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Medical Science

IMPACT OF CLIMATIC FACTORS ON DIARRHOEAL DISEASE

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ABSTRACT Diarrhoeal diseases depends on several climate factors including temperature, rain fall and humidity. During two years a total of 3987 diarrhoea patients were enrolled in this surveillance system and a total of 9235 patients attended the Diarrhoea Treatment Unit (DTU) in B.C. Roy Children Hospital. *V. cholerae* isolations were 11.05% cases. All *V. cholerae* strains were susceptible to ofloxacin, azithromycin, norfloxacin and gentamicin while *Shigella* strains were susceptible to only ceftriaxone. In the present study a logistic bi-variant regression was undertaken to ascertain the risk factors of gender, age, income, source of drinking water, practices of storage of drinking water, hand washing, and covered stores of drinking water on the sever /some dehydration of diarrhoea. The results revealed that dehydration was significantly correlate with age, hand washing source of drinking water. The initial observation of climatic data temperature, rain-fall and humidity has well correlation with the number of diarrhoea cases.

KEYWORDS : Diarrhoea, climate, antimicrobial resistance

INTRODUCTION

Acute diarrhoeal diseases are the leading causes of morbidity and mortality worldwide, especially in the developing countries. Globally it account for 1.3 billion episodes with 3.2 million deaths annually among children under 5 years of age[1]. *Vibrio cholerae* O1 and O139 are responsible for producing acute diarrhoea untreated-death may occur[2]. *Shigella* causes 50% or more of all episodes of bloody diarrhoea in young children, with a high fatality in complicated and untreated cases. Different species of diarrhoeagenic *E. coli* are also the common causes of watery diarrhoea particularly in children which usually are associated with abdominal cramps, nausea, vomiting and fever. Diarrhoeagenic *E. coli* is also the common cause of traveler's diarrhoea. About 5 to 15% of diarrhoeas in the toddlers may be caused by *Campylobacter jejuni*[3]. The resulting diarrhoea may be watery, but in one-third of cases dysenteric stools with blood and mucus appear after a day or two. Rotavirus is a major cause of gastroenteritis among children. The diseases caused by rotavirus manifests as watery diarrhoea, vomiting, fever, and occasionally abdominal pain. *Cryptosporidium* is a parasite, which is responsible of 5 to 15% of all childhood diarrhoea. It may cause life-threatening diarrhoea in immunocompromised patients. Thus constant surveillance of diarrhoeal pathogens is very essential from a public health point of view to prevent and control diarrhoeal diseases in the community.

Diarrhoeal pathogens has huge correlation with the dynamicity of climate change and environmental factors[6]. Climate variation plays an important role in shaping the patterns of human and other host activities and behaviours. Studying climate change helps to understand what causes the changes. No area on the planet has remained unaffected by climate change. Climate changes include alternations in one or more climate variables including temperature, precipitation, wind, and sunshine, rain fall, humidity etc. Climate change results on human infectious diseases are imposed through impacts on pathogens, hosts/vectors, and disease transmission. Climate change may lead to changes in health threat to human beings, multiplying existing health problems. Hence in the present study is undertaken to find out the impact of climate on diarrhoeal diseases.

The objectives of the study is to compare the climatic characteristics with prevalence rate of diarrhoea and cholerain the Infectious Diseases Hospital, Kolkata where the patients are coming from in and around of the Kolkata and to asses long term changes to develop Time series model as well as statistical models. The climatic factors such as temperature, relative humidity and rainfall will be used for prediction of cholera.

METHODS

Study population and clinical specimens The in-patient (IP) diarrhoeal cases were included in the surveillance system attending at Infectious Diseases Hospital (IDH), Kolkata, India.Stool samples were collected from every fifth patient havingdiarrhoea or dysentery with or without other complaints on two randomly selected days in each week. Diarrhoeal children were included in the surveillance system attendingat Diarrhoea Treatment Unit (DTU) of Dr. B. C. Roy Post Graduate Institute of Pediatric Sciences (BCPGS), Kolkata, Indiabetween 10 AM to 2 PM from Monday to Thursday.

Patients were clinically diagnosed with demographic, socio-economic, medical history and patient management either before or after admission in a pre-deigned pro-forma.Clinical specimens including stools or rectal swabs were aseptically collected using sterile rectal catheter or swab sticks from every fifth diarrhoea patients. For isolation and identification of enteric pathogens including viral, parasitic and bacterial origin, laboratory diagnosis was performed inIndian Council of Medical Research-National Institute of Cholera and Enteric Diseases (ICMR-NICED), Kolkata, India.

