

Acta Tropica

Published by Elsevier

This article is being provided to filariasis.net with the permission of Acta Tropica and the Elsevier. You are free to download the article for education and teaching purposes, however, you must not post this article on any other web site or media, without first obtaining permission from the Editor of the Journal.

About the Journal

Acta Tropica, is an international journal that covers biomedical and health sciences with particular emphasis on topics relevant to human and animal health in the tropics and the subtropics.

Its scope includes the biology of parasites and vectors, welcoming contributions concerning either basic or applied research in disciplines such as taxonomy, morphology, biochemistry, physiology and immunology; the development of tools for diagnosis and disease control; clinical and community medicine; and the epidemiology of communicable disease and health systems.

Contributions may be in the form of original papers, review articles or short communications - case reports are not considered for publication.

Editors:

A. Björkman, K. Berzins, F. Guhl

See [editorial board](#) for all editors information

Author enquiries:

Instructions to authors can be found in the first issue of every volume and online at <http://www.elsevier.com/locate/.actatropica>.

Useful Links

Bibliographic & ordering Information

ISSN: 0001-706X

Imprint: ELSEVIER

Commenced publication 1944

Subscriptions for the year 2007, Volumes 101-104, 12 issues

Institutional online access:

[ScienceDirect eSelect](#)

For purchase of online access to this journal on ScienceDirect by credit card.

Institutional price:

[Order form](#)

JPY 216,200 for Japan

USD 1,829 for all countries

except Europe and Japan

EUR 1,637 for European countries

See also information about [conditions of sale & ordering procedures](#), and links to our [regional sales offices](#).

For an overview of recent dispatched issues, see the Journal issue [dispatch dates](#)

Audience

All clinicians and researchers dealing with tropical diseases, including parasitologists, microbiologists, immunologists and epidemiologists

Impact factor of this journal

2005: 1.80

Non-filarial elephantiasis in the Mt. Elgon area (Kapchorwa District) of Uganda

Ambrose W. Onapa^a, Paul E. Simonsen^{b,*}, Erling M. Pedersen^b

^a Vector Control Division, Ministry of Health, PO Box 1661, Kampala, Uganda

^b Danish Bilharziasis Laboratory, Jaegersborg Alle 1 D, 2920 Charlottenlund, Denmark

Received 8 September 2000; received in revised form 1 December 2000; accepted 11 December 2000

Abstract

Following reports of a high frequency of elephantiasis in Kwen County (Kapchorwa District) on the slopes of Mt. Elgon in Uganda, a baseline survey for lymphatic filariasis was carried out in three villages in the affected area. Individuals aged 1 year and above were examined for chronic manifestations of lymphatic filariasis, and for specific circulating filarial antigens and microfilariae of *Wuchereria bancrofti*. Elephantiasis was observed in all age groups from 10 years and above. The overall prevalence was 4.5%, and the prevalence among individuals aged ≥ 20 years was 8.2%. Males and females were equally affected. However, there were only few cases of hydrocele (overall prevalence in males of 1.0%) and blood examinations were negative for *W. bancrofti* circulating antigens and microfilariae. Sampling of potential filariasis mosquito vectors revealed low densities of *Anopheles gambiae* s.l. and *An. funestus*, and none of these were infected with filarial larvae. In view of the low hydrocele to elephantiasis ratio, the absence of filarial infection in humans and mosquitoes, the high altitude (1500–2200 m above sea level) and the volcanic soil type, it is concluded that elephantiasis seen in this area is not of filarial origin but most likely is due to podoconiosis (endemic non-filarial elephantiasis). © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Elephantiasis; Podoconiosis; Filariasis; Volcanic soils; Uganda

1. Introduction

Lymphatic filariasis, resulting from infection with the mosquito borne nematode parasite *Wuchereria bancrofti*, is a major health problem in

many tropical and subtropical regions of the World, including Africa (Michael and Bundy, 1997; Ottesen et al., 1997). Its characteristic and debilitating overt clinical manifestations, which include hydrocele and elephantiasis, cause much discomfort and suffering in endemic human populations. Attempts to control lymphatic filariasis have recently gained momentum and have received high priority at international level (Ottesen et al., 1997; WHO, 1999).

