



Statistical Relation Of Accidental Death With Geomagnetic Activity Parameters And Cosmic Ray Intensity During 1990-2010

¹Dr. Preetam Singh Gour, ²Dr. Shiva Soni & ³Dr. Arun Kumar

^{1,2}Jaipur National University, Jaipur (Rajasthan) India

³Raj Kumar Inter College Naraini, Banda, U.P. India

Email- singhpreetamsingh@gmail.com

Abstract

We have studied the statistical relation between deaths due to traffic accident in India and geomagnetic activity parameters: K_p , Dst indices and yearly average of cosmic ray intensity, during the period of 1990-2010. It is seen that rate of death by traffic accident are well correlated with these parameters. We have found large negative correlation with correlation coefficient of -0.84 between rate of death by traffic accident and K_p index. Large positive correlation with correlation coefficient 0.79 between rate of death by traffic accident and Dst index. Further a positive correlation with correlation coefficient of 0.69 between rate of death by traffic accident and yearly average of cosmic ray intensity was also found.

Keywords: Cosmic ray intensity, K_p index, Dst index, Traffic accident death.

Introduction

Solar activity (SA), geomagnetic activity (GMA) and cosmic ray activity (CRA), respectively are major constituents of space weather that affects our daily life navigation (Ptitsyna et al., 1996) as well as human health in space and in the Earth (Breus, 2003). Over the last years, many studies have been carried out concerning the possible effect that solar and geomagnetic activity might have on human physiological state (Stoupel, 2002; Dorman et al., 2001; Cornelissen et al., 2002; Dimitrova et al., 2004). Cosmic ray intensity (CRI) and GMA variations can influence not only the performance and reliability of space-borne or ground-based technological systems, but also human life (Cornelissen et al., 2002; Dzvonik et al., 2006; Stoupel et al., 2007). These results refer not only to the possible influence of GMA disturbances on the human cardiovascular state through variations of physiological parameters such as heart rate (HR) and arterial diastolic and systolic blood pressure (Dimitrova et al., 2009), but also on the central and vegetative

nervous system through changes of the human brain's functional state and the psycho - emotional state (Babayev et al., 2006). Some studies revealed that the most significant effects on myocardial infarctions, brain strokes, and traffic accidents were observed on the days of geomagnetic field disturbances accompanied with Forbush decreases (FDs) (Zhadin, 2001; Ptitsyna et al., 1998) and especially during the declining phase of FD (Villoresi et al., 1994; Dorman, 2005). At the same time, it was shown that very low GMA could also adversely affect human cardio-vascular system (Stoupel et al., 2004, 2005, 2007; Stoupel, 2006) and that is why it is suggested that the role of environmental physical factors becoming more active in low GMA, like CR (neutron) activity, should be an object of further studies (Stoupel, 2006). In the last decades, many scientists have worked on the impact of space weather parameters, through the geomagnetic field, on different diseases (Dorman et al., 2001; Stoupel, 2002; Gmitrov and Ohkubo, 2002; Gmitrov and Gmitrova, 2004; Dimitrova et

al., 2004). It has been revealed that cardiovascular, circulatory, nervous and other functional systems react under changes of geophysical factors (Kay, 1994; Watanabe et al., 1994; Persinger and Richards, 1995; Gurfinkel et al., 1995; Cornelissen et al., 2002). It has long been claimed that geomagnetic storms and other electromagnetic variations are associated with changes in the incidence of various diseases, myocardial infarctions and strokes (Halberg et al., 2000). Some evidence has also been accumulated on the association between geomagnetic disturbances and increases in work and traffic accidents (Stoupel et al., 2004; Ptitsyna et al., 1996; Dorman, 2005). Others have also been reported on the association between geomagnetic disturbances and increases in number of road traffic and work (industrial) accidents (Stoupel et al., 2004; Srivastava and Saxena, 1980; Ptitsyna et al., 1996; Babayev et al., 2006). These studies were based on the hypothesis that a significant part of traffic accidents could be caused by the incorrect or retarded reaction of drivers to the traffic circumstances, the capability to react correctly being influenced by the changes in the environmental physical activity, particularly, sharp fluctuations of GMF. Some evidence has been reported on the association between geomagnetic disturbances and increases in work and traffic accidents (Ptitsyna et al., 1998). Reiter (Stoupel et al., 2004) found that work and traffic accidents in Germany were associated with disturbances in atmospheric electricity and in the geomagnetic field (defined by sudden perturbations in radio-wave propagation). On the basis of 25 reaction tests, it was found also that the human reaction time, during these disturbed periods, was considerably retarded. On the basis of huge statistical data on several millions of medical events in Moscow and in St. Petersburg, there were found sufficient influence of geomagnetic storms accompanied with Cosmic Ray (CR) Forbush-decreases on the frequency of myocardial infarctions, brain strokes and car accident road traumas (Villoresi et al., 1994). The most remarkable and statistically significant effects have been

