



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Seasonality and prevalence of rotavirus in Al-Ain, United Arab Emirates

M.K. Ijaz ^{a,*}, S. Alharbi ^h, S.A. Uduman ^b, Y. Cheema ^c,
M.M. Sheek-Hussen ^d, A.R.A. Alkhair ^d, A.G. Shalabi ^d, S.S. Ijaz ^e,
S.A. Bin-Othman ^f, S.A. Sattar ⁱ, L.F. Liddle ^g,

^a Department of Medical Microbiology, Faculty of Medicine and Health Sciences, United Arab Emirates University, P.O. Box 17666, Al-Ain, United Arab Emirates; ^b Department of Pediatrics, Faculty of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, United Arab Emirates; ^c Department of Occupational and Public Health, Faculty of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, United Arab Emirates; ^d Department of Preventive Medicine, Ministry of Health, Al-Ain, United Arab Emirates; ^e Department of Primary Health Care, Ministry of Health, Al-Ain, United Arab Emirates; ^f Department of Pediatrics, Al-Ain Hospital and School Health in Al-Ain Medical Districts, Ministry of Health, Al-Ain, United Arab Emirates; ^g Department of Family Medicine, Oasis Hospital, Al-Ain, United Arab Emirates; ^h Department of Microbiology, Faculty of Medicine, University of Kuwait, Kuwait; ⁱ Department of Microbiology and Immunology, Faculty of Medicine, University of Ottawa, 451 Smyth Road, Ottawa, Ont. K1H 8M5, Canada

Received 27 October 1993; revised 13 February 1994; accepted 7 March 1994

Abstract

Background: Rotaviruses are the single most important causative agent of acute neonatal enteritis in most avian and mammalian species including humans. Rotaviruses infections have also been shown to be associated with the elderly, immunocompromised individuals and more recently with epidemic diarrheal illness in adults.

Objectives: To study the incidence and the effect of seasonality on the prevalence of rotaviruses in Al-Ain, United Arab Emirates.

Study design: A total of 650 stool samples submitted to the laboratories of two University Teaching Hospitals (Al-Ain and Tawam) and a private hospital (Oasis) were examined for the presence of rotaviruses from January 1990–December, 1992, using a commercially available latex agglutination assay. The meteorological data (temperature, relative humidity and rainfall) recorded during the sampling period was analyzed statistically to examine the effect of seasonality on the prevalence of rotavirus cases in Al-Ain, United Arab Emirates.

Results: Rotavirus was detected in 21.4% of the samples examined. The predominant number of positive cases (35%) were in the 7–12 months age group. It was interesting to find rotavirus-positive cases in as low an age group as <3 months (3.6%) and as high as 10 years (8.04%). There was no significant difference on infection rates between male and female groups in the study. However, there was a significant difference between the national (38.18%)

*Corresponding author. Fax: (+971) 3-511305.

and non-national children (61.28%). The higher rate of the latter may be due to import of infections. There appeared to be a seasonal pattern of rotavirus occurrence in the cases studied, with a marked increase in the number of positive cases during the months when the relative humidity was low (25–45%) and there was no rainfall.

Conclusions: Rotavirus was detected in all age groups with a predominance in 7–12 month age groups, and a higher incidence in non-nationals. There was a marked increase in the number of positive cases during the months when the relative humidity was low (25–45%) and there was no rainfall. These findings are discussed in relation to the epidemiology and prophylaxis of rotavirus infections.

Key words: Rotavirus; Epidemiology; Seasonality; Relative humidity; Temperature; United Arab Emirates

