

## Summary

The transit times of food residues through the gastrointestinal tract have been studied by administering food mixed with a small amount of barium sulphate. Observations were made on 88 normal subjects, 75 patients with the irritable colon syndrome, and 43 patients with diverticulosis. The transit times were found to be substantially shorter in the patients with diverticula than in normal subjects and to follow closely the transit shown by patients with the irritable colon syndrome. This finding is put forward as evidence supporting the hypothesis that incoordinated colonic activity is the basic abnormality in diverticulosis.

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## REFERENCES

- Alvarez, W. C., and Freedlander, B. L. (1924). *J. Amer. med. Ass.*, **83**, 576.  
 Barclay, A. E. (1933). *The Digestive Tract*, p. 279. London.  
 Beer, E. (1904). *Amer. J. med. Sci.*, **128**, 135.

- Burnett, F. L. (1923). *Amer. J. Roentgenol.*, **10**, 599.  
 Cole, L. G. (1914). *Amer. J. med. Sci.*, **148**, 92.  
 Edwards, H. C. (1939). *Diverticula and Diverticulitis of the Intestine*, p. 195. Bristol.  
 Feldman, M. (1948). *Clinical Roentgenology of the Digestive Tract*, 3rd ed., p. 473. London.  
 Fischer, M. H. (1900). *J. exp. Med.*, **5**, 333.  
 Horner, J. L. (1958). *Amer. J. dig. Dis.*, **3**, 343.  
 Hurst (Hertz), A. F. (1907). *Guy's Hosp. Rep.*, **61**, 389.  
 Hurst, A. F. (1919). *Constipation and Allied Intestinal Disorders*, 2nd ed. London.  
 Johnson, T. A. (1943). In H. L. Bockus's *Gastroenterology*, vol. 2, p. 683. Philadelphia.  
 Jordan, A. C. (1926). *Chronic Intestinal Stasis*, 2nd ed. London.  
 Keith, A. (1910). *Brit. med. J.*, **1**, 376.  
 Lönnerblad, L. (1951). *Acta radiol. (Stockh.)*, Suppl. No. 88.  
 McCance R. A., Prior, K. M., and Widdowson, E. M. (1953). *Brit. J. Nutr.*, **7**, 98.  
 Manousos, O. N., Ritchie, J., and Truelove, S. C. (1967a). To be published.  
 — Truelove, S. C., and Lumsden, K. (1967b). *Brit. med. J.*, **3**, 762.  
 Morson, B. C. (1963). *Brit. J. Radiol.*, **36**, 385.  
 Painter, N. S., and Truelove, S. C. (1964). *Gut*, **5**, 201.  
 Todd, T. W. (1930). *The Beaumont Foundation Lectures*, series No. 9, p. 79. Baltimore.  
 Turell, R. (1959). *Diseases of the Colon and Anorectum*, vol. 2, p. 633. London.  
 Vega, de la, J. M., Gonzalez, J. N., and Ponce de Leon, A. (1964). In H. L. Bockus's *Gastroenterology*, 2nd ed., vol. 2, p. 933. Philadelphia.  
 Williams, I. (1963). *Brit. J. Radiol.*, **36**, 393.

## Prevalence of Colonic Diverticulosis in General Population of Oxford Area

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It has been generally accepted that diverticulosis of the colon is a common condition in Western countries, especially in the older age groups (Barborka, 1958; Reichman and Watkins, 1962). However, up to the present time the frequency of diverticulosis has been calculated from radiological studies carried out on patients or from post-mortem examinations in hospital, and consequently the results apply only to selected sections of the population. Spriggs and Marxer (1925) examined 1,000 consecutive barium enemas and found diverticula in 10%. Rankin and Brown (1930) studied 24,620 barium enemas and found diverticula in 5.7%. They reported a similar prevalence of diverticulosis (5.2%) in 1,925 necropsies. All except one of the necropsies were carried out on subjects older than 40 years.

Pemberton *et al.* (1947) reviewed a large number of radiographs of the colon and found diverticula in 8.5%. Welch *et al.* (1953) examined 2,000 barium enemas and found diverticula in 20% of the patients over the age of 60.

