Possible Effects of Geomagnetic Fluctuations on Road Accidents

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The daily road accidents recorded in Ahmedabad city for four years (1972-75) are found to increase with increase in the daily $K$-sum values (measure of activity in the geomagnetic field). The correlation coefficient is found to be 0.677 ± 0.172. Analysis of data for individual years shows increasing trend in road accidents with increase in daily geomagnetic activity for the years 1975 and 1974. For the year 1973, it is almost a flat line, while for 1972 it seems to be slightly decreasing with the increase in daily $K$-sum values.

1. Introduction

Effect of space environment on human beings has become a field of recent interest. Scientists from different parts of the world have reported some results in this field. However, the poor statistics available so far do not make it possible to draw any definite conclusion about it. Being a worldwide phenomenon, it is essential that more effort is made in this direction.

One aspect of this kind of study is to find out the effect of abnormal changes in the geomagnetic field (daily $K$-sum values) on road traffic accidents. A person driving a vehicle on a road is likely to meet with an accident if his mind is disturbed in some way. Sudden changes in the geomagnetic field are electromagnetic disturbances. Working of the human brain is also based on electrical phenomena. Thus electromagnetic changes all over the space around earth may have some minute effect on the human brain.

A comparison of the daily road accident data for Ahmedabad city and the daily $K$-sum values (geomagnetic activity) has been made for the period 1972-75, and the results are discussed in this paper.

2. Collection of Data

In order to study the effect of sudden changes in the geomagnetic field on human beings, the following methods are possible.

(i) One method is to collect the data from the old record of previous years. This method has the advantage that it is less time consuming but the disadvantage is that the data may be in a form which is not very suitable for this kind of study.

(ii) In the second method, cooperation may be obtained from the Police Department to collect the data in a form suitable for the study as well as special attention may be given to data collection whenever there is a prediction of magnetic storm. This process is time consuming but has an advantage that the data may be available in the form in which we need it. For example, one would like to exclude those accident cases where there were mechanical failures of vehicles or where the drivers were drunk, etc., because in such cases accidents are generally beyond human control.

In the present work the first method has been adopted, though attempts are being made to set up guide-lines to collect the data by the second method also.

Data on daily road accidents which occurred in Ahmedabad city for the years 1972, 1973, 1974, and 1975 were obtained from the Police Commissioner's Office, Ahmedabad. Since there is no magnetic observatory in Ahmedabad, the daily $K$-sum values for the years 1972, 1973 and 1974 were obtained from the National Geophysical Research Institute, Hyderabad, which is one of the nearest places to Ahmedabad where there is a magnetic observatory and from where data are available. For the year 1975, the daily $K_p$-sum values were used as the Hyderabad $K$-sum values for that year were not readily available.

3. Method of Analysis

The number of accidents taking place daily in Ahmedabad city was written in a tabular form starting from 1 Jan. 1972 to 31 Dec. 1975. The corresponding daily $K$-sum values were also written. All the days for zero accidents were separated out and the average of the corresponding $K$-sum values was found out. Similar procedure was followed for the days when only 1 accident occurred or 2 accidents occurred, etc. Now these average $K$-sum values were plotted against the number of accidents. The error in each point was calculated using the standard deviation formula.
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\[ \sigma = \left[ \frac{1}{n} \sum_{i=1}^{n} (y_i - y)^2 \right]^{1/2} \]  

where \( n \) is the total number of observations. The points were found to lie on a straight line and the equation of the straight line was obtained using the least square fit method. The correlation coefficient was found out using the formula

\[ \gamma = \frac{XY}{(XX)(YY)^{1/2}} \]

where \( X = x - \bar{x} \) and \( Y = y - \bar{y} \), \( \bar{x} \) and \( \bar{y} \) being the average of \( x \) and \( y \) values, respectively.

4. Results and Discussion

Fig. 1 shows the plot of \( K \)-sum values versus daily road accidents which occurred in Ahmedabad city in the year 1974. Fig. 2 shows the plot of \( K \)-sum values versus daily road accidents for the four years

![Figure 1](image1)

![Figure 2](image2)

![Figure 3](image3)

![Figure 4](image4)

1972, 1973, 1974 and 1975, all combined. Daily \( K \)-sum values were used for the year 1975 as the \( K \)-sum values were not available. To show that the use of \( K_p \) instead of \( K \) does not change the trend of this line, the data for the year 1974 was also analyzed using \( K_p \)-sum values. Table 1 shows the slope, intercept and correlation coefficient of the plot for 1974 with both \( K \)-sum and \( K_p \)-sum values. Table 2 shows the slope, intercept and correlation coefficient for the years 1975, 1974, 1973 and 1972 separately and then for all these years combined together to improve the
Table 1—Extrapolated Values of Correlation Coefficient etc. from the Plot for 1974

<table>
<thead>
<tr>
<th>K or Kp</th>
<th>Slope</th>
<th>Intercept on Y-axis</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>0.436 ± 0.109</td>
<td>18.05 ± 0.673</td>
<td>0.785 ± 0.115</td>
</tr>
<tr>
<td>Kp</td>
<td>0.562 ± 0.212</td>
<td>21.92 ± 1.263</td>
<td>0.605 ± 0.191</td>
</tr>
</tbody>
</table>

Table 2—Extrapolated Values of Correlation Coefficient etc. from the Plot in Fig. 2

<table>
<thead>
<tr>
<th>Year (Kp)</th>
<th>Slope</th>
<th>Intercept on Y-axis</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>0.398 ± 0.194</td>
<td>18.07 ± 1.043</td>
<td>0.565 ± 0.215</td>
</tr>
<tr>
<td>1974</td>
<td>0.436 ± 0.109</td>
<td>18.05 ± 0.673</td>
<td>0.785 ± 0.115</td>
</tr>
<tr>
<td>1973</td>
<td>−0.098 ± 0.051</td>
<td>18.13 ± 0.250</td>
<td>−0.247</td>
</tr>
<tr>
<td>1972</td>
<td>−0.440 ± 0.217</td>
<td>16.1 ± 1.074</td>
<td>−0.533</td>
</tr>
<tr>
<td>1972-75</td>
<td>0.312 ± 0.019</td>
<td>16.973 ± 0.333</td>
<td>0.677 ± 0.172</td>
</tr>
</tbody>
</table>

Similar results were obtained by Bhaskara Rao and Srivastava1 when the road accident data of Hyderabad were analyzed by them for the years 1965, 1966, 1967 and 1968, though their slope of 2.6 is much higher than those found in the present work. This could be ascribed to higher sunspot numbers for 1965-68 (maximum sunspot years) with greater geomagnetic activity than for 1972-75 (low sunspot years). On the other hand the work of Lipa et al.2 fails to find any correlation between sudden changes in the geomagnetic field and average mortality due to coronary heart disease (which is likely to be affected by electromagnetic phenomena) in USA.

The analysis presented in this paper suggests a possible correlation between road accidents and sudden changes in the geomagnetic field (magnetic storms). More definite conclusions can be drawn if similar studies on road accidents and hospital admissions of heart cases versus geomagnetic activity are carried out for other cities in India. Investigations with improved statistics are also desirable.

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References