CLINICAL RESEARCH

Does adding fibre to a low energy, high carbohydrate, low fat diet confer any benefit to the management of newly diagnosed overweight type II diabetics?

V A BEATTIE, C A EDWARDS, J P HOSKER, D R CULLEN, J D WARD, N W READ

Abstract

The effect of supplementing a low energy (roughly 5·0 MJ), high carbohydrate (180 g), low fat (roughly 25 g) diet with 10-15 g of either cereal fibre or guar gum was investigated in 24 newly diagnosed overweight non-insulin-dependent (type II) diabetics. The patients were divided into three treatment groups: one received a low fibre control diet throughout the study period of 20 weeks and the other received two supplements of cereal fibre and guar gum in a crossover manner. The nutrient content of the diets was kept constant throughout. Though patients taking the low fibre diet showed a smaller reduction in fasting plasma glucose concentrations over the first eight weeks than patients taking a high fibre diet, this difference was not evident at the end of 20 weeks; reductions in weight and glycated haemoglobin values were similar for each dietary regimen throughout the trial.

There was little evidence that supplementing a low energy, high carbohydrate diet with fibre confers any therapeutic benefit to type II diabetics and no evidence that taking fibre as viscous polysaccharides is any more beneficial to overweight diabetics than taking a similar fibre supplement as cereal. On the contrary, guar gum caused more abdominal discomfort and flatulence than the other diets.

Introduction

During the past decade the dietary recommendations for diabetic patients have been modified to include a high intake of fibre.[1-3] Diets rich in fibre derived from either leguminous, cereal, or tuberous sources[4-6] and supplementation of the diet with viscous polysaccharides such as guar gum[7,8] have been shown to improve glycaemic control in patients with non-insulin-dependent (type II) diabetes. Increasing the fibre content of the diet, however, is usually accompanied by changes in other dietary constituents, such as an alteration in the amount and source of carbohydrate, a reduction in fat intake, and changes in the type of protein eaten. It is possible, therefore, that the increased fibre intake is not the main factor improving glycaemic control[9] and that the concomitant changes in other dietary constituents may be more important. We have investigated the role of dietary fibre in the management of newly diagnosed overweight type II diabetics by supplementing a low fat, high carbohydrate, low energy diet with similar amounts of either cereal fibre or guar gum without altering any of the other dietary constituents. The study was approved by the ethical subcommittee of the Sheffield District Health Authority.

Patients and methods

Twenty seven newly diagnosed overweight type II diabetics were recruited at their first visit to the diabetic clinic after referral by their general practitioners. All had the study protocol explained and gave written, informed consent. No patient was treated with oral hypoglycaemic agents or insulin.

The patients were immediately randomly allocated to one of three dietary treatment groups. Patients in group A (six women, three men; median age 64) were instructed to eat a low fat, high carbohydrate (180 g), low energy (5·0 MJ; 1200 kcal) diet containing about 15 g fibre for 20 weeks (low fibre diet). Those in group B (six women, three men; median age 64) received the low fibre diet for four weeks, then changed to a diet that contained the same

Dietetic Department and Sub-Department of Human Gastrointestinal Physiology and Nutrition, Royal Hallamshire Hospital, Sheffield S10 2JF

V A BEATTIE, BSC, SRD, district dietitian
C A EDWARDS, PHD, research associate
J P HOSKER, MRCP, senior registrar
D R CULLEN, MD, FRCP, consultant physician
J D WARD, MD, FRCP, consultant physician
N W READ, MD, FRCP, honorary consultant physician and director, sub-department of human gastrointestinal physiology and nutrition

Correspondence to: N W Read, Sub-Department of Human Gastrointestinal Physiology and Nutrition, K Floor, Royal Hallamshire Hospital, Sheffield S10 2JF.

amount of carbohydrate, protein, and fat but included an additional 10-15 g of cereal fibre for eight weeks, after which they returned to the low fibre diet supplemented with 15 g of guar gum (Guarem). Patients in group C (six women, three men; median age 58) had the low fibre diet for four weeks followed by the guar gum diet for eight weeks and the high cereal fibre diet for eight weeks. In this way the nutrient content of the diets remained constant and the only component of the diet that changed was the fibre. A crossover design allowed us to compare the effects of the different fibre rich diets in the same patients and was an attempt to control for the variability in response among different patients.

