

# **Spatial & temporal analysis of cold-wave incidences and Mortality in Indian States**

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## **Introduction**

Cold Wave is a rapid fall in temperature within 24 hours to a level requiring substantially increased protection to agriculture, industry, commerce, and social activities. Cold Wave Conditions for the plains, when the minimum temperature is 10 degrees Celsius or below and is 4.5 degrees Celsius (C) less than normal for two consecutive days. For coastal stations, the threshold value of minimum temperature of 10 degree Celsius is rarely reached. However, the local people feel discomfort due to the wind chill factor which reduces the minimum temperature by a few degrees upon the wind speed. A wind chill factor is a measure of the cooling effect of the wind on the temperature of the air. India's 'core cold wave zone' covers Punjab, Himachal Pradesh, Uttarakhand, Delhi, Haryana, Rajasthan, Uttar Pradesh, Gujarat, Madhya Pradesh, Chhattisgarh, Bihar, Jharkhand, West Bengal, Odisha and Telangana. During 23 of the last 38 years (1980-2018), the human death toll in India due to cold waves was higher than that due to heat waves. Cold wave and frost in added in the central list of disasters and hence eligible for assistance from National Disaster Response Funds in 12<sup>th</sup> Finance Commission. Cold waves are common in the plains of north India with foggy conditions that prevail during the winter season for several days or weeks at a stretch. It affects the day-to-day life of local people. During a cold wave, common issues like electricity failures, roadblocks and health issues are reported commonly in the media. A cold wave with heavy and persistent snowfall causes crop damage and a shortage of food for grazing animals. Fire incidences are also common during the winters due to excess load on the supply systems and unsafe heating measures.

## **Temporal distribution of cold-wave incidences during 1995 to 2020**

More than 15 states/UTs out of 36 are annually affected by cold waves. There is no significant change in the geographical distribution of cold wave incidence during 1995- 2020. Number of cold wave days and affected states were significantly low in the year 2021. There was a significant decrease in the number of states reported to be affected by cold-wave in 2020

National level analysis, number of states affected by cold waves is not showing any significant rise or fall in trend except in 2020 i.e. only 10 out 36 state and UTs.

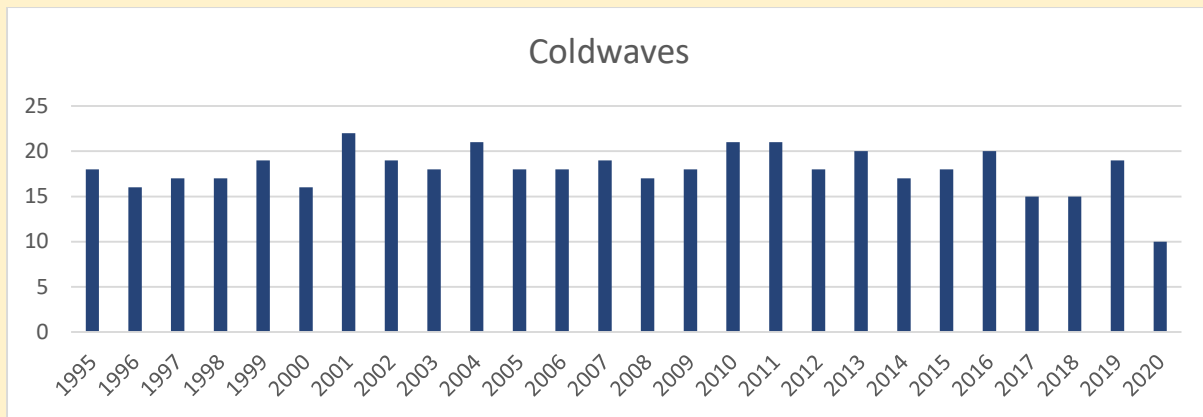


Figure 1: Number of states/ UTs reported cold wave during 1995-2020 (Data Source: Disastrous Weather events report of IMD<sup>1</sup>)

However, during after 2015, states such as Madhya Pradesh, Jharkhand, Gujarat, Chhattisgarh and Uttarakhand as well as Himachal Pradesh, cold wave events indicated rising trend. Cold waves in the four states of Tripura, Arunachal Pradesh, Sikkim and Meghalaya were showing rising trend after 2015. Number of cold wave events in Delhi and Chandigarh are showing a decreasing trend since 2015 (Gupta et al., 2021).

