SEASONAL DISTRIBUTION OF MYCOBACTERIAL SKIN ULCERS

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Chronic necrotizing skin ulcers caused by *Mycobacterium ulcerans* are a common and serious disorder in certain parts of the tropics. This infection was first described in Australia, but most of the reported cases have come from Uganda (where the disease is known as Buruli ulcer) and from the Congo. The disease is also known to occur in Nigeria, Ghana, Mexico, and New Guinea. The results of epidemiological studies in Uganda strongly suggest that the disease is not usually transmitted from one person to another, and that there is a non-human source of *Myco. ulcerans* infection (Uganda Buruli Group, 1971). This source remains unknown, but there is some evidence in support of a recent hypothesis that *Myco. ulcerans* occurs on vegetation growing on poorly drained soil, and that Buruli disease is contracted by contact with this vegetation and subsequent penetration of the organism through small scratches or other traumatic lesions in the skin (Barker, 1971).

One implication of this hypothesis is that there will be a seasonal variation in the incidence of Buruli disease in Uganda in accordance with seasonal changes in the vegetation. This paper describes a study of the seasonal occurrence of the disease in Ibuje sub-county of Lango District, Uganda.

In Ibuje there is usually a long period of low rainfall extending from November until the onset of the rains in March. During this period the perennial grasses, which comprise most of the wild vegetation, wither and die down; and some areas of grassland are burnt by the local people. New shoots begin to grow with the rains in April and within three months they have regained heights of up to 10ft (3m) or more. It seems unlikely that *Myco. ulcerans* could survive on the grasses when they wither during the dry season. Neither would one expect the young grass to be infective until it had reached the minimum height which would enable contact with people, and is perhaps necessary for the re-establishment of the

organism. Therefore the hypothesis that Buruli disease is contracted by contact with grasses and other wild vegetation has the implication that transmission of the infection will be reduced at the end of the dry season and the beginning of the rains, that is from about January to April. Since it has been estimated that the interval between infection with *Myco. ulcerans* and the first appearance of the Buruli lesion is usually around two months (Uganda Buruli Group, 1971) this reduced transmission should be reflected as a reduced frequency of lesions whose onset is during the months of March to June.

However, the annual pattern of vegetation drying up during the first three months of the year does not apply to plants growing in permanent swamps. The permanent swamps at the edge of the River Nile are used as a source of water by many households in the Ibuje area, especially during the dry season when the seasonal swamps dry up. Many of the women and girls go to the swamps daily to collect water for household use. Therefore the transmission of *Myco. ulcerans* infection to women and girls may be continued during the dry season. On the other hand, the frequency of the disease may be expected to decline among men and boys, who do not usually collect water, although they may on occasions go to the swamps and rivers to bathe and catch fish. Young children of around 1 to 4 years of either sex are too old to be carried by their mothers and too young to walk to the water to bathe themselves. The fall in disease transmission in this age group should be especially marked.

This analysis of the seasonal distribution of Buruli disease was undertaken to investigate the specific hypothesis that, within the latter part of the dry season and the beginning of the rainy season, that is from about March to June, there is a period of low frequency of onset of lesions among men, boys, and young children of both sexes, but little variation in frequency among women and girls.

METHOD

Clinics for the treatment of Buruli disease have been held in Ibuje sub-county by one of us (W.D.L.R.) since 1968. Attendance at these clinics is not confined to people living within Ibuje sub-county but includes those from other parts of Lango District and from adjacent parts of Bunyoro District on the opposite bank of the Nile. The patients in this study comprise all new cases presenting from 1 December 1969 until 30 November 1970 (this being the only 12-month period when clinics were held regularly every week). Assuming a two months' delay between onset and presentation at the clinic, transmission of the infection to these patients was mainly effected from August 1969 to July 1970. It is to this period that the monthly rainfalls shown in the Figure relate.

During the 12 months under study there were 236 new patients in whom clinical diagnosis and biopsy established the diagnosis of Buruli disease. Of the 236 patients, 41 were unable to give precise information about the month of onset of their lesion and were excluded, leaving 195 patients.

