

For example, mount a series of specific disease control programmes through immunisation, drug programmes, insecticides and of course multi-disease control by environmental engineering. But these are not a substitute for primary health care which involves attention to community felt wants for relief of pain, care when sick and MCH services. Specific programmes merely fulfil health needs as seen by the professional — that is control of the communicable diseases, the conquest of malnutrition and the stabilisation of the fertility rate. (A recent article in the *New England Journal of Medicine* highlights some of these issues under the title of "selective primary health care").⁷

However, the long-term solution must lie in setting up the basic foundation for a health service upon which a variety of programmes can be grafted and which can be adapted to integrated rural development programmes.

To these six restraints to socio-economic development (namely, the limited financial resources, the inadequate educational base, the wasteful demographic pattern, the epidemiological picture, the malnutrition and culture) must be added the constraints fashioned by the conceptual approach. Whilst the restraints impose impediments, the constraints have placed development in a straight-jacket: the straight-jacket of economic development.

The removal of that conceptual straight-jacket is our professional responsibility. We are responsible for ensuring that politicians, who are the decision makers and pace setters, receive the right guidance. In proffering that guidance the question we must ask of ourselves is "What is in the best interest of the community as a whole, not what is in the best interest of this or that particular section of medicine".

TO BE CONTINUED.

Studies on the Incidence and Seasonal Pattern of Hookworm Infection in Lactating Mothers and the Possible Transmission to Infants Via the Breastmilk, in Mombasa and Machakos, Kenya.

by

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SUMMARY

A study was carried out to determine if arrested development and transmammary transmission of hookworm occurred in the Machakos and Mombasa areas of Kenya. Although post natal maternity cases had a higher incidence of hookworm than that shown by hospital laboratory records for other sectors of the community, examination of breastmilk samples showed no infective larvae, and no marked seasonal pattern of hookworm incidence was observed indicating that arrest and milkborne transmission may not be an important feature of hookworm epidemiology in Kenya. Moreover the only species of hookworm observed was *Necator americanus* and it is suggested that with the provision of rural and urban health facilities and the use of modern anthelmintics *Ancylostoma duodenale* is now rare in Kenya and no longer constitutes a public health problem.

INTRODUCTION

The distribution of both species of human hookworm, *Necator americanus* and *Ancylostoma duodenale* in Kenya although not precisely mapped has been studied to some extent in the past.^{1,2} Clearly the predominant species in the country is *N. americanus* which occurs extensively along a wide coastal belt, around Lake Victoria in the West, in the Machakos and Nyeri districts and elsewhere in isolated pockets, whereas *A. duodenale* is thought to be restricted to the coastal region where it occurs associated with *N. americanus*.² There is little recent information on the distribution of these two species in Kenya, yet such information is necessary to evaluate their public health importance because of differences in the pathogenicity and susceptibility to anthelmintics shown by the two species.³ Moreover recent detailed studies by Nawalinski *et al*⁴ and Schad *et al*⁵ from West Bengal,

indicating that arrested development or hyopbriosis of migratory larvae may be a normal feature of the life cycle of *A. duodenale* and related to the monsoon period, suggest that the epidemiology and transmission of the two hookworm species may also be rather different.

In those nematodes in which arrest of the larval stage has been demonstrated, transmission to the newborn has been shown to occur, in many cases by the arrested larvae continuing their migration to the mammary glands and thence to infect the young via the milk. Several reports indicate that pups become infected with *A. caninum*, a species closely related to *A. duodenale* by this method.^{6,7,8} However this mode of infection appears to depend on two features of the life cycle, somatic migration of the larvae, and arrested development at this stage. As yet arrest has not been demonstrated in *N. americanus* and transmammmary transmission of either *A. duodenale* or *N. americanus* has not been studied in the population of Kenya where a bimodal rainfall pattern occurs, and where a different pattern of arrest and development from that described from West Bengal may emerge.

A study was planned to determine if newly delivered mothers in two areas of Kenya were passing infective or fourth stage hookworm larvae to their infants during breast-feeding.

Materials and Methods

Areas and period of study.

In-patients in the post-natal wards of Machakos Provincial and Mombasa General Hospitals were included in the study. The wards of each hospital were visited once per month for one year and samples and biographical information including age, tribe and location were collected from fifteen to thirty patients each month. The study continued for one year to determine seasonal fluctuations in incidence and intensity of infection and, if arrested development or transmammmary transmission occurred, to determine if this was also based on seasonal or climatic factors.

Stool examination

Stool samples from patients were examined using the formol ether concentration method to identify all intestinal helminths and protozoa, and any showing hookworm ova were preserved in formol saline for later sizing. A faecal egg count was carried out on all stools showing hookworm ova using the McMaster technique and correcting for stool consistency according

to Nawalinski *et al*⁹. If sufficient stool was available a culture was also made for seven days at 25°C by the Harada-Mori method to identify hookworm species at the infective larval stage.

