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Research Article

PROTECTIVE EFFECTS OF OZONE AND UV-B FLUX ON CARDIOVASCULAR DISEASES

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ABSTRACT
Human race and its relation with sun are known from ancient times. The controlled and efficient uses of sunlight exposure have enormous use in day to day life and medical sciences. In recent past natural and anthropogenic activities have changed the scenario of optimality. The tremendous increase of green house gases affects globally the surface temperature of the earth and chemically active species have changed the concentration of Ozone in the atmosphere. The exposure of UV-B radiation after the threshold can cause many diseases like skin cancer and eye damage. But its controlled exposure of UV-B radiation can prevent a number of very common and often fatal heart diseases breast cancers, colon cancer, prostate, ovarian cancer and multiple sclerosis etc. Hypertension is the most important risk factor in cardiovascular disease. In this paper an attempt has been made to correlate the erythemal flux concentration with the spreading of cardiovascular diseases. The disease is affected more locally with the living and climatic conditions of the region or area. Erythemal Climatic Index (ECI) has been generated with the help of erythemal flux concentration, temperature, of sun exposure and humidity, Wind and the health status (in terms of LDL or HDL) among adults (20-50 years). In the preliminary stage, this methodology is tried for Meerut City (28.5 ^{0}N, 77.0^0 E). It has been observed that, during peak summer (Moist or Humid) or winter (Chill) the frequency of heat stroke is more with the age groups (45-50) followed by 40-45, 35-40, 30-35, 30-25 and 25-20. ECI and erythemal flux both shows increasing trend for summer (March –May) and winter (December to February) seasons for the year 2007 & 2008. Other months of the years shows increasing or decreasing trend of ECI and erythemal flux.

Keywords: *Cholesterol, HDL, LDL, ECI and Coronary Heart Disease*

INTRODUCTION
Meerut (28.5 ^{0}N, 77.0^0 E) is an ancient metropolitan city in the Indian state of Uttar Pradesh (U.P). It is a part of National Capital Region of India (http://ncrup.up.nic.in & http://www.delhiline.com/ncr). Meerut is the 63rd fastest growing urban area in the world (http://www. citymayors.com/statistics). OMI is onboard the NASA Earth Observing System (EOS) Aura spacecraft is a nadir-viewing spectrometer that measures solar reflected and backscattered light in a selected range of the ultraviolet and visible spectrum Ultraviolet radiation is at shorter wavelengths than the visible spectrum (400 to 700 nm) and is divided into three components: UV-A (315 to 400 nm), UV-B (280 to 315 nm) and UV-C (less than 280 nm). The shorter wavelengths that comprise UV-B are the most dangerous portion of UV radiation that can reach ground level. Atmospheric ozone shields life at the surface from most of the UV-B and almost all of the UV-C. UV-A and UV-B are reduced by a small amount from Rayleigh scattering in the atmosphere. Various authors (Kerr, 2003; McKinlay and Differey, 1987; Meleti and Cappellani, 2000) studied about the UV radiation and solar irradiances.

MATERIALS AND METHODS
Data and Methodology
Erythemal Climatic Index (ECI) relation used in the present work is given below
ECI= a + b Temperature (deg C)+ c R.H. (%) + d (wind in m/sec) + e (sun shine duration hours) + f (erythemal flux in J/m2) + e (medical diagnosis constant)

Where, a to f are constants.
a = -12.5
b= 0.1
c = 0.2
d= 0.3
e = 0.01
f = 0.005
e = 0.25

RESULTS AND DISCUSSION

The level of Cholesterol in the blood is the physiological measurement of hypertension (Gordon *et al.*, 1977). In the presence of UV –B radiation the Cholesterol molecule is converted into Vitamin D (Kerr, 2003), which is useful for the body and hence increases the excretion of blood sodium through urine. The rate and ranking of the coronary diseases is different for different countries (Table 2) as per the World Health Organization, 2011 report (WHO, 2011).