RESULTS

All but 32 of the 195 patients presented at the clinic within two months of the onset of the lesion. The longest delay between onset and presentation was one year. There is reason to doubt the accuracy of information about the time of onset when the patient presents several months after this occurred. Therefore these 32 cases are excluded from the analysis. Their distribution by stated month of onset is shown in Table I. Among the remaining 163 cases there is a monthly fluctuation in the numbers ranging from 4 cases in April to 22 cases in August. When grouped into quarters, with January-March as the first, the numbers are 42, 29, 54, and 38. The frequency of onset of the disease is therefore lowest in April-June and highest in July-September.

In Tables II and III the month of onset of lesions is shown for each age and sex group. Among the 75 male patients there are two periods, April-June and November-January, when the frequency of onset was low (Table II); and there are no cases in which

FIGURE—Monthly rainfall in Ibuje.

the lesion first appeared during April. There is no marked difference between the monthly pattern of onset in each age group. Among the 88 female patients there is a slight fall in frequency during March-April and a peak of 12 cases in whom the lesions first appeared during August, but otherwise the distribution is even throughout the year (Table III). The numbers of cases in the different age groups are too small to permit detailed comparison. However, there is a suggestion that in the 0-4 years and 10-14 years age groups there is a period of low frequency, April-June, similar to that seen in the males.

The observation of a period of low frequency of onset of lesions in the period April-June among males of all ages and females of 0-4 years is in accord with the initial prediction. This is shown in Table IV where the months are grouped into quart-

TABLE I
MONTH OF ONSET OF LESIONS: ALL CASES

Duration of Lesion before Presentation	J	F	M	A	M	J	J	A	S	O	N	D	Totals
2 months or less	11	16	15	4	11	14	15	22	17	16	7	15	163
More than 2 months	4	3	3	4	3	5	2	1	1	0	2	4	32
All cases	15	19	18	8	14	19	17	23	18	16	9	19	195

TABLE II
MONTH OF ONSET OF LESIONS: MALE CASES PRESENTING WITHIN TWO MONTHS OF ONSET

Age-group	J	F	M	A	M	J	J	A	S	O	N	D	Totals
0-4	1	2	2	0	0	1	2	5	2	2	0	2	19
5-9	0	3	4	0	1	4	4	2	3	3	2	1	27
0-14	1	3	2	0	2	1	1	3	4	2	1	2	22
15 and over	1	0	2	0	0	0	1	0	0	2	0	1	7
All age-groups	3	8	10	0	3	6	8	10	9	9	3	6	75

TABLE III
MONTH OF ONSET OF LESIONS: FEMALE CASES PRESENTING WITHIN TWO MONTHS OF ONSET

Age-group	J	F	M	A	M	J	J	A	S	O	N	D	Totals
0-4	0	2	2	0	1	1	2	4	1	3	1	3	20
5-9	3	3	2	3	2	2	1	3	2	1	0	3	25
10-14	3	2	0	1	1	0	1	2	3	2	3	2	20
15 and over	2	1	1	0	4	5	3	3	2	1	0	1	23
All age-groups	8	8	5	4	8	8	7	12	8	7	4	9	88

TABLE IV
ONSET OF LESIONS BY QUARTER OF THE YEAR: ALL CASES PRESENTING WITHIN TWO MONTHS OF ONSET

Sex and Age-group	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Totals
Males					
0-4	5	1	9	4	19
5-9	7	5	9	6	27
10-14	6	3	8	5	22
15+	3	0	1	3	7
Females					
0-4	4	2	7	7	20
5-9	8	7	6	4	25
10-14	5	2	6	7	20
15+	4	9	8	2	23
All males + females 0-4	25	11	34	25	95
Females 5 and over	17	18	20	13	68

TABLE V
PRESENTATION OF CASES BY QUARTER OF THE YEAR: CASES PRESENTING MORE THAN TWO MONTHS AFTER ONSET

Sex and Age-group	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Totals
All males + females 0-4	3	3	4	3	13
Females 5 and over	4	6	7	2	19

TABLE VI
ONSET OF LESIONS BY QUARTER OF THE YEAR ACCORDING TO DOMICILE: CASES PRESENTING WITHIN TWO MONTHS OF ONSET

Sex and Age-group	Domicile	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Totals
All males + females 0-4	Ibuje	18	9	21	13	61
	Outside					
	Ibuje	7	2	13	12	34
Females 5 and over	Ibuje	11	11	14	8	44
	Outside					
	Ibuje	6	7	6	5	24

ers so as to make April-June one quarter. Adding the figures for all males to those of females of 0-4 years there is a striking fall in frequency during the April-June period. This is not seen among females of 5 and over for whom the distribution of onset is more even throughout the year.

