

CLIMATIC ENVIRONMENTAL FACTORS IN THE ETIOLOGY OF SKIN DISEASES*

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Military service, especially in hot climates, is always associated with a large incidence of skin disease, and in some theatres of war has proved a serious medical and administrative problem. It is not easy to distinguish the relative importance of the various possible causes, and it may therefore be of value to record the variation in incidence of skin diseases with environmental heat and humidity in a relatively stable community, especially if the medical data are not open to the criticisms that apply to centrally collected statistics based on a variety of diagnostic criteria.

CLINICAL MATERIAL

At Karachi, India, in 1946 there was only one hospital for British troops (the No. 10 R.A.F. General Hospital) and no beds for patients with skin diseases were available elsewhere in the area except for a few at two R.A.F. sick-quarters. The only source of specialized dermatological advice was at the hospital, and there was close co-operation with unit medical officers. The principal criterion for admission of cases to hospital was their severity, and available beds were increased in number (up to 150 for one period of several weeks) to serve the demand, although at the peak of the hot season the admission of some cases had to be postponed. Cases transferred from other areas have been omitted from the analysis. The hospital admission rate therefore provided a good basis for assessing the effect of environment at Karachi, which varied from the cool winter, when British weight clothing could be worn, to the very hot and humid summer. The summer of 1946 was the worst in this respect in living memory.

By 1946 the war was over and the troops in Karachi formed a fairly stable population. The military camps were situated along the coast and at different distances from the sea. Meteorological data, given in full elsewhere (1), showed that the most humid area was the coastal strip, and the further inland the camp, the lower the minimum temperature and the higher the maximum temperature. The incidence of skin diseases in the different camps thus provided another means for determining the effect of climatic environment. A third means was provided by comparing the incidence in 1946 with that in 1947, when the climatic conditions during the summer were not nearly so severe.

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† In receipt of an expenses grant from the Medical Research Council of Great Britain. Acknowledgment is due to Air Ministry for permission to publish.

Received for publication July 19, 1950.

RESULTS

Figure 1 shows that there was a marked seasonal variation in the admission rate for prickly heat, bullous impetigo and hydradenitis. All the cases occurred in the same period of the year, the height of the hot weather. The admission rate for fungous infections and "other pyogenic infections" of the skin showed only a small seasonal variation, but there was no clear variation of this type in the other skin diseases. Some climatic factor was therefore of considerable im-

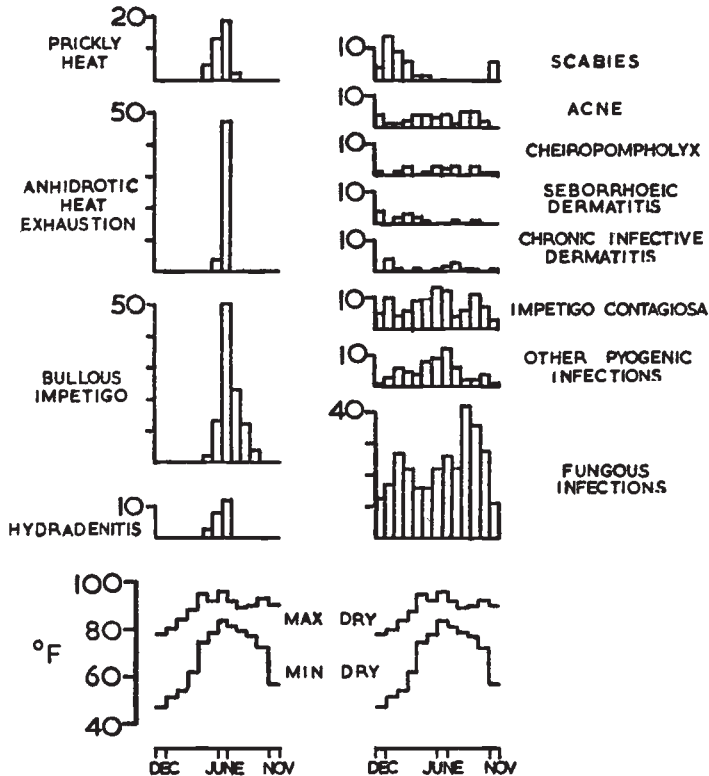


FIG. 1. Four-weekly hospital admissions of principal skin diseases and climatic data, 1st December, 1945, to 30th November, 1946. During the summer months the wet bulb temperature lay approximately 5°F. below the minimum dry bulb temperature.

portance in the etiology of the first group, of less importance in the second and apparently of no importance in the third. The figure suggests that this factor was the minimum dry bulb temperature and humidity rather than the maximum temperature, since the latter lay between 89° and 95° F. for the greater part of the year. Small differences of a few degrees seemed to be important when the minimum temperature was of the order of 80° F.