* Corresponding author. Tel.: +45-773-27732; fax: +45-773-27733.

E-mail address: pes@bilharziasis.dk (P.E. Simonsen).

While gathering baseline epidemiological information on lymphatic filariasis in Uganda, it was reported that elephantiasis was very common in two subcounties (Kapchorwa and Binyiny) of Kwen County, Kapchorwa District, near the Uganda/Kenya border. This area, at an altitude of ~1500–2200 m above sea level, has rich soils derived from the Mt. Elgon volcanics. The area is densely populated. The main occupation is farming, with wheat and maize being the main crops. It was decided to carry out a survey for lymphatic filariasis in the affected area. The findings, which did not implicate filarial infection as a cause of the observed disease, are presented here.

2. Materials and methods

2.1. Study area

The study was carried out in October/November 1998 in Kwen County, Kapchorwa District, on the slopes of Mt. Elgon in Eastern Uganda (Fig. 1) The County has three topographical zones, namely a southern high-altitude zone (above 2200 m) constituting the Mt. Elgon National Park with no human settlements or cultivation, a middle plateau zone (altitude 1500–2200 m) which is densely populated and cultivated, and a northern zone, located below an escarpment and comprising the Ngenge plains (altitude ~1000

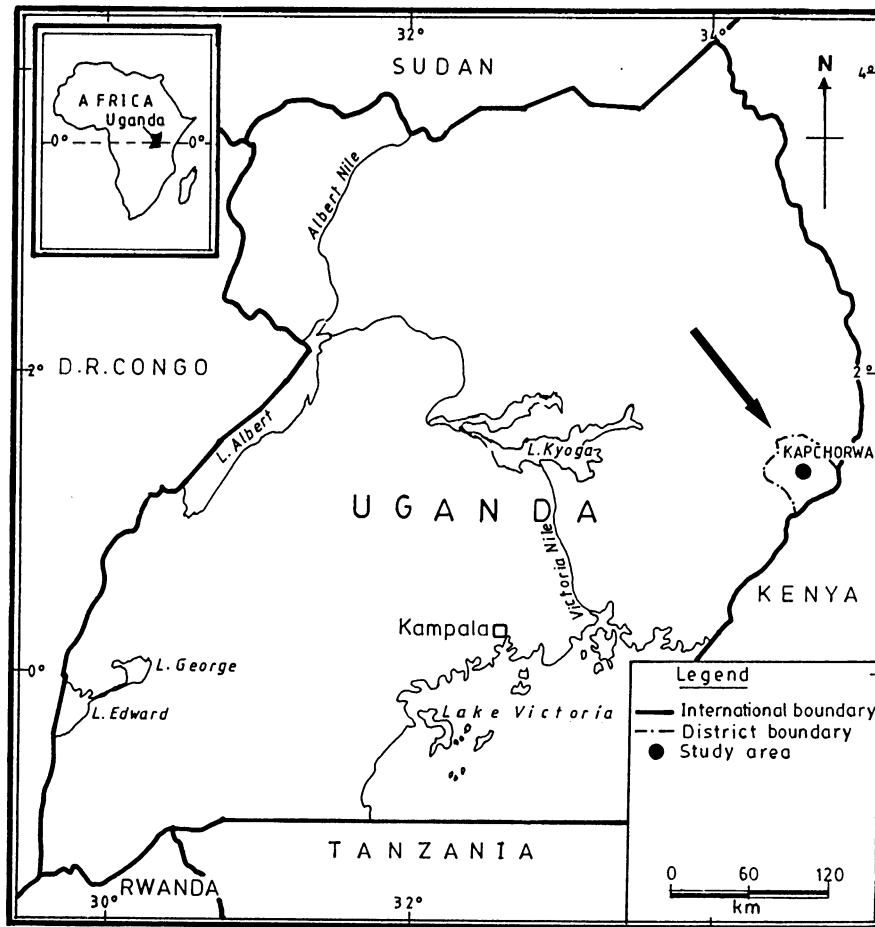


Fig. 1. Map of Uganda showing the study area in Kapchorwa District.

m), which is sparsely populated mainly by pastoralists. Three adjacent villages in the middle zone (Kongelel, Reberwo and Rarawa in Kapron Subcounty) were selected for the survey.