Table 2: Coronary heart disease Death rate in per 100,000 (WHO 2011)

1	Turkmenistan	405.1	65	Saint Vincent	132.5	129	Colombia	85.8
2	Ukraine	399.8	66	Chad	132.2	130	Antigua/Bar.	85.7
3	Kyrgyzstan	349.4	67	Central Africa	132.2	131	Sri Lanka	84.5
4	Belarus	348.1	68	Cameroon	131.8	132	St. Kitts	82.5
5	Kazakhstan	346.5	69	Uganda	130.9	133	Singapore	82.4
6	Moldova	335.3	70	Equ. Guinea	129.7	134	Brazil	81.2
7	Afghanistan	328.6	71	Cambodia	128.8	135	United States	80.5
8	Uzbekistan	323.2	72	Angola	128.1	136	Qatar	80.1
9	Russia	296.7	73	Dominican Rep	127.8	137	China	79.7
10	Georgia	285.9	74	Namibia	127.7	138	Ireland	79.2
11	Armenia	248.5	75	Congo	127.6	139	Cook Islands	79.1
12	Yemen	238.5	76	Rep Of Congo	125.9	140	Paraguay	77.6
13	Marshall Isl.	237.7	77	Tunisia	124.3	141	Cyprus	77.4
14	Lithuania	233.7	78	Poland	122.4	142	Grenada	76.7
15	Azerbaijan	232.9	79	Philippines	121.6	143	New Zealand	76.5
16	Djibouti	232.3	80	Nigeria	121.6	144	Mongolia	75.7
17	Pakistan	222.9	81	Burundi	121.0	145	Algeria	75.2
18	Bhutan	221.7	82	Burkina Faso	120.3	146	Germany	75.0
19	Latvia	220.8	83	Ghana	120.1	147	Sao Tome	74.2
20	Somalia	219.1	84	Benin	119.3	148	Costa Rica	74.0
21	Slovakia	217.7	85	Mauritius	118.4	149	Dominica	72.8
22	Iraq	214.1	86	Lesotho	118.3	150	Austria	72.7
23	Tajikistan	213.7	87	Tanzania	117.6	151	South Africa	71.0
24	Sudan	212.0	88	Comoros	115.1	152	Sweden	71.0
25	Bangladesh	203.7	89	Liberia	113.8	153	Uruguay	70.9
26	Libya	199.3	90	Sierra Leone	113.7	154	Argentina	70.6
27	Iran	194.5	91	North Korea	113.2	155	United Kingdom	68.8
28	Laos	194.3	92	Samoa	113.1	156	Bahrain	68.8
29	New Guinea	186.0	93	Viet Nam	112.5	157	Cape Verde	68.7
30	Nauru	184.1	94	Vanuatu	111.4	158	Iceland	68.1

31	Oman	181.9	95	Cuba	111.3	159	Canada	66.2
32	Saudi Arabia	180.6	96	Jamaica	110.7	160	Belize	63.5
33	Egypt	174.0	97	Micronesia	110.3	161	Panama	62.4
34	Estonia	173.3	98	Kuwait	109.6	162	Australia	60.3
35	Hungary	169.0	99	Gambia	108.5	163	Greece	60.3
36	Morocco	168.0	100	Mali	108.5	164	Slovenia	60.0
37	India	165.8	101	Mauritania	108.2	165	Guatemala	58.9
38	Syria	165.3	102	Venezuela	107.3	166	Belgium	58.0
39	Myanmar	164.7	103	Togo	107.2	167	Norway	57.2
40	Lebanon	164.4	104	Rwanda	106.9	168	Denmark	55.9
41	Tuvalu	163.2	105	Serbia/Monten	105.1	169	Haiti	55.5
42	Jordan	162.5	106	Gabon	104.8	170	Barbados	55.4
43	Malawi	157.9	107	Tonga	101.7	171	Brunei	54.3
44	Turkey	157.1	108	Kenya	101.2	172	Luxembourg	53.6
45	Romania	155.0	109	Palau	101.0	173	Saint Lucia	53.2
46	Albania	154.1	110	Madagascar	100.9	174	San Marino	52.9
47	Nepal	152.6	111	Niue	100.6	175	Switzerland	52.2
48	Honduras	152.4	112	Niger	100.4	176	Italy	51.7
49	Bulgaria	151.4	113	Eritrea	99.6	177	Chile	51.5
50	Guyana	151.4	114	Macedonia	98.1	178	Maldives	50.9
51	Indonesia	150.8	115	Solomon Isl.	97.9	179	Seychelles	50.3
52	Cote d Ivoire	148.8	116	Senegal	97.3	180	Bahamas	46.9
53	Trinidad/Tob.	145.7	117	Malta	96.3	181	Israel	46.4
54	Czech Republic	144.0	118	Bosnia/Herzeg	96.1	182	Andorra	45.4
55	Zambia	141.3	119	Nicaragua	95.3	183	Peru	45.0
56	Fiji	140.2	120	Arab Emirates	94.5	184	Portugal	43.8
57	Malaysia	138.7	121	Finland	93.8	185	Spain	43.5
58	Timor-Leste	137.8	122	Bolivia	93.5	186	Ecuador	39.9
59	Mozambique	137.7	123	Botswana	93.4	187	Netherlands	39.8
60	Guinea	136.9	124	Zimbabwe	90.0	188	Monaco	37.4
61	Swaziland	136.7	125	Suriname	88.8	189	South Korea	34.7
62	Guinea-Bissau	136.5	126	El Salvador	88.6	190	Japan	31.2
63	Croatia	133.6	127	Mexico	87.7	191	France	29.2
64	Ethiopia	133.1	128	Thailand	87.1	192	Kiribati	11.8
Rank	Country	Rate	Rank	Country	Rate	Rank	Country	Rate

