

- ³ Engelhardt, H T, *Texas Reports on Biology and Medicine*, 1974, **32**, 225.
⁴ Kendell, R E, *The Role of Diagnosis in Psychiatry*. Oxford, Blackwell Scientific, 1975.
⁵ Eisenberg, L, in *Research and Medical Practice: Their Interaction*. Ciba Foundation Symposium No 44 (new series). London, Ciba, 1976.
⁶ Wulff, H R, *Rational Diagnosis and Treatment*. Oxford, Blackwell Scientific, 1976.
⁷ Copeland, D D, *Perspectives in Biology and Medicine*, 1977, **20**, 528.
⁸ *Proceedings of the First Trans-Disciplinary Symposium on Philosophy and Medicine*, Galveston, Texas. Dordrecht, Holland/Boston, USA, Reidel, 1974.
⁹ Scadding, J G, *Lancet*, 1959, **1**, 323.
¹⁰ Scadding, J G, *British Medical Journal*, 1963, **2**, 1425.
¹¹ Scadding, J G, *Lancet*, 1967, **2**, 877.
¹² Scadding, J G, *International Journal of Biomedical Computing*, 1972, **3**, 83.
¹³ Scadding, J G, in *Proceedings of the Third International Symposium on Computers in Medicine*, ed J Rose and J H Mitchell. London, Churchill Livingstone, 1975.
¹⁴ Ciba Foundation Study Group No 38, *Identification of Asthma*. Edinburgh, Churchill Livingstone, 1971.
¹⁵ Ciba Foundation Guest Symposium, *Thorax*, 1959, **14**, 286.
¹⁶ American Thoracic Society, *American Review of Respiratory Disease*, 1962, **85**, 762.
¹⁷ Medical Research Council, *Lancet*, 1965, **1**, 775.
¹⁸ Scadding, J G, in *Bronchial Asthma*, ed W B Weiss and M S Segal. Boston, Little, Brown and Co, 1976.
¹⁹ Scadding, J G, in *Asthma*, ed T J H Clark and J Godfrey. London, Chapman and Hall, 1977.

Diet and Crohn's disease: characteristics of the pre-illness diet

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Summary and conclusions

Thirty newly diagnosed patients with Crohn's disease were interviewed about their habitual, pre-illness diet and compared with 30 healthy controls, matched for age, sex, social class, and marital status. The patients ate substantially more refined sugar, slightly less dietary fibre, and considerably less raw fruit and vegetables than the controls.

A diet high in refined sugar and low in raw fruit and vegetables precedes and may favour the development of Crohn's disease.

Introduction

The incidence of Crohn's disease is increasing in industrialised nations,¹⁻⁹ but the condition is almost unknown in developing countries.^{10 11} Food is the major factor affecting the intestinal environment, and the considerable change in dietary habits during this century¹² may explain why Crohn's disease has become more common. In 1976 workers in Marburg¹³ and Düsseldorf¹⁴ reported that before developing Crohn's disease patients had eaten more refined sugar and foods containing it than matched controls. In these studies dietary data were collected up to 12 years after diagnosis. It is doubtful whether people recall their eating habits of many years previously with any accuracy. Furthermore, neither study included information on dietary fibre, although a low-fibre diet has been suggested as causal factor.^{11 15 16} In view of continuing ignorance about the cause of Crohn's disease, we decided to investigate the possible role of dietary fibre and at the same time to see if these German results could be confirmed with improved methods.

Patients and methods

Thirty consecutive newly diagnosed patients were studied. The diagnosis of Crohn's disease was made by experienced gastroenterologists and supported by typical radiological changes and often by histological examination of tissue. All patients were interviewed within three months of diagnosis. The median duration of symptoms before diagnosis was five months (range 1-92). A single dietitian used the dietary history method¹⁷ to question each patient about his or her habitual, pre-illness diet. Using a specially designed questionnaire, she determined the frequency of consumption and the size of helpings of each of a comprehensive range of foods and drinks. Special care was taken with items containing refined sugar or dietary fibre. Refined sugar was defined as any fibre-depleted sugar, including brown sugar. These data were analysed by computer, using a programme specially compiled from the recent edition of McCance and Widdowson's food tables,¹⁸ to determine the average daily intake of different food components. These tables are the first to contain values for dietary fibre as opposed to crude fibre, which is an inaccurate measurement.^{19 20}

Control subjects were otherwise healthy people who had recently attended the fracture clinic with minor fractures or orthopaedic conditions. They were matched for age (± 5 years), sex, social class,²¹ and marital status, and were closely similar to the patients in height and weight (table I). The controls were interviewed about their diet in the same manner as the patients. Neither group was informed of the purpose or possible findings of the study. The statistical significance of differences was calculated by Student's *t* test or the Wilcoxon rank sum test for paired data, as appropriate.

