TEXTBOOK OF
GASTROENTEROLOGY

Ian A.D. Bouchier.
MD, FRCP, FRCPEd
Professor of Medicine, University of Dundee;
Honorary Consultant Physician,
Ninewells Hospital and Medical School, Dundee, Scotland

Robert N. Allan
MD, PhD, FRCP
Senior Clinical Lecturer,
University of Birmingham;
Consultant Physician,
The General Hospital,
Birmingham, England

Humphrey J.F. Hodgson
DM, FRCP
Senior Lecturer in Medicine,
Royal Postgraduate Medical School;
Honorary Consultant Physician,
Hammersmith Hospital,
London, England

Michael R.B. Keighley
MS, FRCS
Reader in Surgery, University of Birmingham;
Consultant Surgeon, The General Hospital,
Birmingham, England

Tropical sprue. Mathan VI.
Contributors

M. S. Losowsky, MD, FRCPE
Professor, Department of Medicine, St James's Hospital, Leeds LS9 7TF, UK.
The Consequences of Malabsorption

M. H. Lyall, CHM, FRCSEd
Honorary Senior Lecturer, University of Dundee; Consultant Surgeon, Ninewells Hospital and Medical School, Dundee DD1 9SY, UK.
Embryology and Anatomy of the Large Intestine; Congenital Abnormalities of the Anterior Abdominal Wall, Peritoneum and Mesentery

Juan-Ramón Malagelada, MD
Professor of Medicine, Mayo Medical School; Consultant in Gastroenterology, Mayo Clinic and Mayo Foundation, Gastroenterology Unit, Saint Mary's Hospital, Rochester, Minnesota 55905, USA.
The Gut Response to a Meal and its Hormonal Control

Christopher Niels Malling, MB, FRCPE
Consultant Physician, Lewisham Hospital, London SE13 6LH, UK.
Insulinoma including Nesidioblastosis; Glucagonoma

Bibhat K. Mandal, FRCPEd
Lecturer in Communicable Diseases, University of Manchester; Consultant Physician, Regional Department of Infectious Diseases, Monsall Hospital, Newton Heath, Manchester M10 6WR, UK.
Salmonella Infections

Janet M. Marks, DM, FRCPE
Senior Lecturer in Dermatology, University of Newcastle upon Tyne, University Department of Dermatology, Royal Victoria Infirmary, Newcastle upon Tyne NE1 4LP; Honorary Consultant Dermatologist, Newcastle upon Tyne Health Authority, UK.
Skin Disease and the Gut

V. I. Mathan, MD, PhD, MRCP, FAMS
Professor of Medicine and Gastroenterology, and Director, Wellcome Research Unit and Department of Gastroenterology, Christian Medical College Hospital, Vellore 632 004, Tamil Nadu, India.
Tropical Sprue

P. N. Maton, MSc, MB BS, MRCP
Digestive Diseases Branch, National Institutes of Health, Bethesda, Maryland 20205, USA.
Carcinoid Tumours and the Carcinoid Syndrome; Internal Parasitic Syndromes Associated with Cancer

H. B. McMichael, MD, FRCPE
Honorary Senior Lecturer in Medicine, Royal Postgraduate Medical School; Consultant Physician, General Wing, Ealing Hospital, Uxbridge Road, Southall, Middlesex UB1 3HW, and Hammersmith Hospital, London, UK.
Digestion and Malabsorption of Fat

A. S. McNeish, MSc, MB ChB (Glas), FRCP
Professor of Paediatrics and Child Health and Director of the University of Birmingham Institute of Child Health; Francis Road, Birmingham B16 8ET; Honorary Consultant Paediatrician, Children's Hospital, Ladywood, Birmingham, UK.
Paediatric Gastroenteritis

