Solar Coronal Index in Relation with Suicide Incidents in United State and Northern Ireland (1997 to 2008)

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Abstract

We have studied the relationship between deaths due to suicide incident in United State and Northern Ireland with solar coronal index (CI) observed during the period of 1997 to 2008. The data shows that the number of deaths due to suicide and suicide rate (Death due to suicide per 100000) in United State and male, female, total death in Northern Ireland is well correlated with the yearly mean of coronal index (CI). We have calculated a medium good negative correlation, with correlation coefficients of -0.46, -052, between yearly total number of male deaths, yearly total number of deaths (male female) in Northern Ireland and yearly mean of solar coronal index (CI) and large negative correlation with correlation coefficient -0.62 between total number of female death in Northern Ireland and yearly mean of solar coronal index (CI). Further we have determined very large negative correlation, with a correlation coefficient of -0.74 between yearly total number of death due suicide in United State and yearly mean of solar coronal index and -0.80 between yearly rates (Death per 100000) of deaths due to suicide in United State and yearly mean of solar coronal index. Further it is seen that rate of suicidal death in United State and total yearly death in Northern Ireland is positively correlated with yearly average of cosmic ray intensity .Large positive correlation with correlation coefficient 0.74 has been obtained between rate of suicidal death in United State and yearly average of cosmic ray intensity and medium good correlation with correlation coefficient 0.52 between yearly total death due to suicide and in Northern Ireland and yearly average of cosmic ray intensity .

Key words - Suicide Incidents in United State, Suicidal Incidents in Northern Ireland, Solar Coronal Index.

Introduction

The technological and biological systems, including human beings, are exposed to the influence of so called space weather (P.Song, H. J.et al 2001) and are very sensitive to solar and geomagnetic activity and to changes in these activities and their manifestations on the Earth (F.Jansen,et al 2000, I.

A. Daglis et al 2001a). It is well known that the Sun as a main driver of the space weather is overwhelmingly important to life on the Earth, but most of us have not been given a proper description of solar activity variations and their negative influences on living beings. Space weather changes undoubtedly affect the geosphere, our physical environment, which in turn, influences human health and all-kind of activities of human beings (T.K.Breus, 2002, T.K.Breus 2003, B.M.Vladimirskii, et al 2004). Thus there is need to be continued and intensified for research works on these effects, to address health and safety, as well as to study societal economical impacts and to verify the existence of possible influence of space weather on biological systems. The idea that spots on the sun or solar flares might influence human health on earth at first appears to lack scientific credibility. However, when significant correlations between hospital admissions and health registers and Solar-Geomagnetic Activity (S-GMA) are found, then the challenge is to conceive of and to document a scientifically plausible and observationally supported mechanism and model. The idea that variations on the Sun and in the Earth's magnetic field can affect human health has global implications, and this field of research becomes increasingly important and study in a new field of research clinical cosmobilogy. Heliobiological is the branch of science that deals with the impact of solar activity and related effects on living organisms (Palmer et al. 2006; Babayev and Allahverdiyeva 2007). Heliobiological studies have shown that living beings, including humans, have the ability to adapt to normal variations of GMA (Dimitrova 2008a). but, any deviations from this normal level, either extremely high or extremely low fluctuations in the GMA, will undoubtedly have an effect on the brain, the cardio-vascular, nervous and other biological systems of living organisms (Palmer et al. 2006; Babayev and Allahverdiyeva 2007; Stoupel et al. 2007a). Several scientists have studied solar interplanetary and geomagnetic effects on human health (Kay, 1994; Watanabe et al., 1994; Persinger and Richards, 1995; Zhadin, 2001; Cornelissen et al., 2002 ; Ptitsyna et al., 1996; Dorman, 2005 ,Dimitrova, 2006, Dimitrova S,et 2009, Mavromichalaki H,2008, Mavromichalaki H,2012 , Cornelissen G,et al 2011, Kasatkina EA, et 2014, Nishimura T, et al 2014) and have obtained close relations between heliophysical parameters and human physiological state .Verma (2012) has tried to establish the relationship between death due to suicide in India and various Solar Activity (SA) parameters; i.e. Sunspot Numbers (SSN), Solar Flare Index (SFI), Coronal Index (CI) and Cosmic Ray Intensity (CRI) observed during the period of 1989 to 2011 and concluded that the number of Suicide Incidents of male, female, is well correlated with yearly averages of the SSN, SFI, and CI; as well as being positively correlated with CRI. Verma (2013) has also analyzed the data of Suicide Incidents in India, geomagnetic activity parameters, such as the planetary Ap, Kp, and Dst Indices for the period of 1989-2010, and found large negative correlations between Suicide Incidents and the yearly averages of geomagnetic activity parameters: the Kp,