1. Introduction

Following the discovery of rotavirus in the feces of calves suffering from diarrhea (Mebus et al., 1969), and in biopsy specimens of an infant's intestinal tissue (Bishop et al., 1973), it has been reported that rotaviruses are ubiquitous animal and human pathogens that cause significant diarrheal diseases in most mammalian and avian species (Flewett et al., 1974; Flewett and Babiuk, 1984; Estes and Cohen, 1989; Kapikian et al., 1974; Kapikian and Chanock, 1990; Middleton et al., 1974). More recently, rotaviruses have been shown to be involved in causing extra-intestinal infections in immunodeficient children (Gilger et al., 1992). They have been associated with enteritis particularly in young animals (under one month of age) and in infants (six months to two years). Epidemics of rotavirus among adults (Hrdy, 1987; Hung, 1988) and the elderly have also been described (Kapikian and Chanock, 1990). It has been estimated that over 500×10^6 cases of diarrhea occur annually in humans, resulting either directly or indirectly in approximately 10×10^6 deaths, of which approximately 1×10^6 deaths have been attributed to rotaviruses (DeZoysa and Feachem, 1985; and Ratafia, 1987). Despite their significant involvement in pediatric diarrhea, the role played by these viruses remained undetermined in human populations in the United Arab Emirates (UAE). The present project, therefore, was designed to define the role of rotaviruses in pediatric hospitalized diarrheal cases. This information has shed some light on the role of these viruses in acute viral enteritis in the local population. In addition it defined the effect of seasonality on the prevalence of rotavirus in this part (Al-Ain) of the UAE.

2. Materials and methods

Stool samples were collected from the pediatric wards of hospitalized children suffering from diarrhea in the Al-Ain Medical District. The Al-Ain Medical has three main hospitals serving a population of approximately two hundred thousand. Al-Ain Hospital (serving mainly expatriates but UAE Nationals are also served here) and Tawam Hospital (serving mainly UAE nationals but a limited number of

expatriates, mainly hospital employees or cases referred from Al-Ain hospital are also served here) are the large teaching hospitals with 420 beds and 245 beds respectively. The third hospital, Oasis Hospital is a private hospital which serves both populations and has 45 beds.

Stools or rectal swabs were collected in sterile containers and sent immediately to the laboratories of the respective hospitals for rotavirus analysis. These samples underwent routine bacteriological or parasitological examination. The samples were examined for the presence of rotavirus using commercially available latex agglutination assay (Rotazyme, Abbott Laboratories, IL, USA or Rotalex, Orion Diagnostica, Espoo, Finland). The statistical analysis was performed using different computer software. Z-Test was applied to determine the significant difference between the two populations. The data was processed on DOS 5.0 editor for statistical analysis on Statistical Package for Social Sciences (SPSS) software. Harvard Graphics software was used for the graphical presentation of both clinical and meteorological data.

3. Results

Between January, 1990 to December, 1992, a total of 650 stool samples were analyzed for the presence of rotavirus. Rotavirus was detected in a total of 139 (21.4%) of the samples submitted to the three hospitals. It was interesting to note that none of the samples which were positive for rotavirus were positive for any other infectious agent. Rotavirus was detected in all age groups under study (Fig. 1). However, it was predominant in the 7–12 month age group (34.82%). It was interesting to note that rotavirus was present in diarrheal cases in the age group

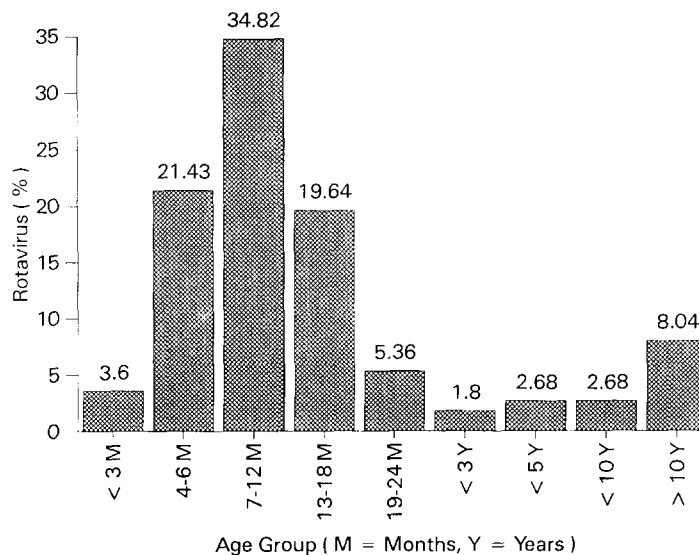


Fig. 1. Prevalence of rotavirus in different age groups.

under three months as well as in the group of over 10 years of age. The rotavirus-positive cases were analyzed statistically to determine if there was any significant difference between different sex groups (rotavirus was detected in 43% of male and 57% of female stool specimens) and no significant difference between the two groups was observed. The rotavirus-positive cases were also analyzed to determine if there is any difference between the local (nationals) [38.18%] and expatriate [61.82%] populations and a significant difference ($P < 0.01$) between the two populations was observed.

