

## THE TRIBAL DISTRIBUTION OF ENDOMYOCARDIAL FIBROSIS IN UGANDA

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Endomyocardial fibrosis (EMF) is a relatively common form of heart disease in Uganda and accounts for about 14 per cent of subjects with clinical cardiovascular disease admitted to Mulago Hospital, Kampala (Shaper and Williams, 1960) and for 10 per cent of heart disease seen at necropsy (Davies, 1961). Though there have been pathological and clinical descriptions of this disorder (Davies, 1948; Davies and Ball, 1955; Williams, Ball, and Davies, 1954; Shillingford and Somers, 1961), the aetiology of EMF remains obscure, and its relation to the obscure forms of heart disease seen in Nigeria (Abrahams and Brigden, 1961; Edington and Jackson, 1963) and in South Africa (Becker, 1963) is uncertain.

Mulago Hospital, Kampala, is situated in the Kingdom of Buganda, the largest province of Uganda, and about half the patients admitted to the hospital belong to the local Ganda tribe. There is also a large immigrant population in Buganda coming in particular from Ruanda-Urundi (now Ruanda and Burundi)\* and from Western Province of Uganda (Kigezi, Ankole, Toro, and Bunyoro districts). In an early report on the distribution and nature of EMF it was noted that the highest incidence was amongst immigrant labourers from Ruanda-Urundi (Ball, Williams, and Davies, 1954). The possibility that the Ruanda immigrants might have an increased susceptibility to EMF was further examined in a general analysis of medical admissions to Mulago Hospital (Shaper and Shaper, 1958) and in more detailed study of cardiovascular disorders seen at that hospital (Shaper and Williams, 1960). In an attempt to assess more accurately the question of tribal predominance, the present study examines the age, sex, and tribal distribution of subjects in whom the presence of EMF had been established at necropsy (Shaper and Wright, 1963) and discusses the environmental and other factors that might be correlated with tribal predominance.

### SUBJECTS AND METHODS

The necropsy records of Mulago Hospital, Kampala, were studied for the years 1950–1961 and all cases in which a diagnosis of endomyocardial fibrosis or necrosis had been established were included in this study. Several cases in which endomyocardial fibrosis was of a moderate degree occur in this series and no attempt has been made to include only advanced cases. Death was not always due to the presence of endomyocardial fibrosis. Two subjects diagnosed at necropsy as having endomyocardial necrosis have been included in this series as they possibly represent the more acute lesions of the endomyocardial fibrosis syndrome. The

\* As all the material discussed in this paper is from the period preceding the independence of Ruanda and Burundi the term "Ruanda-Urundi" is used throughout.

TABLE I  
THE OBSERVED AND EXPECTED DISTRIBUTION BY SEX, AGE, AND TRIBE OF SUBJECTS WITH ENDOMYOCARDIAL FIBROSIS  
(Expected numbers in brackets)

Age* (yr.)	Ganda		Ruanda		Ankole		Others	
	M	F	M	F	M	F	M	F
1-4	0 (1.1)	0 (—)	3 (1.0)	0 (—)	0 (0.1)	0 (—)	0 (0.9)	0 (—)
5-14	2 (1.6)	0 (2.7)	1 (0.2)	5 (1.6)	1 (0.2)	1 (0.1)	0 (1.3)	0 (1.5)
15-24	0 (3.5)	2 (2.7)	16 (6.1)	4 (1.4)	1 (1.1)	0 (0.5)	1 (7.2)	0 (1.2)
25-34	1 (5.7)	1 (4.6)	25 (9.9)	6 (3.1)	1 (1.4)	4 (0.7)	3 (13.0)	0 (2.6)
35-44	2 (6.1)	2 (3.2)	15 (6.3)	4 (1.4)	1 (1.2)	0 (0.6)	6 (10.4)	1 (1.8)
45-54	2 (3.5)	1 (1.2)	2 (1.4)	1 (0.2)	2 (0.5)	0 (0.1)	3 (3.5)	0 (0.5)
55-64	1 (1.5)	0	0 (0.3)	0 (—)	0 (0.1)	0 (—)	2 (1.0)	0 (—)
Total	8† (23.1)	6 (14.3)	62 (26.0)	20 (7.7)	6 (4.6)	5 (2.1)	15 (37.3)	1 (8.0)

\* Plus one male Ganda age unknown to give a total of 9 Ganda males.

