Selected Summaries

Worms and satellites

Brooker S, Beasley M, Ndinaromtan M, Madjiouroum EM, Baboguel M, Djenguinabe E, Hay SI, Bundy DAP. (Department of Infectious Diseases Epidemiology, Imperial College School of Medicine, London, UK; Hôpital Général de Référence, N'Djamena, Chad; Ministry of Health and Ministry of Education, N'Djamena, Chad; Department of Zoology, University of Oxford, Oxford, UK; International School Health Initiative, Human Development Division, The World Bank, Washington DC, USA.) Use of remote sensing and a geographical information system in a national helminth control programme in Chad. *Bull World Health Organ* 2002;**80:**783–9.

SUMMARY

This article highlights the utility of the geographical information system (GIS) and remote sensing method to determine the target population for helminthic infection. The study was carried out in Chad which has a diverse climatic and population distribution. The objective of the study was to provide rapid feedback to healthcare providers, so that a school-based antihelminthic programme could be developed at the national level. For this purpose, meteorological information on the characteristics of soil, land surface temperature, rainfall, etc. was necessary to predict the distribution of helminths. However, the meteorological infrastructure in Chad was inadequate to provide the relevant spatial data on climatic variation for the whole country. This led to the utilization of remote sensing data for this purpose. Data for 18 years (1982–2000) were collected from the National Oceanic Atmospheric Administration's (NOAA) American satellite. The annual mean, minimum and maximum values of land surface temperature, rainfall and vegetation index were calculated. On the basis of the satellite findings, the entire country was mapped into 7 ecological zones with the help of GIS (computer-based technology for spatial mapping) and a prediction was made of the target population exposed to helminthic infection. This proxy prediction of the distribution of helminths was followed by a field survey to test the validity of the former system.

For the purpose of the field survey, 20 schools were selected from the country on the basis of the proportion of population in each ecological zone. From each school, 25 boys and 25 girls of class III who were 9–10 years of age were randomly selected. In several schools as it was difficult to get the desired number of subjects (particularly girls); students from other classes were also recruited to obtain an adequate sample size. The local school committee and parents approved the study and the students participated voluntarily. Stool and urine samples were collected from each child for the laboratory investigation of helminths. A total of 1023 students were examined of whom 626 were boys and 397 were girls; 1017 provided urine samples and 22.5% were found to have *Schistosoma haematobium* infection. Out of the 1000 students who gave stool samples, 32.7% were found to be infected by hookworms. Both *S. haematobium* and hookworm were present in 7.1% of children. The distribution of *S. haematobium* and hookworm showed a significant relationship with the environmental variables. Among all ecological zones the highest prevalence of *S. haematobium* was found in the area where the mean land surface temperature was maximum and the total rainfall was minimum. The highest prevalence of hookworm infection was associated with low mean land surface temperature and high rainfall. The prevalence of hookworm was lowest or nil with ³47 °C mean land surface temperature. There was a significant positive association of probability of infection by *S. haematobium* in relation to male sex (OR 2.4, $p<0.001$), mean land surface temperature (OR 0.66, $p<0.001$) and rainfall (OR 1.01, $p<0.001$). In contrast, there was an inverse relationship between the probability of getting infected by hookworm and the mean land surface temperature (OR 0.07, $p<0.01$).

COMMENT

The GIS is a rapidly emerging computer-based technology that incorporates graphical features with tabular data to assess the world's problems. Its application in solving public health problems has been encouraged globally, particularly in socioeconomically poor countries with diverse and complex health problems, rapidly growing populations and severe resource constraints.[1,2] Its role has already been studied in the surveillance and control of vector-borne diseases such as malaria and dengue in many countries including India.[3–10] Several other communicable and non-communicable diseases are being studied.[11–15]

As the sample units (schools) in this study were derived on the basis of proportion of population of each ecological zone and the schools were selected randomly from each zone, a selection bias in the study sample may have been taken care of. The statistical tests for significance were appropriately applied and the presentation of the data was simple and easily comprehensible. But it is not clear why a sample of 25 boys and 25 girls was selected from each school.

The present study is particularly important because helminthic infection in children is a public health problem in many developing countries including India. The prediction of GIS showed a variable accuracy for different types of helminths. It accurately predicted that Chad would not have *A. lumbricoides and T. trichiura* infection as these two helminths are unlikely to survive at high temperatures (>37 °C), which was supported by similar findings from the field survey. However, the prediction for *S. haematobium* was less reliable, as the GIS predicted that 9 schools would have an infection rate exceeding 50%, but the field survey detected only one such school. However, no prediction model for hookworm could be developed from this study as there were dissimilarities between the field survey results and previous experimental studies on the development of eggs of this particular species of helminth. This encourages more research on the epidemiology of hookworm in relation to ecological and climatic differentials.