Stools from infants in the nursery of the hospital up to four weeks of age were collected wherever possible and examined for hookworm eggs to give presumptive evidence of transmammmary transmission of hookworm larvae.

Milk examination

Breastmilk was expressed by hand from each patient into a sterile container. In normal deliveries patients were discharged 24 to 48 hours after delivery, thus in some cases colostrum was collected. The quantity of breastmilk varied from a few drops to approximately 50 ml. If the quantity was small physiological saline was added to make handling easier. All milk samples were spun at approximately 1000 rpm for five minutes and the sediment examined under the dissecting microscope for the presence of third or fourth stage hookworm larvae or indeed any parasites.

RESULTS

Infection rate

The rate of hookworm infections among the post natal patients in both Mombasa and Machakos Hospitals are shown in Fig. 1 and compared with the percentage of positive stools among all samples processed by the hospital laboratory, approximately 1000 each month. In both areas studied the rate observed among maternity cases is higher than that observed from hospital records. The rate in Machakos mothers varied between a peak at 50% and the lowest level at 0% but the fluctuations were normally between approximately 20% to 45%. However laboratory records show that the infection rate remains remarkably constant between 5 and 13%.

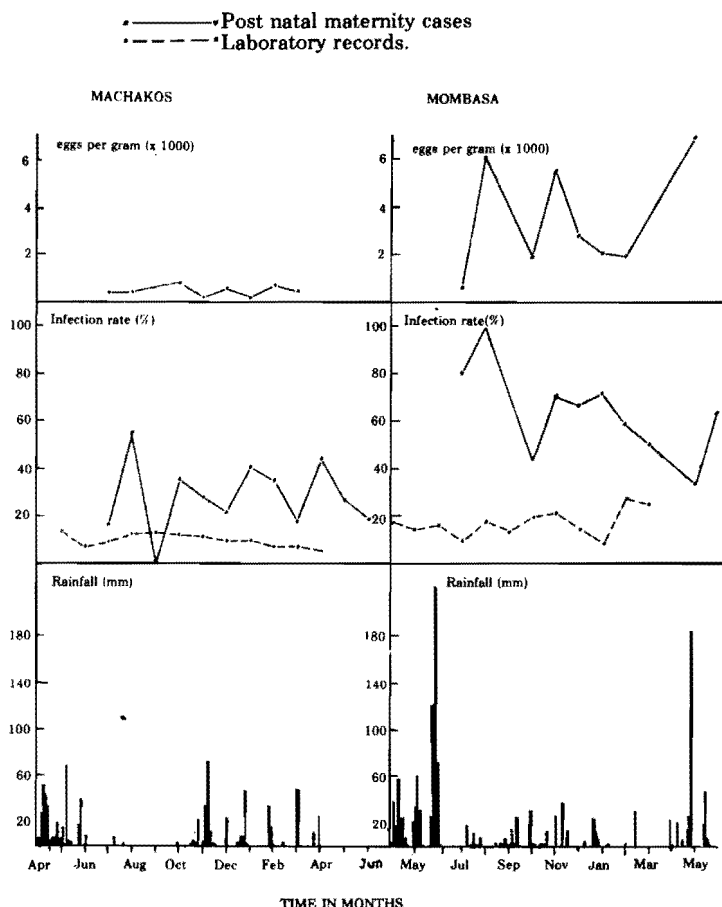
The infection rate among Mombasa mothers was markedly higher than from Machakos varying between extremes of 43 and 100% but normally between about 43 and 70%. The laboratory records also showed a higher rate of infection than from Machakos, 9 to 27% although again being much lower than the levels reached among the post-natal cases.

No eggs were ever detected in the stool from infants.

Intensity of infection

The intensity of infection as shown by the mean egg output in eggs per gram of faeces corrected for consistency in maturity patients is also shown in Fig. 1. In Machakos the mean egg

Fig. 1. The incidence (as percentage) and intensity (as eggs per gram of faeces) of hookworm infection in post natal maternity patients compared with hospital laboratory records at Machakos and Mombasa Hospitals correlated with rainfall data during the course of one year.



output remained very uniform throughout the year between 200 and 800 epg, while at Mombasa the output fluctuated widely between 600 and 7000 epg. The results of faecal egg counts were classified according to the intensity of infection following the categories adopted by Miller,¹ namely less than 500 epg, 501 - 1000 epg, 1001 - 2000 epg and more than 2000 epg. The total numbers of samples within each category during the year for the two areas studied are shown in Table 1. Samples from Machakos show a lower intensity of infection than those from Mombasa with more patients in the lower categories, whereas in Mombasa more patients showed high egg counts, in some cases well over 6000 epg was frequently observed.

Table 1. The intensity of hookworm infection in post natal maternity patients from Machakos and Mombasa areas.