observed during days of geomagnetic perturbations defined by the days of the declining phase of Forbush decreases in CR intensity. During these days the average numbers of traffic accidents increase by (17.4±3.1%) (Dorman, 2005). Some studies show correlations between high SA and GMA and increased number of traffic accidents (Stoupel et al., 2004). In the present investigation, an attempt has been made to get possible relationship between geomagnetic and cosmic ray activities with rate of traffic accident death in India. For this study, rate of traffic accident death, geomagnetic and cosmic ray activity parameters for the period of 1990-2010 has been used.

Data Sources

In this study, we have to take the rate of male and female death by traffic accident in India, yearly average of cosmic ray intensity, geomagnetic activity parameter Kp and Dst indices for the period 1990-2010. The data of traffic accident has been taken from the National Crime Records Bureau (NCRB) 2010 records, ministry of home affairs of India. The data of cosmic ray intensity yearly average count rates of Oulu super neutron monitor has been used. The data of geomagnetic activity parameters has been taken from Omni web data system (Table 1).

Data Analysis and Results

In this study, statistical method of correlation has been used. The correlation is one of the most commonly used statistical method. A correlation is a single number that describes the degree of relationship between two variables. Correlation coefficient, symbolized as r, is a numerical summary of a bivariate relationship and can range from -1.00 to +1.00. Any r that is positive indicates a direct or positive relationship between two measured variables. Negative r indicates indirect or inverse relationship. The formula for the correlation is:

$$r = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{[N \sum X^2 - (\sum X)^2] [N \sum Y^2 - (\sum Y)^2]}}$$

Where

N= Number of pairs of scores, $\sum XY$ = Sum of the products of paired scores, $\sum X$ = Sum of x scores, $\sum Y$ = Sum of y scores, $\sum X^2$ =

Sum of squared scores, $\sum Y^2 =$ Sum of squared scores

The scale of correlation coefficient is:

- ❖ 0.8 to 1.0 or -0.8 to -1.0 (very large relationship)
- ❖ 0.6 to 0.8 or -0.6 to -0.8 (large relationship)

- ❖ 0.4 to 0.6 or -0.4 to -0.6 (good medium relationship)
- ❖ 0.2 to 0.4 or 0.2 to -0.4 (weak relationship)
- ❖ to 0.2 or 0.0 to -0.2 (weak or no relationship)

Table 1. Yearly average of geomagnetic activity parameter, cosmic ray intensity and rate of traffic accident during period of 1990-2010.

S.No.	Year	Kp Index	Dst Index	Average of cosmic ray intensity	Death Rate
1.	1990	775.42	-638	5416	21.1
2.	1991	918.5	-932.83	5432	22.1
3.	1992	787.5	-617.75	5922	22.5
4.	1993	723.1	-501.42	6203	21.8
5.	1994	822.67	-629.92	6280	21.2
6.	1995	657.92	-511.67	6387	24.3
7.	1996	578.1	-331.92	6503	23.6
8.	1997	496.42	-440.42	6545	24.5
9.	1998	613.67	-518.67	6399	26.6
10.	1999	665.25	-398.17	6203	27.6
11.	2000	718.42	-581.33	5784	25.5
12.	2001	637.42	-539.75	5889	26.4
13.	2002	686.33	-638.67	5806	24.8
14.	2003	870.33	-527.25	5759	24.3
15.	2004	663.33	-372.58	6093	25.5
16.	2005	643.25	-480.17	6156	26.7
17.	2006	490.58	-353.1	6478	28.1
18.	2007	460.83	-250.1	6632	30
19.	2008	444.1	-239.58	6662	29.7
20.	2009	274.17	-337	6804	30.5
21.	2010	382	-186.92	6623	32.4

- Large negative correlation with correlation coefficient, - 0.84 between rate of death by accident and Kp indices.
- Large positive correlation with correlation coefficient, 0.79 rate of death by traffic accident and Dst indices.
- Positive correlation with correlation coefficient, 0.69 has been found between rate of death by traffic accident and yearly average of cosmic ray counts rate.

