MEDICAL PRACTICE

Clinical Topics

Effect of wheat bran on weight of stool and gastrointestinal transit time: a meta analysis

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Abstract

Twenty original papers that reported on the effect of wheat bran on large bowel function were analysed. Bran increased the stool weight and decreased the transit time in each study in healthy controls and in patients with the irritable bowel syndrome, with diverticula, and with chronic constipation. Statistical evaluation of the data showed, however, that constipated patients had lower stool output and slower transit whether or not they had taken bran, and they responded less well to bran treatment than controls. From these data it is concluded that bran can be expected to be only partially effective in restoring normal stool weight and transit time in patients who are constipated.

Introduction

Dietary fibre, particularly wheat bran, is commonly recommended as a treatment for chronic constipation. It might be expected, therefore, that the success of this treatment is either obvious or has been proved, but when some 200 physicians were interviewed it was found that nearly all prescribed dietary fibre but that a satisfactory result was obtained in only one third of constipated patients (unpublished data). More than half of the doctors believed that if treatment with fibre has no effect it is because patients do not follow the diet.

To find out whether treatment with fibre has ever been shown to be effective for constipated patients I carried out a meta analysis[1] of studies in which the effect of fibre treatment on bowel function was investigated.

Methods

The biomedical literature was searched for studies on the effect of fibre on stool weight or on oroanal transit time, or both. Three sources were used: *Current Contents* (headings: bran, dietary fibre, constipation) from January 1980 to March 1987, reference lists in textbooks, and reference lists in published papers on constipation, the irritable bowel syndrome, and treatment with dietary fibre. A total of 35 original papers were found that dealt with fibre from various sources and bowel function. In 27 of the studies wheat bran was prescribed; in three studies ispaghula, barley, and soy were used once each; in two psyllium; in two dietary fibre was not specified; and in one study meat eating volunteers were compared with vegetarians and vegans. The analysis was therefore restricted to studies in which wheat bran was prescribed. Seven papers were excluded because they gave no data on stool weight or transit time.

In the analysis the following information was sought: the definition of the population studied, the study protocol (control treatment, control group), and the comparability of the subjects studied and of the methods used. Data on individuals, when available, were taken from either tables or figures.

The sex ratio in the four diagnostic groups was compared by χ^2 analysis (4×2 table). As this comparison yielded a significant difference (χ^2 58·7, $p<0·0001$) each group of patients was compared with the volunteers separately (three 2×2 tables). Studies that did not report the sex of subjects were excluded from the analysis. For the studies that reported data on individual stool weights repeated measures of analysis of variance were used. Firstly, it was determined whether data for volunteers and for constipated patients from the different studies could be pooled. For this purpose belonging to a particular study was regarded as the group factor and treatment regarded as the repeated measures factor. Secondly, patients were compared with volunteers, and again treatment was the repeated measures factor.

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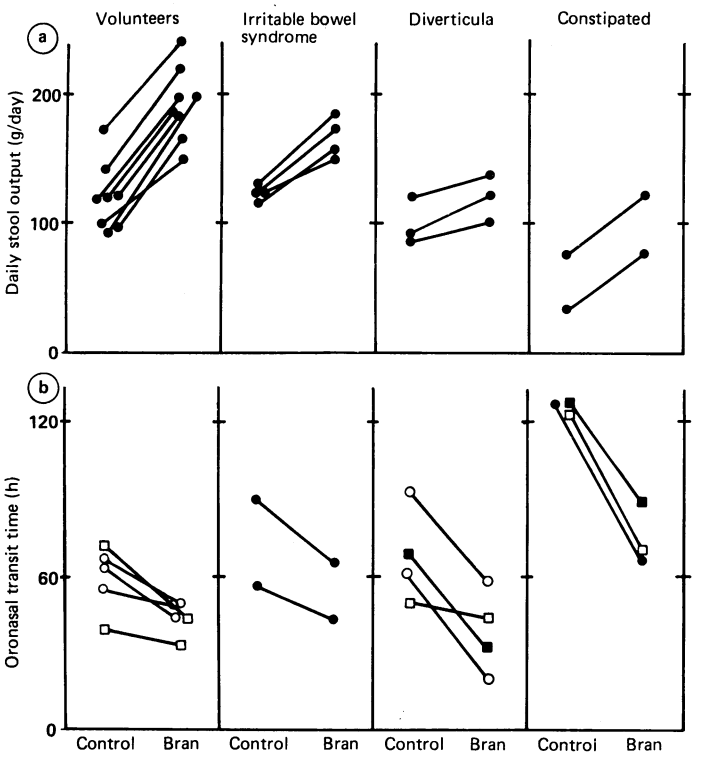

(*a*) Daily stool output in volunteers and patients with and without (controls) bran supplements. Each pair of dots represents the means from one of the analysed papers. (*b*) Oroanal transit times in volunteers and patients with and without (control) bran supplements. Each pair of dots represents the means from one of the analysed papers. ○ is time required to empty 50% and ● 80% of ingested markers; ■=single capsule; □=mean marker transit.