Data Source: WHO 2011
http://www.worldlifeexpectancy.com/cause-of-death/coronary-heart-disease/by-country/

The possible cause can be the variation of low density lipoprotein (LDL) or high density lipoprotein (HDL). LDL is found to be positively correlated while HDL is negatively correlated with the cardiovascular diseases.

The variation of UV-B radiation flux remotely can be monitored by Ozone Monitoring Instrument (OMI) onboard the NASA Earth Observing System (EOS) Aura spacecraft. The OMI UV-B algorithm inherits from the Total Ozone Mapping Spectrometer (TOMS) UV algorithm. OMI measurements of ozone, aerosols and clouds are used as inputs to the algorithm. The values of UVI derived from OMI data are shown in the Figures (1,2). Most of the UVI values lies between 4 to 10 (Figure 1) with standard

deviation 0f 2 -4 units. This exposure depends on the concentration of ozone and its variation. The weather will affect the humans in different ways at different season. The humidity, sunshine and winds are different throughout the year. The adaptability of the persons is also varying depending on the age, sex and time. The level of Cholesterol, of low density lipoprotein (LDL) or high density lipoprotein (HDL) is varying for normal and patient. These values differ after and before the medication also. Thus, ECI is normally providing a basic idea of the weather impact on skin and heart related issues. After regular observation of few samples of healthy and unhealthy persons of different age group it is seen that ECI higher value (> 315) is sensitive for skins and low value (< 285) is sensitive for heart related diseases. The yearly variation is shown in the figure 4. Erythemal exposure sensitivity of Meerut City for the year 2007-2008 is shown in the figure 3. It is seen that higher values are observed during summer months (March to May). The Cholesterol chart for female of different age groups of Meerut City is given in Table 1. The ratio of cholesterol /HDL lies between 3 to 7. It is very difficult to identify the health status of the person before and after the medication by seeing the cholesterol /HDL ratio. There are various factors that affect the cholesterol level of the persons like diet, weight exercise, age, gender, heredity, medical conditions and medications etc. Seasonal and irregular fluctuation of the cholesterol level may be the cause of hypertension and coronary heat diseases. In general, stress at various levels (student, old age etc) will affect the health and will be the cause of coronary heart diseases. Hence, the biologic factors which influence the level of cholesterol are of even greater diversity and importance. The changes in UV light affect vitamin D and parathyroid hormone status and UV light intensity are influenced by seasonal change and latitude, these disparate observations suggest an association between blood pressure and ultraviolet light. UV light intensity and efficiency of epidermal vitamin D_3photosynthesis may contribute to geographic and racial variability in blood pressure and the prevalence of hypertension. Mean systolic and diastolic pressures and the prevalence of hypertension vary widely throughout the world. BP is higher and the occurrence of hypertension greater in more industrialized or Westernized regions (20% to 30%), whereas the opposite is found in the least industrialized regions (0% to 15%).

