ORIGINAL ARTICLE

A Longitudinal Analysis of TH Index and Identification of Period of Acute Heat Stress

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Temperature Humidity Index is a simple and reliable criterion for evaluation of thermal comfort. Analysis of the Index over a three year period at different periods of the day is used to identify periods of thermal stress in a flying station for the purpose of advanced planning in allotment of flying task.

It has been brought out in an earlier study [1] that Temperature Humidity Index (TH Index) is a simple and reliable criterion for evaluation of thermal comfort. At present the decision to call off flying is mostly based upon subjective feelings of aircrew and flying task requirements. The present study deals with the analysis of TH Index over three consecutive years at different periods of the day to identify periods of heat intolerance for the purpose of advanced planning in allotment of flying task.

Methodology

The meteorolcgical data of temperature and relative humidity (RH) recorded at 1130 hrs, 1430 hrs and 1730 hrs IST at the Air Force Academy Meteorological Section during 1978, '79 and '80 were analysed. It was observed that temperature started rising beyond 30°C around 15th March and came down abruptly to the same level around 17th June due to onset of monsoon. The temperature and RH data of this period, i.e., 15th March to 17th June, were grouped into penteds I to XIX for the three years under reference. Their mean values for each pented were converted into TH Index with the help of the nomogram[2] (Fig 1) for TH Index. The various zones of discomfort were identified based on the value of this TH Index. TH Index values of 81 and above were considered to be uncomfortable. Figure 2 shows the TH Index plotted against penteds I to XIX in graphical form for the above period.

Findings

A comparative analysis of TH Index at the Air Force Academy during the period 15 March to 17 June in 1978, '79 and '80 revealed the following :

(a) At 1130 hrs, TH Index entered into uncomfortable zone around 9th April. From 29th April onwards till 2nd June TH Index was consistently found to be in the region of 81/83.