Results

Table I gives details of the patients, methods, and results of the 20 studies that were analysed. In all of the studies a crossover design was used, each subject acting as his or her own control. In only one study were patients (with diverticula) compared with controls.[2] In four studies placebo was compared with bran,[3-6] and in one study ispaghula was given during the control period.[7] As far as could be determined there was no difference between the studies in the fibre content of the basal diet to which bran was added. The dose of bran was usually about 20 g/day. More bran was prescribed for patients with the irritable bowel syndrome, otherwise the dosage was comparable among groups.

The criteria for entry in to the studies were well defined for volunteers and for patients with either the irritable bowel syndrome or colonic diverticula, but they varied for patients with constipation. In the studies on volunteers three quarters of the subjects were men, whereas in studies of patients with the irritable bowel syndrome, diverticula, and constipation the proportion of men was one quarter, four tenths, and three tenths respectively (χ^2 analysis, all $p<0{\cdot}01$). There is a trend for the volunteers to be younger than the patients, though a statistical comparison could not be made because of lack of data.

Treatment with bran increased stool output and decreased transit time in all studies. This was significant except for stool weight in the studies by Findlay *et al* (patients) and Lucey *et al*,[2,8] and for transit time in Findlay's study (volunteers),[2] and in three other studies.[6,9,10] The figure shows the mean stool output with and without bran in the different studies. The volunteers and the patients with the irritable bowel syndrome have similar results, whereas the constipated patients have lower stool weights both with and without bran. Individual data for stool weight were extracted from five studies.[11-15] Analysis of variance showed no difference between the three studies in volunteers (table II).[11-13] The data were therefore pooled. In the two studies in constipated patients stool output differed significantly and could not be pooled. Comparing the data from volunteers with the data from constipated patients shows significantly lower stool weights in both samples

TABLE II—*Repeated measures analysis of variance in studies that reported individual data on stool weight*

Subjects	F value	p Value
Volunteers[11-13]:		
Reference	1·19	0·32
Bran	156·83	0·0001
Reference on bran response	2·50	0·095
Constipated patients[14-15]:		
Reference	17·79	0·001
Bran	25·46	0·0003
Reference on bran response	0·06	0·80

TABLE I—*Details of the studies that were analysed*

Study No	No of subjects	No of men	Age range (years)	Basal diet (both test periods)	Amount of bran added (g)	Mean (SD) weight of stool (g/day)		Mean (SD) transit time		
						Control	Bran	Method*	Control	Bran
Volunteers:										
1[2]	6	?	28-36	Not specified	20	120 (44)	183 (22)	80%	66 (44)	50 (12)
2[3]	4	2	65-69	Not specified	39	93 (20)	166 (30)	—	—	—
3[11]	28 (21)†	9	20-40	Normal	20	140 (52)	220 (73)	—	—	—
4[12]	5	5	?	20-25 g fibre	27	116 (19)	193 (24)	—	—	—
5[13]	6	6	20-38	22 g fibre	20	92 (22)	194 (30)	Mean	73 (24)	43 (8)
6[9]	8	8	25-43	<20 g fibre	16	120 (18)	183 (22)	80%	55	49
7[22]	19	19	16-48	Not specified	20	—	—	80%	66 (38)	48 (22)
8[10]	8	8	17-62	15·4 g fibre	12·3	173 (42)	240 (40)	Mean	39 (11)	34 (9)
9[19]	11	11	18-50	8-12 g fibre	16	100 (43)	149 (39)	—	—	—
Irritable bowel syndrome (typical symptoms):										
10[4]	18	4	26-28	Free	30	124 (72)	182 (102)	—	—	—
11[23]	38	7	19-61	Usual	9-38	116 (92)	155 (74)	50%	56 (31)	42 (25)
12[8]	24	8	22-78	Not specified	25	123 (69)	148 (98)	—	—	—
13[5]	18	4	26-68	Free	30	122 (72)	174 (105)	50%	91 (36)	67 (31)
Diverticula (presence of diverticula):										
1[2]	7	?	30-84	Not specified	20	84 (37)	101 (48)	80%	93 (37)	58 (21)
14[24]	15	?	?	Not specified	20	—	—	Single	68 (54)	32 (23)
15[6]	58	24	43-78	Not specified	15	119 (48)	137 (50)	Mean	50 (24)	45 (22)
16[25]	6	?	?	Not specified	20	96 (16)	123 (28)	80%	61 (16)	21 (22)
Constipation:										
7[22] (subjective)	1	0	60	Not specified	20	—	—	80%	168	120
17[7] (regular need for laxatives)	10	4	66-87	Not specified	20	—	—	Single	126 (54)	89 (37)
18[14] (subjective)	6	6	23-51	20-25 g fibre	18	78 (36)	121 (14)	—	—	—
19[15] (≤3 stools/week)	10 (6)‡	0	20-40	No foods rich in fibre	20	31 (14)	78 (36)	50%	137 (60)	67 (47)
20[20] (transit >70 h)	20	4	38-69	~20 g fibre	10-32	—	—	Mean	120 (35)	68 (35)

*Method for transit measurement: 50% (80%)=time until 50% (80%) of 20 ingested markers left the intestines; mean: mean transit time estimated by repeated marker feeding; single: transit time for one single capsule.
†Twenty eight experiments were performed in 21 subjects; since these repeated measurements could not be identified, the mean was calculated from 28 pairs of data.
‡Five subjects were treated with wheat bran, five with corn bran. Exclusion of subjects on corn bran leads to even smaller means of stool weight and longer transit times. The transit studies were done in a subsample of six women.

of constipated patients whether or not they were treated with bran (tables III and IV). In addition, the absolute increase in weight induced by bran was lower in patients.