Conclusion

The long term study confirms results of number of previous observations on links between timing of human death and environmental physical factors (Gmitrov and Ohkubo, 2002, Gmitrov and Gmitrova, 2004; Stoupel, 2002, 1999; Stoupel et al., 2004, 2005, 2007). This

study also shows that there is strong relationship between death by traffic accident and geomagnetic activity, parameters (Kp index, Dst index) and cosmic ray activity. The significant correlation with correlation coefficient of - 0.84 and 0.79 between yearly average of Kp and Dst index and rate of death by traffic accident shown in Figures 1 & 2 and 0.69, between yearly average of cosmic ray count rate and death by traffic accident shown in Figure 3; confirms the relationship of geomagnetic activity parameter, cosmic ray activity and rate of death by traffic accident.

Although, there are several factors of traffic accident like medical-biological; social; sleeping while driving, etc; as well as terrestrial weather changes – meteorological conditions. Nevertheless, alongside with aforementioned medical-

biological, meteorological, social and other affecting factors, disturbances and variations in space weather (geophysical and cosmic ray activity) can also play a significant role in traffic accidents as a trigger factor, increasing the risk of traffic accidents.

In this study, the phenomena with geomagnetic and cosmic ray activity in relation to India and obtained significant correlation. For general picture of the phenomena, further study is needed for different latitude and longitude.

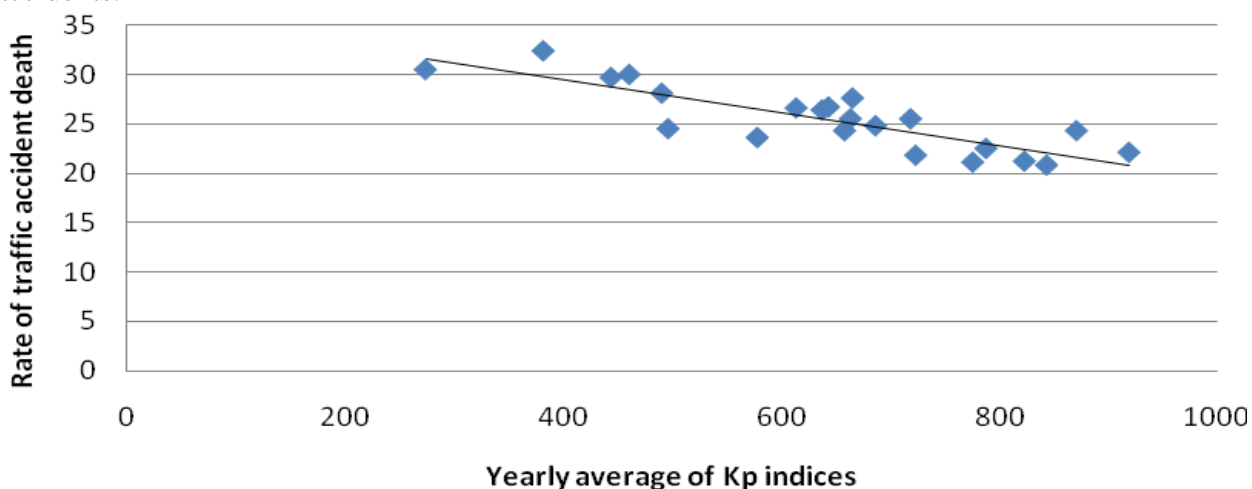


Figure 1. Scatter plot between yearly average of Kp indices and rate of death by traffic accident during period of 1990-2010 showing negative correlation with correlation coefficient -0.84.