It is necessary to determine whether these findings can be attributed to seasonal variations in patients' willingness to attend the clinic. Table V shows the quarterly presentation at the clinic for the 32 longstanding cases who delayed presentation until more than two months after the onset of the lesion. Among the males and the females of 0-4 the time of presentation is distributed evenly throughout the year. This suggests that the fall in frequency of onset of lesions in April-June, among males and young females with lesions of short duration, cannot be attributed to an unwillingness of patients in this sex and age group to present at the clinic during these months. If they deferred attendance at the clinic during April-June, perhaps because of the need to clear the land and plant crops at this time, one might expect a consequent increase in the number of longstanding cases presenting at the end of the period. If the demands of cultivation made patients who develop lesions in April-June unwilling to attend the clinic it seems likely that this would also affect the women and girls, who do much of the agricultural work. Table V suggests that women and girls are not unwilling to attend the clinic during April-September. Indeed they seem more willing to attend then than during the other half of the year.

Table VI shows the distribution of onset of lesions according to whether or not the patients lived within the sub-county of Ibutje, where the clinic is held. The patients are again divided into two groups, males with young females, and females of 5 and over. The distribution of onset of lesions within the two groups does not differ for those living in Ibutje or outside it. These findings suggest that the seasonal pattern of onset of lesions among cases presenting at Ibutje clinic is not determined by seasonal changes in the willingness of people to travel long distances to attend the clinic.

DISCUSSION

The findings in this study are in general agreement with observations made on 165 Ruandese patients living within Kinyara refugee settlement in Bunyoro District, Uganda (Uganda Buruli Group, 1971). Comparison of these observations with those made in Ibutje is complicated by differences in the use made of local swamps as a source of water. Within the refugee settlement there were boreholes, and the

seasonal pattern of use of the swamps was determined by the proximity of each family's hut to these boreholes and the recurrent breakages of the borehole pumps. In addition, the habits of the refugees differed from those of the surrounding people in that the men more often carried out domestic tasks, such as fetching water, which are usually left to the women. Interpretation of the findings at Kinyara was further complicated by a BCG trial started during 1967, which reduced the incidence of the disease. However, it was concluded that the transmission of *Myco. ulcerans* infection in Kinyara was lowest from April to June, and that male patients showed a more marked seasonal variation in disease frequency than females. In Ibutje among males of all ages and young females of 0-4 years, there was a decline in onset of lesions during April-June, suggesting a decline in transmission during February-April. This period of low transmission was followed by one of increased transmission during May-July (Table IV).

A seasonal fluctuation in infection by mycobacteria from an environmental source has been reported in Suffolk, England (Stewart, Dixon, and Curtis, 1970). Observations on mycobacteria other than *Myco. tuberculosis* isolated from tonsils, lymph nodes, nose and throat swabs suggested that there may be an environmental source of mycobacteria which is present predominantly during the spring months.

The findings at Ibutje are in accord with the initial predictions. Although other hypotheses could also accommodate these observations, it may be concluded that the demonstration of the predicted decline in transmission of Buruli disease at the end of the dry season gives some support to the hypothesis that the disease is transmitted by contact with vegetation.

SUMMARY

A recent hypothesis suggests that *Myco. ulcerans*, the organism causing Buruli ulcer, is transmitted to man through contact with vegetation growing in poorly drained soil. An implication of this hypothesis is that during the dry season in Uganda there will be a decline in transmission of the disease to men, boys, and very young children of both sexes. A study has been made of the seasonal occurrence of the disease in one district of Uganda. The results are in accord with the prediction made from the hypothesis.

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