Ap, and Dst indices. Kancírová and and Kudela (2014) have studied the Suicide incidents in Slovakia and concluded that changes in solar radiation and geomagnetic activities may contribute to the frequency and the seasonal pattern of suicides.

P. L. Verma (2014) studied suicide incidents in Northern Ireland 1986-2010 with solar interplanetary geomagnetic activity parameters and determined number of deaths due to suicide of males and females is well correlated with the yearly mean of Sunspot Numbers (SSN), Solar Flare Index (SFI), Sudden Storm Commencements (SSC), and geomagnetic activity parameter Ap, and Kp Indices. He has determined large negative correlation, with correlation coefficients of -0.71, -0.64, between yearly total number of deaths due to suicide and the geomagnetic activity parameters Kp, Ap, index -0.709, -0.635 between the yearly total number of male deaths due to suicide and the geomagnetic activity parameters Kp, Ap, index ,-0.56, -0.50, between the yearly total number of female deaths due to suicide and the geomagnetic activity parameters Kp, Ap, index -0.43,-0.42, between yearly total number of deaths due to suicide and the yearly mean of the SSN and SFI , -0.38 and -0.33, between yearly total number of female deaths due to suicide and the SSN, SFI, -0.41 and -0.41 . P.L.Verma (2014) has also studied the relationship between death due to suicide incident in United Sate and various Solar, Interplanetary and Geomagnetic Activity parameters, such as Sunspot Numbers (SSN), Solar Flare Index (SFI), Sudden Storm Commencements (SSC), and geomagnetic activity Ap, and Kp Indices observed during the period of 1997 to 2010 and concluded that the number of deaths due to suicide and suicide rate (Death due to suicide per 100000) are anti correlated with the yearly mean of Sunspot Numbers (SSN), Solar Flare Index (SFI), Sudden Storm Commencements (SSC), and geomagnetic activity parameter Ap, and Kp Indices and large negative correlations has been obtained between solar interplanetary, geomagnetic activity parameters and death due to suicide incidents. In the present investigation an attempt has been made to get possible relationship between solar coronal index and death due to suicide in United State and Northern Ireland during the period of 1997- 2008.

2. Data Sources

Solar Activity (SA) parameters, coronal Index (CI), are taken from STP Solar Data (http://www.ngdc.noaa.gov/stp/solardataservices). The data of Suicide Incidents in Northern Ireland has been taken from the Northern Ireland statistics and research agency available at www.nisra.gov.uk.The data of Suicide Incidents in United State has been taken from the Idaho Vital statics Suicide Report for the period of 197-2010 (htp:/www.healthandwelfare.idaho.gov/Portals/0/Users/074/54/1354/Suicide%20Report%202013.pdf). For the data of CRI, yearly average count rates of Oulu

super neutron monitor has been used.

Table-Suicidal Death in United State, Northern Ireland and Solar Coronal Index for the period of 1997-2008.

YEAR	Yearly mean of Coronal Index (CI)	Yearly Average of Cosmic ray Intensity	Yearly Total Suicidal death in US	Suicidal Death Rate (death per 100000)US	Total Male Suicidal Death in Northern Ireland (NI)	Total Female Suicidal Death in Northern Ireland (NI)	Total Suicidal Death in Northern Ireland (NI)
1997	3.08	6545	30,535	11.2	108	30	138
1998	6.35	6399	30575	11.1	113	37	150
1999	8.93	6203	29199	10.5	127	27	154
2000	9.74	5784	29350	10.4	140	45	185
2001	10.53	5889	30622	10.7	132	26	158
2002	10.14	5806	31655	11	142	41	183
2003	6.21	5759	31484	10.8	112	32	144
2004	6.4	6093	32439	11	105	41	146
2005	4.64	6156	32637	10.9	167	46	213
2006	4.54	6478	33300	11	227	64	291
2007	2.11	6632	34598	11.3	175	67	242
2008	1.6	6662	36035	11.6	218	64	282