Until some years ago diverticula were more common in men than in women (Spriggs and Marxer, 1925; Ochsner and Borgen, 1935); recently, however, it appears that a change in sex ratio is taking place and a female preponderance is now commonly observed (Ford, 1953; Brown and Toomey, 1960). Table I shows the sex ratio in diverticulosis and diverticulitis reported by various authors. In a recent study on the prognosis of diverticulosis and diverticulitis (Manousos and Truelove, 1967) it was found that whereas below the age of 60 diverticula were equally common in men and women, above that age the condition was much more common in women. It was also shown that the number of patients admitted to hospital with diverticulosis, diverticulitis, and the complications of diverti-

cular disease is increasing, and this probably indicates a true increase in the prevalence of the disease as a whole.

In view of the lack of accurate information on the frequency of diverticulosis in the population at large the present study was made.

TABLE I.—Illustrating a Change in Sex Ratio in Diverticulosis and Diverticulitis. A Female Preponderance in Recent Years is Shown

Authors	Male:Female ratio
Telling and Gruner (1917)*	2:1.0
Spriggs and Marxer (1925)†	2.7:1.0
Mayo (1930)†	1.7:1.0
Rankin and Brown (1930)†	2.3:1.0
Ochsner and Borgen (1935)†	1.25:1.0
Brown and Marxer (1937)†	1.6:1.0
Laufman (1941)*	1.7:1.0
Smithwick (1942)*	1.6:1.0
Ford (1953)†	1.0:1.5
Ford (1953)*	1.0:1.2
Friesen and Schmidt (1955)*	1.0:1.3
Greene (1957)†	1.0:1.4
Greene (1957)*	1.0:1.5
Boles and Jordan (1958)†	1.0:1.2
Brown and Toomey (1960)†	1.0:1.5
Brown and Toomey (1960)*	1.0:1.3
Botsford and Curtis (1961)*	1.0:1.3
Bevan (1961)*	1.0:2.0
Reichman and Watkins (1962)*	1.0:1.7
Manousos and Truelove (1967)†	1.0:1.8
Manousos and Truelove (1967)*	1.0:1.4

\* Diverticulitis and its complications. † Diverticulosis.

### Methods and Subjects

The radiological appearances of the colon of 109 subjects without gastrointestinal symptoms were studied. The majority of the subjects were healthy volunteers who were either members of the staff of the Radcliffe Infirmary or visitors to inpatients. A minority of the subjects were patients in a geriatric unit (Cowley Road Hospital, Oxford) who were volunteers and who were completely free from gastrointestinal symptoms.

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The subjects studied were instructed to drink a small quantity of radio-opaque material (30 ml. of Micropaque or Fotogel) with each of their four main meals on one day. The next morning a radiograph of the abdomen was taken, and this was repeated on successive mornings (up to a maximum of six) until the radio-opaque material had virtually disappeared. The degree of accuracy of the method in demonstrating colonic diverticula (see Fig.) was tested on 20 known cases of diverticulosis in which the diverticula had been shown by barium enema. The follow-through method revealed the diverticula in every case.



Radiograph showing extensive diverticulosis of colon revealed by barium follow-through technique described in text.

It is interesting that in the first recorded case of colonic diverticula in which the diagnosis was made radiologically (Abbé, 1914) the diverticula were shown by follow-through examination whereas the radio-opaque enema had failed to demonstrate them.

By the follow-through method employed in the present study it was possible to obtain an estimate of the prevalence of diverticulosis. The method was also used as a measure of the transit times of food (Manousos, Truelove, and Lumsden, 1967).

### Results

The radiographs were examined carefully, and only when the appearances were unequivocal were the diverticula accepted. The results (Table II) indicate that diverticulosis of the colon is slightly commoner in women than in men in the population studied. No cases of diverticulosis were found below the age of 40, but the prevalence of the condition increases steadily with age and reaches a peak above the age of 80 years. Above the age of 60 the condition was present in 15 out of 43 subjects

(34.9%); below the age of 60 it was present in 5 out of 66 subjects (7.6%).