Laurence J. Miller, MD, MS
Assistant Professor of Internal Medicine, Mayo Medical School; Consultant in Gastroenterology, Mayo Clinic and Mayo Foundation, Gastroenterology Unit, Saint Mary's Hospital, Rochester, Minnesota 55905, USA.
The Gut Response to a Meal and its Hormonal Control
Tropical Sprue

Tropical sprue is a primary malabsorption syndrome occurring in residents of, or visitors to, certain tropical areas where the disease is endemic. The aetiology of this disease and the pathogenesis of malabsorption is not fully understood. The diagnosis of tropical sprue in the individual patient is therefore dependent on the clinical features described from different parts of the tropics suggests that the aetiology of the syndrome is likely to be multiple. Several factors which may damage the intestinal mucosa and produce malabsorption have been described, what is now described as the syndrome of tropical sprue is likely eventually to be identified into several entities.

Historical aspects

Chronic diarrhea associated with wasting was familiar to the physicians of India from at least 600 BC; they attributed this to the weakness of the digestive fire which only sanctified the ingested food and did not allow it to contribute to the growth of the body. In English medical literature, the syndrome was first documented in Barbados by Hillary. British and Dutch physicians described the clinical syndrome in great detail in expatriates from Europe in India and south-east Asia during the eighteenth and nineteenth centuries. These clinical descriptions emphasize the presence of anaemia and glossitis as well as wasting. It was generally thought at that time that the disease did not affect indigenous populations of tropical countries. Reports from the Caribbean region, especially the detailed studies undertaken by the United States Army, emphasized the haematologic abnormalities considered essential for diagnosis and for some time sprue was considered to be a primary haematologic disease. During the Second World War, tropical sprue occurred as epidemics in the Assam Theatre of War, and in

the 1960s several epidemics of tropical sprue were reported from southern India.14,31 After the mid-1950s, the availability of a variety of methods to study intestinal absorption and the ability to obtain intestinal mucosal biopsies established that tropical sprue was a gastrointestinal disease and that the nutritional deficiencies seen are secondary to malabsorption. It was also shown that the syndrome was widely prevalent in the indigenous populations of many tropical developing areas.

Epidemiology and aetiology

Hillary12 reported that two years after his arrival in Barbados, tropical sprue assumed epidemic proportions. On clinical and investigational grounds all patients with tropical sprue have malabsorption of unknown aetiology. However, on epidemiological grounds, it appears reasonable to divide patients into three groups:

a. Tropical sprue in expatriates from temperate climates.
b. Endemic tropical sprue in indigenous populations.
c. Epidemic tropical sprue in indigenous populations.

Endemic tropical sprue in expatriates and in indigenous populations occurs sporadically without any temporal or spatial relationship with other known cases of tropical sprue. While the clinical manifestations are similar, it is possible that the aetiological factors are different. One particular group affected in this way are overland travellers from Europe to the Indian subcontinent who were detected to have malabsorption on return to their home countries.28 A proportion of these patients had diarrhæa, while others were considered to be cases of tropical sprue since no agent could be detected. In these patients, treatment with folie acid, vitamin B12 and tetracycline was very effective.

There are many reports of endemic tropical sprue from the Indian subcontinent and descriptions of the disease from different centres in the country appears to be similar.26,10,11 In the Caribbean, although tropical sprue has been described from many of the islands, it has not been found in Jamaica. The reasons for this, or the low prevalence of tropical sprue in sub-Saharan Africa, are not clear.27

Epidemic tropical sprue was first described in detail in British and Indian troops and Italian prisoners of war during the Second World War. While malabsorption and its sequelae were present, no aetiological studies were carried out. Subsequently, several large epidemics of tropical sprue have been described from southern India.18,19,20 A high proportion of the population in affected villages is afflicted; the incidence is higher in adults than in children. Fifty percent of the subjects affected in an epidemic are symptom-free by the end of a month, but patients have been followed up for over 20 years after the first reported epidemic in 1960.21 There is temporal and spatial clustering of cases in villages and the evolution of an epidemic in a village usually takes one or two years, with secondary and tertiary waves of the epidemic appearing 5–10 years later. In subsequent waves of the epidemic, the age-specific attack rate is changed; those who had been asymptomatic at the time of the original epidemic in a village appear to be protected during the subsequent waves. The attack rate in children born after the first wave of the epidemic is significantly higher than would be expected in the secondary and tertiary waves. Available data suggest that these epidemics are likely to be caused by an infectious agent, but detailed bacteriological, virological and other studies thus far have failed to identify an agent.