Results

The patients' intake of refined sugar (median 122 g/day) was considerably greater than the controls' (median 65 g/day, $P < 0.002$; fig 1). Table II shows that the patients consistently took more sugar in both food and drink. Intake was higher in both sexes and with all sites of disease. Sugar consumption was similar in patients whose symptoms had lasted for more and less than 12 months before diagnosis (median 112 and 128 g/day respectively). The patients ate more carbohydrate than the controls but this difference was almost entirely due to their greater consumption of sugar. The two groups ate almost identical quantities of protein and fat.

Dietary fibre intake in the patients (17.3 ± 0.6 g/day) was slightly lower than in the controls (19.2 ± 0.9 g/day, $P < 0.05$), and the patients ate considerably less raw fruit and vegetable fibre (median 0.6 g/day *v* 2.3 g/day in controls; $P < 0.001$; fig 2). As with sugar, this finding was independent of sex, the site of disease, or the duration of symptoms. Thus, median raw fibre intakes in patients who had had symptoms for more and less than 12 months before diagnosis were 0.6 and 0.7 g/day respectively. Intakes of cereal fibre and cooked fruit and vegetable fibre were similar in patients and controls. There was no significant

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TABLE I—Details of patients and controls

	No	Sex (M:F)	Mean age (and range) (years)	Social class				Single: married	Mean height \pm SE of mean (cm)	Mean weight* \pm SE of mean (kg)	% Desirable weight†	Site of disease		
				I	II	III	IV					Small intestinal	Ileo-colonic	Colonic
Patients	30	10:20	33 (16-61)	3	8	12	7	9:21	167 \pm 4	60 \pm 6	100 \pm 3	15	12	3
Controls	30	10:20	33 (17-63)	3	8	12	7	9:21	168 \pm 4	64 \pm 7	104 \pm 4			

*Pre-illness weight. †Taken from table of Metropolitan Life Insurance Company of New York; desirable weight taken as average weight age 20-24.

TABLE II—Dietary intake of patients with Crohn's disease and matched healthy controls (g/day)

	Patients	Controls	P value
Refined sugar (median intake):			
Total	122	65	<0.002
In foods	49	25	<0.02
In drinks	69	30	<0.01
Total carbohydrate	295 \pm 15	241 \pm 17	<0.02
Protein	73 \pm 3	74 \pm 3	NS
Fat	112 \pm 5	111 \pm 5	NS
Total dietary fibre:	17.3 \pm 0.6	19.2 \pm 0.9	<0.05
Cereal fibre	7.2 \pm 0.5	7.8 \pm 0.6	NS
Total fruit and vegetable fibre	10.1 \pm 0.5	11.4 \pm 0.7	<0.05
Raw fruit and vegetable fibre (median)	0.6	2.3	<0.001
Alcohol (median)	3.2	5.1	NS
Energy (MJ/day)	10.38	9.56	NS

Conversion: SI to traditional values—Energy: 1 MJ/day \approx 239 kcal/day.

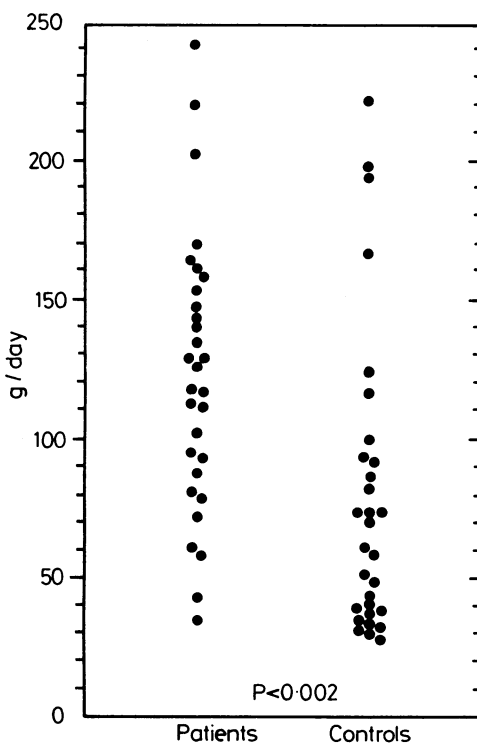


FIG 1—Habitual intake of refined sugar in 30 patients with Crohn's disease before their illness and in 30 healthy controls.

difference in the drinking of alcohol or the consumption of cornflakes. Cornflakes were eaten once a week or more by 15 patients and eight controls and at least four times a week by five patients and six controls.