Table 1: Cholesterol chart Female of Meerut City

			Cholesterol chart for females only		
S_no	**Age group**	**Frequency**	**Cholesterol**	**Hdl**	**Ch/hdl ratio**
1	Below 20	1	150	53	2.8
2	20-25	3	158	42	3.73
3	25-30	6	166.33	41	4.21
4	30-35	10	178.4	44	4.17
5	35-40	14	173.28	40	4.47
6	40-45	20	165.95	40	4.31
7	45-50	27	188.74	44	7.2
8	50-55	32	187.39	42	4.75
9	55-60	21	197.57	41	4.92
10	ABOVE 60	42	177.92	44	4.29

Blood test is called a lipoprotein profile. That includes:

- Total cholesterol level
- LDL (the "bad" cholesterol)
- HDL (the "good" cholesterol)
- Triglycerides

Total Cholesterol	**Category**
Less than 200	Desirable
200 - 239	Borderline High
240 and above	High
LDL Cholesterol	**LDL Cholesterol Category**
Less than 100	Optimal
100 - 129	Near optimal
130 - 159	Borderline high
160 - 189	High
190 and above	Very high

HDL*	**HDL Cholesterol Category**
60 or more	Desirable - helps to lower risk of heart disease
Less than 40	Major risk factor - increases the risk for developing heart disease

**HDL (good) cholesterol protects against heart disease, so for HDL, higher numbers are better.*
Source: http://www.webmd.com/cholesterol-management/guide/lower-cholesterol-risk?page=2

