

HIGH CARBOHYDRATE HIGH FIBRE DIET IN DIABETES

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The importance of diet in the management of diabetes mellitus has been recognised for many centuries. Some years ago, there was some laxity in the rigid dietary regulations. This was because the emphasis in treatment had shifted to drug therapy. Today, however, based on several recent studies, the pendulum has swung back and the importance of diet as the first line of treatment has once again been established, all over the world.

History tells us that the role of dietary therapy of diabetes mellitus was known to the Egyptians even in 3500 B.C. In India, as early as 2500 years ago, Sushruta and Charaka realised the importance of diet restriction in the treatment of diabetes mellitus, and even mentioned specific dietary principles, some of which hold good even today!

In the 18th century, John Rollo (cited by Joslin 1949) observed that glycosuria could be decreased by a moderation in the quantity of food eaten by the diabetic and by restriction of the diet to animal foods. In the 20th century, prior to discovery of insulin, the treatment of diabetes mellitus included intermittent fasting, undernutrition and carbohydrate restriction.

With the advent of insulin, a more liberal diet was made possible and a variety of diets were advocated. There was considerable variation in the total calories recommended and in the pro-

portions of carbohydrate, protein and fat prescribed.

Evolution of the high carbohydrate high fibre diet in diabetes :

It was generally believed till recently, that the fundamental principle in the diabetic diet was to restrict the carbohydrate intake. This principle was being followed in India also till the 1950's. The typical diabetic diet of India at that time was similar to the diet followed in the western countries as recommended by the special report of Committee on Food and Nutrition (1967), and consisted of about 33 per cent carbohydrate, 17 per cent protein and 50 per cent fat.

The diet of the average Indian is cereal based and consequently rich in carbohydrate, which constitutes 70-80 per cent of the total calories. Way-back in 1958, we, at the Diabetes Research Centre, Madras, noted that a marked reduction in the carbohydrate content of the diet of the diabetic resulted in drastic changes in the diet pattern which could not be adhered to, by our patients over long periods of time. In order to achieve better dietary adherence, we allowed diabetics to have their usual pattern of food with a restriction only in

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the total calories and avoidance of free sugars. This resulted in diet that we then called the "High Carbohydrate Diet", carbohydrate constituting 60 per cent of the total calories. (Viswanathan, 1968). The details of this diet is shown in Table 1.

TABLE 1
HIGH CARBOHYDRATE DIET OF
DIABETES RESERCH CENTRE, MADRAS.

	Grams	Calories	Per-centage
Carbohydrate	265	1060	60
Protein	50	200	10
Fat	60	540	30
Total Calories		1800	

In a study of patients who were on this diet for periods upto 10 years, we found that contrary to existing beliefs, the carbohydrate tolerance did not worsen. On the other hand, control of diabetes was better, (Viswanathan 1968, 1973a, 1973b; Viswanathan, Subramaniam and Swaminathan, 1974) and the dose of drugs did not go up. In fact, in most patients, the requirement of the drugs was less (Viswanathan, Ramachandran, Mohan Viswanathan, 1975).

The usefulness of the high carbohydrate diet in diabetes have also been reported by other Indian workers like Singh (1955), Patel et al (1966), Gulati and Vaishnava (1969) and Tripathy et al (1975).

We noted that the protein intake of our diet was not quite sufficient. In order to make the diet a more balanced one, the protein content was raised, while keeping the carbohydrate content constant. This resulted in a further reduction in the fat content. This modified diet was called the "High Carbohy-

drate High Protein Diet". (Viswanathan et al, 1974). Experience with the high carbohydrate high protein diet showed that the diet helped in achieving rapid and effective control of diabetes. (Viswanathan et al, 1978a; Viswanathan and Vaishnava, 1977).

Recently we took up a collaborative study with Prof. Anderson at Lexington, U.S.A. to analyse the fibre content of the above diet. By computer analysis, it was found that the plant fibre content of our diet was about 52 grams which was approximately double that of the standard American Diabetes Association diet, (Anderson, 1979). Hence we now call this diet 'The High Carbohydrate High fibre diet (HC HF)'. The composition of this diet is given in Table 2.

TABLE 2
HIGH CARBOHYDRATE HIGH FIBRE
(HCHF) DIET OF DIABETES
CENTRE, MADRAS

	Grams	Calories	Per-centage
Carbohydrate	301	1204	67
Protein	86	344	19
Fat	28	252	14
Total Calories		1800	

Thus during the last three decades, there has been a gradual evolution in the type of diet used by us for diabetic patients in India. (Fig. 1). (Viswanathan et al, 1979).