To determine the effect of seasonality on the prevalence of rotavirus in diarrheal cases, the meteorological data on temperature, relative humidity (RH) and rainfall (RF) during the sampling period (January, 1990–December, 1992) was obtained from the Division of Meteorology, Department of Agriculture, Al-Ain, United Arab Emirates. Rotavirus was detected throughout the year with its predominance during the months with low RH and no rainfall, and during the months with relatively low temperature (Fig. 2).

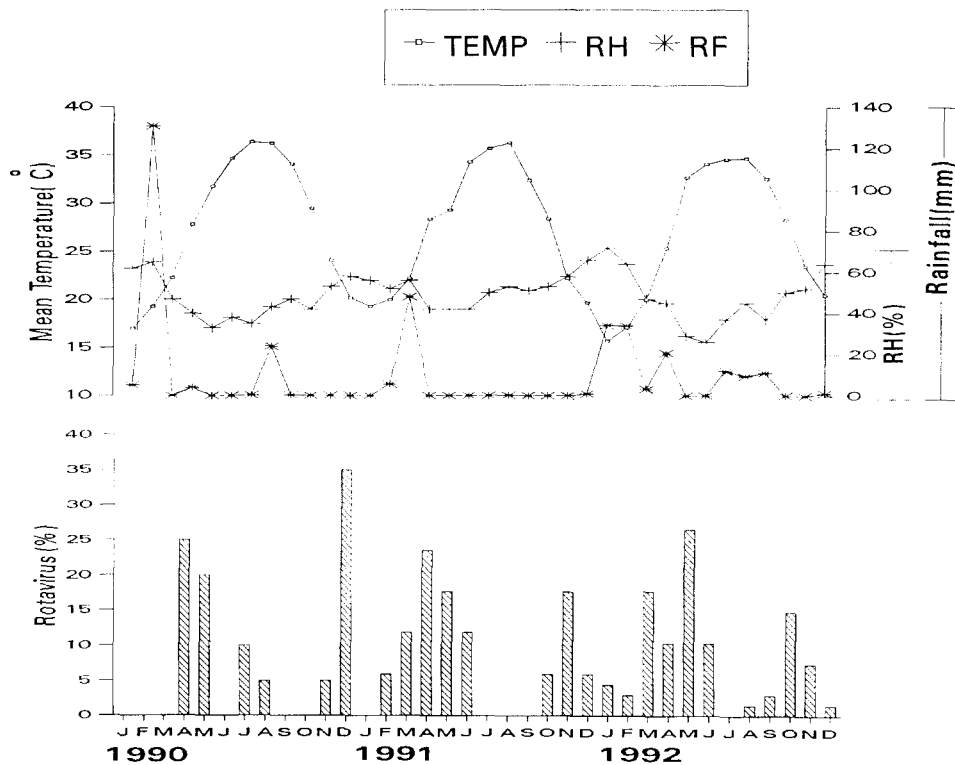


Fig. 2. Meteorological features and distribution of rotavirus case in Al-Ain, United Arab Emirates during 1990–1992. Temp (temperature), RH (relative humidity), and RF (rainfall).

4. Discussion

Rotaviruses remain an important pathogen-inducing diarrhea in infants and young children in both developed and developing countries of the world. In Al-Ain the population is mixed, i.e., locals and expatriates representing the Middle East, South East Asia, the Subcontinent, North America, Australia and Europe. Therefore, the presence of rotavirus in the Al-Ain population was not a surprise. Rotavirus was detected in all age groups under study and predominately in the 7–12 months age group. It was interesting to note that rotavirus was also recovered in the group of less than 3 months of age. This agreed with the age incidence observed in Nigerian (Oyejide and Fagbami, 1988), Native American Indians in the United States (Santosham et al., 1985) and Mexican children (Velazquez et al., 1993). The increasing incidence of rotavirus in children after the age of 6 months coincided with the age weaning usually begins and with the age at which maternally derived antibodies start to decline. Rotavirus have been reported in adults and the elderly (Bourgeois et al., 1993; Hrdy, 1987; Pryor et al., 1987). In the present study we also observed rotavirus in older children (>10 years). The importance of rotavirus in this age group and in adults needs further investigation.

