Boiled rice 75 g cooked (80 calories)
Whole milk (1 glass-240 ml) (170 calories)	Skimmed milk (1 glass-240 ml) (80 calories).
Sour cream 100 g (210 calories)	Curds, 100 g, (60 calories).
Fried egg (Omellete) (210 calories)	Poached/boiled egg (60 calories).
Fried chicken or fish, 135 g, (250 calories)	Grilled chicken or fish 135 g, (160 calories.)
Fried vegetables 100 g, (140 calories)	Baked vegetables, 100 g (50 calories).
Salad oil/Mayonaise 1 tbs. (100-120 calories)	Lemon/vinegar 1 tbs (0 calories).
Regular pudding or desert 1 serve (150 calories)	Fresh fruit, 1 serve (40 calories.)
Aerated drink (Limca/Campa Cola) (60-80 calories)	Plain soda with fresh lime (0 calories.)

Table sugar 1 tsp. (20 calories)

Caramelized sugar 1 tsp.  
(5 calories)

Cashew nuts 50 g, (300 calories)

Bengal gram roasted 50 g  
(180 calories.)

*(b) Nutritive alternatives*

Germination and fermentation of certain grains (cereals/pulses) has been in vogue with nature food fads and in Indian traditional diets. These processes increase the vit. B complex and vit. C content and as well increase availability of proteins due to enzyme hydrolysis that ensues. Some actual changes on germination are as follows :

*Effect of germination on vitamin content  
mg/100 g of legume/gram :*

	Before	After
Vitamin C	0.0	8.20
Niacin	2.4	4.15

Use of coarse grains, whole gram and lentils involves increase of fibre content. This slows the absorption of starches so that post-prandial rise in glucose is reduced. A high fibre diet of 30 g/day is beneficial for diabetics. Difference of fibre g/100 content of some cereal products in refined/coarse form is indicated as follows :

*Fibre content-Refined vrs. Coarse g/ 100g*

Refined	Cereals	Coarse	Cereals
Rice-milled	0.2	Ragi	3.6
Maida	0.3	Barley (Jau)	3.9
Suji	0.2	Bengal gram	3.9
		Maize	2.7
Washed dal	0.8	Whole dal	4.0
Sphagetti	0.8	Whole wheat	1.18
Noodles	0.8	Bran	10.0

*(c) Net change in energy balance-augmentating expenditure*

In the concept of alternatives, besides intake, expenditure of calories by exercise is as well of great value. It increases tissue sensitivity to effect of insulin and promotes insulin binding to its receptors. In context of diabetic it can promote weight reduction.

Some of the examples of exercise energy expenditure for weight reduction are as follows : walking (5 km/hour) for 1 hour a day, one loses 1.2 kg. in a month, cycling (moderate) for 1

hour a day, one loses 1.5 kg. in a month, with playing outdoor games (Swimming) for 1 hour a day, one loses 2 kg. in a month.

The other advantages of regular exercise are :

- (a) Improvement in cardiorespiratory reserve.
- (b) Psychological reinforcements of normal health and improvement in mental attitude.
- (c) Effect on metabolic parameters, such as lowering of blood glucose/blood lipids.

## **7. Diet Counselling**

### *(a) Practice of Art*

Diet counselling is an art. It requires tact and persuasion in making a patient understand the underlying principles of diet therapy. Any diabetic clinic or physician specialist in diabetes should have facilities wherein a special session is provided for patients education on nutrition and individualize diet programme that can suit him best.

### *(b) Behaviour modification*

There is now great deal of effort that through counselling, regular exercise and meticulous monitoring, changes in life style or behaviour modification can be ensued. In a study in U.S.A. at Longevity Centre, use of high complex carbohydrates, high fibre, low fat diet, daily walking and personal contact for adequate explanation of the programme, majority of NIDDM cases could give up oral drug therapy or insulin therapy.<sup>10</sup> In practise, role of other members of family or parents in modifying their schedule to accommodate for diabetic family member goes a long way to achieve success with dietary practises. All means to secure better patient compliance need to be mobilized to achieve better control of diabetic state.

### *(c) Preparedness for situations wherein routine meal is not practical.*

Travelling, eating out or going to parties constrains the diabetic regarding his regular schedule. Guidance on items to select, stall over and eat slowly and not to regret for left overs in their plate are some of the practical steps in this direction. On sick days change over to soft foods, soups however to continue insulin and not to indulge in self doctoring on such occasions.

