giving the following findings: (1) 66 (71%) were assessed as recovered or much improved; (2) in 90% of these 66 cases recovery appeared to have occurred within two years of first attendance; (3) no relation could be demonstrated between outcome and psychiatric in-patient or supportive out-patient treatment; (4) for female patients but not for males a history of previous psychiatric illness was associated with an unfavourable outcome; (5) for patients of both sexes a short duration of illness before the key consultation was related to a favourable outcome; and (6) the frequency with which abnormal personality characteristics were observed at follow-up has prompted the hypothesis that persons with such traits are peculiarly liable to neurosis.

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Radiology in Diagnosis of Coeliac Disease

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It is common for children to present with complaints which raise the possibility of coeliac disease. As is widely appreciated, this diagnosis must be considered not only in the child with an obvious "coeliac syndrome" but in such widely differing diagnostic problems as dwarfism, obscure anaemia, recurring diarrhoea, and even behaviour disorders. The clinician will, quite properly, be reluctant to admit all such children to hospital for the rather prolonged and laborious process of complete investigation. Any single screening test would therefore be of great value, particularly if it were suitable for out-patients.

Among the routine procedures in common use in the investigation of coeliac disease the only one which is suitable for out-patient use is radiological examination of the small intestine. The appearances of the small intestine in this disease have been well described (Astley and Gerrard, 1954), and Cameron *et al.* (1962) have emphasized the particular significance of dilatation of the jejunum.

The present study was carried out to find whether radiological abnormalities of the small bowel are frequent enough in coeliac disease for this investigation to be of value as a screening test.

Methods

Fifty children with untreated coeliac disease were included in the study. The ages of the patients ranged from 8 months to 8½ years. In each case the diagnosis was based on the demonstration of impaired absorption of fat and xylose and the typical histological appearances of the jejunal mucosa. Absorption of fat was estimated by a five-day fat balance, the faecal fat being estimated by a modification of the method described by van de Kamer *et al.* (1949). Xylose absorption was tested by the method described previously (McCrae, 1963). Jejunal biopsy specimens were taken by Crosby capsule (Crosby and Kugler, 1957). Barium examinations were made after overnight starvation. Two mucus-resistant contrast media were used. Twenty-one patients were given Micropaque and 29 had B.A.S. 16. These preparations were used undiluted, 3 oz. (85 ml.) to infants and 4 oz. (114 ml.) to those over 2 years of age. Radiographs were taken in the supine position at 30 minutes, one hour, and two hours.

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During the course of the study barium examinations were carried out in 50 patients shown not to have coeliac disease or any other malabsorptive state. These patients were used as controls and the reasons for carrying out the investigation in them are given in the Table.

Reasons for Investigation in 50 Control Patients

Presenting Complaint	No.	Diagnosis	No.
Vomiting	21	Hiatus hernia	4
		Periodic syndrome	9
		Mental deficiency	1
		N.A.D.	7
Failure to thrive	10	Bronchiectasis	1
		Pyelonephritis	2
		Tuberculosis	1
		Subnutrition	6
Recurring diarrhoea	6	N.A.D.	6
Pallor	6	Nutritional iron-deficiency anaemia	6
Abdominal pain	3	N.A.D.	3
Constipation	1	N.A.D.	1
Rectal bleeding	2	Haemophilia	1
		Nephrotic syndrome	1
Post-operative review	1	Duodenal atresia	1

In order to keep the study as free from bias as possible, all the radiographs, from both patients and controls, were collected, mixed, and assessed at one session. This assessment was carried out by one of us (E. M. S.), who had no previous knowledge of these cases and was not aware of the diagnosis.

Three features were considered: dilatation of the jejunum, alteration in the mucosal folds, and delay in the transit of the meal to the caecum. An objective method of demonstrating dilatation was used. The width of the jejunum was measured at three loops. The average of these measurements was recorded as a percentage of the width of the upper border of the body of the third lumbar vertebra. In this way the calibre of the intestine was estimated in terms of a standard which is related to the size of the child. Assessment of the changes in mucosal folds was entirely subjective. Three grades of abnormality were recognized, and were recorded on a 3+ system. The mouth–caecum transit time was recorded only so far as was possible within the limits imposed by the timing of the radiographs.

Results

In Fig. 1 the width of the jejunum, expressed as a percentage of the width of the third lumbar vertebra, is shown in relation

to age for both the controls and the subjects with coeliac disease. All patients with coeliac disease showed dilatation beyond 65% of the width of the vertebra. Of the control subjects only three showed dilatation of this degree and none showed dilatation beyond 70%.

The subjective recognition of alteration in mucosal folds proved rather less satisfactory. In 90% of the cases of coeliac disease there were changes which could confidently be diagnosed as abnormal. In the remaining cases there were only minor changes which were indistinguishable from appearances found in 46% of the controls (Fig. 2).

