ONSET OF CHILBLAINS IN RELATION WITH WEATHER CONDITIONS

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Background: Chilblains or perniosis is a moderately severe form of cold injury, localized to peripheral parts of the body, which occurs after exposure to non-freezing temperatures and damp conditions. Although inter-individual variations exist with respect to susceptibility to develop chilblains, no study has been carried out in this region to determine the role of different weather conditions either alone or in combination, in predisposing the susceptible individuals to chilblains. The objective of this study was to determine the relationship between weather conditions and onset of chilblains at a moderately cold weather station. **Methods:** This study was conducted at the Department of Dermatology, Combined Military Hospital, Abbottabad, from Dec 2004 to Mar 2005. All patients fulfilling the clinical criteria for diagnosis of chilblains were included in the study. These patients were interviewed and examined thoroughly. A specially designed proforma was filled for each patient separately. Meteorological department was contacted for record of weather conditions. Onset of chilblains in each patient was related with weather conditions of that particular month. Computer programme SPSS 10 was used for statistical analysis. **Results:** Out of 111 patients, 67 (60.4%) were males and 44 (39.6%) were females. Eighty nine (80.2%), 90 (81.1%) and 90 (81.1%) patients had onset in relation with lower temperature (<10 ºC), relatively low atmospheric pressure (<1500 kpa) and higher relative humidity (>60%) respectively. There was statistically significant relationship of weather conditions with onset of chilblains when different groups, i.e., elderly and young, males and females, locals and non locals, outdoor workers and those remaining inside most of the time and those having disease of longer or shorter duration were compared. **Conclusion:** The cold weather conditions that can be endured by humans depend on combination of the duration and the extent of the exposure, in addition to physiological adaptive changes. However, susceptibility to chilblains increases when ambient temperature is less than 10ºC and relative humidity is more than 60%. Elderly, females, outdoor workers and those having chronic or recurrent episodes of chilblains are less tolerant to cold weather and develop the disease under lesser ambient cold.

Keywords: Chilblains, Perniosis, Onset, Weather conditions.

INTRODUCTION

Weather has a profound impact on human health. Many diseases are influenced by weather conditions or display strong seasonality, suggesting a possible climatic contribution. The risk, nature and magnitude of cold injuries depend largely on the interaction of weather conditions, protective measures and metabolic heat production.[1] Inter-individual differences exist with respect to the relative contribution of metabolic and insulative adaptation to cold.[2]

The cutaneous blood flow response to cold varies across body regions, because of local variations in vasoconstrictor control, with major differences between the apical and non-apical regions. The apical regions (feet, hands, lips, nose, and ears) are innervated solely by adrenergic sympathetic nerves, whereas the non apical regions (limbs and trunk) are under dual control of the noradrenergic, active vasoconstrictor system and an active vasodilator system for which the neurotransmitter has yet to be isolated.[3] Although the extremities are under strong sympathetic influence, the head displays only a minimal constrictor response to cold, having a high sympathetic tone even under thermo neutral conditions, and is not involved in generalized peripheral vasoconstriction. Prolonged exposure to moderate degrees of cold can result in chilblains. Chilblains or perniosis is a moderately severe form of cold injury, localized to the peripheral parts of the body, which occurs after exposure to nonfreezing temperatures and damp conditions.[4,5] It presents as inflammatory, erythematous or violaceous, pruritic or painful acral lesions. Normally, moderate cold exposure induces cutaneous vasoconstriction succeeded by vasodilatation in an attempt to maintain reperfusion. However, in individuals afflicted by chilblains, a persistent cold induced constriction of the large cutaneous arterioles and persistent dilatation of the smaller, more superficial vessels occurs.[6] In England the annual incidence is said to be up to 10%[7] and in France it is 2–6%.[8] The exact incidence of the disease is not known and the frequency of chilblains varies with weather conditions.[7] Although inter-individual variations exist with respect to susceptibility to develop chilblains, no study has been carried out in this region to determine the role of different weather conditions either alone or in combination, in predisposing the susceptible individuals to chilblains.

The purpose of this study was to determine the relationship of onset of chilblains with weather conditions at Abbottabad (Kakul), a moderately cold

weather station. Weather station Kakul (Abbottabad) is at about 34.18° N 73.25° E at a height of about 1284 m/ 4212 feet above sea level.[9]

MATERIAL AND METHODS

The study was carried out at Combined Military Hospital, Abbottabad from 1 Dec 2004 to 31 Mar 2005. Patients reporting sick to dermatology out-patient department of the hospital with persistent painful or pruritic, erythematous or dusky erythematous lesions of less than 3 weeks duration involving, digits or other peripheral parts of the body, during above mentioned period were diagnosed as cases of chilblains and were included in the study. However, patients having past or present history of collagen vascular disease, acrocyanosis and peripheral vascular disease were excluded from the study. The selected patients were interviewed thoroughly and dermatological as well as systemic examination carried out in detail after explaining the study and taking informed consent. History included patients' age, sex, occupation, permanent residence, time since arrival at the area under study, duration of the disease and duration of present episode of chilblains. Lesions of chilblains were examined in detail to note the site and extent of involvement. Diagnosis of chilblains was based on history and clinical examination. A specially designed proforma was filled for each patient separately. Meteorological department was contacted and requested for the record of weather conditions including temperature, relative humidity, rainfall, atmospheric pressure and wind on monthly basis from Oct 2004 to Mar 2005. Onset of chilblains in each patient was related with weather conditions of that particular month.