No. of patients with faecal egg counts (epg) in range:—

	100 - 499	500- 999	1000- 1999	2000 —	Total
Machakos	25	8	5	1	39
Mombasa	14	3	2	17	36

Meteorological data

The rainfall in mms during the year of study is also shown in Fig. 1 but there seemed to be no seasonal pattern in either infection rate or intensity correlating closely with rainfall. The rainfall was lower throughout the year in Machakos than in Mombasa. In both cases most rain fell during April and May followed by a cold dry period from June to September and October with another rainy period during November and December.

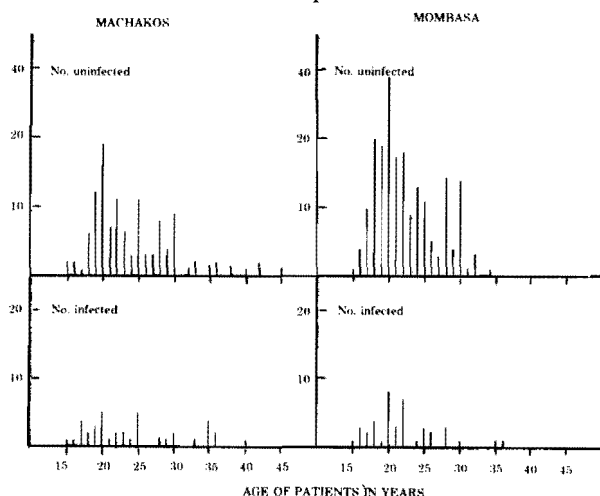
The temperatures in each area varied between a maximum of 37.8°C and 35.6°C and a minimum of 6.1°C and 18.1°C for Machakos and Mombasa respectively. In both areas the lowest maximum and minimum temperatures occurred during July and August with the highest during February, March and April.

Age and tribe distribution

The numbers of mothers of different ages with and without hookworm infection is shown in Fig. 2. The age distribution patterns of patients in both Machakos and Mombasa were much the same in infected and uninfected patients in each case being highest between 18 and 24 years of age in Mombasa and between 19 and 25 years of age in Machakos. Thus mothers of all ages were equally likely to be infected.

In Machakos almost all patients were *Mkumba*, whereas in Mombasa all Kenya tribes were represented, and infected patients belonged to a wide variety of these tribes, no one tribe being more or less frequently infected.

Fig. 2. The age distribution of post natal maternity patients with and without hookworm at Machakos and Mombasa Hospitals.



Species of hookworm observed.

As all patients were routinely given an enema immediately before delivery it was not possible for all of them to provide stool samples. Thus during the year 100 stools from Mombasa and 200 stools from Machakos were collected. Although not all of these provided sufficient stool for all techniques to be done, in all those cultured to the infective larval stage the only species identified was *N. americanus*.

This was confirmed by sizing the eggs using the microscope and the ZBI coulter counter. In both methods eggs from Machakos and Mombasa were in the size range 60-70 μm x 35-45 μm .

Other parasites observed

The most common parasites observed were the non-pathogenic amoebae including *Entamoeba coli*, *Iodamoeba butschlii* and *Endolimax nana*. Of the pathogenic parasites in both regions after hookworm, *Ascaris* was the most prevalent followed closely by *Trichuris* and *Entamoeba histolytica* with occasionally *S. mansoni*, particularly in Machakos, and also *Strongyloides*, tapeworm and *Giardia*.

Milk examination

260 samples from Machakos and 281 samples from Mombasa were examined over the course of one year. No parasites of any species were observed in the breastmilk samples.

DISCUSSION

The rates of infection in the post-natal mothers from both areas studied, were considerably higher than the rates of hookworm infection among all stool samples examined in the hospital laboratories through the year. As the same techniques were used in each case this suggests that pregnant mothers may be more susceptible to infection by hookworm larvae, possibly due to depression of the immune response which occurs during pregnancy and lactation. In this case this section of the community may constitute a problem in the transmission and epidemiology of this disease, particularly as they are in close contact with susceptible uninfected hosts.

The figures from Machakos showed no marked seasonal pattern either in infection rate among laboratory samples or among maternity cases or in the intensity of infection as measured by faecal egg output. The figures from Mombasa showed greater fluctuations in both rate and intensity of infection and although showed lowest figures during October and after the hot dry season of December to April with increases after the periods of heavy rain in May, the numbers of samples from maternity cases are too small to allow detailed statistical analysis such as that done by Miller¹ who demonstrated that rainfall appeared to be the limiting climatic factor to incidence of infection. He also confirmed earlier work by Chandler¹⁰ that a dynamic equilibrium in turnover of infection exists whereby adult worms are lost and acquired over a six month period, in the normal population of a village. It is possible however that under the conditions of immune depression prevailing within certain hosts, such as pregnant and lactating mothers, worms are not lost so readily, thereby increasing the incidence and perhaps the intensity of infection in these hosts above that observed in other sections of the community.

