East African Medical Journal Vol 70 No 5 May 1993
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SUMMARY

A prospective study of acute diarrhoeal diseases in the Eastern Province of Saudi Arabia was carried out over a 19-month period to determine aetiology, risk factors and other epidemiological characteristics. Of the 853 subjects studied, 344 were cases and 509 controls. More cases were seen in children than in adults. Enteric pathogens were detected in 49% of the cases, but none in the controls. Of the pathogens, 68% were bacterial with *Salmonella* (34%) and *Shigella* species (14.7%) being the most common; *Campylobacter jejuni* emerged as an important cause especially in adults. Contrary to most reports, rotaviruses were responsible for only 11.5% of the cases in children. *Entamoeba histolytica* (13.5%) and *Giardia intestinalis* (10.4%) were parasites commonly detected. Shigella organisms were the only pathogens that were isolated in hospital cases without being isolated in cases from the community.

INTRODUCTION

Acute diarrhoeal diseases remain common throughout the world. In developed countries, they are largely a nuisance with economic impact, but they are the leading cause of death in developing countries(1,2).

Acute diarrhoeal diseases are among the major health problems in the Kingdom of Saudi Arabia (KSA), but reports from the Eastern Province of KSA on them are few. The monthly "Epidemiology Bulletin" compiled by the Medical Department of Saudi Arabia Oil Company (ARAMCO), is restricted to staff and their relatives and is therefore, not representative. Furthermore, publications on diarrhoeal diseases in the region have been limited to children(3-6). We therefore, conducted a prospective study on acute diarrhoeal diseases in all age groups.

MATERIALS AND METHODS

The study was carried out between December 1987 and July 1989 in three hospitals in the Eastern Province of KSA. The population studied comprised of: patients of all age groups presenting at any one of the participating hospitals with a history of acute diarrhoea; acute cases of diarrhoea detected by purpose-trained staff during home visits in a designated community; controls matched for age and sex, being patients who presented at KFHU with conditions other than diarrhoea or abdominal disease.

Acute diarrhoea was defined as a significant change of bowel habit towards a decreased consistency and increased frequency, as determined by the individual or parent of a child, which was not more than five days duration(7). Cases of diarrhoea or vomiting or abdominal pain during the preceding two weeks were excluded.

Cases and controls were interviewed using a coded questionnaire. Questions asked included family size, source and storage of drinking water, refuse disposal, eating and personal hygienic habit, infant feeding practices during the attack and concepts of diarrhoea, oral rehydration salts and medication. Consent was obtained from the head of each household before administering the questionnaire, and respondents were assured of confidentiality of the information obtained.

Microbiological methods: Fresh faecal specimens were collected in cups but where this was not feasible rectal swabs were accepted from cases. For subjects in the community, specimens were collected and delivered to the microbiology laboratory by designated project technicians. All specimens were examined microscopically within 30 minutes of receipt in the laboratory for parasites using both direct smear and concentration techniques.

Bacterial cultures were done simultaneously on MacConkey (Mac), Xylose Lysine Desoxycholate, Salmonella, Shigella, Butzlers and Thiosulphate-Citrate-Bile-Sucrose agar. Inoculations were also made on Selenite 'F' broth, and processed by standard microbiological practices. Additionally, for the isolation of *Yersinia enterocolitica,* portions of faeces were inoculated on Mac and incubated at 25°C for 48 hours. Cold enrichment technique was also done by inoculating phosphate-buffered saline and incubating at 4°C for 7 days, after which subcultures were made on Mac and incubated at 25°C for 48 hours.

Isolates were identified by standard bacteriological

methods. Colonies of *Escherichia coli* were later subcultured on nutrient agar slopes and sent to Bangladesh for detection and characterization of *E. coli* toxins at the International Centre for Diarrhoeal Disease Research, Dhaka.

Virological studies were done using electron microscopy to detect viruses by negative staining techniques (courtesy of Department of Pathology, King Khalid University Hospital, Riyadh); and ELISA with Abbot Rotazyme kit, following instructions of the manufacturer.

RESULTS

Completed questionnaires were received from 853 subjects and were analyzed using a Biomedical Computer Programme. There were 344 cases comprising 157 children and 187 adults. Their distribution by community or hospital, case or control, and by age group is shown in Table 1. More cases in children were seen from the community than adults (72% vs 28%). The proportions were reversed in the hospital (39% children vs 61% adults).