3. Methods of Analysis

In this study a statistical method correlation has been used. A correlation is a single number that describes the degree of relationship between two variables. The 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:

$$r = \frac{N\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right]\left[N\sum Y^2 - \left(\sum Y\right)^2\right]}}$$,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 score
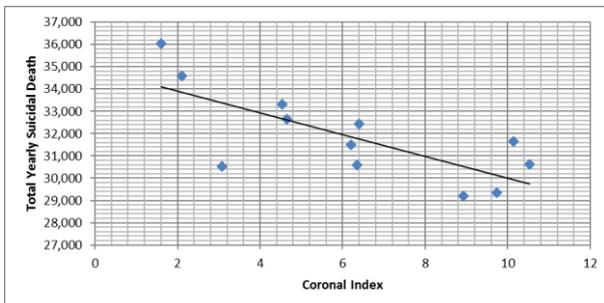
The scale of correlation coefficient is

.8 to 1.0   or -.8 to -1.0 (very large relationship)

.6 to .8 or -.6 to-.8 (large relationship)

.4 to .6 or -.4 to -.6 (good medium relationship)

.2 to .4 or .2 to -.4(weak relationship)

.0 to .2or .0to -.2 (weak or no relationship)

Data Analysis

From the data analysis of Table and Figure 1, it is observed that the rate of suicidal death (Death per 100000) in   United State is anticorrlated with yearly mean of solar coronal index (CI). Around solar maximum, in the year 2000,2001   the yearly mean of the solar coronal index are maximum and are 9.74,10.53 but the rate of suicidal death have been found comparatively low 10.4,10.7 and about solar minimum, in the years   1997 and, 2007,2008, the yearly mean of solar coronal index are low, 3.08, 2.11,1.6 but the rate of suicidal death around these years have been found comparatively higher than solar maximum (2000,2001), in 1997 rate of suicidal death is 11.2 in the year 2007   rate of suicidal death is 11.3 in the year 2008, rate of suicidal death is11.6   but at solar maximum in year 2000,2001 the rate of suicidal death is 10.4,10.7 which are comparatively low in comparison to the years around solar minimum (1997,2007,2008,) . To know the statistical behavior of yearly total suicidal death with yearly mean of solar coronal index (CI) a scatter plot has been plotted between these two events and the scatter plot so obtained is shown in Figure 2. The trend line of the scatter plot shows very large negative correlation between yearly total suicidal death and yearly mean of coronal index (CI). Statistically calculated correlation coefficient has been determined -0.74   between these two events. Large negative correlation with correlation coefficient -0.80 has also been found between yearly mean of coronal index and rate of suicidal death (Death per 100000) by statistical method.
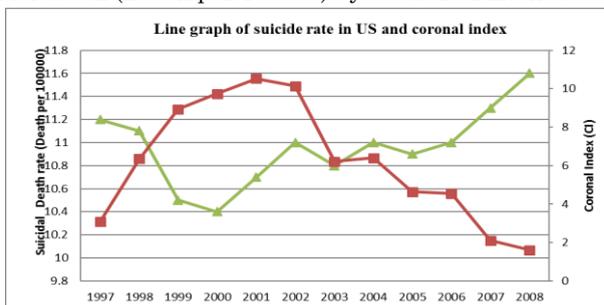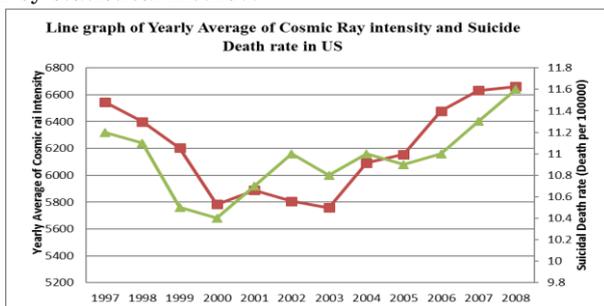
Figure-1-Shows line graph of yearly mean of Solar Coronal Index (CI) and Suicidal Death Rate in United State during the period of 1997-2008 showing anti co-relation between yearly rates of suicidal death and yearly mean of coronal index.
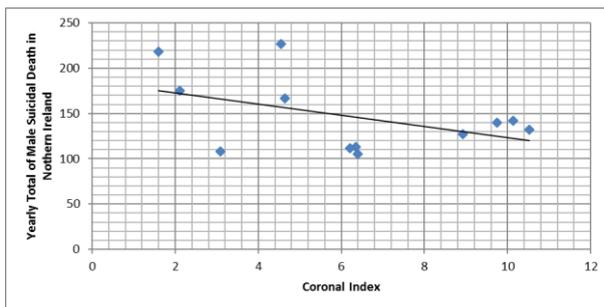