DATA ANALYSIS

Typical climatic data was collected from Meteorological Department, Kolkata, India. The climatic data was reviewed and correlated with diarrhoeal diseases for comparative analyses. Statistical calculations were performed using SPSS software. a logistic bi-variant regression was undertaken to ascertain the risk factors of gender, age, income, source of drinking water, practices of storage of drinking water, hand washing, and covered stores of drinking water on the sever /some dehydration of diarrhoea. Final report was communicated through proper channel to the West Bengal State Health Department, India and Kolkata Municipal Corporation, India for further necessary action

RESULTS

In the present study , a systematic sample (i.e. every 5th patient on two randomly selected days per week) of all patients with diarrhoea or dysentery with or without other complaints attending the casualty of IDH, Kolkata were enrolled in this surveillance programme.

A total of 3987 diarrhoeal patients were enrolled in the surveillance system during March, 2016 to March, 2018 from IDH. Of the 1145 patients (male: 51.6%, female: 48.4%), acute diarrhoea was found in 96.3% of the cases and mucoid bloody diarrhoea was noticed in 3.7% of the cases. The 286 patients were children under 5 years of age. Vomiting was the predominant feature. Prior to hospital admission 79.4% patients received medicines, 31.1% received ORS and/or HAF (Home Available Fluid). On admission, dehydration was present in 100% cases. Severe dehydration was present in 9.3%, moderate in 90.6% cases and no in 0.1% cases. Combination of ciprofloxacin and metronidazole was received by 49% of patients. Eighty eight percent of cases were from Rs. 2000 and above income group. Mean duration of hospital stay up to 24 hours is 38.4% of cases. Only few deaths were recorded in this study. A total of 1140 stool samples were examined for the presence of diarrhoeagenic pathogens. Out of 1140 fecal samples, 11.1% of cases were infected with *V. cholerae*. Among those *V. cholerae* 01, *V. cholerae* 0139 and *V. cholerae* non 01, non 0139 were 0% and 3% respectively. Other entero-pathogens are as follows: *Campylobacter* spp. 9.2%, *Shigella* spp. 13.9%, *E. coli* 7.6%, Rota Virus 48.8%, *Cryptosporidium* spp. 12.2%, *Giardia* spp. 17.7% and *Entamoeba histolytica* 2.1%.

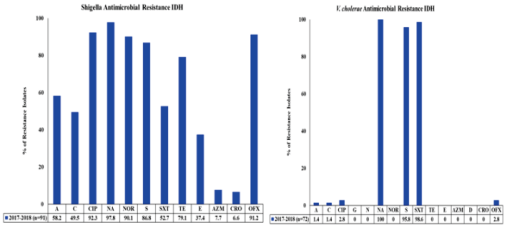
In BCPGS, a total of 9235 patients attended the DTU.Out of total diarrhoea cases, 1605 cases (male:57.3%, female: 42.7%) were included in the study. Majority of cases were presented with no dehydration (52.9%). Moderate and severe dehydration was observed only in 46.8%. and 0.3% cases.

All isolated stains of *V.cholerae* were susceptible to ofloxacin, azithromycin, norfloxacin and gentamicin while *Shigella*isolates were susceptible to only ceftriaxone (Figure1).

The effect of risk factors including gender, age, income, source of drinking water, practices of storage of drinking water, hand washing, and covered stores of drinking water on the sever /some dehydration of diarrhoea were depicted in Table 1 .

Some dehydration was significantly more among the female patients in respect to male patients. Monthly income of the family had no correlation with the dehydration status. The diarrhoea patients in children aged more than five years and less than twelve years had

Figure 1: Antimicrobial resistance profile of Shigella spp. and Vibrio cholerae



significantly some dehydration. The storage of drinking water had no effects on dehydration status. During the analysis of sources of drinking water the study revealed that the patients who used tube well water had significantly more both sever and some dehydration as compare to those used tap water. The patients who had no habit of hand washing suffered significantly from both sever and some dehydration. Moreover, it was observed that some dehydration was significantly more among the patients who used the uncover storage water. In the present study was also observed the correlation of climate (temperature, rain fall and humidity) all factors with the incidence of diarrhoea. The preliminary observation is shown in the figure II, III and IV. The figure: I indicates the number of diarrhoea cases increased when the temperature was ranging 36°C to 42°C during the month of June to the end of August. Hence, it can be undertake that there may be an association between rising of temperature and number of diarrhoea cases. The number of extreme rainfall days were positively correlated with diarrhoea using 3-, 4-, 5 week lag periods. The figure II indicates the prevalence of diarrhoea case was correlated with climate because in the lag period of rainy season number of diarrhoea cases was high whereas less in winter season.The figure III presented the month wise correlation between diarrhoea cases and humidity. It was observed that when humidity was increasing the diarrhoea cases also increasing. It was revealed that the diarrhoea cases had strong positive correlation with the humidity. However in the present study more data for more years are required to draw the final correlation between climate and diarrhoeal diseases.