Though the study provides variable reliability on the prediction of helminthic distribution, GIS and remote sensing may have a role in carrying out rapid, valid epidemiological surveys and control of diseases. It is particularly important in remote, inaccessible areas of developing countries where the meteorological and health sector infrastructure is inadequate. It may be helpful to rapidly implement interventions, bypassing time-consuming and costly field surveys.[17]

In India, there is no health programme at the national level for the control of helminths though it is a serious health problem. India has a strong satellite network which is being successfully used in many fields.[16,17] However, it has not been used for public health problems, except to some extent in controlling malaria.[7,8] Hence, this tool could be used more often to conduct studies

which could help in planning the control of various endemic diseases.

REFERENCES

1 Elliot P, Wakefield JC, Best NG, Briggs DJ. *Spatial epidemiology—methods and applications*. Oxford:Oxford University Press; 2001.
2 World Health Organization. GIS and public health mapping. Geneva: WHO; 2003. *www.who.int/entity/csr/mapping/gis*.
3 Beck LR, Rodriguez MH, Dister SW, Rodriguez AD, Rejmankova E, Ulloa A, *et al*. Remote sensing as a landscape epidemiologic tool to identify villages at high risk for malaria transmission. *Am J Trop Med Hyg* 1994;**51**:271–80.
4 Kitron U, Pener H, Costin C, Orshan L, Greenberg Z, Shalom U. Geographic information system in malaria surveillance: Mosquito breeding and imported cases in Israel, 1992. *Am J Trop Med Hyg* 1994;**50:**550–6.
5 Ribeiro JM, Seulu F, Abose T, Kidane G, Teklehaimanot A. Temporal and spatial distribution of anopheline mosquitos in an Ethiopian village: Implications for malaria control strategies. *Bull World Health Organ* 1996;**74:**299–305.
6 Booman M, Durrheim DN, La Grange K, Martin C, Mabuza AM, Zitha A, *et al*. Using a geographical information system to plan a malaria control programme in South Africa. *Bull World Health Organ* 2000;**78:**1438–44.
7 Srivastava A, Nagpal BN, Saxena R, Eapen A, Ravindran KJ, Subbarao SK, *et al*. GIS based malaria information management system for urban malaria scheme in India. *Comput Methods Programs Biomed* 2003;**71:**63–75.
8 Srivastava A, Nagpal BN, Saxena R, Sharma VP. Geographic information system as a tool to study malaria receptivity in Nadiad Taluka, Kheda district, Gujarat, India. *Southeast Asian J Trop Med Public Health* 1999;**30:**650–6.
9 Bergquist NR. Vector-borne parasitic diseases: New trends in data collection and risk assessment. *Acta Trop* 2001;**79:**13–20.
10 Hay SI, Tucker CJ, Rogers DJ, Packer MJ. Remotely sensed surrogates of meteorological data for the study of distribution and abundance of the arthropod vectors of disease. *Ann Trop Med Parasitol* 1996;**90:**1–19.
11 Glass GE, Schwartz BS, Morgan JM III, Johnson DT, Noy PM, Israel E. Environmental risk factors for Lyme disease identified with geographic information systems. *Am J Public Health* 1995;**85:**944–8.
12 Bentham G, Hinton J, Haynes R, Lovett A, Bestwick C. Factors affecting non-response to cervical cytology screening in Norfolk, England. *Soc Sci Med* 1995;**40:**131–5.
13 Braddock M, Lapidus G, Cromley E, Cromley R, Burke G, Banco L. Using a geographic information system to understand child pedestrian injury. *Am J Public Health* 1994;**84:**1158–61.
14 Wilkinson D, Tanser FC. GIS/GPS to document increased access to community-based treatment for tuberculosis in Africa: Geographic information system/global positioning system. *Lancet* 1999; **354:**394–5.
15 Amat-Roze JM. Geographic inequalities in HIV infection and AIDS in sub-saharan Africa. *Soc Sci Med* 1993;**36:**1247–56.
16 *Annual Report 1988–89*. Department of Space, Government of India; 1989.
17 Chandrashekhar MG , Radhakrishana K, Jayaraman V, Manikiam B, Honne Gowda H. *Achievements in remote sensing application in India*. Bangalore:Indian Space Research Organization; 1994.

T. K. RAY
Department of Community Medicine
Maulana Azad Medical College
New Delhi
tapasr60@hotmail.com