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Mortality during summer season in the Raipur and Durg district of Chhattisgarh

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ABSTRACT

Climate change is a serious and urgent issue. The global mean temperature of the earth is rising; it has risen by 0.7 oC in the 20th century, and continues on an upward trend. The extreme heat and humidity associated with mortality for the cities of the developed world. In this report is access the effect of ambient heat on all-cause mortality on the population of Raipur and Durg district of Chhattisgarh. The retrospective analysis was performed for the summer months (April-June) for the period 2012-2015.

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I. INTRODUCTION

Climate change is recognized as a considerable man-made global environmental challenge. It is also treated as a hazard. International efforts to address climate change began with the adoption of the United Nations Framework Convention on Climate Change in 1992. The importance and significance of the susceptibility of natural and human systems to climatic changes and adaptation to such changes is increasingly being realized. Thus, there is now a growing recognition of the susceptibility and the impacts of climate change on the key sectors of economic development [1]. Climate change is the variation in global or regional climates over time. It reflects changes in the variability or average state of the atmosphere over time scales ranging from decades to millions of years. These changes can be caused by processes internal to the Earth, external forces (e.g. Variations in sunlight intensity) or, more recently, human activities. In recent usage, especially in the context of environmental policy, the term "climate change" often refers only to changes in modern climate, including the rise in average surface temperature known as global warming. In some cases, the term is also used with an assumption of human causation, as in the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC uses "climate variability" for non-human caused variations. The earth has undergone periodic climate shifts in the past, including four major ice ages. These consisting of glacial periods where conditions are colder than normal, separated by interglacial periods. The accumulation of snow and ice during a glacial period increases the surface albedo, reflecting more of the Sun's energy into space and maintaining a lower atmospheric temperature. Increases in greenhouse gases, such as by volcanic activity, can increase the global temperature and produce an interglacial. Suggested causes of ice age periods include the positions of the continents, variations in the Earth's orbit, changes in the solar output, and volcanism.

Many studies have shown that temperature extremes are a major underlying weather related cause of mortality on both sides of Atlantic ocean [2][3][4][5][6]. Cities experience higher levels of heat exposure than surrounding suburb and rural areas because of the urban heat island (UHI) effect, whereby temperatures in the urban regions are generally 3.5–12 ^{o}C higher than those outside city limits. The UHI is an artefact of the complex built environment, the lack of cooling vegetation and the high density of human activities in urban areas and is a result of differences in the energy balance of urban and rural environments. Various possible approaches for mitigation of UHI effects are white roofs, green roofs and planting trees in cities. New York City installed and monitored green roofs on a few building as a mitigation effort. Germany is using eco-proof technology/urban vegetation. Many German cities possess by-laws which

ensure that industrial building incorporates a green roof. A combination of vegetation and albedo enhancement helped reduce heat-related mortality by 40–99% across the three metropolitan regions of Atlanta, Philadelphia and Phoenix in the US. This demonstrates that climate adaptation strategies can be designed to lessen the risk of heat exposure through mitigation of the UHI effect. However, the heat management strategies that are effective in reducing the mortality vary with region. Throughout the world, a changing climate has increased the risk of temperature-related morbidity and mortality, as is evident from studies in Australia, Greece, Russia and the US. The mortality impact of extreme heat has been explored for many regions of the world. The US and European data suggest that the contribution of mortality due to heat waves is much higher than mortality due to any other extreme weather events. India also witnessed a series of heat waves with considerable mortality for instance, heat wave-related deaths were highest for Rajasthan, Bihar and Uttar Pradesh during the period 1978 and 1999 (ref. 25). In 1998 Odisha faced an exceptional heat wave situation which caused the death of 2042 people26. A similar situation was also noted from Andhra Pradesh in 2003, which killed 1421 people [7]. Azhar et al. [8] reported excess 1344 all-cause mortality associated with the May 2010 heat wave for Ahmedabad city in Gujarat [8]. This shows that significant increase in premature heat-related mortality poses a threat to public health in many Indian states [7].

In this study the Raipur and Durg district of Chhattisgarh are considered for the reporting the association of maximum temperature, relative humidity and heat index (HI) on allcause mortality for summer (April- June) from 2012 to 2015.

II. Material and Methods

According to the Köppen system, Indian states and districts are classified under six climatic zones, namely Montance, Humid subtropical, Tropical wet and dry, Tropical wet, Semiarid and Arid. Figure 1 depicts Köppen climate zone classification of India.