Patients were interviewed by the same experienced dietitian at two week intervals throughout. At each visit they were weighed, questioned in detail about the content of their meals over the past two weeks, and asked to complete a symptom questionnaire. Samples of venous blood were taken for measurement of fasting plasma glucose, glycated haemoglobin, and fasting plasma lipid values. Glucose was measured by a glucose oxidase method, glycated haemoglobin by the method of Fluckiger and Winterhalter,[10] and cholesterol by a chromatographic method using a kit.

ANALYSIS OF RESULTS

Within group analysis—The results were divided into three chronological periods: the run in period, dietary period 1, and dietary period 2. Results from groups B and C during periods 1 and 2 constituted the crossover part of the trial; these results were analysed by the methods of Hills and Armitage[11] to see whether there was any effect of the order that the diets were given in and to detect any significant differences between the two fibre diets. Symptom scores were analysed by χ^2 test.

Between group analysis—Results during period 1 from groups A, B, and C and the results at the end of the trial were analysed by analysis of variance.

Results

Two patients dropped out of group A and one out of group B, leaving seven, eight, and nine patients in the three groups respectively. There were no significant differences among the groups when compared for body mass index (weight (kg)/height (m)^2) and fasting plasma glucose, glycated haemoglobin, and plasma lipid values at the beginning of the trial or at the end of the run in period.

DIET AND SYMPTOM SCORES

There were no significant changes in total daily energy, carbohydrate, fat, or protein intake within any group as the study progressed. Supplementing the diet with either cereal fibre or guar gum roughly doubled the daily intake of fibre.

Positive scores for abdominal discomfort were much higher during consumption of the diet containing guar than during consumption of either the high cereal fibre diet or the low fibre diet (table I). Moreover, patients scored positively for diarrhoea and flatulence only when they were taking guar. A significantly higher proportion of patients said that they did not enjoy their diet when they were taking guar (9/17) compared with diets containing small (2/24; $p<0.01$) or large amounts of cereal fibre (2/17; $p<0.01$).

TABLE I—*Numbers (percentages) of patients reporting gastrointestinal side effects during each diet*

	Low fibre diet (n=24)	High fibre diet (n=17)	Guar gum diet (n=17)
Abdominal discomfort	3 (13)	5 (29)	13 (76)*
Diarrhoea	0	0	3 (18)*
Flatulence	0	0	10 (59)*
Constipation	1 (4)	1 (6)	0

*$p<0.05$ Compared with low and high fibre diets (χ^2 test).

BODY MASS INDEX

Within group analysis—Body mass index (normal 20-23) was abnormally high in all three groups of patients on admission to the trial (table II). Values fell significantly during the run in period and again during the first eight week study period in groups A and C ($p<0.05$) but not in group B (table II). At 20 weeks the body mass index was significantly lower than at the end of the run in period in all three groups. Crossover analysis did not show a chronological effect on weight loss; there was no significant difference in weight loss between dietary periods 1 and 2 in groups B and C. Neither was there a significant difference in loss when the two high fibre diets were compared.

TABLE II—*Body mass indices and biochemical measurements in patient groups during study. Figures are means (95% confidence intervals)*