The clinical features and natural history of tropical sprue reported from different regions suggest that there are regional differences and that the disease is a syndrome of multiple aetiology.29 However, as yet no critical comparison of study of patients evaluated according to a uniform protocol in different areas has been performed.

It is reasonable to consider this syndrome as the end result of damage to the intestinal absorptive cell. Nutritional deficiency, food toxins or infections have been considered as possibly factors which could produce the intestinal mucosal damage. The majority of the people in many of the areas where tropical sprue is endemic live on marginal diets, but it has not been possible to identify a particular nutritional deficiency that can produce an enteropathy, or to 'cure' the intestinal lesion by giving physiological amounts of nutrients. It is, however, possible that deficiency states may be predisposing or perpetuating factors for enterocyte damage. Food toxins or an immunological response similar to those produced in patients with a nutritional deficiency have been considered but has not been demonstrated. Immunological abnormalities are common in tropical sprue and the mucosal immunological alterations appear to be secondary to enterocyte damage.22

The study of epidemic tropical sprue gives the strongest support for an infectious aetiology but...
Tropical Sprue

Physical Findings

The findings on abdominal examination are usually minimal: mild abdominal distension, loud and irregular bowel sounds, and visible peristalsis, especially when the abdominal wall is thin due to weight loss. Marked dehydration and acidosis may be present in a small number of patients, especially in hot and dry climates.

The signs of nutritional deficiency dominate the clinical picture in the chronically ill patient. Severe megaloblastic anaemia is characterized by pallor and mild icterus. Other features of nutritional deficiency are glossitis, stomatitis, cheilitis, cutaneous and mucosal hyperpigmentation associated with vitamin B₁₂, or folate deficiency, dependent oedema, exfoliation of the skin, and thin dyspigmented hair. Sigmoidoscopic examination is usually remarkable, although in about a third of patients with chronic symptoms, internal haemorrhoids may be present as well as some hyperaemia of the rectal mucosa.

Laboratory Findings

Investigations of patients with tropical sprue should determine the severity and extent of malabsorption, exclude secondary malabsorption, and evaluate the extent of nutritional deficiency.

Stool Examination

The volume and weight of stool passed in 24 hours is increased in patients with tropical sprue. Although the prevalence of intestinal parasites such as Entamoeba histolytica, Giardia lamblia and Strongyloides stercoralis in patients with tropical sprue is the same as in the general population, if any of these parasites are found in the individual patient, it would be advisable to give appropriate therapy to see if there is improvement in absorptive parameters and clinical status. However, these are not usually significantly altered by parasite eradication. The rate of isolation of bacterial pathogens from the stool in tropical countries in patients and control populations is similar. Examination of a Sudan III stained smear of the stool is useful for screening patients for enterotoxigenic

Tests of Absorption

It is possible to test the absorption of water, electrolytes and a large number of nutrients by appropriate techniques. In the clinical situation, the absorption of fat, D-xylene and vitamin B₁₂...
are usually tested; it is accepted that malabsorption of at least two of these three substances is necessary for the diagnosis of tropical sprue.