† There were no cases of EMF under 1 year or over 65 years of age.

TABLE II  
NECROPSY RATES IN THE VARIOUS TRIBAL GROUPS AT MULAGO HOSPITAL 1950-61

	Ganda		Ruanda		Ankole		Others		Total	
	M	F	M	F	M	F	M	F	M	F
Deaths .. ..	3296	1891	1684	506	365	143	3201	905	8546	3445
Necropsy .. ..	1414	638	1202	300	233	80	1995	376	4844	1394
Necropsy rate (%)	43	34	71	59	64	56	62	42	57	41
Tribal necropsy rate .. ..	40%		69%		62%		58%		52%	

material comprises 124 African subjects and information on tribe and sex was available in all and an age assessment had been made in 123 cases. The age and sex distribution of cases of EMF in the various tribal groups is shown in Table I.

The Mulago Hospital register of deaths and necropsies for the years 1950-1961 was studied and an analysis made by tribe, age, and sex to establish the necropsies for these various groups. Stillbirths and medico-legal cases were included in the series, the former comprising 3.5 per cent and the latter about 15 per cent of all necropsies carried out. The analysis of deaths and necropsies by sex, tribe, and age was made for each year separately and a table drawn up for the whole 12-year period under review. A summary of this analysis is given in Table II.\*

By reference to the observed figures for EMF (Table I) and the detailed table of necropsies from which the summary in Table II is derived, the expected number of deaths due to EMF in each sex, age, and tribal group (if there was no difference in incidence between the tribes) can be calculated by simple proportion.

For example, 163 necropsies were performed on males aged 1 to 4 years in the 1950-1961 period and 3 cases of EMF were observed. Since 58 necropsies among male children in this age-group were from the Ganda tribe, the number of EMF cases *expected* for male Ganda subjects aged 1-4 years can be calculated as  $\frac{58 \times 3}{163} = 1.1$ . A similar calculation for all other age, sex, and tribal groups leads to the figures presented in Table I in which the observed distribution of necropsy cases of EMF is compared with the expected distribution. Male and female figures in each tribal group were then summed and a  $\chi^2$  test was done for the series as a whole.

\* Copies of the full analysis of deaths/necropsies 1950-1961 are available on request.

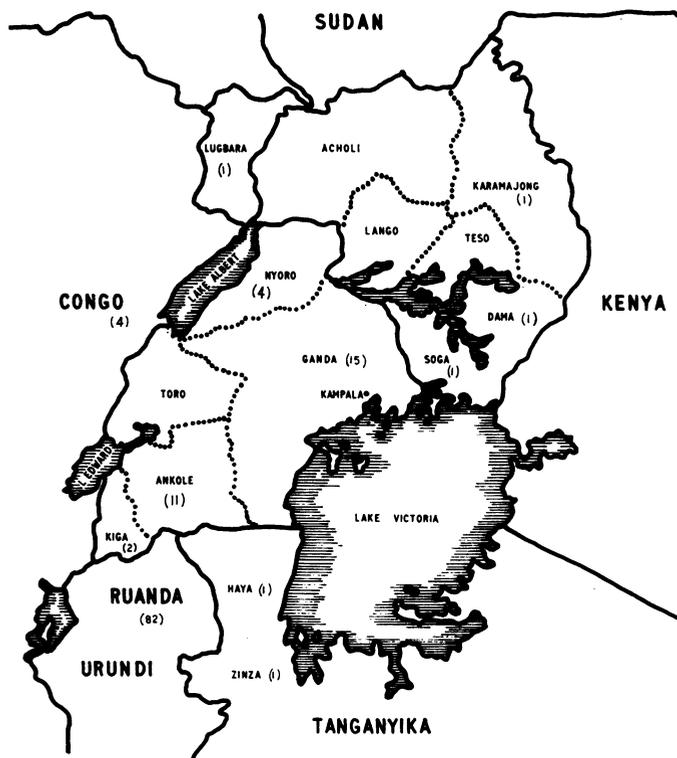


FIG. 1.—The distribution by tribal origin of subjects with EMF coming to necropsy at Mulago Hospital, Kampala. Number of subjects in brackets.