The data was analysed using SPSS version 10 for analysis. Descriptive statistics like mean age with standard deviation, male female ratio and point prevalence of disease were calculated. Student *t*-test was used for comparison of means and Chi square test was used for comparison of proportions. A *p*-value <0.05 was taken as significant.

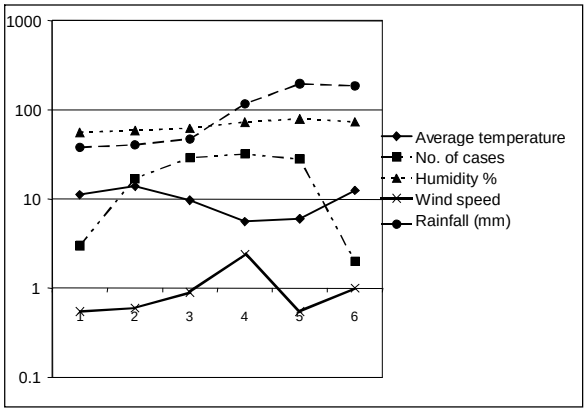
RESULTS

A total of 4666 patients were registered in dermatology out patient department of Combined Military Hospital, Abbottabad during the period from 1 Dec 2004 to 31 Mar 2005. Out of these 4666 patients, 111 (2.37%) were diagnosed to be suffering from chilblains. Out of 111 patients having chilblains, 67 (60.4%) were males and 44 (39.6%) were females. Mean age was 26.44±17.65 years. Table-1 shows the descriptive statistics of different weather conditions. Figure-1 shows the relationship of different weather conditions with onset of chilblains.

Table-1: Descriptive Statistics of Weather conditions at Kakul (Abbottabad) (October 2004–March 2005)

	Min	Max	Mean	SD
Average temperature ºC	5.60	13.90	8.3203	3.0640
Average Rainfall (mm)	38.00	196.10	106.1180	62.6104
Ave relative humidity (%)	56.00	79.50	69.3018	8.0123
Average wind speed (km/h)	0.55	2.40	1.1905	0.7861
Average pressure (kpa)	1469.20	1508.05	1486.8162	14.9686

We arbitrarily defined relatively low temperature as <10 ºC, high humidity as >60% and relatively low atmospheric pressure as <1500 kpa. We found that 89 (80.2%) patients had onset in relation with low temperature (December, January and February), 90 (81.1%) patients had onset in relation with relatively low pressure (December, January, February and March) and 90 (81.1%) cases had onset in relation with relatively high humidity (December, January, February and March). Combinations of weather conditions and their relation with onset of chilblains are shown in Figure-2.



(1–6 represent October 2004 to March 2005)
(Weather conditions and onset plotted on logarithmic scale)

Figure-1: Onset of chilblains in relation with weather conditions

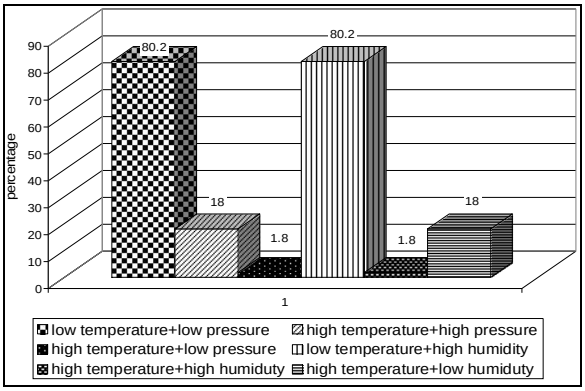


Figure-2: Relationship of Temperature, Atmospheric Pressure, and Humidity with onset of chilblains

We also compared relation of age, gender, residential status, occupation and duration of the disease with different weather conditions. Patients <60 years of age in comparison with >60 years had onset of