Discussion

This study confirms that people who develop Crohn's disease habitually eat more refined sugar than healthy people and also shows that they eat less raw fruit and vegetables. Our data should be more reliable than those from previous studies since

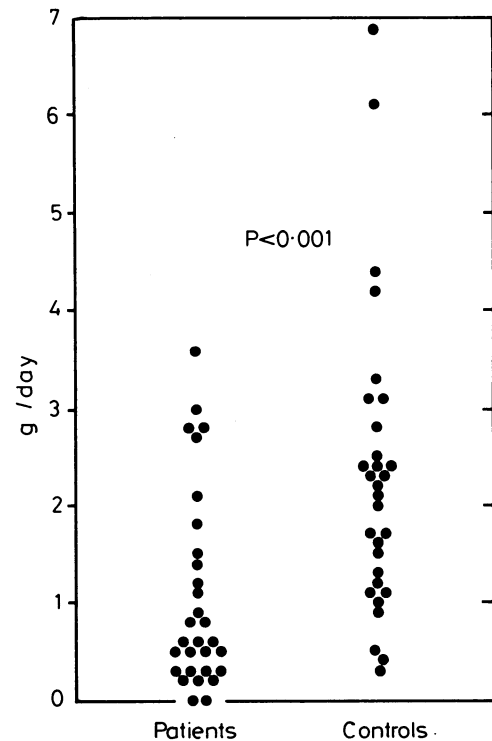


FIG 2—Habitual intake of dietary fibre from raw fruit and vegetables in 30 patients with Crohn's disease before their illness and in 30 healthy controls.

they are derived from newly diagnosed patients. Moreover, the patients' symptoms were usually of only a few months' duration.

The differences are unlikely to be due to atypical dietary habits in the control subjects. Their median sugar intake of 65 g/day is identical to that obtained in a recent survey of randomly selected, Cambridgeshire villagers,²² using weighed measurements of food intake (when adjusted to the appropriate sex ratio). The National Food Survey²³ estimated that the average refined sugar intake of the British population is 79 g/day. Similarly, dietary fibre intake averaged 19.9 g/day in the villagers²⁴ and 20.4 g/day in the National Food Survey,²⁵ whereas our controls ate 19.2 g/day.

It might be argued that patients may gradually modify their diets in the months and years before their symptoms become troublesome, eating more sugar to try and counteract weight loss or lassitude and eating less raw food to counteract loose stools. But the data do not support this suggestion. There was no difference in the intake of sugar or of raw fruit and vegetables between patients with recent and longer-lasting symptoms. The German studies^{13 14} found that after the onset of disease patients ate less, not more, sugar. These eating habits therefore seem to precede the disease.

Our data lend some support to suggestions that the development of Crohn's disease is favoured by a low intake of dietary fibre. The difference in total fibre intakes was relatively slight (and there was no difference in cereal fibre), but there was a pronounced difference in the consumption of fibre from raw

fruit and vegetables. This is consistent with the idea that a low intake of raw fruit and vegetables is a causal factor. It has been reported that patients with Crohn's disease eat significantly more cornflakes at breakfast than controls.²⁶ In common with three other studies,²⁷⁻²⁹ our study could not confirm this finding.

How eating habits, such as those identified in this study, predispose to Crohn's disease is uncertain and will remain so until the pathogenesis of the disease is understood. A role for diet does not exclude the involvement of a virus or bacterium. Dietary influences may alter the milieu of the intestinal lumen or modify the intestinal flora and so promote the growth of an infective agent or its invasion of the gut wall.

The dietary tendencies shown in our study may help to explain the recent emergence of the disease and its rarity in communities eating simple, traditional diets. At a practical level, reversing these eating habits might be helpful in the management of this intractable condition (see accompanying paper).

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References

- ¹ Norlen, B J, Krause, U, and Bergman, L, *Scandinavian Journal of Gastroenterology*, 1970, **5**, 385.
- ² Myren, J, et al, *Scandinavian Journal of Gastroenterology*, 1971, **6**, 511.
- ³ Kyle, J, *Gastroenterology*, 1971, **61**, 826.