Weeks	Type of diet	Body mass index (kg/m^2)	Glycated haemoglobin (mmol hydroxymethylfurfural/mmol Hb)	Fasting plasma glucose (mmol/l)	Total cholesterol (mmol/l)
			Group A		
0	—	33 (29 to 37)	66 (58 to 74)	11·2 (8·4 to 14·0)	6·9 (4·6 to 9·2)
4	Low fibre	32 (28 to 36)*	58 (52 to 64)*	7·8 (5·5 to 10·1)*	6·2 (5·0 to 7·4)
12	Low fibre	31 (26 to 34)*†	50 (40 to 60)*	8·0 (4·7 to 11·3)*	6·4 (5·2 to 7·6)
20	Low fibre	30 (26 to 34)*†	50 (38 to 61)*†	7·8 (4·4 to 11·0)*	6·5 (5·6 to 7·4)
			Group B		
0	—	30 (29 to 32)	64 (57 to 70)	9·6 (7·1 to 11·9)	6·7 (5·1 to 8·3)
4	Low fibre	29 (27 to 31)*	60 (53 to 67)	8·2 (6·9 to 9·7)	6·2 (5·3 to 7·1)
12	High fibre	28 (26 to 31)*	51 (46 to 55)*†	7·4 (6·0 to 8·8)†	6·4 (5·7 to 7·1)
20	Guar gum	28 (26 to 30)*†	49 (43 to 54)*†	6·8 (5·0 to 8·7)	6·2 (5·3 to 7·1)
			Group C		
0	—	32 (30 to 34)	62 (50 to 74)	9·6 (6·7 to 12·5)	7·4 (6·5 to 8·3)
4	Low fibre	31 (28 to 33)*	53 (45 to 61)*	7·8 (4·9 to 10·7)*	6·6 (5·7 to 7·5)
12	Guar gum	29 (27 to 31)*†	44 (38 to 50)*†	6·5 (4·2 to 8·8)*†	6·4 (5·5 to 7·3)
20	High fibre	28 (26 to 30)*†	45 (40 to 50)*†	6·5 (4·9 to 8·1)*	6·9 (6·5 to 7·4)

*Significant reduction compared with beginning of trial ($p<0.05$).
†Significant reduction compared with week 4 ($p<0.05$).

Between group analysis—Analysis of variance of the reductions in body mass index in the three groups in dietary period 1 showed no significant difference among the three diets ($F=1.61$) (table II). Neither was there any significant difference in the overall reduction in body mass index among the three groups at the end of the trial ($F=1.41$).

FASTING PLASMA GLUCOSE

Within group analysis—Fasting plasma glucose concentrations were abnormally high on admission to the trial but fell during the low fibre run in period (table II), the falls being significant only for groups A and C ($p<0.05$). During the first eight week treatment period the fasting plasma glucose value fell significantly in groups B and C but not in group A, but there was no overall significant difference in plasma glucose concentration at the end of the trial compared with the end of the run in period in any group. When the crossover part of the trial was analysed there was a significant chronological effect; plasma glucose concentration fell significantly more in dietary period 1 than period 2 irrespective of diet ($p<0.05$). There was no significant difference in the reduction in fasting plasma glucose concentration between the fibre diets.

Between group analysis—Analysis of variance of the data from period 1 showed that the plasma glucose concentration fell less during this period in group A than in groups B and C ($p<0.05$; $F=5.9$); however, there were no differences in the decreases in fasting plasma glucose concentration among the groups at the end of the trial ($F=1.24$).

GLYCATED HAEMOGLOBIN

Within group analysis—The glycated haemoglobin value was abnormally high on admission to the trial but fell during the low fibre run in period ($p<0.05$) and fell again during the first eight week treatment period in groups B and C ($p<0.05$; table II), but not in group A. The reduction in glycated haemoglobin value, however, had attained significance in all three groups by the end of the trial. As with the data on plasma glucose values, crossover analysis disclosed a significant chronological effect, with a greater reduction of glycated haemoglobin in period 1 than period 2 ($p<0.05$). There were no significant differences in the reduction of glycated haemoglobin between the two fibre diets.

Between group analysis—Analysis of variance showed no significant difference in the fall of glycated haemoglobin values among the three diets after period 1 ($F=0.023$) at the end of the trial ($F=0.19$).

FASTING LIPID VALUES

Fasting triglyceride and cholesterol concentrations in each group on admission were at the upper end of the normal range and remained essentially unchanged throughout irrespective of the dietary regimen (table II).