DESCRIPTION OF THE HIGH CARBOHYDRATE-HIGH FIBRE DIET (HC HF)

Type of Carbohydrate :

Cereals in the form of rice and wheat are the staple food of the people in the South and North of India respectively.

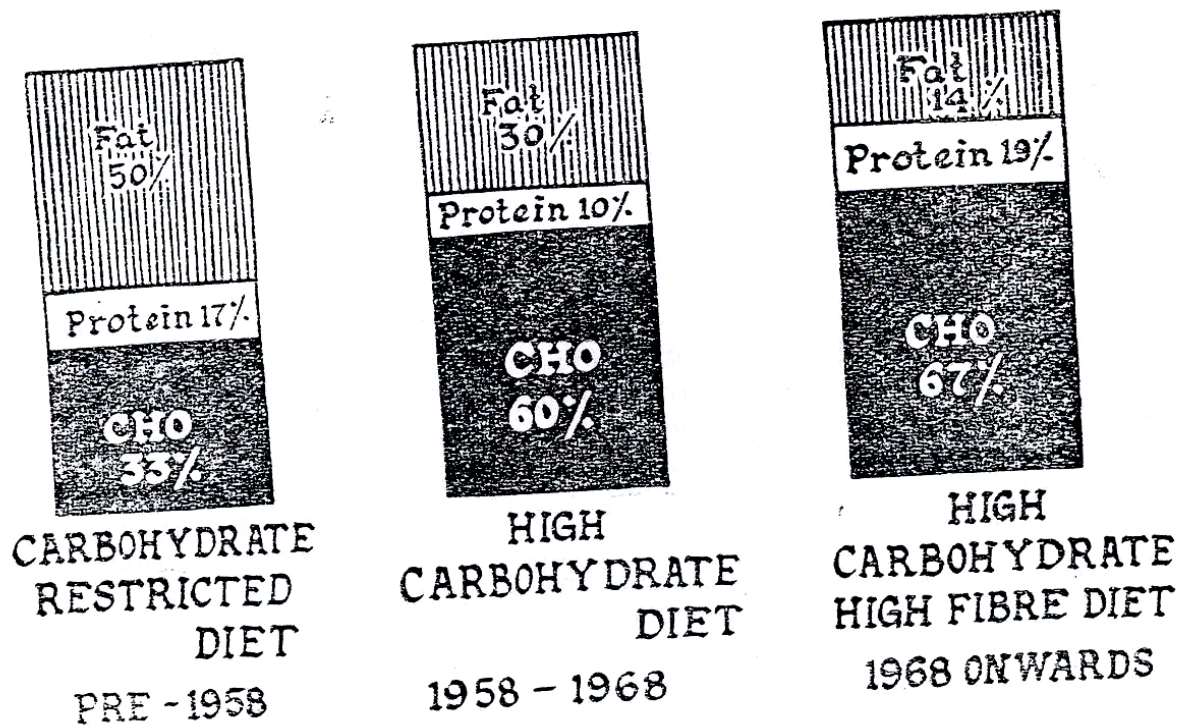


Fig. 1. Evolution of the High-carbohydrate high fibre diet.

Hence the carbohydrate we advocated for our patients was in the form of whole cereals, chiefly rice. Refined carbohydrates and free sugars were totally prohibited.

Proteins :

In India, even though many people take non-vegetarian food, the actual intake of the non-vegetarian items is restricted to once or twice a week. The amount of protein derived from animal sources is hence meagre. We therefore added vegetable protein in the form of pulses (Legumes) like bengal gram, green gram and black gram to increase the protein intake. (Viswanathan, 1976).

The proteins of cereals and pulses have a mutual supplementary effect and the deficiency of one amino acid in one is made good by an excess in the other, if both are consumed at the same time. (Gopalan, Rama Sastri and Balasubramaniam, 1971).

Fats :

The fat content of the diet was restricted to the oil used in cooking. At least 50 per cent of the fat was in form of polyunsaturated fatty acids.

Vegetables and fruits :

By prescribing vegetables containing 3-4 per cent carbohydrates like greens, cucumber, drumstick, bitter gourd, banana flower, banana stem, cabbage, cauliflower, ladies finger and ash pumpkin, the bulk of the meal was increased and the patient's hunger satisfied without appreciably increasing the total calories.

Fibre content :

Use of natural foods such as whole cereals, pulses (legumes) and leafy vegetables helped to increase the fibre content of the diet. Hence addition of artificial fibre such as bran or guar gum

to the diet was not considered necessary. Besides, natural fibre seems to be far superior. The fibre of natural foods is distributed in the outer coats (as in cereals) or distributed more evenly throughout (as in pulses) and thus will act as a barrier to enzymatic degradation. (Jenkins, 1979).