The exact time at which the caecum was filled by the meal was not recorded. It was found, however, that in all but four of the control subjects the mouth–caecum transit time was less than two hours. The transit time was longer than this in 50% of the patients with coeliac disease.

All the 50 small-bowel studies carried out in these patients with active coeliac disease were abnormal. In five cases the degree of dilatation, although greater than 65%, came just within the range of the control subjects. In all these cases, however, the mucosal folds were obviously abnormal. In eight cases the mucosal pattern showed only minimal abnormalities, but in all eight there was distinct dilatation of the jejunum.

Two contrast media were used in this trial. Both gave a satisfactory demonstration of the mucosal pattern. With B.A.S. 16 there was less segmentation, and it was therefore easier to measure the width of several loops. In practice B.A.S. 16 was preferred mainly because it was apparently more palatable and therefore more convenient for administration to small children.

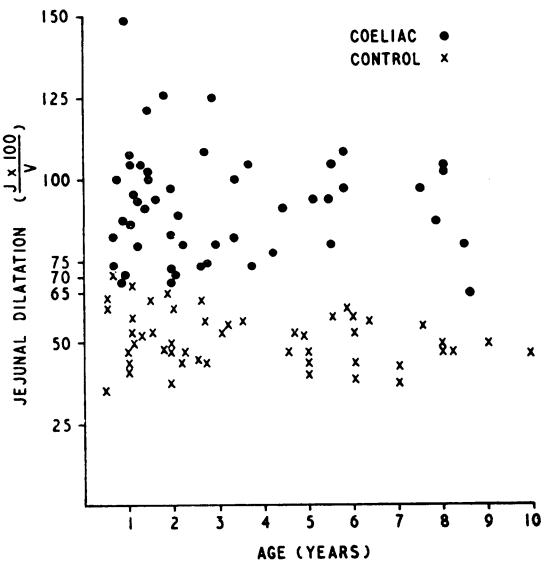

FIG. 1.—Jejunal dilatation is recorded as the ratio of jejunal width to the width of the third lumbar vertebra. The ratio is expressed as a percentage.

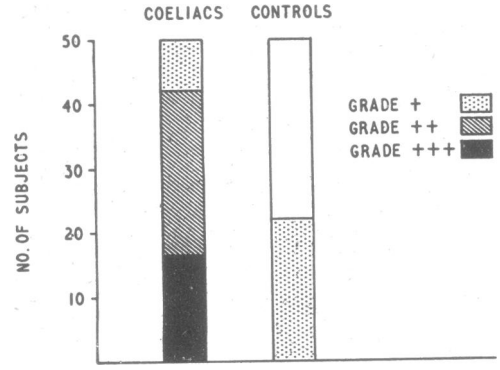

FIG. 2.—Mucosal changes are graded on a 3+ system as described under "Methods."

Discussion

The results of this study indicate that radiological abnormalities in the small bowel are constantly present in active coeliac disease. Cameron *et al.* (1960) found that dilatation of the jejunum was the single most important sign, and this was confirmed in our series. The introduction of an objective method for measuring the dilatation has increased the ease and certainty with which this sign can be detected.

All the cases of coeliac disease had a jejunal width greater than 65% of the width of the third lumbar vertebra. Obvious coarsening of mucosal folds was found to be a less constant sign, but was useful in confirming the presence of abnormality when the degree of dilatation, between 65% and 70%, was of doubtful significance. In all the cases studied it seemed possible to make adequate assessment of the small intestine by consideration of these two features—jejunal dilatation and coarsening of mucosal folds. Delay in the mouth–caecum transit time occurred in half the cases but was never the single essential sign in reaching the diagnosis.

The presence of these radiological abnormalities does not confirm the diagnosis of coeliac disease. Similar appearances are found in less common malabsorptive states (Ross *et al.*, 1955 ; Schwartz and Jarnum, 1959 ; Laws and Pitman, 1960 ; Salt *et al.*, 1960). Our experience would lead us to believe that when the small-bowel radiograph is abnormal complete investigation is indicated. When no abnormality is seen coeliac disease can be excluded.

As a screening test this procedure has distinct advantages. It is not beset by the frequent collection failures and inaccuracies of absorption studies. It is not time-consuming, technically difficult, or dangerous. Only three radiographs are required and the radiation hazard is therefore negligible. In the young child, however, the main advantage is that the patient need not be admitted to hospital. It therefore provides a most useful preliminary investigation before laborious procedures are undertaken.

Summary

Radiological studies were carried out in 50 children with active coeliac disease and 50 control subjects. It was found that in active coeliac disease the small intestine was always abnormal.

Dilatation of the jejunum was the most frequent sign of abnormality, and an objective method of assessing this dilatation is introduced.

Since radiological examination of the small intestine can be carried out conveniently on out-patients it has a particular place in the preliminary investigation of possible cases of coeliac disease.

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