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Bacteriology

Enteric pathogens associated with diarrhea in children in Fayoum, Egypt☆,☆☆

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Abstract

In a cross-sectional study of children <60 months old from Fayoum, Egypt, presenting with diarrhea, 46% (162/356) had detectable enteric pathogens. Bacterial pathogens were identified in 25% (89/356), whereas rotavirus and *Cryptosporidium* were detected in 21% (54/253) and 15% (39/253), respectively. *Cryptosporidium* is an important pathogen in this region.

Keywords: Egypt; Enteric pathogens; *Cryptosporidium*

Diarrheal diseases continue to be a major cause of morbidity and a leading cause of mortality in children less than 5 years of age living in developing countries (Kosek et al., 2003). Implementation of effective control measures for diarrheal illness requires an awareness of the most common pathogens within a region.

For the past decade, numerous studies evaluating diarrheal diseases among children living in the Nile River Delta, northern Egypt, have been conducted (Abu-Elyazeed et al., 1999; Naficy et al., 1999; Rao et al., 2003; Wierzba et al., 2006). Enterotoxigenic *Escherichia coli* (ETEC) has been shown to be the most commonly identified cause of bacterial-induced diarrhea in these studies (Abu-Elyazeed et al., 1999; Naficy et al., 1999; Rao et al., 2003; Wierzba et al., 2006). Rotavirus, although responsible for fewer episodes of diarrhea relative to ETEC, is the most commonly identified cause of diarrhea among children seeking medical care for severe illness (Wierzba et al., 2006). In addition, *Cryptosporidium parvum* has also been identified as a prevalent and virulent agent of childhood diarrhea in the Nile River Delta (Abdel-Messih et al., 2002; Antonios et al., 2001). Although numerous studies concerning childhood diarrhea have been conducted in Egypt, only one study has been published involving children from southern Egypt (Mikhail et al., 1989). Therefore, a pilot study was initiated to determine the prevalence of selected enteric pathogens associated with diarrheal disease in children living in the Tamiya District of the Fayoum governorate located in southern Egypt. Between August and September 2003, 356 children, aged ≤60 months median age, 12 (interquartile range [IQR] 8–20 months) with acute diarrhea, defined as the occurrence of 3 or more unformed (or ≥1, if bloody) stools in a 24-h period (Abu-Elyazeed et al., 1999), were enrolled after informed consent was obtained from a parent or legal guardian.

Each child was asked to provide 2 rectal swabs and a stool sample for analysis. Methods detailing specimen

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Table 1
Enteric pathogens isolated from children with diarrhea, Fayoum Hospital, August to September 2003

Pathogens (number of samples) Tested	Number of positive cases (*n*)	%
Bacteria (N = 356)[a]		
ETEC	37	10.8
Campylobacter spp.	19	5.6
C. jejuni	16	
C. coli	3	
Shigella spp.	7	2.0
S. flexneri	4	
S. dysenteriae	2	
S. boydii	1	
Salmonella spp.	2	0.6
Aeromonas hydrophila	4	1.1
Vibrio fluvialis	2	0.6
Parasitic (n = 253)[a]		
Cryptosporidium	27	10.7
Viral (n = 253)		
Rotavirus	43	17
Mixed infection[b]	21	6.1
No pathogen identified[c]	194	54

[a] Rectal swabs were collected from 100% (n = 356) of subjects and a stool sample collected from 71% (n = 253).

[b] Mixed infections: 2 ETEC and *Campylobacter*; 1 *Campylobacter* and *Shigella*; 5 *Cryptosporidium* and ETEC; 2 *Cryptosporidium* and *Campylobacter*; 2 rotavirus and *Campylobacter*; 4 rotavirus and ETEC; 3 *Cryptosporidium* and rotavirus; 1 rotavirus and *Cryptosporidium* and ETEC; and 1 rotavirus and *Cryptosporidium* and *Salmonella*.

