Cryptosporidium infections in children in Durban

Seasonal variation, age distribution and disease status

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Summary

One hundred and eleven of 1 229 children (9%) aged < 10 years admitted to King Edward VIII Hospital, Durban, with gastro-enteritis over a period of 1 year were found to harbour *Cryptosporidium*. Of these, 96 (89,7%) were < 2 years of age. *Cryptosporidium* was the only potential pathogen identified in 80 of these patients (6,5%). The prevalence in paediatric patients without gastro-enteritis was 2,4% (3/124). During the study period *Cryptosporidium* infections were significantly more prevalent during the high rainfall season ($P = 0,03$).

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The coccidian parasite, *Cryptosporidium*, was first described in 1907 by Tyzzer[1] in laboratory mice. However, human infection was only recognised 70 years later by Nime *et al.*[2] This parasite is being reported more frequently as clinical and laboratory awareness increases and specific techniques for its detection are implemented. A resurgence of interest in human *Cryptosporidium* infections occurred with the recognition of its role in patients with the acquired immunodeficiency syndrome (AIDS).[3-5] However, *Cryptosporidium* has also recently been implicated as a causative agent of diarrhoeal disease in immunocompetent children and adults.[6-9] The resultant diarrhoea in patients with AIDS may be fatal,[4] while in immunocompetent patients it is less severe.[7] Although generally regarded as a self-limiting infection in immunocompetent persons, published data suggest that *Cryptosporidium*-associated gastro-enteritis in infants is associated with higher morbidity and mortality than gastro-enteritis caused by other infectious diseases.[9,10] Whether this increase in morbidity and mortality in *Cryptosporidium*-associated diarrhoea reflects a degree of immunodeficiency, as has been suggested, has not been established.[10]

Previously reported prevalences of *Cryptosporidium* infections at King Edward VIII Hospital, Durban,[9-11] have varied between 3,2% and 15,4%. None of these reports nor any other study conducted in South Africa[12-14] has fully appraised the occurrence of *Cryptosporidium* infections in relation to seasonal variation. Only one local study has addressed the importance of *Cryptosporidium* as an intestinal pathogen in children with diarrhoea.[9]

A study was undertaken to: (*i*) carry out a more detailed longitudinal investigation on the occurrence of *Cryptosporidium* infections in children during a 1-year period with a view to monitoring seasonal variations; (*ii*) determine whether or not this infection has an age-related prevalence; and (*iii*) confirm the role of *Cryptosporidium* as a local causative agent of diarrhoeal disease.

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Patients and methods

Observations were made over a period of 1 year, from May 1987 to April 1988. The study population comprised 1 229 children < age of 10 years who were admitted to King Edward VIII Hospital, Durban, with a primary diagnosis of gastro-enteritis. A smaller inpatient group of 124 children randomly sampled during the study period served as controls; none of these patients were suffering from diarrhoea. This hospital predominantly serves the black community of the surrounding peri-urban and rural areas of Durban. A stool specimen was collected from each patient within 24 hours of admission to hospital. Specimens were screened for the presence of *Cryptosporidium* oocysts employing Sheather's flotation technique;[3] we found this to be the most reliable method for detecting *Cryptosporidium* oocysts in faeces. All faecal specimens were also examined in the Department of Medical Microbiology, King Edward VIII Hospital, for the presence of other enteric pathogens with the exclusion of viruses. The prevalence of cryptosporidiosis was then correlated with seasonal changes and the age of infected individuals.

Results

During the study period 9,0% of patients (111/1 229) with diarrhoea were found to be passing *Cryptosporidium* oocysts compared with only 2,4% of the control patients (3/124). Statistical analysis (chi square) indicated that the 9% positivity in patients with diarrhoea was significantly higher than the 2,4% in the control group ($P = 0,012$).

Table I summarises the number and range of enteric pathogens detected in the study group. *Cryptosporidium* was the second most common enteric pathogen isolated. In patients

TABLE I. FREQUENCY OF POTENTIAL INTESTINAL PATHOGENS IN DIARRHOEAL STOOLS FROM 1 299 CHILDREN <10 YEARS OF AGE

Pathogens	% frequency	No. of patients
***Salmonella* spp**	**14,0**	**172**
***Shigella* spp**	**2,7**	**33**
***Campylobacter* spp**	**1,5**	**18**
***E. coli* (EPEC)**	**3,0**	**37**
Cryptosporidium	**9,0**	**111**
G. lamblia	**1,4**	**17**
E. histolytica	**0,2**	**2**
A. lumbricoides	**3,7**	**46**

with *Cryptosporidium* infection, other enteric pathogens were detected in 31 (27,9%) (Table II). Notably, *Cryptosporidium* was the only pathogen identified in 80/1 229 of patients (6,5%). Other pathogens detected in the 124 control subjects included enteropathogenic *Escherichia coli* (EPEC) (4), *Shigella* spp (5), *Giardia lamblia* (3) and *Entamoeba histolytica* (1).