The study area is hilly and fertile. Both subsistence and commercial farming is practiced, and the area is a major source of wheat and maize in Uganda. Villages are small with compact settlements, and most residents are of the Sabinu tribe. Mean minimum and maximum temperatures are 12°C (May–July) and 25°C (February), respectively, and the average annual rainfall is ~1100 mm. The major soil type is a red clay loam referred to as Elgon volcanic (Uganda Government, 1970). Movement in the area is difficult due to the hilly terrain and the roads, which become extremely slippery after light drizzles.

2.2. Study design

The study was a cross-sectional survey for infection, disease and vectors of *W. bancrofti*, and the study design was similar to that described for previous filariasis surveys in other parts of Uganda (Onapa et al., 2001). The village residents were registered with the assistance of chiefs, local councillors and district health staff. Meetings were held in the communities to explain the background for the survey and the need for night blood samples. Cattle rustling is a common practice in nearby areas and the residents were not much in favor of night movements. Arrangements therefore had to be made with a local defense unit to provide security to the survey team and the villagers. Oral informed consent to participate was obtained from individuals ≥ 15 years, and from the parents of younger individuals. The study was approved by the Ministry of Health, Uganda.

2.3. Examinations for clinical manifestations, antigenemia and microfilaraemia

Examinations took place at a central point in each village and were carried out as previously described (Onapa et al., 2001). Briefly, individuals were clinically examined during daytime for chronic manifestations of lymphatic filariasis. Ele-

phantiasis (includes both lymphoedema and true elephantiasis) was graded from I to III, and hydrocele was graded from I to V, as described by Estambale et al. (1994). However, since grade I hydrocele is a pre-stage, only grades II–V are included as hydrocele in the present report. Immediately after clinical examination, individuals were examined for circulating filarial antigens (CFA) with the ICT card test for whole blood specimens (Amrad ICT, Australia), by following instructions from the manufacturers. Later, in the same evening between 21:00 and 02:00 h, individuals returned for parasitological examination. Fingerprick blood specimens, each of 100 μ l, were collected and examined for microfilariae by the counting chamber method (McMahon et al., 1979). For some individuals, blood smears were also prepared, stained with Giemsa and examined under microscope for microfilariae.

2.4. Entomological surveys

Mosquitoes were collected by Pyrethrum Spray Catch and CDC Light Traps (Service, 1993). Nine and ten houses were selected for light traps and spray catch, respectively, in Kongelel, whereas five houses were selected for each method in both Reberwo and Rarawa. Catching was performed, and caught mosquitoes were identified, dissected and examined for filarial infections, as previously described (Onapa et al., 2001).

3. Results

A total of 884 individuals aged ≥ 1 year were registered in the three villages, namely 313 from Kongelel, 235 from Reberwo and 336 from Rarawa. Of these, 575 (65.0%) were clinically examined (282 females, 293 males). 26 cases of elephantiasis were recorded in the three villages (Table 1), thus giving an overall prevalence of 4.5%. There were ten cases in Kongelel (3.8% prevalence), seven cases in Reberwo (5.6% prevalence) and nine cases in Rarawa (4.8% prevalence). The youngest individuals with elephantiasis were two boys aged 13 years. The prevalence increased by age, and was 8.2% among

Table 1

Prevalence of elephantiasis in the combined examined populations of Kongelel, Reberwo and Rarawa villages, Kapchorwa District, Uganda