- ⁴ Høj, L, et al, *Scandinavian Journal of Gastroenterology*, 1973, **8**, 381.
- ⁵ Miller, D S, Keighley, A C, and Langman, M J S, *Lancet*, 1974, **2**, 691.
- ⁶ Brahme, F, Lindström, C, and Wenckert, A, *Gastroenterology*, 1975, **69**, 342.
- ⁷ Smith, I S, et al, *Gut*, 1975, **16**, 62.
- ⁸ Truelove, S C, and Peña, A S, *Gut*, 1976, **17**, 192.
- ⁹ Rozen, P, et al, *Gastroenterology*, 1979, **76**, 25.
- ¹⁰ Kyle, J, *Crohn's Disease*. London, Heinemann, 1972.
- ¹¹ Trowell, H C, in *Refined Carbohydrate Foods and Disease*, ed D P Burkitt and H C Trowell, p 135. London, Academic Press, 1975.
- ¹² Trowell, H C, in *Refined Carbohydrate Foods and Disease*, ed D P Burkitt and H C Trowell, p 47. London, Academic Press, 1975.
- ¹³ Martini, G A, and Brandes, J W, *Klinische Wochenschrift*, 1976, **54**, 367.
- ¹⁴ Miller, B, et al, *Verhandlungen der Deutschen Gesellschaft für innere Medizin*, 1976, **82**, 922.
- ¹⁵ Heaton, K W, *Nutrition* (London), 1973, **27**, 170.
- ¹⁶ Painter, N S, *Diverticular Disease of the Colon*, p 285. London, Heinemann, 1975.
- ¹⁷ Burke, B S, *Journal of the American Dietetic Association*, 1947, **23**, 1041.
- ¹⁸ Paul, A A, and Southgate, D A T (editors), *McCance and Widdowson's The Composition of Foods*. London, HMSO, 1978.
- ¹⁹ Van Soest, P J, and McQueen, R W, *Proceedings of the Nutrition Society*, 1973, **32**, 123.
- ²⁰ Southgate, D A T, in *Dietary Fibre: Current Developments of Importance to Health*, ed K W Heaton, p 9. London, Newman Publishing, 1978.
- ²¹ *Classification of Occupations*. 1970, London, HMSO.
- ²² Bingham, S, McNeil, N I, and Cummings, J H. In preparation.
- ²³ *Household Food Consumption and Expenditure*, 1977, London, HMSO.
- ²⁴ Bingham, S, Cummings, J H, and McNeil, N I, *American Journal of Clinical Nutrition*. In press.
- ²⁵ Southgate, D A T, Bingham, S, and Robertson, J, *Nature*, 1978, **274**, 51.
- ²⁶ James, A H, *British Medical Journal*, 1977, **1**, 943.
- ²⁷ Mayberry, J F, Rhodes, J, and Newcombe, R G, *British Medical Journal*, 1978, **2**, 1401.
- ²⁸ Rawcliffe, P M, and Truelove, S C, *British Medical Journal*, 1978, **2**, 539.
- ²⁹ Archer, L N J, and Harvey, R F, *British Medical Journal*, 1978, **2**, 540.

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Treatment of Crohn's disease with an unrefined-carbohydrate, fibre-rich diet

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Summary and conclusions

Thirty-two patients with Crohn's disease were treated with a fibre-rich, unrefined-carbohydrate diet in addition to conventional management and followed for a mean of four years and four months. Their clinical course was compared retrospectively with that of 32 matched patients who had received no dietary instruction. Hospital admissions were significantly fewer and shorter in the diet-treated patients, who spent a total of 111 days in hospital compared with 533 days in the non-diet-treated control group. Whereas five of the controls required intestinal operation, only one diet-treated patient needed surgery. This is in strong contrast to general experience with this disease.

Treatment with a fibre-rich, unrefined-carbohydrate diet appears to have a favourable effect on the course of Crohn's disease and does not lead to intestinal obstruction.

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Introduction

The traditional attitude to diet in the treatment of Crohn's disease is summed up in the following quotation from a respected gastroenterology textbook: "There is no evidence that what the patient eats in any way affects the symptoms or course of Crohn's disease. . . . Beyond the elimination of "roughage" from the diet in order to reduce the chances of partial or complete intestinal obstruction, the kinds of food eaten by the patient should not be a matter of concern for the physician."¹

Some years ago one of us, impressed by Cleave's hypothesis² that many diseases of civilisation are attributable to the habitual consumption of refined carbohydrate, suspected that refined carbohydrates might promote the development of Crohn's disease.³ On the basis that removing a promoting factor might help in treatment, a diet which excludes refined carbohydrates was introduced as part of the routine management of Crohn's disease in one clinic of the Bristol Royal Infirmary. After some time the diet-treated patients seemed to be faring unusually well. To test this impression, we decided to compare their progress with that of a matched group of patients who had been given no dietary instruction.

Patients and methods

From April 1972 to July 1977 32 patients with Crohn's disease were prescribed an unrefined-carbohydrate diet in addition to usual forms of treatment. The diet was not advised to a mentally handicapped