Table 1

Distribution of the population studied

Age group (in years)	Community		Hospital	
	Cases	Controls	Cases	Controls
Under 1	16	61	43	38
1-2	11	33	17	18
2-12	22	118	48	58
Sub total	49	212	108	114
12-18	1	7	32	19
Over 18	18	57	136	100
Sub total	19	64	168	119
Grand total	68	276	276	233

Table 2

Distribution of organisms in hospital cases

	Children	Adult
Salmonella	27	25
Shigella	16	18
Entamoeba hystolitica	7	10
Giardia intestinalis	6	8
Campylobacter jejuni	3	6
EPEC	11	0
Rotavirus	6	0
ETEC	3	3
Total	83*	71**

* Plus 1 each of *Strongyloides stercoralis, Aeromonas hydrophilia* NAG and *Blastocystis hominis* in children

** Plus 1 *Strongyloides stercoralis* in one adult

Table 2 shows the distribution of organisms in cases seen from the hospitals. In the community only the following organisms were detected in adults: *Salmonella* 4, *Entamoeba histolytica* 5, and 3 each of *Giardia intestinalis* and *Campylobacter jejuni*. The overall detection rate of enteric pathogens was 49%, with 52% in hospitals and 29% in the community. Bacteria comprised 68.1% of the pathogens, parasites 25.8% and viruses 6.1%.

DISCUSSION

Numerous epidemiological studies on diarrhoeal diseases have been conducted worldwide. However, because of the serious consequences of acute diarrhoeal disease in developing countries, periodic investigations such as this one are still warranted. This is mainly so when they involve home visits and the use of questionnaires on such topics as knowledge, attitudes, beliefs and practices in the event of diarrhoea.

The overall detection rate of 49% of enteric pathogens in this study compares well with the 60% stated by DuPont(8) as reflecting on improvements on laboratory diagnostic techniques. The detection rate in hospital cases was 1.8 times more than that in the community, suggesting that there was a better chance of finding a causative agent if the patient considered the attack severe enough to seek medical advice.

The traditional enteric pathogens, *Salmonella* and *Shigella* were the most common causes of diarrhoea, being responsible for 34% and 15% respectively when organisms could be detected. This contrasts with studies in Jeddah, KSA where *Salmonella* were only 7.7%(9) and in Brazil where *Shigella* were 8.0%(7).

Campylobacter jejuni was an important bacterial enteric pathogen for acute diarrhoea in this study. It was the third most common bacterial pathogen with a rate of 7.4%, similar to others(2,10). It is noteworthy that in this report, although children formed 63.5% of the study population, proprotionately more cases of *Campylobacter* enteritis were in adult cases, contrasting with reports from England and Bangladesh where children were the main victims(1,2). We have no immediate explanation for this feature of Campylobacter diarrhoea in this study probably the actual trend will be seen in a larger population size.

While *Yersinia enterocolitica* is now a recognized bacterial cause of acute diarrhoea in Europe and North America(13), it was not isolated in this study in spite of diligent search for it. It was also not seen from Central African Republic(14). Its absence in our study may have to do with the fact that most cases of yersinia diarrhoea have been associated with consumption of pork(15,16), a food item which is prohibited in KSA.

With the exception of *Shigella* species which were all isolated from hospital cases, there was no consistent pattern in the detection rate of the other enteric pathogens when the cases in the community and hospitals were compared. For example the relative

proportions of *Salmonella spp*. Enteropathogenic *E. coli* (EPEC) and Enterotoxigenic *E. coli* (ETEC) detected were more frequent in the hospital group than in the community. On the other hand, *C. jejuni, E. histolytica, G. intestinalis* were more frequently detected in the community group than the hospital group (Table 2). We have no obvious explanation for these differences in distribution of the various pathogens except for the *Shigella spp* for which we can only speculate. Apart from host factors which could partly explain the differences, we saw no differences in the patients' environment, since they were all drawn from the same catchment area and therefore from presumably identical general environmental conditions.

Contrary to most reports on the important role of rotaviruses in acute diarrhoea in children with frequency rates ranging from 19% to 53%(17-19), they did not appear to be important in children in this study group. They were responsible for only 11.5% of cases of diarrhoea in children up to 2 years old. It must be pointed out that most of the detection was by the Rotazyme kit, which is claimed to be useful in diagnosing rotavirus infection in children under 3 years(8). Attention is also drawn to the fact that for technical reasons, only 66 of the 157 cases of diarrhoea in children could be examined by electron microscopy. Presumably this may have contributed to the under-detection of rotaviruses.

A comparison between the detection rate in children and in adults shows an interesting trend; whenever a pathogen was detected in a child, the child would be a hospital case except if the pathogen was a rotavirus when some cases were seen in the community as well. The situation in adults was mixed; there were more cases of diarrhoea due to *Salmonella* (25/61), *Shigella* (8/61) and ETEC (3/61) in the hospitals, whilst in the community there were more of *E. histolytica* (5/15), *C. jejuni* and *G. intestinalis* (3/15) each. Our inference from this observation is a child with diarrhoea caused by enteric pathogens other than rotaviruses, would be ill enough for the parents to actively seek medical advice than staying at home to resort to traditional remedies. It is also noteworthy that 57.6% of the cases in the hospital group in whom pathogens were detected were in children, as opposed to 42.4% in adults. That is not surprising since, in general, children are more severely affected by diarrhoeal diseases than adults.