### RESULTS

It can be seen from Table I and Fig. 1 that only 15 (12%) of 124 EMF cases were from the local Ganda tribe, and the remaining 109 (88%) cases were from several tribes all of whom were immigrant to Buganda. Subjects from Ruanda-Urundi provide 82 of these 109 cases, i.e. two-thirds of all patients coming to necropsy through EMF in the period under examination. The value of probability resulting from the  $\chi^2$  test is infinitesimally small and inspection shows that this is principally due to an excess among the Ruanda tribe, though there is also some excess among the Ankole group.

The number of EMF cases in each of the tribal groups included under "other tribes" is too small to draw any valid statistical conclusions, but it may be of interest to note that in the tribal group coming to necropsy most frequently after the Ganda, Ruanda, and Ankole groups, i.e. the Toro tribe, no cases of EMF were recorded though EMF cases were recorded in several tribal groups coming to necropsy far less frequently.

The number of cases of EMF found at necropsy in any tribal group may also be expressed as a percentage of all such examinations performed on members of that tribe. The incidence is substantially higher in the Ruanda-Urundi group (5.4%) than in the Ganda tribe (0.73%) or "other tribes" (0.67%), while the Ankole occupy an intermediate position (3.51%).

### DISCUSSION

It is reasonable to state that at the present time virtually nothing is known regarding the aetiology of endomyocardial fibrosis in Uganda though almost every report on the clinical or pathological findings discusses the various possibilities. This study has been carried out in an attempt to

TABLE III  
 PERCENTAGE CONTRIBUTION OF TWO LARGE TRIBAL GROUPS TO CHRONIC RHEUMATIC HEART DISEASE AND ENDOMYOCARDIAL FIBROSIS BY SEX, COMPARED WITH THEIR PERCENTAGE CONTRIBUTION TO THE MEDICAL ADMISSIONS  
 (SHAPER AND WILLIAMS, 1960)

Percentage contribution to	Male		Female	
	Ganda	Ruanda	Ganda	Ruanda
Total medical admissions .. .. .	35	21	64	13
Rheumatic heart disease .. .. .	41	19	63	16
Endomyocardial fibrosis .. .. .	19	57	34	38

discover whether any group of subjects examined after death at Mulago Hospital is particularly susceptible to this obscure heart disease and to see whether any increased susceptibility that may emerge from this analysis can be related to environmental or other factors.

Williams and his colleagues (1954) noted a preponderance of the Baganda groups among those diagnosed clinically and a preponderance of Ruanda-Urundi subjects among those coming to necropsy. EMF was the cause of death in 3 per cent of such examinations on Ruanda-Urundi subjects and 1.2 per cent in other subjects. This preponderance does not necessarily mean that these folk are more prone to EMF than others, since they are more likely to stay on in hospital when seriously ill, and more likely to come to necropsy than patients who have settled homes and families in the neighbourhood.

In a study of cardiovascular disorders seen at Mulago Hospital over a three-year period, a comparison was made between the contributions to the EMF and chronic rheumatic heart disease (RHD) groups by subjects from Ruanda-Urundi and by the Ganda tribe (Table III) (Shaper and Williams, 1960).

In chronic RHD the percentage contribution made to the medical admissions and to the disease group was strikingly similar, i.e. Ganda and Ruanda males and females contributed to the RHD group in proportion to their admission rates to the hospital. In EMF, the Ganda males and females contributed a far smaller percentage to the disease group than expected from their percentage contribution to admissions; on the other hand the Ruanda males and females contributed to the EMF group almost three times their percentage contribution to the medical admissions.

As the diagnosis of EMF and RHD in this study was confirmed at necropsy in only 25 per cent of cases in each disease group, this was regarded as a study in approximations and the present survey avoids this problem of diagnostic uncertainty by dealing only with those cases of pathologically proven EMF.

The question must be asked whether the difference in EMF incidence at necropsy between the various tribal groups demonstrated in this paper could be entirely due to the selective factors that go into determining whether or not the patient is admitted to hospital, dies in hospital, or has necropsy.