RESULTS OF STUDIES WITH HCHF DIETS :

The most difficult aspect of the dietary therapy is the patients' acceptance and adherence to the prescribed diet. With the HCHF diet, which was almost similar to the usual dietary pattern of the people in India, dietary adherence was found to be very satisfactory. (Viswanathan et al, 1978b). This made it possible to study the prolonged effects of this diet in a large number of diabetics attending the Diabetes Research Centre, Madras, and to periodically assess the response to therapy.

SHORT-TERM STUDIES :

In a study of 250 diabetics admitted as in-patients, it was found that with the HCHF diet and small doses of oral drugs, 84.8 per cent of the patients showed "rapid response", i.e., good control of blood sugar within a week. (Fig. 2) (Viswanathan et al, 1978a). There was also a significant reduction in the levels of serum cholesterol and triglyceride even during this short period.

LONG-TERM STUDIES :

The effects of the HCHF diet in reduction of hyperglycaemia and hyperlipidaemia was sustained over a number of years.

The fasting and post-prandial blood sugar concentrations were consistently

within normal limits. An oral G.T.T. repeated in 50 patients at the end of one year of treatment showed definite improvement in the glucose tolerance. (Viswanathan et al, 1974). The serum cholesterol and triglyceride levels were also significantly reduced.

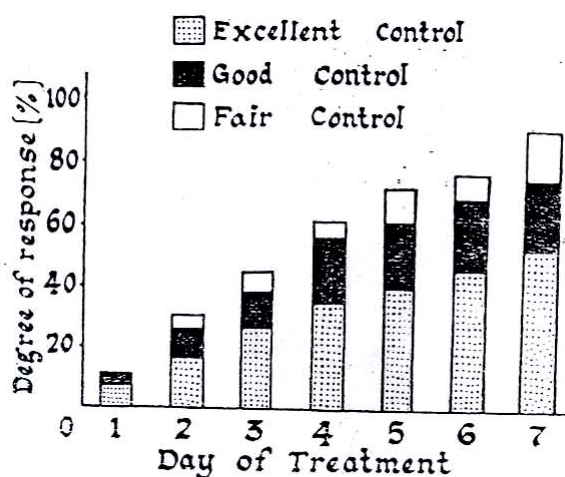


Fig. 2. Rapidity and degree of response to the diabetic therapy.

Further long term follow-up studies were reported by us in 1976. (Viswanathan et al, 1976). The results were analysed at the end of 3 years, separately in a group of 20 diabetics who had been on the HCHF diet alone, and in another group of 170 patients who received oral antidiabetic drugs in addition to the diet. This study showed definite reduction in serum lipid values with this diet therapy. (Viswanathan et al 1978b).

A more recent analysis compiling the overall efficacy of the HCHF diet in a larger group of patients for periods extending upto 10 years, has again shown that the beneficial effects of the diet are sustained. (Viswanathan et al, 1979).

MECHANISM OF ACTION OF HIGH FIBRE ON BLOOD GLUCOSE :

Fibre being unabsorbable and resistant to degradation in the bowel, slows the

absorption of carbohydrate, and thereby flattens post-prandial hyperglycaemia. (Jenkins, 1979). This slow absorption is produced by slower gastric emptying and slower small intestinal absorption.

MECHANISM OF ACTION OF HIGH FIBRE ON LIPIDS :

The main action of fibre in lowering serum cholesterol was thought to be due to binding of bile salts in the intestine. (Jenkins, 1979). Other theories have now been put forward. These include increased neutral steroid faecal loss and decreased post-prandial glucose levels which reduce the stimulus to hepatic cholesterol synthesis.

INSULIN RESPONSE TO HIGH CARBOHYDRATE HIGH FIBRE DIETS :

Immuno-reactive insulin response to glucose load was estimated by us in patients on long-term treatment with the HCHF diet. The IRI response was studied in 10 maturity-onset diabetics on this diet for periods ranging from 2 months to 2 years. It was noted that while there was a significant improvement in the glucose tolerance (Fig. 3), there was a simultaneous reduction in mean IRI levels. (Fig. 4).

This observation suggests an improved peripheral sensitivity to insulin in patients on HCHF diet. (Viswanathan et al, 1979). The lowered insulin may be attributed to a depression of the entero-insulin response after fibre rich meals. (Jenkins, 1979).