[c] This group includes diarrheal cases where no pathogen was detected.

collection, handling, and storage have been previously reported (Wierzba et al., 2006). Testing for enteric bacteria (*E. coli*, *Campylobacter* spp., *Shigella* spp., and *Salmonella* spp.), as well as *E. coli* heat-stable and heat-labile enterotoxins, and colonization factor antigens (CFAs) were performed as previously described (Wierzba et al., 2006). Commercially available ELISA diagnostic kits were used according to the manufacturer's instructions to test for the presence of *C. parvum* (Techlab, Blacksburg, VA) and rotavirus (Premier Rotaclone®, Meridian Bioscience, Cincinnati, OH) antigens in stool samples. Statistical comparisons were made using the χ^2 test for comparison among proportions, Fisher's exact test or the Kruskal-Wallis test. All data were double-entered into Epi-info V6 (CDC, Atlanta, GA) and analyzed using SAS V8 (SAS Institute, Cary, NC). Statistical significance was 2-tailed and set at $P < 0.05$ for each analysis.

Overall, an enteric pathogen was identified in 162 children (46%) (Table 1). Bacterial pathogens were isolated from 25% (89/356) of the children, and ETEC was the most commonly isolated bacterial pathogen followed by *Campylobacter* spp. and *Shigella* spp. Rotavirus and *C. parvum* were identified in 21% (54/253) and in 15% (39/253), respectively.

A single enteric pathogen was identified in 91% of the cases with a detectable pathogen (141/162) (Table 1). In the remaining 21 cases, 18 samples had a bacterial pathogen

Table 2
Clinical characteristics of diarrhea in Egyptian children less than 60 months old seeking treatment in Fayoum Hospital, August–September, 2003

	Fayoum hospital						
	Mixed, *n* (%)	*Campylobacter*, *n* (%)	*Cryptosporidium*, *n* (%)	ETEC, *n* (%)	*Rotavirus*, *n* (%)	Shigella, n (%)	No pathogen identified
Characteristics	21 (6.1)	19 (5.5)	27 (10.6)	37 (10.8)	43 (16.9)	7	(n = 200)
Age (months)							
0–11	15 (71.4)	13 (68.4)	21 (77.8)	7 (18.9)	21 (48.8)	3 (42.9)	93 (46.5)
12–23	3 (14.3)	3 (15.8)	6 (22.2)	18 (48.7)	19 (44.2)	3 (42.9)	47 (23.5)
24–60	3 (14.3)	3 (15.8)	0 (0.0)	12 (32.4)	3 (7.0)	1 (14.2)	60 (30.0)
Diarrhea type							
Acute watery	19 (90.5)	17 (89.5)	24 (88.9)	34 (91.9)	38 (90.5)	4 (57.1)	170 (86.7)
Dysentery	2 (9.5)	1 (5.3)	2 (7.4)	1 (2.7)	3 (7.1)	3 (42.9)	20 (10.2)
Persistent	0 (0.0)	1 (5.3)	1 (3.7)	2 (5.4)	1 (2.4)	0 (0.0)	6 (3.1)
Hospitalized	2 (9.5)	0 (0.0)	0 (0.0)	4 (11.1)	6 (14.3)	0 (0.0)	4 (2.0)
Fever present	18 (94.7)	16 (84.2)	22 (88.0)	32 (88.9)	39 (97.5)	6 (85.7)	167 (85.6)
Blood in stool	2 (10.0)	1 (5.3)	3 (11.5)	1 (2.7)	3 (7.3)	3 (42.9)	20 (10.1)
Vomiting present	14 (66.7)	7 (36.8)	16 (59.3)	16 (44.4)	36 (83.7)	4 (57.1)	100 (50.0)
Dehydration present	9 (42.9)	6 (31.6)	11 (42.3)	15 (42.9)	21 (51.2)	2 (28.6)	73 (36.7)
Rectal temperature >38.2	1 (4.8)	2 (10.5)	1 (3.7)	3 (8.3)	4 (9.3)	0 (0.0)	9 (4.5)
Median (Q1–Q3)							
Max no. of stool (n = 351)	5 (3.5,8.5)	6 (4,7)	5 (3,9)	7 (4,10)	6 (4,10)	7 (5,10)	5 (4,7)
No. of stool in last 24 (n = 355)	5 (4,7)	5 (4,6)	6 (4,8)	7 (5,10)	6 (4,10)	7 (5,12)	6 (4,7)
Days to evaluation (n = 353)	3 (2,5)	3 (2,4)	3 (3,5)	3 (2,5)	3 (2,4)	2 (2,4)	4 (3,7)

P value from Fisher's exact test for comparisons among proportions, or for continuous data, Kruskal-Wallis test. Significant *P* values are reported as $P = 0.061$ blood in stool, $P = 0.0013$ vomiting present, and $P = 0.062$ median days to evaluation. Mixed pathogens were excluded from the analysis.