In conclusion, in the Eastern Province of Saudi Arabia, *Salmonella* and *Shigella* are still the major enteric pathogens and for religious reasons, *Y. enterocolitica* is unlikely to play any major role.

ACKNOWLEDGEMENTS

To the King Faisal University for funding this project, College of Applied Sciences, and King Khalid Hospital of King Saud University, for their assistance in the electron Microscopy studies: Drs. Absood and Abed Balush for help in statistical analysis. Finally, we also thank Drs. Imdadul Haq, Mohammad Qadri and Mohammed Al-Ghamdi all of the Diarrhoea Control Centre for their technical assistance and cooperation.

REFERENCES

1. Skirrow, M.B. Campylobacter enteritis: A "new" disease. *Brit. med. J.* **99**:9, 1977.
2. Guerrant R.L., Shields, D.S., Thornson, S.M., Schorling J.B. and Groschel, D.H.M. Evaluation and diagnosis of acute infectious diarrhoea. Amer. J. Med. **78** (Suppl. B):91, 1985.
3. Abomelha, A., El-Mouzan, M.I. and Refat, M. Gastroenteritis in the Eastern Province: A survey of hospitalized children. *Tropical Gastroenterol.* **3**:217, 1982.
4. El-Mouzan, M.I. and Abomelha, A. Clinical aspect of gastroenteritis in Saudi Arabia. *Trop. Gastroenterol.* **5**:35, 1984.
5. Al-Abbad, A.A. Diarrhoea in the under-fives in a Saudi semi-urban community. Dissertation in partial fulfillment of KFU fellowship in family and community medicine, 1988.
6. Qadri, M.H., Al-Ghamdi, M. and Imadulhag, M. Acute diarrhoeal disease in children under 5 years old in the Eastern Province of Saudi Arabia. *Ann. Saudi Med.* **10**:280, 1990.
7. DuPont, H. [illegible] enic organisms. *Med. Clin. N. Amer.* **62**:945, 1978.
8. DuPont, H.L. Diarrhoeal disease: An overview. *Amer. J. Med.* **78** (Suppl. B): 63, 1985.
9. Goshing, P.J. and Mohamed, A.K. Salmonella Gastroenteritis in Jeddah. *Saudi Med. J.* **4**:61, 1983.
10. Butzler, J.P. and Skirrow, M.B. Campylobacter enteritis. *Gastroenterol.* **8**:737, 1978
11. Skirrow, M.B. Campylobacter enteritis: A "new" disease. *Brit. Med. J.* **99**:9, 1977.
12. Blazer, M.J., Glass, R.I., Hug, M.I. [illegible]ll, B., Kibriya, A.M. and Slim Arma. Isolation of the C. fetus ssp. jejuni from Bangladesh. *J. Clin. Microbiol.* **12**:744, 1980.
13. Marks, M.I., La Meur, L., Lachman, L. and Hammerberg, O. Yersinia enterocolitica gastroenteritis: A prospective study of clinical, bacteriological and epidemiologic features. *J. Paediatr.* **96**:26, 1980.
14. Georges, M.C., Wachsmuth, I.K., Meunier, D.M.W., Nebout, N., Didier, F., Siopathis, M.R. and Georges, A.J. Parasitic, bacterial and viral enteric pathogens associated with diarrhoea in Central African Republic. *J. Clin. Microbiol.* **19**:571, 1984.
15. Cover, T.L. and Aberr, R.C. Yersinia enterocolitica. *New Engl. J. Med.* **321**:16, 1989.
16. Doyle, M.P. Pathogenic E. coli, Y. enterocolitica and V. parahaemolyticus. *Lancet.* **336**:1111, 1990.
17. Guerrant, R.L., Kirchoff, L.V., Shields, D.S., Nations, M.K., Leslie, J., de Souza, M.A., Araufo, J.G., Correia, L.L., Sauer, T.K., McClelland, K.E., Trowbridge., F.L. and Hughes, J.M. Prospective study of diarrhoeal illnesses in northeastern Brazil: Patterns of disease nutritional impact, etiologies, and risk factors. *J. Infec. Dis.* **146**:986, 1983.
18. Champsaur, H., Questiaux, E., Prevot, J., Henry-Amar, M., Goldszmidt, D., Bourjouane, M. and Bach, C. Rotavirus carriage, asymptomatic infection and disease in the first two years of life. I Virus sheddling. *J. Infect. Dis.* **149**:667, 1984.
19. Nelson, D. Etiology and epidemiology of diarrhoea in the United States. *Amer. J. Med.* **78** (Suppl. 1.6 B): 76, 1985.