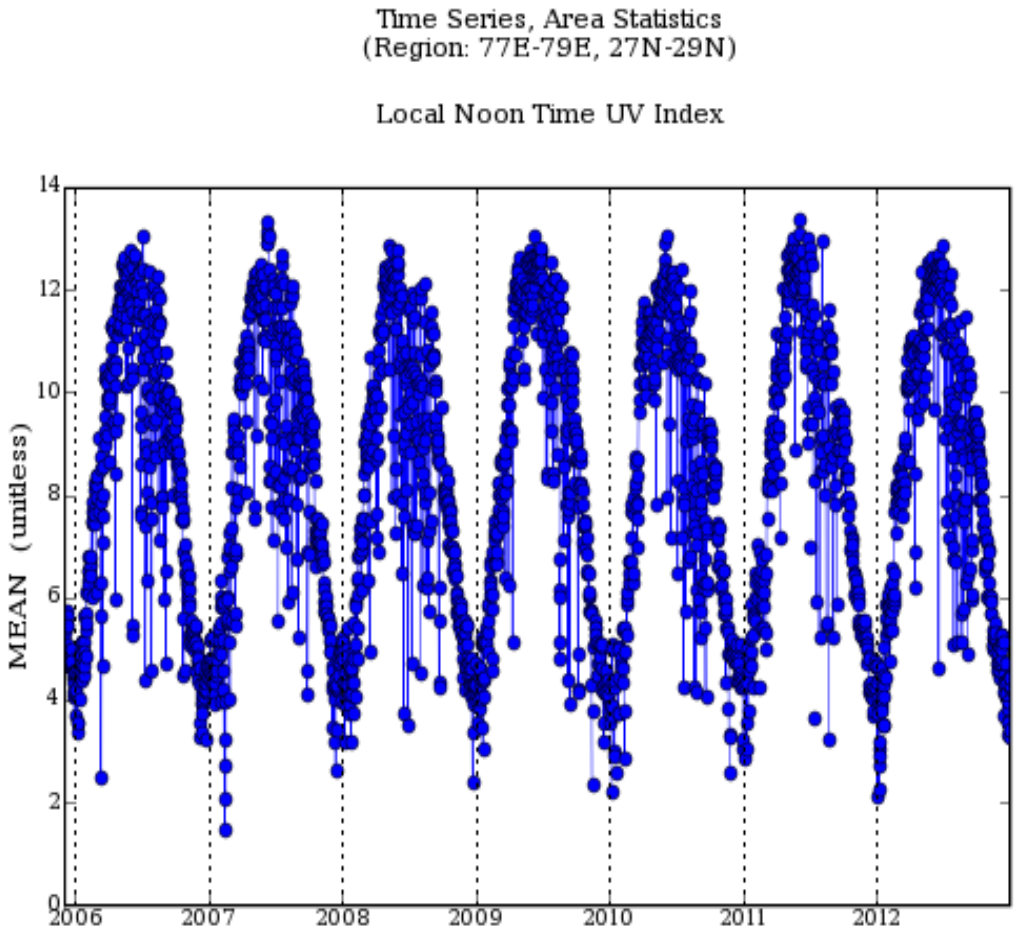

Figure 1: Ultraviolet Index (UVI) from Ozone monitoring Instrument (OMI) of Meerut (2006-2012) from OMI

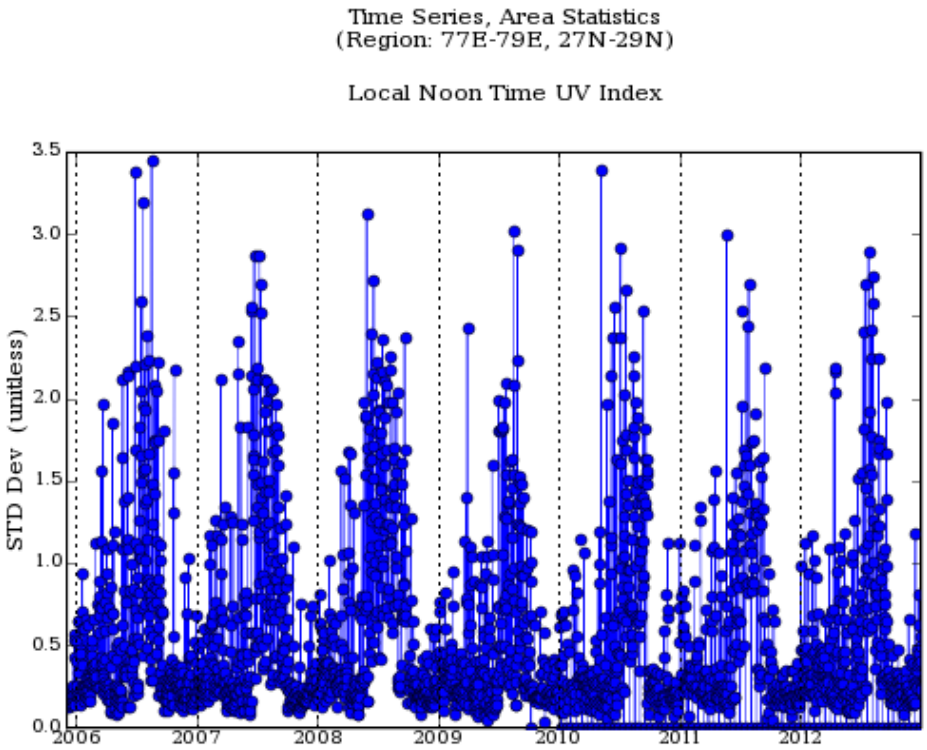

Figure 2: Standard deviation (STD) of Ultraviolet Index (UVI) from Ozone monitoring Instrument (OMI) of Meerut (2006-2012) from OMI