In most reported series, over 90% of the patients have steatorrhoea, the daily faecal fat excretion on a 50 g fat intake ranging from about 6 g to around 25 g. Malabsorption of xylose is found in almost 99% of patients, but its absence in an occasional patient does not invalidate the diagnosis. Vitamin B₁₂ malabsorption has been reported in 60 to over 90% of patients in different regions. The highest prevalence of vitamin B₁₂ malabsorption appears to be in expatriates from temperate countries and in the Caribbean area, while in India it is found in only about 60% of the patients. The absorption of vitamin B₁₂ is usually not improved when additional intrinsic factor is given, but in a small number of patients vitamin B₁₂ malabsorption improves or becomes normal with intrinsic factor, suggesting that there is also a gastric lesion in this condition.³⁰

Tropical enteropathy - the presence of morphological abnormalities in the jejunal mucosa associated with malabsorption of one nutrient such as fat, xylose or vitamin B₁₂ in apparently healthy asymptomatic individuals - which occurs in many tropical countries has to be taken into consideration when tests of absorption and jejunal mucosal biopsies are evaluated in indigenous populations.³¹ Tropical enteropathy is probably an adaptation of the intestinal mucosa to the contaminated environment of the tropics.³² The prevalence of tropical enteropathy varies in different parts of the world and is highest in countries like southern India and Haiti. The results in an individual patient with chronic diarrhoea and malabsorption therefore have to be evaluated in the light of the normal background for the population being studied.

**Intestinal mucosal morphology**

The availability of peroral biopsy instruments since the mid-1950s has made it possible to undertake systematic studies of the intestinal mucosal morphology in patients with tropical sprue, and confirm the early findings from post-mortem or laparotomy material.

The overall thickness of the mucosa in patients with tropical sprue is within normal limits, but the villi are shortened and the crypt height is increased (Figure 8.50). The surface epithelial cells are abnormal, low cuboidal or columnar, and at higher power cytoplasmic damage can be recognized as atrophy as is seldom found and the damage is less than basement membrane droplets of fat may be present and the crypt epithelium is thickened and inconspicuous. In the majority of the jejunal biopsies, villi are significantly shortened and malabsorption is confirmed by normal biopsy. This sampling error of jejunal mucosal biopsies has been reported in the epithelium and surface epithelial cells, with short microvilli, a marked increase in the amount of lamina propria, and a marked increase in the amount of lamina propria, with degenerative changes occurring in the surface epithelial cells. The ulcers (Figure 8.51) are said to be due to infection with the virus and the changes in the lamina propria are said to be due to the virus. The damage to the crypts and the lamina propria has been identified as in the lamina propria.
Tropical Sprue

The secondary malabsorption syndromes are the result of deficient intraluminal digestion, damaged intestinal mucosa, or interference with transport from the gut. In the individual patient in whom tropical sprue is suspected, it is important to exclude these conditions. Apart from a careful history and physical examination, the investigations that are particularly useful are jejunal mucosal biopsy and careful radiology. Conditions such as agammaglobulinaemia with nodular lymphoid hyperplasia, parasites damaging the intestinal epithelium, Whipple's disease, coeliac disease, or diffuse intestinal lymphoma can often be diagnosed by peroral biopsy.

Careful radiological examination of the small intestine using stabilized barium preparations and image intensification can show structural abnormalities such as blind loops, diverticula, fistulas, or strictures - conditions associated with bacterial overgrowth and the stagnant bowel syndrome. The radiological features of tropical sprue include altered peristalsis with slow transit of the barium column through the small intestine, dilatation of the loops of intestine, and thickening of the primary mucosal folds. These features are nonspecific and not of themselves diagnostic. Other tests which are of importance are the detection of parasites in jejunal luminal fluid, the demonstration of bacterial overgrowth by appropriate sampling of the intestinal luminal contents, the detection of hypo- or agammaglobulinemia, abetalipoproteinemia or other metabolic abnormalities.

Assessment of nutritional status

In tropical sprue the prevalence and severity of nutritional deficiency states increases with the increasing duration of symptomatic diarrhoea. Anaemia is the result of varying degrees of deficiency of iron, folic acid and vitamin B₁₂. Megaloblastic anaemia is found in over 60% of the patients, although in different regions the role of vitamin B₁₂ deficiency may differ. Since nutritional iron deficiency is widely prevalent in the normal population of many tropical developing countries, the additional contribution of tropical sprue to iron deficiency anaemia in the tropics is difficult to assess. Reports from temperate climates suggest that megaloblastic anaemia is far more common in patients with tropical sprue than iron deficiency anaemia.