Transit times were similar in volunteers and in patients with either the irritable bowel syndrome or diverticula, irrespective of the method used. In contrast, transit was apparently longer in constipated patients (table I, figure). Individual data could not be compared as the different methodology did not allow pooling of data.

TABLE III—*Stool weight in volunteers from three studies[11-13] and in constipated patients from two other studies[14 15] (mean (SD))*

	Volunteers	Constipated patients	
		Cowgill and Sullivan[14]	Graham *et al*[15]
No of subjects	39	6	10
Control (no bran)	129·6 (48·2)	78·0 (36·1)	31·1 (14·8)
Wheat bran	211·6 (61·5)	120·5 (14·1)	69·8 (35·6)

For statistical comparison see table IV.

TABLE IV—*Repeated measures analysis of variance of stool weight in volunteers and in constipated patients from studies that provided individual data*

Comparison	Factor	F value	p Value
Volunteers *v* patients[14]	Group	10·65	0·0025
	Bran	67·64	0·0001
	Response of group on bran	6·83	0·0119
Volunteers *v* patients[15]	Group	49·39	0·0001
	Bran	102·82	0·0001
	Response of group on bran	13·26	0·0010

Discussion

Epidemiological studies show a positive correlation between the intake of dietary fibre and the weight of the stool.[16] Undoubtedly, fibre supplements increase stool output and decrease transit time in healthy people. It has been concluded from these studies that chronic constipation may be due in part to a diet that is low in fibre and that constipation may in general be treated by adding fibre to the diet, but extrapolating the data from volunteers to patients does not seem to be justified. In a dietary survey of 40 constipated women and 40 healthy women it was found that the composition of their diets was similar,[17] which does not support the low fibre hypothesis for the pathogenesis of constipation. Remarkably few constipated subjects taking bran treatment have been studied. In no study was the effect of bran on bowel function investigated in constipated patients and in controls. Thus, a meta analysis is necessary to establish differences between these groups.[1]

Compared with volunteers people who were constipated had lower basal stool weights and longer transit times and responded less to similar doses of bran than controls who did not take bran supplements. The last fact shows that possible differences in the fibre content of the basal diet are very unlikely to account for the lower stool weight of the patients. The response of the patients with the irritable bowel syndrome as a group is similar to that of controls. The standard deviations shown in table I suggest, however, that the range of stool weights and transit times in the irritable bowel syndrome is greater than that in controls. The data from patients with diverticula fall between those of controls and patients with the irritable bowel syndrome on one side and constipated patients on the other side. This may be due to the fact that constipated patients were included in the diverticula groups. Information on this could not be extracted from the papers.

Since the studies of volunteers comprised a much higher percentage of men than the studies of constipated patients and since men have higher stool outputs than women[10 18] the sex difference might explain the above findings. But this is not the case. Firstly, the stool weights of women who were not constipated[18] is still in the range of stool weights of male volunteers[13 19] and higher than those in constipated women.[15] Secondly, the patients with irritable bowel syndrome in the present analysis have stool weights that are similar to the volunteers, but the proportions of men and women are similar to those of the constipated patients. The suspected difference in age also cannot explain the differences in bowel habits between volunteers and constipated patients as age does not affect stool weight and transit.[10]

Finally, it may be that the constipated patients who are studied are particularly selected and are not representative of all constipated patients. This may in part be correct. In one study geriatric patients who were partly wheelchair bound were studied.[7] In another study only patients with established slow bowel transit were included.[20] In addition, there are obviously differences in the degree of constipation between different studies, and constipation may not be considered to be a useful category at all since it is an ill defined symptom. All the data, however, show either lower stool weight or slower transit or both in constipated patients (regardless of the definition) when compared with both controls and patients with the irritable bowel syndrome. From the data there is no justification for claiming that bran treatment in constipation can return stool output and transit time to normal. The same is true for psyllium, the only source of fibre other than bran whose effect on stool weight was evaluated in constipated patients.[21] Rather it seems likely that there is a motility disorder of the colon, which is either primary or secondary to an underlying disease or an altered lifestyle, that is responsible for constipation. To corroborate the results of this meta analysis, comparative studies in volunteers and unselected patients who are constipated are necessary. Until then constipated patients should not be blamed for non-compliance if dietary advice fails.

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