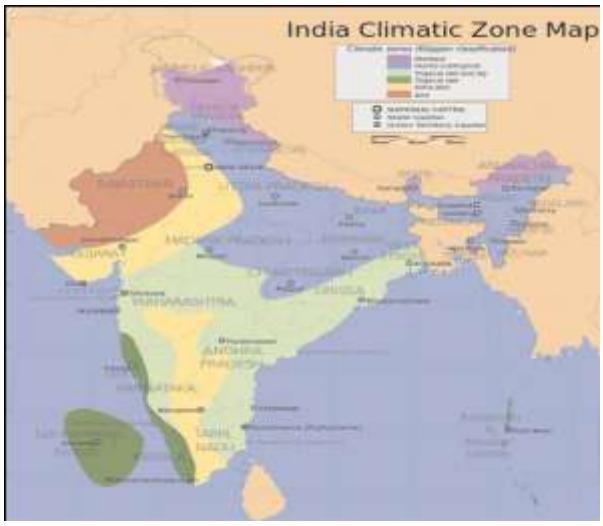

Figure 1. Köppen Climate Zone Classification of India (Source: www.wikimedia.org)

In this study, Raipur and Durg cities of Chhattisgarh State are considered in order to account the heat effect. Raipur City is capital of Chhattisgarh and head quarter of the Raipur district. It is situated at 21.25^{o}N 81.63^{o}E. As of the 2011 census, Raipur city had a population of 1,010,087, of which 519,286 are males and 490,801 are females. Raipur has a tropical wet and dry climate, temperatures remain moderate throughout the year, except from April to June, which can be extremely hot. The temperature in April–May sometimes rises above 48 ^{o}C. Durg is a major city in Chhattisgarh and it is headquarter of Durg district. It is situated at 21.19 ^{o}N 81.28 ^{o}E. Durg city had a total population of 268,679 as per 2011 census, out of which 136,537 were males and 132,142 were females. The mortality data, maximum temperature, humidity of Raipur and Durg during summer months April, May and June for the years 2012 to 2015 was collected from the Directorate of Economics and Statistics Chhattisgarh, Govt. of Chhattisgarh. The heat index was calculated based on the relative humidity.

III. Result

The descriptive statistics is given the Table I. A total of 13525 deaths and 9472 deaths were recorded in Raipur and Durg respectively during the Months of April to June in the years 2012 to 2015. Table II shows the number of death corresponding maximum temperature. Table III shows number of death with heat index value. The mortality with the maximum relative humidity is shown in Table IV.

TABLE I
Descriptive statistics of collected data

N	24
Highest Recorded value of Temperature (^{o}C)	47
Maximum Temperature (^{o}C) mean ± SD	43.67±2014
Highest Recorded value of relative humidity (%)	100
Relative humidity (%) mean ± SD	88.75±10.98
Highest Recorded value of Heat Index (^{o}C)	168.45
Heat Index (^{o}C) mean ± SD	121.34±23.73
Highest death recorded	1495
Recorded Death mean ± SD	958 ± 248

TABLE II
Mortality with Temperature

Max Temp (^{o}C)	**Total of recorded death**	**Average of recorded death**
41	3796	949
42	7141	892
45	5581	930
46	4560	1140
47	1919	959

TABLE III
Mortality with heat Index

Heat Index (^{o}C)	**Total of recorded death**	**Average of recorded death**

86.94	1994	997
90.93	1319	660
98.89	2020	1010
108.70	1776	888
110.55	1772	886
121.49	4050	1013
126.65	2255	1128
133.23	1431	716
136.05	2305	1153
152.69	2156	1078
168.46	1919	960

TABLE IV
MORTALITY WITH MAXIMUM RELATIVE HUMIDITY

Maximum Relative Humidity (%)	Total of recorded death	Average of recorded death
61	1994	997
77	1319	660
82	2255	1128
87	2305	1153
88	2020	1010
90	1431	716
91	1772	886
95	1776	888
98	5969	995
100	2156	1078

IV. DISCUSSION

Heat and moisture content play a significant role in raised heat index factor, which can lead to discomfort and health threat. High temperature along with humidity is a matter of concern. The high heat index values seem to be well correlated with the all-cause mortality, characterized by the combination of very high temperatures (>36 ºC) and relative humidity (60–70%) and consistent with the study by Monteiro et al. [9]. HI is more important than maximum temperature as evident from our analysis by increase of 18% deaths/day versus 11% deaths/day. Hence, there is a need for the inclusion of humidity measures while calculating health/ mortality impacts of heat waves [7].

The present analysis reveals that humidity is almost higher than 61% throughout and highest recorded relative humidity is 100% in the study period and temperature above 40C and highest recorded temperature is 47 ºC (HI is between 86.94 ºC and 168.46 ºC) in the summer days. This is known as extreme danger/ high-risk period and is critical for increased mortality due to extreme heat events. Apart from excess mortality, it can also affect work performance of the population that in turn may have an impact on the economy, and health and may lead to dangerous heat disorders like muscles cramps [7]. Hence, to plan and implement interventions to such adverse climatic heat affects is need in this region.

V. CONCLUSION

A total of 13525 deaths and 9472 deaths were recorded in Raipur and Durg respectively deaths for summer months (2012–2015) were analysed. Mean monthly all-cause mortality was estimated at 958 ± 248 for the study period. Extreme heat related mortality merits further analysis in order to reduce harmful health effects among most vulnerable population. Short- and medium-range temperature forecasts and observed population health effects could be used to generate early warnings of extreme heat which might condense the number of heat related mortalities. Early warning systems also needed for this region specific heat and health action plan and response capacity for health professionals and staff of district office is needed.

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