### Impacts of cold-wave

Cold wave can lead death or injury of humans and also livestock. Besides life loss cold-wave adversely impact agriculture, water supply, transport sector etc. The current analysis of impact is based on human mortality alone. The mortality rates show a marked increase in areas with recurrent cold waves. Total loss of human lives due to cold wave during the 1995-2020 period is 19,126 with 1149 persons lost life in 2015 alone.

The highest number of human deaths reported during 2015, which was the deadliest Cold Wave reported during the analysis period (NCRB). It can also be noted that during the period 2005-15 the number of human-lives loss due to cold wave incidents were maximum and decreased after 2015 in most of the states. Highest number of Cold Wave related deaths i.e. 5023 persons reported in Uttar Pradesh which accounts for 26% of the total deaths in India during 1995-2020 period. Bihar and Punjab followed UP in terms of human life lost due to cold wave (Gupta et al., 2021)<sup>2</sup>.

<sup>1</sup> [Library \(imdpune.gov.in\)](http://library(imdpune.gov.in))

<sup>2</sup> [https://nidm.gov.in/PDF/pubs/GIZNIDM\\_21.pdf](https://nidm.gov.in/PDF/pubs/GIZNIDM_21.pdf)

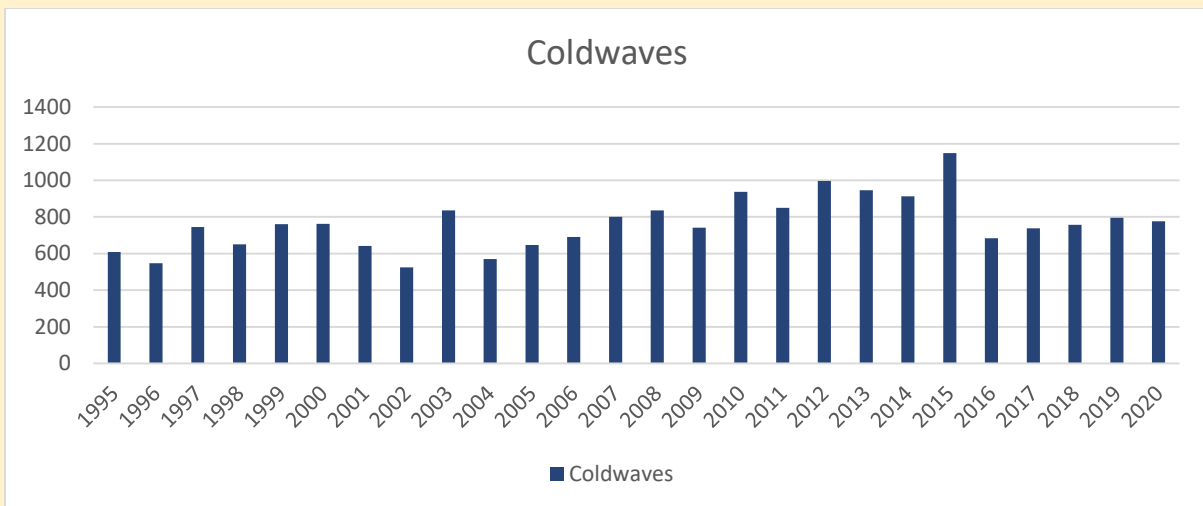
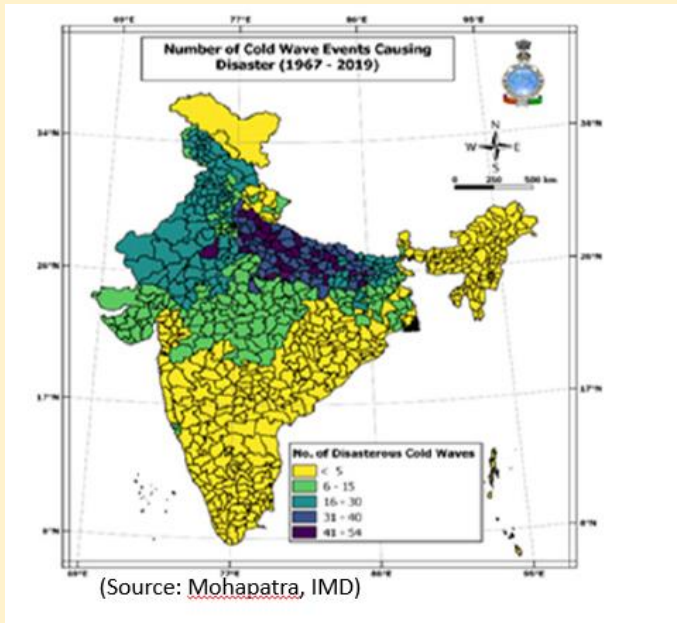