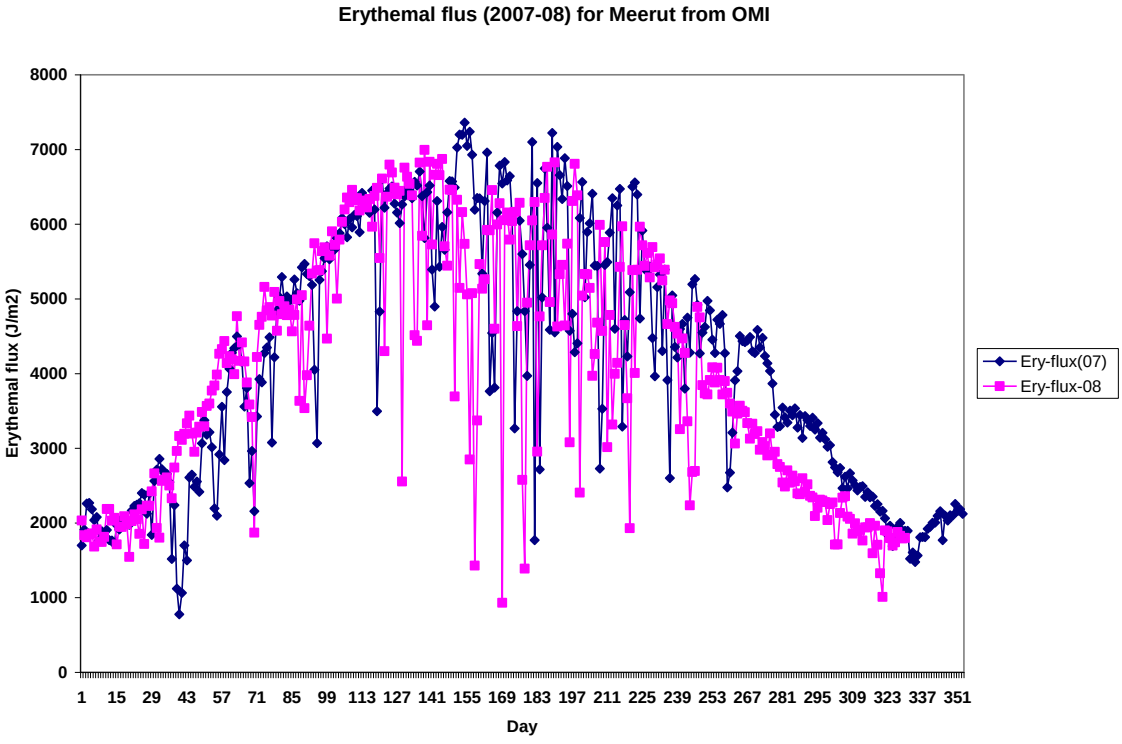

Figure 3: Erythemal flux (J/m2) of Meerut (2007-08) from OMI

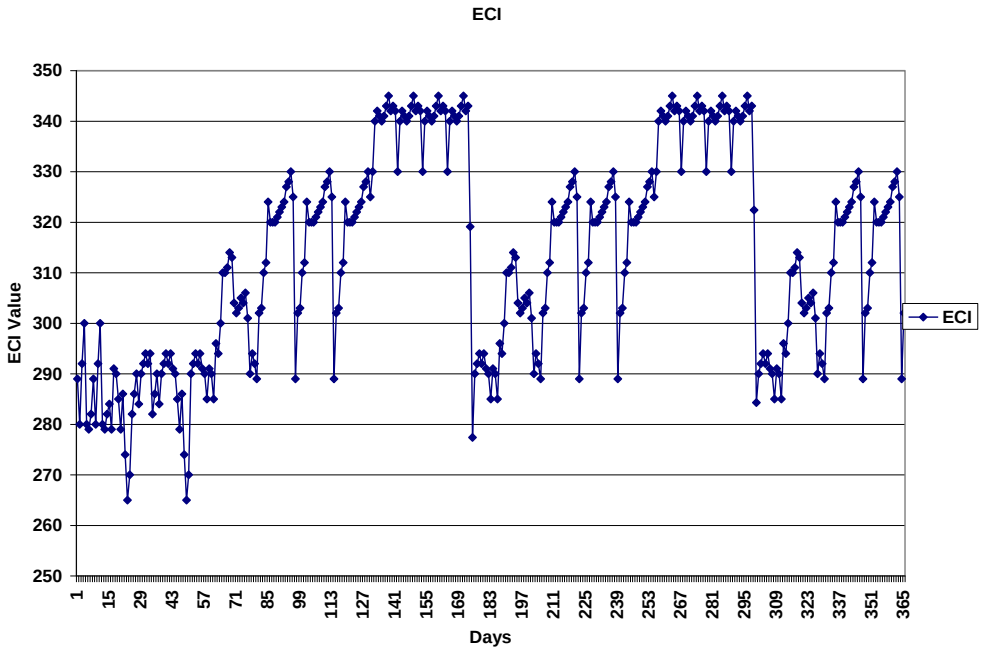

Figure 4: ECI values for Meerut City

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