The role of seasonality in rotavirus dissemination is poorly understood. In our study rotavirus was detected throughout the year, with its predominance during the months with low RH, no rainfall and with relatively low temperature. Cook et al. (1990) have analyzed the data from 34 global studies to investigate the seasonal patterns of rotavirus gastroenteritis and considered their implications on the transmission of the virus. According to their report the global pattern of rotavirus is quite distinct, with its predominance in the cooler months only in the Americas. In most of the world the virus is present throughout the year, which suggests that a low level of transmission occurs all the year round and that humans are a suitable reservoir. The results of our study taken together with the findings of Cook et al. (1990) suggest that temperature alone does not account directly for this broad seasonal pattern and that other environmental factors like RH probably play a significant role in the dissemination of rotaviruses (Ansari et al., 1991; Ijaz et al., 1984; 1985a,b, 1987; Sattar and Ijaz, 1987).

Al-Ain is located 150 km east of the capital city of Abu-Dhabi and is 400 meters above sea level. It is a traditional oasis with a climate ranging between a relatively cool, dry winter and a hot, dry summer. The percentage incidence of rotavirus infection during all the years of study revealed that it peaks in the months of March, April, May, October, November and December (Fig. 2). A comparison of meteorological data with rotavirus percentages throughout the year revealed a significant relationship of the monthly temperature, RH, and RF with rotavirus frequency. More rotavirus-positive cases occurred when there was low temperature, low RH and no RF. Fewer cases occurred in the months with high temperature, RH and rainfall.

In conclusion, our observations point towards an endemicity of rotavirus infection in the area studied. The infection was more frequent during the cooler, less humid months and in the periods of low RF. Further studies are indicated to extend this

to the other regions of the country, particularly those situated on the coast where RH is much higher throughout the year than in Al-Ain. The virus appears to be responsible for inducing enteritis in the age groups studied (<3 months to >10 years). Rotavirus has been recovered in diarrheal cases among adults and the elderly (Bourgeois et al., 1993; Hrdy, 1987; Hung, 1988; Kapikian and Chanock, 1990). Further studies need to be done to look into the possible involvement of rotavirus infections in similar age groups here in Al-Ain and other parts of the UAE, with particular reference to the involvement of different rotavirus serotypes. The information obtained from such studies should be helpful in designing a rotavirus vaccine to control these infections.

Acknowledgements

We are grateful to the laboratory staff of Al-Ain, Oasis and Tawam Hospitals for analysis of stool samples initially. The technical assistance of Mr. Z. Babarindae is highly appreciated in carrying out part of this work. We also acknowledge the support of The Faculty of Medicine and Health Sciences, United Arab Emirates University and the Ministry of Health, United Arab Emirates.

References

- Ansari, S.A., Springthorpe, V.S. and Sattar, S.A. (1991) Survival and vehicular spread of human rotaviruses. Possible relation to seasonality of outbreaks. *Rev. Infect. Dis.* 13, 448–461.
- Bishop, R.F., Davidson, G.P., Holmes, I.H. and Ruck, B.J. (1973) Virus particles in epithelial cells of duodenal mucosa from children with acute non-bacterial gastroenteritis. *Lancet* ii, 1281–1283.
- Bourgeois, A.L., Gardiner, C.H., Thornton, S.A., Batchelor, R.A., Burr, D.H., Escamilla, J., Escamilla, P., Blacklow, N.R., Herrmann, J.E. and Hyams, K.C. (1993) Etiology of acute diarrhea among United States military personnel deployed to South America and West Africa. *Am. J. Trop. Med. Hyg.* 48, 243–248.
- Cook, S.M., Glass, R.I., LeBaron, C.W. and Ho, H. (1990) Global seasonality of rotavirus infections. *Bull. WHO* 68, 171–177.
- DeZoysa, I. and Feachem, R.G. (1991) Interventions for the control of diarrheal diseases among children. rotavirus and cholera immunization. *Bull. WHO* 63, 569–583.
- Estes, M.K. and Cohen, J. (1989) Rotavirus gene structure and function. *Microbiol. Rev.* 53, 410–449.
- Flewett, T.H., Bryden, A.S., Davies, H., Woode, G.N., Bridger, J.C. and Derrick, J.M. (1974) Relationship between virus from acute gastroenteritis of children and newborn calves. *Lancet* ii, 61–63.
- Flewett, T.H. and Babiuk, L.A. (1984) Prospects for rotavirus vaccines in humans and animals. In: E. Kurstak and R.G. Marusyk (Eds.), *Control of Virus Diseases*, Dekker, New York, pp.57–65.
- Gilger, M.A., Matson, D.O., Conner, M.E., Rosenblatt, H.M., Finegold, M.J. and Estes, M.K. (1992) Extra-intestinal rotavirus infections in children with immunodeficiency. *J. Pediatr.* 120, 912–917.
- Hrdy, D.B. (1987) Epidemiology of rotaviral infections in adults. *Rev. Infect. Dis.* 9, 461–469.
- Hung, T. (1988) Rotavirus and adult diarrhea. *Adv. Virus Res.* 35, 193–218.
- Ijaz, M.K., Sattar, S.A., Johnson-Lussenberg, C.M. and Springthorpe, V.S. (1984) Airborne survival of rotaviruses and coronaviruses, implications for disease transmission. In: A.J. Della-Porta (Ed), *Virus Diseases of Veterinary Importance in South-East Asia and the Western Pacific*. Academic Press, Sydney, Australia, pp. 521–522.
- Ijaz, M.K., Sattar, S.A., Johnson-Lussenberg, C.M. and Springthorpe, V.S. (1985a) Comparison of the