In Table II a summary of the detailed analysis of deaths and necropsies at Mulago Hospital 1950-1961 is presented in order to indicate the relative rates for those tribes in whom EMF is most commonly seen. It is evident that both for males and females there is a greater possibility of a necropsy being carried out among subjects from the Ruanda, Ankole, and "other" groups than in the Ganda group. Thus, if there was a special interest in EMF with consequent pressure to get the examination made one might expect a higher proportion to show EMF amongst the non-Ganda tribes. There are, however, far more necropsies carried out over-all in the Ganda tribe than in any other single tribe and it seems highly unlikely that the substantial difference seen in Table I between the observed and expected incidence of EMF could be produced by the differences in necropsy rate shown in Table II. Further, in a parallel pathological study of chronic rheumatic heart disease in Mulago Hospital, there are three to four times as many Ganda subjects with chronic rheumatic heart disease as Ruanda subjects (A. G. Shaper, 1964, unpublished observations). It seems un-

reasonable to suggest that when EMF is the suspected diagnosis more examinations are obtained in Ruanda subjects and when RHD is suspected more are obtained in Ganda subjects. The differential diagnosis between these two conditions can be extremely difficult and sometimes impossible to make. Many subjects with EMF proved at necropsy bear a diagnosis of "heart failure of unknown ætiology", and EMF is not the cause of death in all cases where this condition is found. It is also important to note that the tribal origin of a patient has never been regarded as a factor in the differential diagnosis of obscure heart failure nor in distinguishing between a diagnosis of EMF and RHD. The suggestion that the predominance of EMF amongst the Ruanda group is due to selective factors does not seem tenable.

There seems no reasonable doubt that the immigrant group from Ruanda-Urundi are particularly liable to develop EMF, while the local Ganda tribe appear to be less susceptible than the immigrant groups. The observed incidence of EMF cases in the Ankole group is an excess of the expected incidence, but the numbers involved are small and this finding can only be regarded as suggestive of a possible increase in the susceptibility of the Ankole group to EMF.

Buganda is one of the richest parts of Uganda, and it has a very mixed population, the indigenous Ganda tribe comprising only 55 per cent of the inhabitants of this province. The largest group of immigrants into Buganda are the men and women from Ruanda-Urundi who account for nearly 20 per cent of the total population of Buganda, while immigrants from Ankole constitute another 5 per cent (Uganda Census, 1959). The male: female ratio in the Ruanda-Urundi group in Buganda of 1.6 to 1.0 emphasizes their migrant nature but it is possibly even more important to note that some 25–35 per cent of the Ruanda recorded in the 1959 census were born in Buganda. This large-scale immigration has been a major feature of Buganda for over 40 years, the immigrants coming as unskilled labourers partly to work in industrial and other enterprises but in the main to work for the Ganda people in their smallholdings.

The immigration described began to develop on a large scale in about 1923 and the main cause then, as now, appears to be sheer economic necessity. The average density of population in Ruanda-Urundi is the highest in central Africa and the "picture is simply one of movement from a poor overpopulated area to an unusually wealthy one; from one mainly at a subsistence level to one where the population is largely engaged on the production of cash crops" (Richards, 1954). The immigrants are predominantly from the serf or Hutu class of Bantu origin who comprise 85–90 per cent of the population and members of the Hamitic Tutsi class are less frequently encountered.\*

In the past the distressing condition of these immigrants en route to Uganda and the sickness and death rates in Kampala camps aroused considerable concern and anxiety (Annual Medical and Sanitary Report, Uganda, 1926). With each succeeding famine in Ruanda-Urundi the immigration rate increased and in 1930 it was suggested that camps be established on the migration route for the treatment of easily cured conditions and for the repatriation of those who were so debilitated as to be unemployable. The first of these camps was established only in 1940, and by 1942, when there was a fall in employment in Buganda, "the problem of the existence of half-starving unemployed immigrants in the centre of Buganda arose, with all its implications from the medical point of view" (Richards, 1954). By 1949 it was recorded that the previous distressing conditions no longer obtained, the improvement probably being due to the introduction of bus services along the migration routes. Conditions have steadily improved since then, but it remains true up to the present time that the immigrants from Ruanda-Urundi occupy the lowest levels of the socio-economic scale in Buganda.