Figure 2: Human life lost during 1995-2020 due to cold wave (NCRB<sup>3</sup>).

<sup>3</sup> [ADSI-2021 | National Crime Records Bureau \(ncrb.gov.in\)](https://ncrb.gov.in)

Cold Wave related deaths are also showing an increasing trend in few states including, UP,

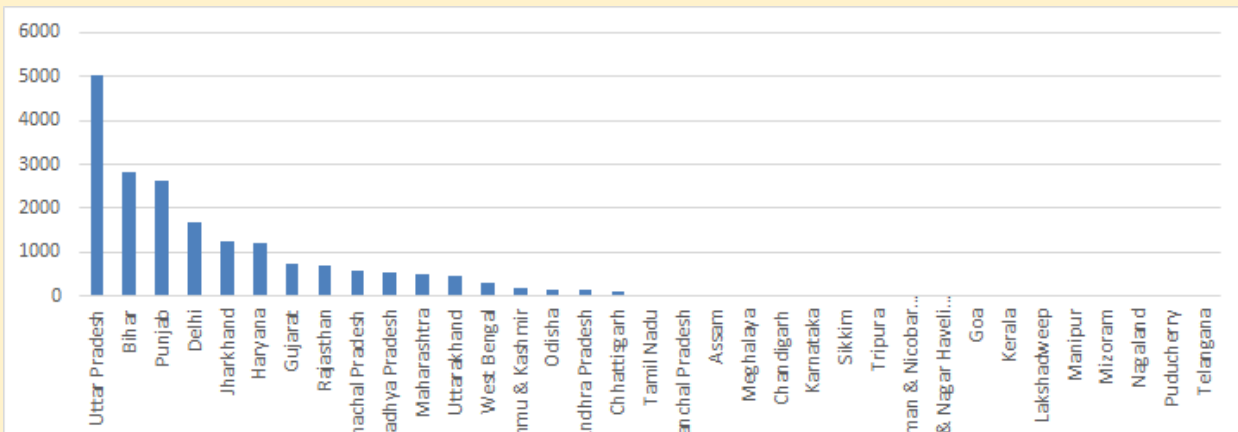


Figure 3 Total number of deaths reported due to cold wave incidents at the state and UT level during 1995-2020 (NCRB and IMD Reports)

Jharkhand, Uttarakhand and Jammu & Kashmir. In contrast, Delhi, Punjab, Haryana, Himachal Pradesh and West Bengal show decreasing trend after 2015

### Summary

Cold wave always remained as one of the deadly extreme climate events in India. A cold wave can have very harmful effects upon all kinds of organisms inhabiting the area, some of which are Death and/or injury to livestock/wildlife, increase in caloric demand of the body, hypothermia in Human Beings and crop failure or death of plants. Fortunately, cold wave related deaths are showing decrease after 2015. Death due to cold wave can be reduced considerably if timely measures can be adopted. Cold wave related deaths can be reduced considerably by identification of vulnerable areas and preparation of Winter Action Plans, timely dissemination of early warning to all concerned stakeholders, well planned out and timely arrangements for day and night shelters for the homeless, Ensure adequate quantity of supplies of food, drinking water, fuel, and medicines etc. and preparations for necessary medical facilities to handle cases of cold wave victims (NDMA, 2021)<sup>4</sup>.

<sup>4</sup> [Cold Wave Cover \(ndma.gov.in\)](https://www.ndma.gov.in)