Table 1: Risk factors for sever/some dehydration in diarrhoea using bi-variate logistic regression

		Assessment (ref: No Dehydration)			
		Severe dehydration		Some dehydration	
		OR (95%CI)		**OR (95%CI)**	**p value**
Sex(ref : Male)	Female	1.34(0.99-1.82)	0.0591	**1.26(1.06-1.50)**	**0.0081**
Age (ref: <5 yrs.)	>=5 - <12 Years	-	-	**11.17(4.05-30.81)**	**<.0001**
	>=12 Years	-	-	-	-
Family monthly Income (ref : <1500)	1500-<5000	-	-	0.26(0.03-2.52)	0.2459
	>=5000	-	-	0.49(0.06-4.21)	0.5160
Source of Drinking Water (ref : Tap)	Tube well	**0.17(0.11-0.26)**	**<.0001**	**0.50(0.42-0.60)**	**<.0001**
	open well	-	-	0.32(0.06-1.57)	0.1583
	Pond				
	Others	0.27(0.06-1.19)	0.0836	**0.43(0.23-0.83)**	**0.0122**
Storage of Drinking Water (ref: No storage)	Earthen pot (narrow mouth)	-	-	0.50(0.04-5.74)	0.5777
	Earthen pot (wide mouth)	0.16(<0.001->999.999)	0.9973	0.10(0.01-1.29)	0.0774
	Bucket	-	-	0.49(0.06-4.21)	0.5167
	others	-	-	0.30(0.03-3.25)	0.3220
Hand Washing habit (Ref: Yes)	No	**0.15(0.09-0.26)**	**<.0001**	**0.28(0.23-0.35)**	**<.0001**
Covered the Storage Drinking Water (ref :Yes)	No	-	-	**0.40(0.23-0.72)**	**0.0023**

Figure 2 Month wise correlation between total diarrhoea cases and temperature

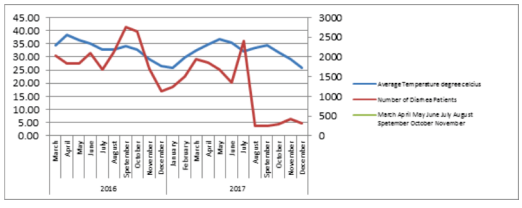


Figure 3 Month wise correlation between total number of diarrhoe a cases and rainfall

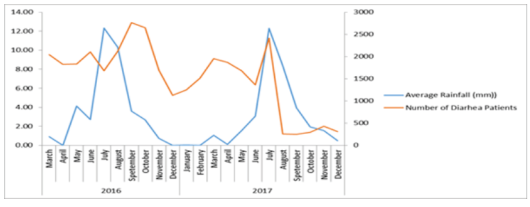
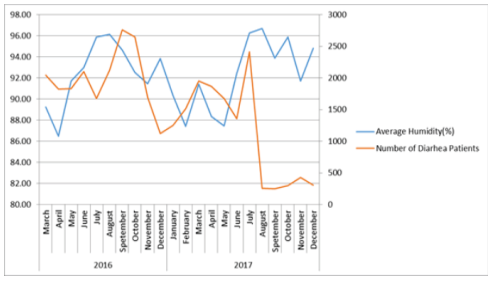


Figure 4: Month wise correlation between diarrhoea cases and humidity



DISCUSSION

Acute diarrhoea cases with moderate dehydration were predominantly noticed among the study patients. *Shigella* spp. isolates (13.9%) susceptible to ceftriaxone only and *V. cholerae* (11.1%) susceptible to ofloxacin, azithromycin, norfloxacin and gentamicin were isolated during the study period as the major bacterial pathogen of diarrhoeal diseases. Similar findings were also reported earlier (2, 3, 7). Children under the age of 5 years affected significantly due to dehydration. The study results showed the increasing occurrences of diarrhoea cases with the gradual rising of temperature, extreme rainy seasons and high humidity. As the study results were based on two years only and change of climate is slow, it would not be justified to correlate the patient outcomes with seasonal variations. Rather further extension of the study for a minimum of up to 10 years would shed light on the climatic factors effecting diarrhoeal diseases.

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