When the incidence of skin diseases during the hot season (April to October) was analysed according to camps, there was a statistically valid excess of cases in the coastal areas in each of the first group (see Table 1). As already stated,

the coastal camps had the higher minimum air temperature and humidity, and the higher incidence here of the first group of skin diseases supports the conclusion that they were particularly dependent on these climatic factors. Just as the incidence of the second and third groups of the skin diseases was independent of season so it was not affected by camp site. Factors other than climate are, of course, important in the causation of skin disease, as was illustrated by a higher incidence in the Army than in the R.A.F., but coastal and inland camps could

TABLE 1

	SERVICE	ARMY		R.A.F.	
	Location of camp	Coastal	Inland	Coastal	Inland
	No. of men at risk	1100	1400	2250	1200
Group I	Prickly heat	12	6	8†	0
[A]	Anhidrotic heat exhaustion	28†	4	18†	5
[B]	Hydradenitis	11†	4	2	3
[C]	Bullous Impetigo	41†	21	12†	3
Group II	Impetigo contagiosa	17	14	7†	2
	Other pyogenic infections	11	6	8†	0
Group III	Acne	6	4	3	3
	Fungous Infections	55	50	14†	3

Hospital admission rate per 1000 for principal diseases of the skin during the hot season (20th. April to 4th. October) 1946, sub-divided by branch of service and by geographical location. The Army figures are likely to be more valuable than those of the R.A.F. for reasons discussed in the text.

The "coastal" camps had a higher minimum and lower maximum dry bulb temperature, and a higher wet bulb temperature, than the "inland" camps, which were situated a few miles from the coast.

Anhidrotic heat exhaustion has been included as it was preceded in every case by prickly heat.

For all comparisons between coastal and inland camps marked with † there is a significantly higher ($P < 0.05$) incidence in the coastal camps.

be compared since living and working conditions for units of the same branch of the Service were similar.

Diseases Obviously Dependent on Climate

Prickly Heat. Only the most severe cases were admitted to the hospital. The real incidence was about one hundred times the admission rate, so great stress is not placed on the comparative data for admissions from the different camps. The actual incidence in one of the coastal camps was greater than 90 per cent. and in one of the inland camps less than 50 per cent.

Anhidrotic heat exhaustion may be considered as some measure of the incidence of severe prickly heat since, at Karachi, this invariably preceded the

anhidrotic syndrome (1). Every case of this syndrome that occurred is known to have been recorded, so that the numerical data in Table 1 are exact, and correspond with the greater severity of the climatic conditions in the coastal area. A fuller discussion on the relation between climate and prickly heat has been made elsewhere (2).

Bullous impetigo. A good description of the severe and extensive nature of this disease as it occurs in the tropics is given by D'Avanzo (3). When it was found at Karachi that it responded dramatically to penicillin, the number of cases needing admission to hospital in the latter part of the hot weather was reduced by the issue of penicillin cream to unit medical officers.

Hydradenitis. This disease also is seen in a much more severe and extensive form in the tropics than in temperature climates (4). It responds to parenteral penicillin, and all severe cases were admitted to hospital.

Combinations of prickly heat, bullous impetigo and hydradenitis in the same patient. Since the incidence of each of these conditions appears to be closely dependent on climate, combination of two or three of them might be expected to occur in the same patient, as they commonly did at Karachi. Six out of 25 cases of hydradenitis and 23 out of 103 cases of bullous impetigo were noted to have marked prickly heat, several cases of anhidrotic heat exhaustion had bullous impetigo when they were first seen, and in some of them it is known to have developed after the onset of anhidrosis. The association of prickly heat and hydradenitis was noticed by Reiss (4) and of prickly heat and bullous impetigo by Bigham (5), Myers (6), D'Avanzo (3) and Robertson (7). Simons (8) stated that bullous impetigo may be followed by hydradenitis.