TABLE II. OTHER POTENTIAL ENTERIC PATHOGENS DETECTED IN STOOLS OF PATIENTS WITH CRYPTOSPORIDIUM-ASSOCIATED DIARRHOEA

Other organisms detected	No.
Bacteria	
Salmonella spp	22
Shigella spp	4
E. coli (EPEC)	2
Protozoa	
G. lamblia	2
Helminths	
A. lumbricoides	1
No other enteric organism	80
Total	111

Of the 111 children excreting *Cryptosporidium* oocysts in their stools, 96 (89,7%) were < 2 years of age; 65 (67,7%) were < 1 year old. Furthermore, the prevalence of *Cryptosporidium* infections in the latter group of children was found to be higher in the 4 - 6-months age group (Fig. 1); this difference was statistically significant ($P = 0{,}001$). Other concomitant clinical diseases in patients with *Cryptosporidium*-associated diarrhoea included bronchopneumonia (10), kwashiorkor (8), marasmus (9), anaemia (2) and septicaemia (1).

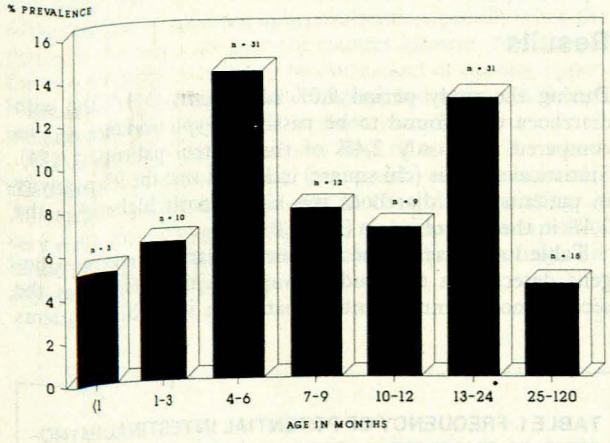

Fig. 1. Prevalence of cryptosporidiosis in children < 10 years for the period May 1987 - April 1988. (*This incidence was covered over a wider age range (1 year) and is therefore not comparable to other high incidences in 2-month age groups.)

Eleven of the 111 children (10%) infected with *Cryptosporidium* died. Autopsy findings indicated gastro-enteritis to be the probable cause of death in 7 of these patients. *Cryptosporidium* was the only enteric pathogen detected in 4. Other deaths were attributed to septicaemia (1), pneumonia (2) and hypoxic encephalopathy (1).

Cryptosporidiosis occurred throughout the year and the monthly prevalence varied between 1,2% and 20,9% (Table I). The prevalence of infection was notably higher during February, March, April (1988) and May (1987) (Fig. 2). Rainfall data for the Durban area for the period January 1988 to December 1988 were obtained from the Weather Bureau, Pretoria, and this was correlated with the monthly prevalence of cryptosporidiosis. Statistical analysis (multiple linear regression) indicated a significant correlation between rainfall and prevalence of cryptosporidiosis ($r = 0{,}6125$; $P = 0{,}0342$). The increased occurrence of *Cryptosporidium* infections during the late summer and early winter coincided with high rainfall experienced during this period. There was no correlation ($r = 0{,}4305$; $P = 0{,}1625$) between environmental temperature and the incidence of *Cryptosporidium* infections.

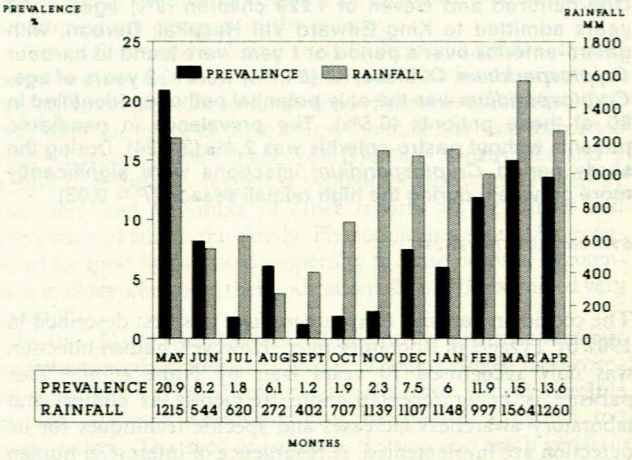

Fig. 2. Relationship between prevalence of *Cryptosporidium* and average monthly rainfall for the period May 1987 - April 1988.