TABLE II.—Prevalence of Diverticulosis in the Various Age Groups

Age	Men			Women			Both Sexes		
	No. of Subjects	With Diverticula		No. of Subjects	With Diverticula		No. of Subjects	With Diverticula	
		No.	%		No.	%		No.	%
<40	14	0	0.0	25	0	0.0	39	0	0.0
40-59	14	2	14.3	13	3	23.1	27	5	18.5
60-79	10	3	30.0	14	4	28.6	24	7	29.2
80+	10	3	30.0	9	5	55.5	19	8	42.1

### Discussion

One of the best studies of the frequency of diverticulosis of the colon is that of Debray *et al.* (1961), which was carried out in France. They studied the radiographs of 500 barium enemas taken at random from a much bigger number carried out in hospital or by their colleagues. They found a low frequency of diverticulosis in patients under the age of 40, but thereafter the frequency rose with each successive age group until it reached 40% over the age of 70 years. The weakness of their study is that many of the patients had gastrointestinal symptoms and therefore they cannot be regarded as an unbiased sample of the general population. The present study, though dealing with comparatively small numbers, has been concerned with subjects completely free from gastrointestinal symptoms, and therefore its results may be a closer reflection of the prevalence of diverticulosis of the colon in the general population.

### Summary

An estimate of the prevalence of diverticulosis of the colon in the Oxford area has been obtained by studying healthy volunteers. A follow-through radiological method was used. Diverticulosis was found to be present in one in every three persons above the age of 60 years. Below that age the condition was present in 7.6% of the population studied. Diverticula were more common in women than in men. A review of the literature shows that a female preponderance in diverticulosis has been constantly observed during recent years.

We are grateful to the volunteers who took part in this study. We also wish to thank Dr. L. Z. Cosin and his staff for allowing us to study patients under their care, the radiographers of the United Oxford Hospitals for taking the radiographs, and the Medical Research Council for financial support.

### REFERENCES

- Abbé, R. (1914). *Med. Rec. (N.Y.)*, 86, 190.  
 Barborka, C. J. (1958). *Gastroenterology*, 34, 278.  
 Bevan, P. G. (1961). *Brit. med. J.*, 1, 400.  
 Boles, R. S., and Jordan, S. M. (1958). *Gastroenterology*, 35, 579.  
 Botsford, T. W., and Curtis, L. E. (1961). *New Engl. J. Med.*, 265, 618.  
 Brown, D. B., and Toomey, W. F. (1960). *Brit. J. Surg.*, 47, 485.  
 Brown, P. W., and Marcle, D. M. (1937). *J. Amer. med. Ass.*, 109, 1328.  
 Debray, C., Hardouin, J. P., Besançon, F., and Raimbault, J. (1961). *Sem. Hôp. Paris*, 37, 1743.  
 Ford, H. S. (1953). *Canad. med. Ass. J.*, 69, 506.  
 Friesen, L., and Schmidt, E. R. (1955). *Surg. clin. N. Amer.*, 35, 1385.  
 Greene, W. W. (1957). *Amer. J. Surg.*, 94, 282.  
 Laufman, H. (1941). *Int. Abstr. Surg.*, 73, 222.  
 Manousos, O. N., and Truelove, S. C. (1967). Awaiting publication.  
 — and Lumsden, K. (1967). *Brit. med. J.*, 3, 760.  
 Mayo, W. J. (1930). *Trans. Amer. surg. Ass.*, 48, 301.  
 Ochsner, H. C., and Barges, J. A. (1935). *Ann. intern. Med.*, 9, 282.  
 Pemberton, J. de J., Black, B. M., and Maino, C. R. (1947). *Surg. Gynec. Obstet.*, 85, 523.  
 Rankin, F. W., and Brown, P. W. (1930). *Ibid.*, 50, 836.  
 Reichman, H. R., and Watkins, J. B. (1962). *J. Amer. med. Ass.*, 182, 1023.  
 Smithwick, R. H. (1942). *Ann. Surg.*, 115, 969.  
 Spriggs, E. I., and Marzer, O. A. (1925). *Quart. J. Med.*, 19, 1.  
 Tellings, W. H. M., and Gruner, O. C. (1917). *Brit. J. Surg.*, 4, 468.  
 Welch, C. E., Allen, A. W., and Donaldson, G. A. (1953). *Ann. Surg.*, 138, 332.