D'Avanzo (3) also noted that the incidence of bullous impetigo bore no relation to that of impetigo contagiosa and at Karachi only the former was related to climate. O'Brien (9) has recently demonstrated a histological, and possibly etiological, connection between prickly heat and bullous impetigo.

Fungous infections were undoubtedly more common during the hot season, and the unchanged admission rate probably did not mean that the actual incidence was stationary. The peak incidence of admissions after the hottest part of the season is accounted for in part by the larger number of beds that became available for the treatment of these conditions, and in part by the higher incidence of chemical dermatitis and eczematization that often followed the treatment of such cases on units and necessitated subsequent admission to hospital.

Other Skin Diseases

Pyogenic infections of the skin and its appendages (folliculitis, furunculosis and sycosis barbae) occurred throughout the whole year, but showed a slightly higher incidence in the hot season. It was perhaps surprising that the seasonal incidence was not more marked. Impetigo contagiosa was more resistant to treatment during the hot season and this may have accounted for the slight increase in numbers admitted. Acne did not show the expected increase in incidence during the hot season, but there is no doubt that the worst cases were seen at this time, and of the 12 cases returned to the United Kingdom for this

condition during the year under review, 6 occurred in June and July. Scabies occurred in two "epidemics" which had no direct relation to climate. All but three of the cases between December and April occurred at the R.A.F. Station responsible for air-trooping between the United Kingdom and India, and the three other men had recently arrived from Rangoon. There were no further cases after air-trooping ceased. The small group in November was also associated with the arrival of three men by air from the U.K. and all six were from the same unit. A similar experience is recorded by Myers (6).

OBSERVATIONS IN 1947

During 1947 the author, while investigating prickly heat (as a civilian) had the opportunity of observing the incidence of skin diseases both at the Hospital and in individual units in the area. Cases of bullous impetigo and hydradenitis were rare, prickly heat much less common and less severe, and there were never more than twenty to thirty patients in the skin wards, even at the height of the hot weather. The summer was much less uncomfortable than in 1946, although the maximum dry bulb temperature was frequently higher. The minimum temperature and humidity, however, were lower. Detailed meteorological data are published elsewhere (1).

DISCUSSION

The survey revealed a definite effect of temperature differences, but only in some skin diseases did they appear to play a crucial etiological role, when the minimum temperature and humidity were apparently important. In 1946 the minimum temperature was over 78° F. for the four hot months, and in the latter half of June was continuously above the temperature at which sweating is bound to occur even in a naked man at rest. Also, according to Mole (10), the higher the humidity of the air the higher the humidity of the skin and, as each of these climatic factors will increase the humidity of the skin surface, it may be an alteration in this property which predisposes to prickly heat, bullous impetigo and hydradenitis. If so, these conditions should be much less common in dry desert climates, even if the dry bulb temperature is much higher. This is true of prickly heat and is also borne out by the fact that all the published reports on the other two diseases come from humid climates, none from the desert.

While there is obviously a close relationship between prickly heat, hydradenitis and bullous impetigo, the nature of this relationship is still obscure, and it is premature, if not confusing, to include the two last named among the "forms of prickly heat" described by Blomfield (11) and quoted by Manson-Bahr (12), in spite of the recent observations of O'Brien (9).

The environmental factor in fungous infections seemed to be of minor importance, but this may be misleading, for reasons stated earlier. Also, it is in this group that the inevitable deficiencies of such data are probably most significant, as only a complete field survey could have revealed the true incidence. When severity is the principal criterion for admission to hospital, the rate will obviously depend to some extent on the ability of unit medical officers to treat

early cases successfully, bearing in mind that their enthusiasm may sometimes actually increase the numbers eventually requiring admission. However, there was close co-operation with all the unit Medical officers, and it is believed that no major errors have occurred as a result of relying on hospital data as a measure of disease incidence.

SUMMARY

At Karachi, climate was a major factor in the causation of prickly heat, bullous impetigo, and hydradenitis, and of much less importance in the causation of other pyogenic and fungous infections of the skin. The important climatic factors appeared to be the minimum dry bulb temperature and humidity, not the maximum dry bulb temperature. Small differences of a few degrees F. seemed to be important when the minimum temperature was of the order of 80° F. Possible ways in which these factors are effective are discussed.

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