Discussion

This study indicates that adding fibre to a high carbohydrate, low fat, low energy diet confers little therapeutic benefit to newly diagnosed overweight type II diabetics. Though the reduction in fasting plasma glucose concentration during the two high fibre diets was greater than during the low fibre diet at the end of eight weeks, there was no significant difference between the reductions in fasting plasma glucose in each dietary group at the end of the trial. In addition, there were no significant differences in the reductions of glycated haemoglobin values among the three dietary groups either at the end of the first dietary period or at the end of the trial. Thus any benefit of including fibre in the diet was short lived.

Long term consumption of high fibre diets has been shown by other workers to improve glycaemic control of diabetic patients, reducing fasting plasma glucose and glycated haemoglobin values and postprandial hyperglycaemia,[4 6 12] but the overall energy content of the diets was not kept constant. Despite physiological data suggesting a specific action of fibre in glycaemic control,[13-15] this study suggests that the long term beneficial effects of high fibre diets in diabetes mellitus may not depend on the increased intake of dietary fibre alone, but rather on the displacement of other dietary constituents. Similar results have been reported by other workers.[16] High fibre diets usually contain less fat and more carbohydrate than low fibre diets, though much of the carbohydrate may be in a form that cannot be absorbed in the small intestine. These factors may have important influences on glycaemic control. Adding fibre to a diabetic diet may thus be seen as a device to enable the patient to eat a diet that is lower in energy and fat and higher in carbohydrate without necessarily having any direct effect itself. If obese diabetic patients can comply with the requirements of a low energy, low fat diet our findings suggest that they will do as well as they would if they took additional fibre.

High fibre diets are often recommended in the initial phase of dietary management of patients with type II diabetes,[1] particularly if they are obese, because such diets are said to facilitate weight loss.[17] The weight loss probably occurs as a result of displacement of energy dense components of the diet, because our study indicates that when the nutrient intake is kept constant low fibre diets produce the same reduction in body mass index as high fibre diets. This result offers support for the view that weight loss may be a factor in the improvement in glycaemic control in type II diabetics.[2 9]

There was no evidence from our data to support the view that giving fibre as viscous polysaccharides improves glycaemic control more than a diet rich in cereal fibre, even though viscous polysaccharides have been shown to slow glucose absorption and reduce the glycaemic response to a standard carbohydrate load.[12 15] In fact, a main disadvantage of the diet containing guar gum was that it resulted in a greater incidence of unwanted side effects such as flatulence and abdominal discomfort than the control diet or the diet supplemented with cereal fibre. Diarrhoea and flatulence were reported only when patients were taking guar gum, and significantly more patients (9/17) complained about the guar diet than any other regimen.

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ONE HUNDRED YEARS AGO

LARGE and representative meetings have been held recently at Edinburgh and Dundee in connection with the national movement for the education and registration of plumbers. This movement is now spreading extensively over the United Kingdom, and we are glad to learn that at both these meetings, at which the trade, the medical profession, and the public were well represented, resolutions were passed such as those which have been passed in so many other great cities of the kingdom, warmly approving of the scheme, and appointing representative persons identified with health and public interests as well as the plumbing trade, to form local councils. The Edinburgh meeting had the great advantage of the presidency of Sir Douglas Maclagan, than whom no person is better qualified to form a judgment on the subject, or possesses more entirely the esteem and confidence of his own profession, and of the public generally. It is obvious that the system of examination must be arranged so as to secure an adequate minimum; and the advantage of having representative local councils in each of the great cities acting together, and in cooperation with a central body on which they are fully represented, is very considerable. This is, indeed, the only condition under which public confidence can be secured, and a downward competition prevented. The petty local movement which has been started in Edinburgh will not, we are convinced, receive serious consideration when the true bearings of the question are generally understood, and we are glad to see that Sir Douglas Maclagan, as well as the plumbing trade generally in Edinburgh, fully appreciate the importance of establishing the movement on a national basis, while leaving adequate local freedom to the local councils.

(*British Medical Journal* 1888;i:479)