symptoms at mean atmospheric pressure of 1485.97±14.8 vs 1496±12.7 (p=0.037), mean humidity 69.83±7.97 vs 63.95±6.57 (p=0.026) and mean rainfall 110.16±63.34 vs 65.21±35.8 (p=0.03). However wind speed and temperature were not significantly different in relation with onset of chilblains in <60 or >60 years age groups. The comparison of patients <30 years and >30 years revealed no significant difference of weather conditions and onset of chilblains except for the rainfall 113.59±65.45 vs 86.81±50.56 (p=0.043). Male patients as compared to females had onset of symptoms at mean atmospheric pressure of 1483.7±14.2 vs 1491.7±14.7 (p=0.005), mean humidity of 70.99±7.65 vs 66.72±7.94 (p=0.006), mean temperature of 7.79±2.95 vs 9.11±3.08 (p=0.026) and mean rainfall of 118.82±61.66 vs 86.76±59.63 (p=0.03). Wind speed had no significant difference in relationship with onset of chilblains in males or females. Outdoor workers as compared to those who remain indoor most of the time had onset of symptoms at mean atmospheric pressure of 1484.79±14.54 vs 1491.28±14.85 (p=0.031), mean humidity of 70.48±7.84 vs 66.84±7.89 (p=0.025), mean temperature of 7.86±2.8 vs 9.26±3.38 (p=0.024) and mean rainfall of 114.35±63.53 vs. 88.9±57.7 (p=0.045). Wind speed had no significant difference in relationship with onset of chilblains in outdoor and indoor groups. Non-locals as compared to residents of the area where study was conducted had onset of symptoms at mean atmospheric pressure of 1483.69±13.98 vs 1489.28±15.21 (p=0.033), mean humidity of 70.98±7.63 vs 67.82±8.11 (p=0.038) and mean temperature of 7.62±2.66 vs 8.93±3.27 (p=0.025). Rainfall and wind speed were not different in relation with onset of chilblains in non locals and local residents. Patients with disease of <2 years duration as compared to >2 years duration had onset of symptoms at mean atmospheric pressure of 1482.70±13.60 vs 1492.82±14.75 (p<0.001), mean humidity of 71.46±7.60 vs 66.25±7.63 (p=0.001), mean temperature of 7.51±2.5 vs 9.45±3.43 (p=0.001) and mean rainfall of 122.67±62.89 vs. 82.59±54.68 (p=0.001). Wind speed had no significant relation with onset and disease duration.

DISCUSSION

Weather is determined by a complex interaction of factors including temperature, humidity, air movement (wind), radiant heat and atmospheric pressure. Although, weather is strongly affected by the temperature, the effect of temperature itself is greatly modified by the moving air and humidity. The lowest temperature that can be endured by humans is a combination of the duration and the extent of the exposure, in addition to physiological adaptive changes, so it is not easily determined. The ability of the body to respond to cold is modified by factors such as age, gender, fatigue, other injuries and illnesses, history of previous cold injury, area of origin, physical activity and psychosocial factors.[2,10] It has also been reported that repeated cold exposures lead to habituations of cold sensation and nor-epinephrine response and the phenomenon is beneficial to those humans who have to stay and work in cold environments.[11]

In our study we found that more than 80% of the patients developed chilblains at the time, when temperature was less than 10 ºC and humidity was more than 60%. This combination of low temperature and high humidity in relation with onset of chilblains has been reported in many studies.[4,7]

It has been suggested in literature that older men are more susceptible to cold environment[12] or they have more variable responses to cold[13] than younger people. We found in our study that older individuals were less tolerant to cold weather conditions when compared with younger patients. However, temperature alone was not significantly different in relation with onset of chilblains in the two age groups.

Females were found more susceptible to develop chilblains under cold weather conditions as compared to males. By virtue of their peculiar anatomical[14] as well as physiological[15] characteristics, females have a higher temperature gradient from skin to body core and are able to better maintain a constant core temperature in cold conditions. Because of this ability, women are able to stay warm but their skin surface, in particular peripheral parts of the body remain relatively cooler and they are more likely to suffer from localized cold injuries.[16]

As outdoor workers are repeatedly exposed to cold, therefore, they develop habituations of cold sensations and probably that was the reason that outdoor workers in our study tolerated cold weather well in comparison with those who would remain inside most of the time.

Our study showed that non-locals were more susceptible to chilblains at relatively lower atmospheric pressure and higher humidity. It was also observed that they developed chilblains at a relatively lower temperature as compared to the locals, which seems difficult to explain. On analyzing this observation, it was revealed that 78.8% non-locals were outdoor workers. As explained earlier, outdoor workers are repeatedly exposed to cold, therefore they develop habituations of cold sensations and probably that was the reason that non locals, majority of them being outdoor workers in our study tolerated cold weather well and developed chilblains at relatively lower temperature, lower atmospheric pressure, higher humidity and higher rainfall in comparison with those who would remain inside most of the time.

Wind is an important factor in lowering the temperature in cold weather and has an important

influence in causation of cold injuries.[17] The maximum wind speed recorded throughout the period of study was 4.8 km/hour during the month of Jan. The lowest and the min average temperatures were also recorded during Jan and were 0.1 ºC and 5.6 ºC respectively. Thirty-two (28.8%) patients had onset of chilblains during the month of Jan when the wind speed was maximum and the temperature was the lowest. However, wind, as an isolated factor had no contributory effect when different categories of patients were compared. The reason probably was that average wind speed throughout the study period was 1.1 km/hour and there was no remarkable variation of wind speed throughout the study period.

CONCLUSION

The cold weather conditions that can be endured by humans depend on combination of the duration and the extent of the exposure, in addition to physiological adaptive changes. However, individuals living at moderately cold weather stations are more susceptible to develop chilblains when ambient temperature is less than 10ºC and relative humidity is more than 60%. Elderly, females, outdoor workers and those having chronic or recurrent episodes of chilblains are less tolerant to cold weather and develop the disease under lesser ambient cold, when compared with younger people, males and those remaining indoor most of the time and having first episode or the disease of shorter duration respectively.

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