Yet possible to say whether the presence of damaged enterocytes in the crypt is a characteristic and possibly diagnostic feature in tropical sprue.
Hypoproteinaemia, with its sequelae of oedema and hair and skin changes, has been extensively documented. It has been suggested that the intestinal lesion is the result of a hypoproteinaemic enteropathy; however, critical analysis of available data does not support this but rather shows that hypoproteinaemia develops as a consequence of malabsorption. Protein-losing enteropathy may also contribute to the hypoproteinaemia in this condition.\textsuperscript{36} Dehydration associated with hypokalaemia, hyponatraemia and acidosis is a major complication in patients with large-volume, watery diarrhoea and is often a cause of death, especially in areas where adequate treatment is not available. Deficiency of other nutrients may also be present.

**Diagnosis and differential diagnosis**

In a patient presenting with chronic diarrhoea and signs of malnutrition or megaloblastic anaemia in the tropics, or with a history of having visited tropical regions, the diagnosis of tropical sprue should be considered.

In the chronic well-established case of tropical sprue, parasitic diseases that are of particular importance are giardiasis, strongyloides and capillariasis. Simple small bowel fluid or, if necessary to exclude localization of the disease, will help to establish the diagnosis.

The most important complication in developing countries is intestinal malabsorption. This may arise from bacteria in the bowel, but only rarely is a bacterial etiology established. The occasional case of coliforms and 

\textsuperscript{10}cf/ml of faecal healthy adults in tropical countries is probably due to the diet. The industrialite rice-eating produces a large disease. However, the high consumption of carbohydrates over the last ten years has been detected.

Primary disease of malabsorption can be mucosal disease of the morphological important to the tropical count

In early cases there is often a stool, especially in the stool, with or without abdominal pain. Most acutely, the disease may present even with high fever. Complications are common. The course of tropical sprue is marked by remissions and exacerbations. The number of severe exacerbations in tropical sprue is unknown, but probably higher than in other countries.
Tropical Sprue

477

Gastroenteritis. Since these parasites damage the upper small bowel, examination of the jejunal luminal fluid or jejunal mucosal biopsies may be necessary to exclude their presence. Rapid nor-
dication of absorptive parameters following appropriate treatment of parasitic infestation will help to establish the diagnosis.

The most important condition to be considered in the differential diagnosis in tropical countries is intestinal tuberculosis producing secondary malabsorption by bacterial over-
growth. This, and other conditions which give rise to bacterial overgrowth and a stagnant bowel syndrome, can best be excluded by careful radiological examination, although laparotomy may occasionally be necessary. Quantitative bacteriological cultures of the intestinal luminal fluid have to be interpreted with caution since coliforms and bacteroides up to a concentration of 10⁷ ml of luminal fluid can be cultured from healthy adults in the tropics.⁴

Coeliac disease is not widely prevalent in tropical countries and it was felt that this was primarily because wheat or rye were not part of the diet. The introduction of wheat to many traditional rice-eating populations was expected to produce a large number of cases of coeliac disease. However, in southern India, although wheat consumption has gone up significantly over the last ten years, no case of coeliac disease has been detected.

Primary disaccharidase deficiency as a cause of malabsorption can be diagnosed by low intestinal mucosal disaccharidase levels in the presence of morphologically normal biopsies. It is important to remember that many populations in tropical countries are lactose deficient.⁵

In early cases with symptoms of acute diarrhoea with or without small amounts of blood in the stool, especially in epidemic situations, infective diarrheal diseases have to be excluded by appropriate microbiological techniques. Most acute infectious diarrheas are of less than two weeks duration although some of them may lead to a post-dysenteric syndrome which may last longer (see later in this chapter). In epidemic tropical sprue, malabsorption is present even during the first few days of the illness.