In Ruanda-Urundi the standards of nutrition in the population are low, and food shortage and famine are recurrent. The diet is largely vegetarian with grains, sweet potatoes, and *légumes* in the uplands and plantains and cassava in the tropical districts. When one considers the present living conditions of these immigrants in Buganda and has to presume that they are better off in Buganda

\* This comment precedes the disturbances of 1963–64 and the large-scale immigration of the Tutsi people to Uganda.

than at home, their desire to leave Ruanda-Urundi becomes readily understandable. In nutrition surveys carried out by a W.H.O. team (Gongora and Norris, 1958) it was apparent that the Ruanda adults and children in Uganda were in a far worse general state of health than the Ganda subjects and the percentage of children born who died before reaching the age of 14 years was higher in the Ruanda group (48%) than in any other tribal group studied. The diet of the Ruanda immigrants was far below their estimated caloric requirement and while the Ganda had more meat, milk, fish, and fat than any other group, the Ruanda immigrants had far less. It is of interest to note that in Buganda the staple foods of the immigrants were maize meal, sweet potato, cassava, fresh beans, and plantains, and that their intake of plantain was half of that taken by the Ganda subjects (Gongora and Norris, 1958).

Early opinion from Kampala on the aetiology of EMF can best be summarized by the statement that "virus infection, some antigen-antibody reaction and malnutrition are possible aetiological factors in the form of EMF common in Uganda" (Davies and Ball, 1955). On the basis of the similarity in age structure and certain clinical and pathological findings, it was later suggested that EMF might represent a modified form of rheumatic heart disease (Shaper and Williams, 1960). From studies of an unusual form of heart disease in Southern Nigeria probably identical with EMF seen in Uganda, Abrahams (1959) initially concluded that this appeared to be "an unusual expression of the rheumatic process", though later opinion from Nigeria was more cautious; "It is *not* suggested that this is caused by rheumatic carditis but that cardiomyopathy, whether due to inflammation, nutritional deficiency, or other metabolic disorder, may during an acute phase precipitate mural intratrabecular clots which subsequently become organized. This process may be recurrent and lead to EMF". "It seems probable that EMF is the final common path resulting from many different forms of myocardial damage. In Southern Nigeria we suggest that rheumatic carditis may be concerned with this process in some cases" (Abrahams and Brigden, 1961).

The Nigerian workers stress the background of chronic anæmia, intestinal parasitism, malaria, dysentery, and protein malnutrition present in the population from which their patients are drawn and suggest that the peculiar pattern of this disease may be determined not only by its primary cause but also by the background factors. These factors, common to so many parts of Africa, affect both the Ganda and Ruanda groups in Uganda, but the effects would certainly be most manifest in the impoverished immigrant labourers.

The fibrotic heart lesions of carcinoid disease are associated with a high level of serotonin in the blood and as the plantain contains large quantities of serotonin it has been suggested (Arnott, 1959) that the plantain diet may be an important environmental factor in the development of endomyocardial fibrosis. This suggestion has been further examined by Crawford (1962) in Uganda and by Foy and Parratt (1962) in Nigeria. The latter workers suggest that "continued ingestion of foods containing serotonin might well contribute to the production of lesions similar to those found in endomyocardial fibrosis". This hypothesis and the possible mechanisms have been recently reviewed by Crawford (1963) who concludes that "the evidence suggests that serotonin by itself is not of importance", and we have already noted that the Ganda eat far more plantain than the Ruanda group and do so far more regularly. Unless it is postulated that the serotonin derived from the plantain diet is not normally "detoxicated" in poorly nourished subjects such as the Ruanda immigrants, it seems unlikely that a diet rich in serotonin will initiate the lesions described in EMF, though it is still possible that this may be a contributory factor in the production of the final picture.

Our findings in this study suggest that whatever the initiating factor in this disorder, a state of increased susceptibility is associated with extremely poor socio-economic conditions, and that a degree of protection is conferred by a dietary and social background which would still be regarded as sub-optimal by western standards. While this chronic state of sub-nutrition in the Ruanda immigrants may be the major background factor we have not yet determined the role of parasitism or of the increased exposure and susceptibility to bacterial and viral infections which may be associated with the inferior economic and social situation of these immigrants.

## SUMMARY

Analysis of the tribal distribution of endomyocardial fibrosis coming to necropsy at Mulago Hospital in the period 1950–1961 shows a conspicuous preponderance among immigrants to Buganda, in particular those coming from Ruanda-Urundi. The condition occurs less frequently than expected among the indigenous Ganda tribe. It is concluded that an increased susceptibility to this disorder is associated with extremely poor socio-economic conditions. A chronic state of sub-nutrition, primarily dietary in origin but modified by many endemic diseases, constitutes the characteristic background to this disorder as seen in Uganda.

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