Figure-2- Shows scatter plot between yearly mean of coronal index and yearly total suicidal death in United State showing large negative correlation with correlation coefficient -0.74.

From the data analysis of Table and Figure 3, it is observed that the rate of suicidal death (Death per 100000) in   United State is positively with   yearly average of cosmic ray intensity. Around solar maximum, in the year 2000, the yearly average of the cosmic ray intensity and the rate of suicidal death have been found comparatively   low 5784,10.4, and about solar minimum, in the years   1997 and, 2007,2008, the yearly   average of cosmic ray intensity and rate of suicidal death have been found comparatively higher than solar maximum (2000,), in 1997 the   yearly average of cosmic ray intensity and rate of suicidal death is   6545,11.2 in the year 2007 the   yearly average of cosmic ray intensity and rate of suicidal death is 6632,11.3 in the year 2008, the   yearly average of   cosmic ray intensity and rate of suicidal death is 6662,11.6   but at solar maximum in year 2000, the yearly average of cosmic ray intensity and rate of suicidal death is 5784 10.4, which is comparatively low in comparison to the years around solar minimum (1997,2007,2008,) . Positive correlation with correlation coefficient 0.74 and 0.57 has been found between yearly average of cosmic ray intensity and suicidal death rate, total yearly death by statistical method.

Figure-3-Shows line graph of yearly average of cosmic ray intensity (CRI) and suicidal death rate in United State during the period of 1997-2008, showing positive correlation between yearly rates of suicidal death and yearly average of cosmic ray intensity.

From the data analysis of yearly total male suicidal death, and yearly mean of coronal index mentioned in Table and crucial examination of Figure 4, it is observed that yearly total male suicidal death is negatively correlated with yearly mean of coronal index. We have calculated negative correlation with a correlation coefficient of -0.46, between yearly total male suicidal death and the yearly mean of coronal index.

Figure-4-Scatter plot between yearly mean of solar coronal index and yearly total male suicidal death in Northern Ireland during the period of 1997-2008, showing negative correlation with correlation coefficient -0.46
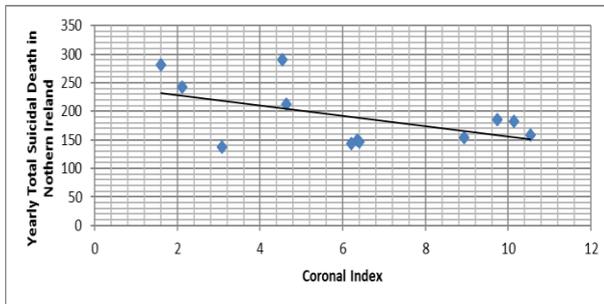
From the data analysis of yearly total female suicidal death, and yearly mean of coronal index mentioned in Table and crucial examination of Figure 5 it is observed that yearly total female suicidal death is negatively correlated with yearly mean of coronal index. We have calculated large negative correlation with a correlation coefficient of -0.62, between yearly total female suicidal death and the yearly mean of coronal index.
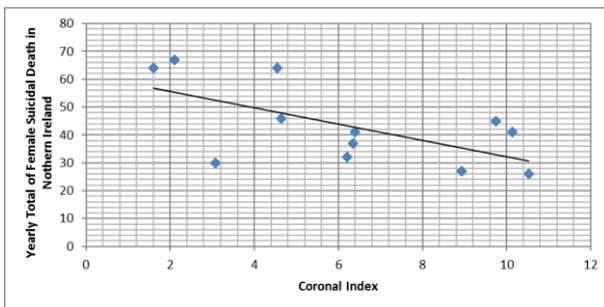
Figure-5-Scatter plot between yearly mean of solar coronal index and yearly total Female Suicidal Death in Northern Ireland during the period of 1997-2008, showing negative correlation with correlation coefficient -0.62.