Complications and mortality

The course of the illness is characterized by remissions and relapses. Prolonged follow-up of patients in southern India for over 20 years did not show a higher incidence of small intestinal malignancy. The susceptibility to infections is increased and the prevalence of tuberculosis (usually pulmonary or nodal) is higher in groups of patients with tropical sprue. Mortality in the indigenous population and in those in whom the nutritional deficiency is not corrected is high and has been as much as 40% in the epidemic situation. However, there is a marked tendency towards spontaneous remissions; in epidemics nearly 90% are symptom-free by the end of the first year.

Treatment

Controlling the diarrhoea, correcting the nutritional deficiencies and attempting to cure the intestinal lesion are the major aims in the treatment of tropical sprue. A follow-up study of a large number of patients has shown that spontaneous recovery occurs in a significant proportion of the patients.⁶

Control of diarrhoea

Symptomatic control of the diarrhoea can usually be achieved using Lomotil (diphenoxylate and atropine) 2.5–5.0 mg three or four times a day, loperamide 5–10 mg three or four times a day, or mixtures of belladonna, opium, par-
egeric or bismuth salicylate. The dosages have to be tailored for the individual patient. While these measures make the patient feel more comfortable and may reduce the extent of fluid and electrolyte losses, it does not appear to shorten the duration or extent of the malabsorption.

Correction of deficiency states

In severely dehydrated patients, parenteral replacement of fluids may be necessary, although the majority of patients can be managed by oral maintenance of hydration; the glucose electrolyte solutions recommended for the treatment of acute diarrhoea have proved to be equally useful in tropical sprue. Maintenance of hydration in epidemics of tropical sprue has significantly reduced the mortality associated with this condition.⁷ Therapeutic supplements of vitamins and trace nutrients may have to be given depending on the pattern of nutritional deficiency found. While iron and folic acid are satisfactorily absorbed when given orally in pharmacological doses, vitamin B₁₂ should preferably be given parenterally.

The diet in patients with tropical sprue should ideally promote weight gain. Various types of experimental or elemental diets have been advocated, but there is no critical study showing a
specific advantage for any of them. Any particular item of the diet which seems to aggravate the symptoms should be avoided. Patients should be encouraged to take at least 2000 calories/day with 1 g of protein/kg ideal body weight. The adequacy of the nutritional intake should be monitored by keeping a careful record of weight gain. The majority of patients gain weight satisfactorily, even though malabsorption is persistent. If sufficient calories are taken, Anorexia and abdominal distension are the major constraints in ensuring adequate nutritional intake.

Specific therapy
Since the aetiology of tropical sprue is unknown, there is as yet no rational therapy for the small intestinal lesion. Evaluation of treatment aimed at curing the lesion is difficult because of the spontaneous remissions that characterize the natural history of the disease. In the Caribbean islands, it is accepted that treatment with folate acid, vitamin B12, and tetracycline for up to six months is curative.12 The reports that tropical sprue in the Caribbean islands is associated with colonization of the small intestine by a toxin-producing coliform provide the rationale for this treatment. In southern India, treatment with folate acid and vitamin B12, with or without tetracycline, did not produce a rate of remission higher than in untreated controls,6 although in an occasional patient there was a rapid and dramatic response to the institution of tetracycline therapy. While the situation in indigenous patients was not clear-cut, expatriates from temperate climates treated in southern India responded promptly to tetracycline and folate acid. It is not clear whether the difference in the response between the indigenous patient and the expatriate is related to differences in nutritional status, differences in aetiology, or due to secondary factors which could perpetuate the lesion.

Definitive treatment of patients with tropical sprue awaits the identification of aetiological agents and possible perpetuating factors but, with our present knowledge, it appears justifiable to treat patients by correcting the deficiencies and giving a course of tetracycline for up to six months.