SUMMARY OF THE FINDINGS OF STUDIES WITH HIGH CARBOHYDRATE DIETS :

At the Diabetes research Centre, Madras, High Carbohydrate diets have been used by us in over 18,000 diabetics,

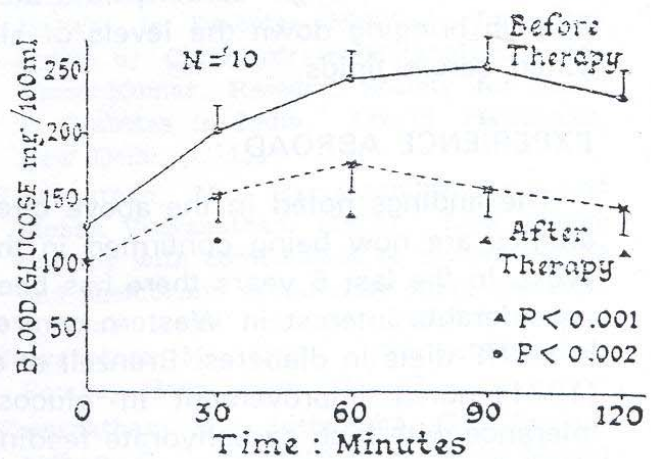


Fig. 3. Results of O.G.T.T. in patients before and after the HCHF therapy.

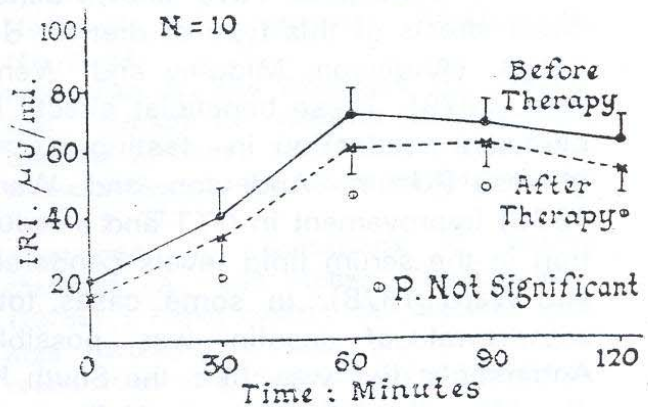


Fig. 4. IRI values in patients before and after the HCHF therapy.

over a period of nearly 22 years. This large clinical experience has convinced us about certain points :

1. The patient's acceptance and adherence to this diet has been very satisfactory.
2. The diet is very useful in achieving rapid and effective control of diabetes which can be sustained for years.
3. The dose of hypoglycaemic agents when required, is small.
4. In many cases, the drugs could be withdrawn at a later date.
5. Occurrence of ketosis is extremely infrequent in these patients.

6. Contrary to the fear of many workers (Bierman and Hamlin, 1961; Ahrens et al, 1961; Albrink, Lavietes and Mann, 1963), high carbohydrate diets do not cause hypertriglyceridaemia. On the other hand, high carbohydrate diets help in bringing down the levels of elevated serum lipids.

EXPERIENCE ABROAD :

The findings noted in the above cited studies are now being confirmed in the West. In the last 5 years there has been considerable interest in Western centres in HCHF diets in diabetes. Brunzell et al (1971) noted improvement in glucose tolerance with high carbohydrate feeding (Carbohydrate 85 per cent). The extensive studies at the University of Kentucky at Lexington, U.S.A. by Anderson and his colleagues have shown beneficial effects of this type of diet for diabetics. (Anderson, Midgley and Wendman, 1979). These beneficial effects included a reduction in fasting plasma glucose (Kiehm, Anderson and Ward, 1976) improvement in GTT and a reduction in the serum lipid levels (Anderson and Ward, 1978). In some cases, total withdrawal of insulin was possible. Anderson's diet was like the South Indian diet composed of natural fibre and artificial fibres were not added, and his findings were similar to the findings of Viswanathan at Madras.

Simultaneous studies in England by Jenkin's group also give similar results (Jenkins, 1979). In his studies, a range of artificial substances including bran, pectin and guar gum were all tried. Of these, guar gum was found to be the most effective. (Goulder, Alberti and Jenkins, 1978). The problem with the artificial forms was palatability. This has been overcome to some extent by the

development of guar crispbread. (Jenkins, 1980).

CONCLUSION

Evidence is now fairly strong, from studies all over the world that the High Carbohydrate-High Fibre diet is suitable for diabetics. While it may not be possible to evolve a single type of diet to be universally used for all diabetics, a diet that contains higher carbohydrate and fibre content seems to be the most satisfactory one, according to our present understanding of diabetes.

ACKNOWLEDGEMENT

We gratefully acknowledge the help of the various staff members of this institution, particularly Mrs. R. Shobana and the dietitians Mrs. Premila Lowe, Miss Vijaya Gowri, and Miss M. S. Shanta.

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