Relationship between seasonal anomalies of meteorological elements and diarrheal diseases in Bangladesh

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Introduction

Infectious diseases (e.g., diarrhea and pneumonia) are still top killers for children in the world. ICDDR,B: Centre for Health and Population Research has the disease surveillance system for major infectious diseases such as diarrhea, pneumonia, tuberculosis, dengue fever and malaria. This system has been integrated into the Health and Demographic System, thus the study can link with various population information including mortality, nutritional status, migration and socioeconomic status for over 40 years. The Centre has initiated health and climate change research and has some publications on diarrheal diseases using remote sensing data on Sea Surface Temperature (SST) and Sea Surface Height (SSH) in Bengal Bay. Although there was a general correlation between patient numbers and SST and SSH, it was difficult to have key elements that can be used for disease prediction modeling.

The research team has made collaborative works with Bangladesh Meteorological Department (BMD) and Bangladesh University of Engineering and Technology (BUET) for fifteen years from 1987 for the prevention and the reduction of various natural disasters in Bangladesh, such as floods, cyclones and severe storms. Through these research processes, we have collected the meteorological data and made nearly complete database of several meteorological elements for the period from 1950 to 2000. It has been well known among meteorologists and climatorogists that these meteorological elements vary in various time scales: decadal, interannual, seasonal, intra-seasonal (10-60days) and synoptic (2-7days). These data can be utilized how these meteorological variations are related to the occurrence of the various epidemic and endemic diseases of public health importance in Bangladesh. The primary objective is to clarify the relationship between epidemic/endemic diseases and weather/climatic conditions in Bangladesh, utilizing the datasets of the number of patient of specific diseases and meteorological elements.

Analysis on diarrheal diseases and meteorological elements

This study explores the data for looking at the correlations between meteorological elements and epidemic diarrheal diseases. Time scales of meteorological elements used were diurnal, intra-seasonal, season inter-annual variations. Meteorological elements available were pressure, wind direction and speed, temperature, relative humidity, cloud amount, precipitation, maximum and minimum temperature and sunshine hours. Medical data used were daily cholera, shigella, typhoid and rotavirus and other diarrheal surveillance data from ICDDR,B Dhaka Hospital(only one diarrhea-specialized hospital in Dhaka City providing free health care services for the impoverished; annual diarrheal cases of 100,000 – 150,000).

Results

There was a general increasing trend in patient number over time (1980-2001; 22 years). The surge of total patient number in cholera epidemic years (1988, 1993.

1998) correspond with the number in the second half year (June – November; rain season). By looking at the anomalies of diarrheal patients, two peaks are found; the first peak is in April-May and the second peak in August-October. There were quite distinguished characteristics found between the first and second peaks. The first peak preceded the start of the rain season and corresponded with the rise in ambient temperatures. By time lag correlation analysis, the first peak lagged by about one month behind the rise in ambient temperature and was related with low temperature in preceding winter. The second peak corresponded with higher overall rainfall especially more with the later half of the rain season.

Conclusion

This study explored the relations with various time-scale meteorological/climatological phenomena; 1) synoptic: daily variability of meteorological elements; 2) intra-seasonal: variations of active (abundant rainfall) and break (scanty rainfall) monsoon phases; 3) seasonal: onset and withdraw of summer monsoon; and 4) inter-annual and decadal climatic change of elements. This study provided the basis to further explore broad spectrum of health-related problems including disease etiology dynamics related with climate change. The first diarrhea peak was related with dry weather, while the second peak was affected by wet weather. Can these phenomenon be explained by herd immunity dynamics in human societies along with etiological agent dynamics in particular environment in particular time and space? How much impact can be expected to have epidemics from human immunity acquisition and loss pattern during wet/dry and hot/cool weather in preceding months? Further studies will be required to conduct more on quantitative evaluation of the impact of meteorological elements on epidemic diseases using multivariate analysis. Future studies ultimately aim to show the usefulness of prediction model for cost-effective interventions and choosing target populations and best timings for such interventions.

Thursday II (Talk)