Acknowledgement
The author's work referred to here is supported by the Wellcome Trust, London.

References
1 Ayrey, F. (1948) Outbreaks of sprue during the Bumrah Campaign. Transactions of the Royal Society of Tropical Medicine and Hygiene, 41, 377-382.
23 McLean, J. Mathan, V. albuminuric jejunum in 55, 725-728.
24 Ross, J. N. changes in 80, 433.
26 The Welclos bellaric Anan.
27 Tomkins, A concepts in Clinical Ser.
28 Tomkins, A. Walters, J. P. eliers to Indi.
29 Vaisch, S. K., metabolism. Medicine, 34.
31 Walters, J. H Indian soldier

POST-INJ MALABSORPTION
Relatively little and severity of conditions — as the extent to which the act of relations from the: noted from the: In this see several factors. A definite ileum — is described. In live cause or c form: a more acute infective disease, the "abnormal" condition. AIM IS of tropical countries themselves are Chapter 14. These show overlap between syndrome (i.e. some cases the mous. Much of those. Mammals.
Post-Infective Malabsorption

Relatively little is known about the incidence and severity of malabsorption in acute infective conditions — viral, bacterial and parasitic — and the extent to which such malabsorption can continue after the specific organism has been eliminated from the intestinal lumen.

In this section, malabsorption following several infective conditions involving the small intestine — 'post-infective' malabsorption (PIM) — is described. In some cases the initiating infective cause or causes may persist in a chronic form; a more precise term is therefore 'post-acute' malabsorption. As with many diseases, the spectrum varies markedly from subclinical cases to those with gross malabsorption. PIM is of particular clinical relevance in tropical countries. The infective conditions themselves are considered in more detail in Chapter 14.

There is obviously an area of considerable overlap between PIM and the tropical sprue syndrome (see earlier in this chapter) and in some cases the entities are probably synonymous. Much of this difficulty is associated with semantics. Manson first used the term tropical sprue in the English language in 1880.13 It was then applied to all cases of malabsorption in tropical countries, undoubtedly including some of those caused by tuberculosis and parasites. Despite suggestions in early descriptions that chronic diarrhoea had an insidious onset,14 it is clear that the vast majority of cases present acutely. The picture is further complicated when acute epidemic cases of small intestinal infection with gross dehydration as well as malabsorption of xylose and fat are labelled tropical sprue.4 The term 'tropical sprue' would be better reserved for a condition where the malabsorption of nutrients is quantitatively more important than that of water and electrolytes. Although the aetiology of tropical sprue remains in doubt (see below), it is known that most cases follow an acute small intestinal insult from either bacterial, viral or parasitic infection.

Overall, evidence for PIM after small intestinal infection is more complete for bacterial and parasitic infections; infections of viral origin might however be more important numerically. Lack of precise data may be attributed to some extent to the fact that virology remains an under-developed discipline in most developing Third World countries, where infections of all types are far more common than in the Western World. In a tropical setting it is likely that multiple intestinal infections of viral, bacterial and parasitic origins are responsible for the small intestinal changes, as demonstrated in preschool Guatemalan village children36 (tropical enteropathy, see below). However, many asymptomatic people in tropical countries have at least one pathogenic organism in the small intestinal lumen, which may be viral, bacterial or parasitic. Hence it is often difficult, or impossible, to incriminate a particular causative agent.

The effect of malabsorption syndromes following divergent small intestinal insults on nutritional status in the Third World is largely unknown;7 children are especially at risk. The magnitude of energy loss is unknown;7 one estimate is 10% of dietary energy, which is substantial in tropical populations subsisting on a marginal diet.68 The role of anorexia in exacerbating the associated malnutrition is also underexplored.38

ACUTE INTESTINAL INFECTIONS PREDISPOSING TO PIM

Viral infections

Significant intestinal protein loss (with a mean of 1.7 g daily) and xylose malabsorption have