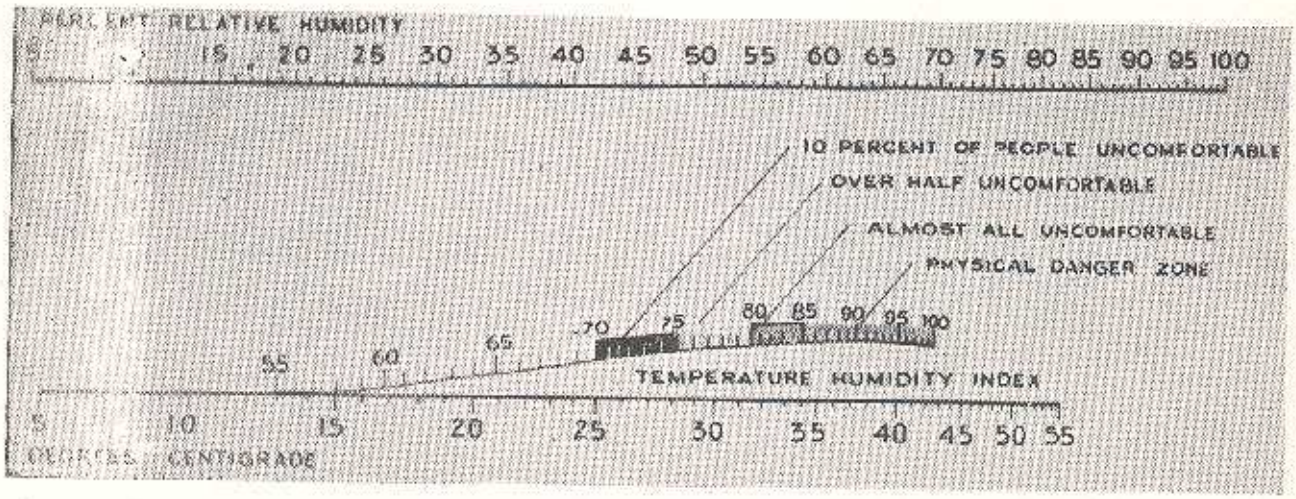

Fig 1 - Temperature - Humidity Index Nomogram

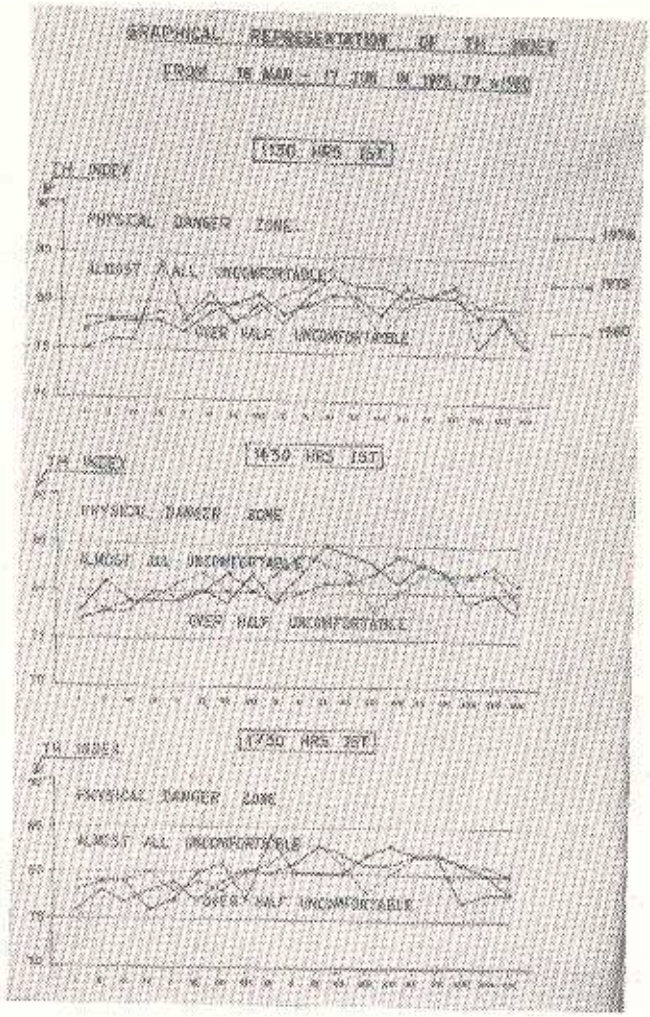

Fig - 2

(b) At 1430 hrs, TH Index was consistently above 81 after 9th April, it tended to reach extreme values of uncomfortable zone, i.e., TH values of 83 — 85, between 29th April and 2nd June and thereafter it gradually came down to value of 80 around 7th June.

(c) At 1730 hrs, TH Index was in the region of 81 — 83 from 24 April to 2 June after which it abruptly came down below 80.

From the above it is clear that at the Air Force Academy the period between 29 April to 2 June shows TH Index to be in the uncomfortable zone at 1130 hrs, 1430 hrs and 1730 hrs IST with accentuation of heat stress at 1430 hrs. This period constitutes the most stressful period for the purpose of human heat tolerance.

Discussion

Anthropologists have shown that man evolved in tropical climate. Sweating and cutaneous vasodilatation help to maintain thermo-neutrality at ideal core temperature of 37°C within wide range of environmental heat stress. The efficiency of sweating mechanism depends upon environmental temperature as well as humidity in that saturated air does not allow evaporation of sweat and thus sweating in hot humid weather not only accentuates heat strain but also results in concomitant loss of fluid and salts.

Environmental heat stress cannot be evaluated in terms of dry air temperature only. It bears very intricate relationship with dry air temperature and humidity which has been brought out in the nomogram[2] as far as effects of these parameters on human body are concerned. The prevalence of various combinations of air temperature and humidity depends upon many factors, viz., solar radiation, wind pattern at low levels, pressure changes etc. TH Index combines various environmental variables for prediction of human thermal comfort and its value is at variance with isolated study of air temperature alone.

The present study shows that for Air Force Academy, the period from 29 April to 2 June has environmental conditions of uncomfortable zone of TH Index from 1130 to 1730 hrs with peak of heat intolerance at 1430 hrs. As such, in advanced planning of flying task it is desirable that flying is not planned between 1130 and 1730 hrs from 29 April to 2 June. This could be achieved by flying only one shift from 0600 to 1130 hrs. In any case periods of extremes of uncomfortable zone should be avoided by not flying from 1330 to 1530 hrs during this period. Flying task allotment during this period should cater for this contingency in advance whereas decision to call off flying during this period can be taken on the basis of actual values of TH Index which can be readily found out with the help of the nomogram. Moreover, the measures for improvement of heat tolerance like effective pre-cooling of aircrew and aircraft should be given due attention.

Conclusion

This study shows that the period between 29 April to 2 June at Air Force Academy is susceptible to produce heat intolerance particularly from 1330 to 1530 hrs and may compromise flight safety.

The nomogram for TH Index can be generally accepted for evaluation of the thermal comfort in operational flying in hot humid weather at various bases. At every base acceptable level of TH Index commensurate with flight safety should be determined after taking into consideration other variables like acclimatisation, facilities for effective pre-cooling of aircrew and aircraft and type of operational flying.

References

1. Gurmukh Singh. Analysis of climatic data and cockpit thermal conditions at a fighter base in North West India. Av Med, 22 (2) : 29, 1978.

2. Thompson, PD and O' Brien, R. Nomogram for Temperature Humidity Index. 'Weather', Life Science Library, 1968, p84.