From the data analysis yearly total suicidal death, and yearly mean of coronal index mentioned in Table and observation of Figure 6, it is observed that

yearly total suicidal death is negatively correlated with yearly mean of coronal index. We have calculated negative correlation with a correlation coefficient of -0.52, between yearly total suicidal Death and the yearly mean of coronal index.

Figure-6-Scatter plot between yearly mean of solar coronal index and yearly total Suicidal Death in Northern Ireland during the period of 1997-2008, showing negative correlation with correlation coefficient -0.52

From the data analysis yearly total suicidal death, and yearly average of cosmic ray intensity, it is observed that yearly total suicidal death is positively correlated with yearly average of cosmic ray intensity. We have calculated positive correlation with a correlation coefficient of 0.52 between yearly total suicidal death and the yearly average of cosmic ray intensity.
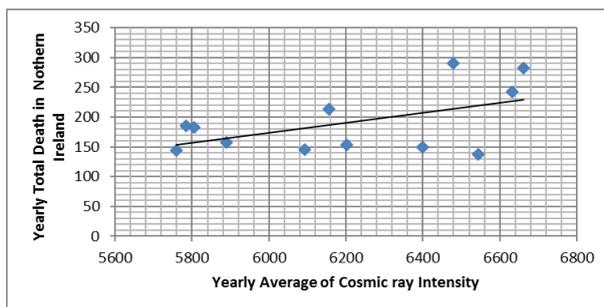
Figure-7-Scatter plot between yearly average of cosmic ray intensity and yearly total Suicidal Death in Northern Ireland during the period of 1997-2008, showing positive correlation with correlation coefficient 0.52

5- Main Results

(a) - Large negative correlation, with a correlation coefficient of -0.80, has been found between the yearly mean of solar coronal index and the yearly rate (Death per 100000) of deaths due to suicide in United State .

(b) - Large negative correlation, with a correlation coefficient of -0.74, has been found between the yearly mean of solar coronal index and the yearly total number of deaths due to suicide in United State .

(c) - Negative correlation, with a correlation coefficient of -0.46, has been found between the yearly mean of solar coronal index and the yearly total number of male deaths due to suicide in Northern Ireland .

(d) - Large negative correlation, with a correlation coefficient of -0.62, has been found between the yearly mean of solar coronal index and the yearly total number of female deaths due to suicide in Northern Ireland .

(e) - Negative correlation, with a correlation coefficient of -0.52, has been found between the yearly mean of solar coronal index and the yearly total number of deaths due to suicide in Northern Ireland .

(f) (f)-Large positive correlation with correlation coefficient 0.74 has been obtained between rate of suicidal death in United State and yearly average of cosmic ray intensity.

(g) (g)-Medium good positive correlation with correlation coefficient 0.52 has been determined between yearly total death due to suicide and in Northern Ireland and yearly average of cosmic ray intensity.

Conclusions

In this investigation I have tried to connect solar coronal index with rate of suicidal death, total yearly suicidal death in United State and male, female total suicidal death in Northern Ireland for the period of 1997-2008 and obtained very strong correlations between these parameters which show close connection between the solar coronal index and suicidal death. In my previous studies (Verma 2012, 2013, 2014) an attempt has been made get possible relation between solar interplanetary and geomagnetic activity parameters and suicidal death of some countries and obtained very close connection between these parameters .From these results it is concluded there is strong relations between solar and geophysical phenomena. Some scientists have tried to explain such kind of human activity by S-GMA model. It is expected that particular changes in the ambient electromagnetic and acoustical signals caused by heliogeophysical factors could promote the exacerbation of mental state and act as a trigger for launching of the suicidal-terroristic behavior. It is important to conduct long-period, detailed investigation of solar geomagnetic and interplanetary effects on human beings in different latitudinal and longitudinal areas in order to get more and better knowledge about solar interplanetary and geomagnetic activities and their possible effects on different parameters of human health state

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