Discussion

Cryptosporidiosis was originally believed to be a zoonosis[3,15] but recently transmission from person to person has been reported.[16] The parasite is known to be primarily transmitted by the faecal-oral route; the poor sanitary conditions attributable to delayed urbanisation are therefore considered to contribute to the high frequency of *Cryptosporidium* infections documented for developing countries,[17] such as Bangladesh (7,8%),[15] Liberia (7,8%),[18] Sudan (6,1%),[19] and Haiti (16,7%),[20] while more developed countries, such as Australia (2,5%),[8] the USA (0,1%),[21] and Britain (3,2%)[22] have lower prevalences of the parasite. However, in South Africa, the high prevalence of *Cryptosporidium* infections in blacks (9,0% in the present study, 11,9%,[10] 18,4%[13]) was not unexpected since a large proportion of this population group lives in areas characteristic of Third World situations where proper sewage disposal systems and protected water supplies are lacking.

During a previous longitudinal study of *Cryptosporidium* infections carried out at King Edward VIII Hospital,[11] a lower overall prevalence of 3,2% was reported compared with the results of the present survey. We believe that the lower prevalence observed in the previous study was due to the following factors: (*i*) microscopic examination of faeces was done by several observers whereas in the present investigation all specimens were examined by one of us (D. M.); and (*ii*) the Sheather's flotation technique, which has been shown to be superior to the modified Ziehl-Neelsen and auramine fluorescence methods used previously,[23,24] was used throughout the present study — both of the latter methods produced nonspecific staining, a feature which has also been reported by other workers.[25-29]

Seasonal variations in the prevalence of *Cryptosporidium* infections have also been reported from Bangladesh[30] and Australia.[31] Like giardiasis, cryptosporidiosis is a waterborne disease[32,33] and in a recent study in Finland the parasite was associated with travellers' diarrhoea due to drinking of contaminated water.[34] It is possible that contamination of rivers by stormwater run-off containing faeces of infected humans or animals has resulted in the observed higher prevalence of *Cryptosporidium* infections during the high-rainfall months.

The observed high prevalences of *Cryptosporidium* infections in children < 2 years of age is consistent with the findings of other workers[18,19,30] including those of Smith and Van den Ende.[9] This strongly implicates *Cryptosporidium* as an important cause of gastro-enteritis in children, particularly those belonging to this age group. The lower prevalence of *Cryptosporidium* infections in neonates may be due to a decreased risk of exposure to infection since babies are carried on their mothers' backs. Breast-feeding is also known to protect infants against gastro-enteritis. Although viruses have been excluded in this study, the occurrence of 'pure' *Cryptosporidium* infections in this and other studies[35,36] is more than coincidental and therefore reinforces the view that *Cryptosporidium* is a probable causative agent of diarrhoea.

A relatively high morbidity and mortality in patients with diarrhoea due to *Cryptosporidium* has been reported by Smith and Van den Ende (22,6%)[9] and Wittenberg *et al.* (23%).[10] The lower mortality from *Cryptosporidium*-related diarrhoea recorded in the present study is believed to reflect the recent overall improvement in mortality from gastro-enteritis, resulting from improved management of these patients.

It is possible that the 2,4% prevalence of *Cryptosporidium* in the control subjects may be due to a less virulent strain; a situation that may be analogous to that reported in the case of *E. histolytica* infections where non-pathogenic zymodemes (strains determined by iso-enzyme electrophoresis) can be isolated from individuals without symptoms of amoebiasis.[37–39] Asymptomatic *Cryptosporidium* infections have also been documented previously in AIDS[40] as well as immunocompetent subjects.[3,13,14,41] Although strain differences in *Cryptosporidium* have not yet been demonstrated by either Western blotting[42] or pulse-field gel electrophoresis of DNA,[43] an iso-enzyme study relating the different strains of the parasite to the clinical status of infected patients may provide information in this regard.

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