Understanding the problem of diabetes in India using geographical information system software

Sir,

As problem of diabetes is a major one, researches on diabetes are becoming a priority.[1] Like other researches, commonly the statistical software packages alone are being relied upon for summarizing, analyzing and presenting the data or results, but Geographical Information System (GIS) is catching pace for its tendency to analyze data a spatially (data/attribute Table) as well as spatially (geo-referenced vector or raster data) and plot them graphically in terms of maps (for example disease maps). A GIS is a system of capturing, storing, checking, integrating, manipulating, analyzing and displaying data, which are spatially referenced to the earth.[2] It consists of hardware, software, data and the respective applications. GIS in spite of being a potential technology, is hardly used by the medical researchers. We decided to write this letter with a view to sensitize diabetes researchers and others, to the need of introducing and utilizing GIS while summarizing and analyzing data and presenting the results. To further clarify and exemplify the utility of GIS, we mapped the diabetes burden in various states of India using an open-source GIS software quantum GIS (version 1.8.0).[3] The output maps are shown as Figures 1 and 2. With the help of the GIS software, the States were classified on the basis of diabetes prevalence separately among men and women, into four categories with equal class intervals i.e., red (high prevalence), orange (moderately high prevalence), yellow (low prevalence) and green (lowest prevalence). It can be easily made out that diabetes prevalence is high (shown red) in southern region/states among males and females both. Based on such finding, the hypotheses may be formulated and the regions can be further compared pair-wise and analyzed using statistical tests to see, which differences were statistically significant. These figures were first log transformed and then compared using unpaired t-test. The differences in prevalence of diabetes, which were found significant after such comparisons, were the following:

1. Between northern and southern regions among males ($P = 0.028$),
2. Between central and southern regions among males ($P = 0.018$) and
3. Between central and southern regions among females (significant at 0.1 significance level; $P = 0.083$).

Similarly, this finding can in turn be analyzed along with the mapping of various risk factors for diabetes and thence tested statistically for any significant difference, which might give rise to new etiological hypotheses, thereby helping the authorities to institute appropriate prevention and control measures. However, due to limited availability of relevant data and as the objective of this letter was merely to sensitize the researchers, analysis was not extended to etiological hypotheses formulation and testing. Many sophisticated GIS software's come with spatial statistical toolbox license and there could be freely available plugins for open-source software or one can customize based on the study. GIS can also be used to classify a district or state, where a separate diabetes prevalence study is conducted, into a pre-specified category of diabetes prevalence based on the prior broader classification pertaining to larger geographical area i.e., at the level of state or country.[4] Although analyzing/interpreting the results in such cases, it must also be kept in mind that when pre-collected data are used, it is often difficult to get information about the quality and the methods used for generation of data. Thus, disease mapping presented can help in the following ways:

1. Identification: It can help in identifying the priority areas of risk and help in immediate decision making
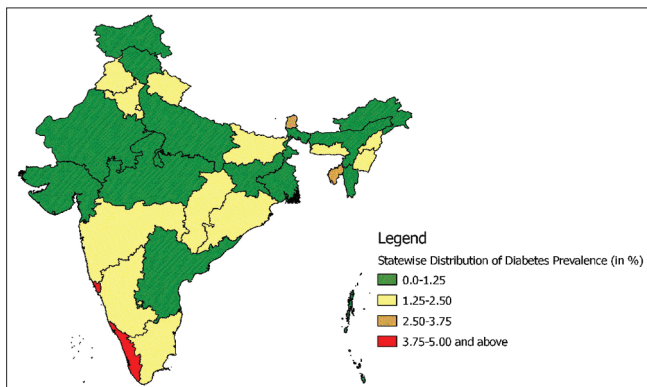

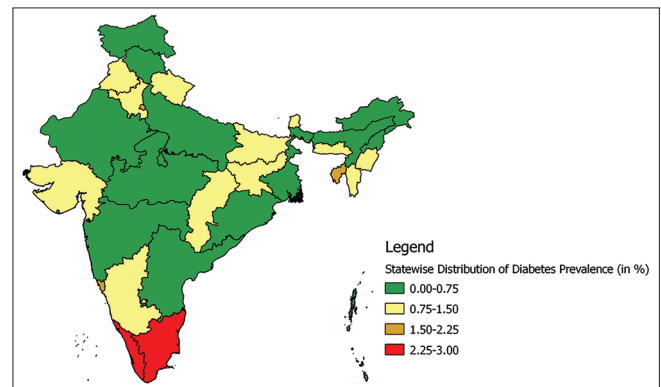**Figure 1:** Diabetes prevalence in India among males

Figure 2: Diabetes prevalence in India among females

2. Ecological or etiological hypothesis formulation and testing: Based on the region and geographical/environmental factors/incidents, one can deduce the cause of the distribution, which can be further proven with statistical tests.

Conclusively, GIS and its software could be of great utility in diabetes research in that it supplements and helps in better spatial data analyses and interpretations as discussed above.

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Arun Kumar, Anjali Grover[1]

Department of Community Medicine, Shaheed Hasan Khan Mewati Government Medical College Nalhar, Mewat, Haryana, [1]Department of Geographical Information System and Remote Sensing, RMS India, Noida, Uttar Pradesh, India

Corresponding Author: Dr. Arun Kumar, Department of Community Medicine, Shaheed Hasan Khan Mewati Government Medical College Nalhar, Mewat, Haryana, India. E-mail: arun.pgims@gmail.com

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