### *(d) Causes of failure of diet therapy*

Analytic approach to various reasons for failure of diet therapy in a diabetic are worth examining. The reasons are as follows :

#### **I. Communication Gap**

Usually a physician prescribes the suitable amount of calories for the individual, however its practical aspects are not covered. Other times instructions are not clearly explained to the patient and as well the person receiving instructions has no relevance in preparation or pattern of the meals. Dieticians and physicians may differ on certain aspects of therapeutic approach and this induces confusion that patient is left to follow his own discretion.



## ***II. Lack of individual approach***

In some clinics, ready made diet sheets or hand outs are given. There is no scope for providing any personal preferences. Health status other than diabetes is not enquired, as patient may have in addition peptic ulcer, colitis, hypertension, wherein other diet adjustments are also warranted. Diet is to be adjusted to suit the patient instead of making the patient adjust to the diet.

## ***III. Rigidity of meal pattern***

Dietary restriction limit the food items and menu becomes monotonous for the routine. One's food being the most intimate subject, limited meal pattern takes the zest out from life. Flexibility and variety are the key words for a successful diabetic diet regime. Broadly it has to be realized, that it may be more achievable goal to optimize calories than insist on weightment of diet and following restricted items only for an idealist state.

## ***IV. Cheating with treatment***

Some diabetics after eating a large hearty meal and now to take care of such extra calories indulge in increasing the dose of hypoglycaemic agents or insulin. The practise should be amended at every cost as this may bring in a never ending vicious cycle and make a proper regulation of the blood glucose impossibility.

Taking it easy on diet while a person has very mild glucose intolerance, is a very wrong attitude, hyperglycaemia aggravates the vascular complications that become apparent in later life. Postponing diet control for some not so good reasons and not following the diet regime, may seem harmless but its long term accumulative consequence on body metabolism, body weight may be enormous and too late to amend.

## **8. Side Effects of Diet Therapy**

### ***(a) Hypoglycaemia***

In context of certain metabolic events related to diet, a diabetic must be familiarized as to the symptoms of hypoglycaemia (feeling of emptiness, apprehension, sweating, palpitation, confusion or drowsiness) that may ensue if one undertakes a fast, misses a meal (especially if he is insulin dependent) or carries out strenuous exercise.

To handle such situations certain amount of resourcefulness is called for. It is felt that a liquid drink, such as orange juice, hot tea or milk should be promptly taken. If symptoms are more severe, 5-10 g glucose (1-2 teaspoonful) may be added to the drink. If there is no immediate response, doctor must be called for or patient taken to the emergency service.

### ***(b) Cyclic rebound***

Again those who indulge in 'crash' diets, join a slimming club, or follow Nature Cure Camp on special diets and exercise for fixed periods, do gain success in the initial phase, however, failure to sustain such strict schedules later or continue to exist in similar environments provide avenues for a rebound state and in long term follow up, such diabetes are not in any manner improved and return to their original weight. The body weight of most individuals is stable throughout adult life and needs a strong motivation, reprogramming of caloric balance,

low calorie recipes with satiety, frequent fasting or augmentation of energy expenditure, walking atleast 30 min/day to secure a new equilibrium of body weight and to sustain it for all the time.

**References:**

1. West, K.M. (1973). Diet therapy of diabetes-an analysis of failure. *Ann. Int. Med.* 79, 425, 1973.
2. Amer. Diabetic Ass. Special Report (1977). Principles of nutrition and dietary recommendation for individuals with diabetes mellitus. *Diabetes* 28, 1027.
3. Arky, R.A. (1983). Nutritional management of the diabetic-historic perspective. In *Diabetes Mellitus*, Ed. Ellenberg, M. & Rifkin, H. Med. Exam. Pub. Co. Inc. p. 540.
4. Nuttall, F.Q. (1983). Diet and the diabetic patient-a review. *Diabetic Care* 6, 197.
5. Thomas, B.J. (1983). New facets of diabetic diets. *J. Roy. Col. Phys. London*, 17, 183.
6. Amer. Dietetic Ass. (1979). Dietary goals for the United States, Second edition 1977. *Diabetic Care*, 2, 278.
7. Huttunen, J.K., Aro. A., Pelkonen, R., Puomio, M., Siltanen, I. and Akeorblom, H.K. (1982). Diet therapy in diabetes mellitus. *Acta Med. Scand.* 211, 469.
8. Walker, W.J. (1977). Changing United States life style and declining vascular mortality : causes or coincidence, *New Eng. J. Med.* 297, 163.
9. Mann, J.I. (1980) Diet and diabetes. *Diabetologia*, 18, 89.
10. Barnard, R.J., Lattimore, L., Holley, R.G., Cherney, S. & Pritikin, N. (1982). Response of non-insulin dependent diabetic patients to an intensive programme of diet and exercise. *Diabetic Care* 5, 370.