- airborne survival of calf rotavirus and poliovirus type 1 (Sabin) aerosolized as a mixture. *Appl. Environ. Microbiol.* 49, 289–293.
- Ijaz, M.K., Sattar, S.A., Johnson-Lussenberg, C.M. and Springthorpe, V.S. (1985b) Effect of relative humidity, atmospheric temperature and suspending medium on the airborne survival of human rotavirus. *Can J. Microbiol.* 31, 681–685.
- Ijaz, M.K., Karim, Y.G., Sattar, S.A. and Johnson-Lussenberg, C.M. (1987) Development of methods to study the survival of airborne viruses. *J. Virol. Methods* 18, 87–106.
- Kapikian, A.Z., Kim, H.W., Wyatt, R.G., Rodriguez, W.L., Cline, W.L., Parrott, R.H. and Chanock, R.M. (1974) Reovirus-like agent in stool, association with infantile diarrhea and development of serological tests. *Science* 185, 1049–1053.
- Kapikian, A.Z. and Chanock, R.M. (1990) Rotaviruses. In Fields, B.N., Knipe, D.M., Chanock, R.M., Hirsch, M.S., Melnick, J., Monath, T.P., Roizman (Eds.), *Virology*, pp. 1353–1404.
- Mebus, C.A., Underdahl, N.R., Rhodes, M.B. and Twiehaus, M.J. (1969) Calf diarrhea (scours): reproduced with a virus from a field outbreak. *Bull. Neb. Agric. Exp. Stn.* 233, 1–16.
- Middleton, P.J., Szemanski, M.T., Abbott, G.D., Bortolussi, R., and Hamilton, J.R. (1974) Orbivirus acute gastroenteritis of infancy. *Lancet* i, 1241–1244.
- Oyejide, C.O. and Fagbami, A.H. (1988) An epidemiological study of rotavirus diarrhea in a cohort of Nigerian infants. Incidence of diarrhea in the first two years of life. *Int. J. Epidemiol.* 17, 908–912.
- Pryor, W.M., Bye, W.A., Curran, D.H. and Grohmann, G.S. (1987) Acute diarrhea in adults, a prospective study. *Med. J. Australia* 147, 490–493.
- Ratafia, M. (1987) Worldwide opportunities in genetically engineered vaccines. *Biotechnology* 5, 1154–1158.
- Santosham, M., Yolken, R.H., Wyatt, R.G., Bertrando, R., Black, R.E., Spira, W.M. and Sack, R.B. (1985) Epidemiology of rotavirus diarrhea in prospectively monitored American Indian population. *J. Infect. Dis.* 152, 778–783.
- Sattar, S.A. and Ijaz, M.K. (1987) Transmission of viral infections through airborne route. *CRC Critical Reviews in Environmental Control* 17, 89–131.
- Velazquez, F.R., Calve, J.J., Guerrero, M.L., Mass, D., Glass, R.I., Pickering, L.K. and Ruiz-Palacios, M.R. (1993) Cohort study of rotavirus serotype patterns in symptomatic and asymptomatic infections in Mexican children. *Pediatr. Infect. Dis. J.* 12, 54–61.