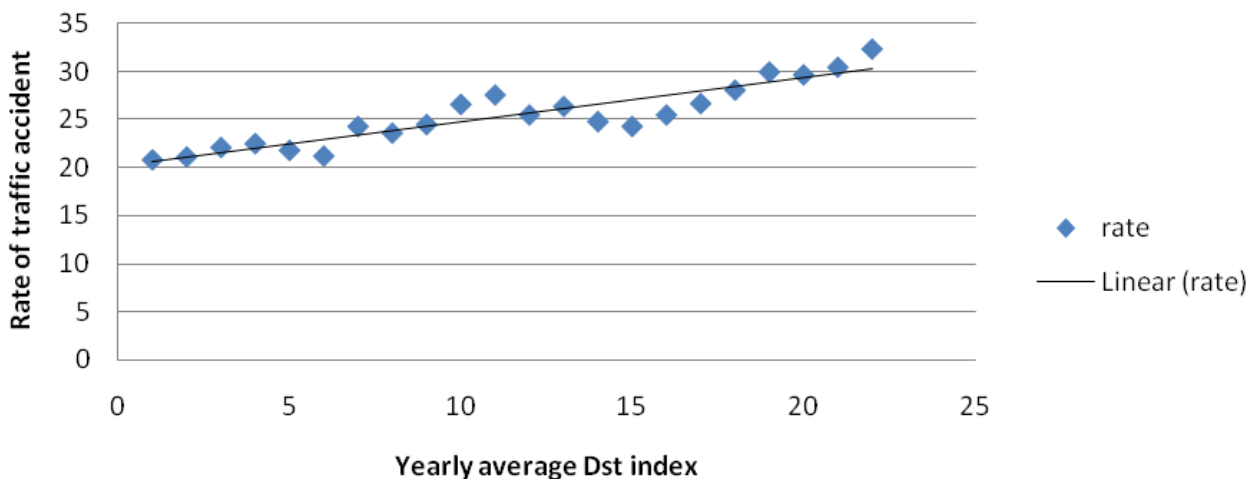


Figure 2. Scatter plot between yearly average of Dst indices and rate of death by traffic accident during period of 1990-2010 showing positive correlation with correlation coefficient .079.

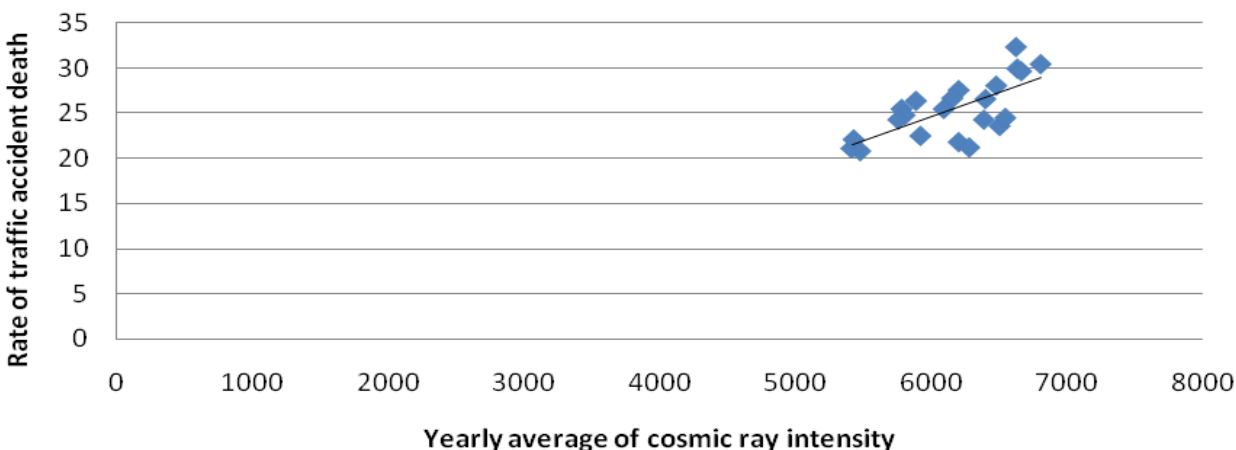


Figure 3. Scatter plot between yearly average of cosmic ray count rate and rate of death by traffic accident during period of 1990-2010 showing positive correlation with correlation coefficient 0.69.

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