All maternity patients are given an enema immediately before delivery and although up to 30 patients were visited in both areas each month few could provide a stool sample, and in many cases the quantity was inadequate for qualitative and quantitative techniques to be done. Nevertheless it is clear from the results that in the incidence and intensity of infection in Mombasa were higher than in Machakos. This may be because of rainfall and temperature were more conducive to rapid development of the free living stages, or it may be due to the incidence of intercurrent infections such as malaria and *Shistosoma haematobium* which

are known to be hyper-endemic in the Mombasa area, or indeed to the lower nutritive status of patients at the coast compared with in Machakos District.

The only species of hookworm identified in this study was *N. americanus*, identification being based on the morphology of the infective larvae and from adult worms expelled after treatment by the few patients that could be treated before being discharged.

Moreover the uniform size of the ova suggests that only one species was involved in all cases. Some authors believe there is no difference in size of ova between the two hookworm species,^{11 12} but Oyerinde¹³ demonstrated close correlation between egg size and hookworm species based on morphology of infective larvae and also the disappearance of the smaller ova from stools of patients after treatment with bephenium. *A. duodenale* responds well to most drugs developed against hookworm in particular to bephenium, whereas *N. americanus* is more difficult to dislodge and requires repeated treatment. The most recent survey of East Africa demonstrated *N. americanus* was largely responsible for hookworm infection in Kenya with only 5% of the positive cases in one locality at the coast along the Tana river showing *A. duodenale* and these always concomitantly with *N. americanus* and in subjects of Arabic descent.¹ It is possible that over the past two decades with the increase in medical facilities in rural as well as urban areas and the development of improved anthelmintics *A. duodenale* may have been almost eradicated from most areas along the Kenya coast leaving only *N. americanus*.

This species has never yet been shown to undergo arrested development as has been demonstrated with *A. duodenale* in West Bengal.^{4 5} This may be, as Ogilvie and Woms¹⁴ suggest, because the greater longevity of the former ensures survival of the species and infection of the next generation of hosts. If this is the case it would explain the lack of an obvious seasonal fluctuation in rate and intensity of infection similar to that demonstrated in West Bengal⁴ and confirms earlier work that *A. americanus* is less subject to seasonal variation than *A. duodenale*.¹⁵ Alternatively the diurnal rainfall pattern in Kenya may mean that external environmental conditions are always conducive to the development of the free living stages of hookworm. Thus survival in the external environment is possible throughout the year

and the ability to arrest confers no special advantage on the parasite. Moreover, certainly in Mombasa, minimum and maximum temperatures were within the range for rapid development of these stages. In Machakos the minimum temperature recorded for three consecutive months was below 7°C, low enough to retard development or indeed as Pierkaski¹² believes to damage the eggs permanently. These differences in temperature may account for the lower incidence and intensity of infection observed in Machakos compared with Mombasa. However if eggs are deposited in more protected micro-environments the ambient temperatures may be slightly higher than those recorded allowing transmission to continue at a low rate.

If arrested development does not occur in hookworm species of Kenya this would explain the fact that no larval stages in the breastmilk of infected mothers were observed, for without hypobiosis, transmammary transmission is most unlikely.

Indeed this observation is supported by the fact that none of the infants examined showed patent hookworm infection in the first few weeks of life. Clearly this mode of transmission is not a common feature of the life cycle of *N. americanus* in Kenya. It would be of interest to conduct a similar study in areas with predominantly *A. duodenale* and where arrest is known to occur as in West Bengal to determine if transmammary transmission is a common feature of the life cycle of this species.

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The Use of Steroids in the Earlier Hypersensitivity Stage of Schistosomiasis

by

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The degree of inflammatory reaction in schistosomiasis varies greatly from period to period in the same patient, depending on how long the infection has been present and on its intensity. In experimental animals the inflammatory exudate and fibrosis in the granuloma show much variation, according to the host's state of immunity. Domingo and Warren (1967) injected living mature ova, isolated from the liver of infected mice, into the pulmonary arterioles of other infected mice for periods of from 2-32 weeks. Those infected for two weeks developed granulomata around the infected schistosomal ova similar to those seen in uninfected animals. The mice infected from 8 weeks showed greater accelerated augmental granulomatous reaction than seen in desensitised ones. The mice infected from 11, 24 and 32 weeks, although continuing to form granulomata at a more rapid rate, showed marked or constant diminution of the peak size of the lesion. By 24 and 32 weeks they were smaller than those seen in uninfected, unsensitised animals.

This diminution of granulomatous hypersensitivity in *S.mansoni* infections was originally described in 1964 as endogenous desensitisation. The immuno-regulating phenomenon when spontaneous diminution of granulomatous