Age group (years)	Number examined			Number with elephantiasis		
	Males	Females	Total	Males	Females	Total (%)
1–9	81	76	157	0	0	0 (0.0)
10–19	89	72	161	3	2 ^a	5 (3.1)
20–29	51	48	99	0	2	2 (2.0)
30–39	20	20	40	1	2	3 (7.5)
40–49	16	24	40	4	1	5 (12.5)
50+	36	42	78	5	6	11 (14.1)
Total	293	282	575	13	13	26 (4.5)

^a Includes one individual with arm elephantiasis (bilateral).

individuals aged ≥ 20 years and 14.1% among those aged ≥ 50 years. Cases were equally distributed between males (13) and females (13). Twenty cases were bilateral and six were unilateral. Ranking of cases according to grade in the most affected side indicated that eight individuals had grade I, eight had grade II, and ten had grade III elephantiasis. All cases except one affected the legs and feet. One case of arm elephantiasis was seen in Reberwo (female aged 15 years, bilateral, stage II in both sides). This individual also had signs of a recent attack of adenolymphangitis, with evident exfoliation of the skin. Nine individuals with elephantiasis had signs of scarification on the affected limb, whereas scarification marks were only observed in one individual without elephantiasis. Examination of the males revealed only three cases of true hydrocele (age range 35–52 years), thus giving an overall prevalence of 1.0% (3/293). For males aged 20 years and above the prevalence was 2.4% (3/123). All cases were small (grades II and III). No cases of scrotal elephantiasis were recorded.

Among those clinically examined, 289 were also tested for *W. bancrofti* CFA (127 from Kongelel, 56 from Reberwo and 106 from Rarawa). All tests were negative. Control lines developed as required, thus indicating that the cards were valid. Microscopic examination of 215 counting chamber blood specimens and 173 Giemsa stained blood smears (96 and 81 from Kongelel, 40 and 40 from Reberwo and 79 and 52 from Rarawa, respectively) revealed no microfilariae.

Mosquito densities were very low. Thus, all light trap and spray catches from Reberwo and Rarawa were negative. In Kongelel, *Anopheles funestus* was the only species caught in light traps (total of 42; mean of 4.7 per catch). *An. funestus* was also predominant in spray catches (total of 59; mean of 5.9 per catch), but 39 other mosquitoes (including *An. gambiae* s.l., *An. coustani*, *An. demeilloni* and *Mansonia africana*) were also caught. All the *An. funestus* sampled were dissected, but no filarial larvae were detected.

4. Discussion

Elephantiasis is one of the characteristic chronic manifestations of lymphatic filariasis. Recent epidemiological surveys carried out in parts of Lira, Soroti and Katakwi districts, ~150 km from the present study area, documented high prevalences of lymphatic filariasis, as well as high prevalences of hydrocele and elephantiasis in the affected populations (Onapa et al., 2001). The suspicion that lymphatic filariasis could also be endemic in parts of Kapchorwa District, where a high frequency of elephantiasis had been reported, led to the present investigation. In fact, the district health authorities regarded elephantiasis as a serious public health problem in this agriculturally rich area, and had embarked on mosquito control measures, in the belief that this was a mosquito borne problem.

Prevalences of elephantiasis in the study communities were found to be as high, or even higher, than those described from areas endemic for lymphatic filariasis in Uganda (Onapa et al., 2001) or other parts of East Africa (Estambale et al., 1994; Simonsen et al., 1995; Meyrowitsch et al., 1995). Unexpectedly, however, the prevalence of hydrocele in the same communities was low, not more than that seen for areas free of filariasis and no scrotal elephantiasis was seen. Furthermore, there was no indication of filarial infection in the human population, such as specific circulating filarial antigens or microfilariae. There were few potential vector mosquitoes, and none of these were infected with filarial larvae. The low hydrocele to elephantiasis ratio and the absence of filarial infection in humans and mosquitoes suggest that elephantiasis in the study area is not of filarial origin, but rather could be a manifestation of podoconiosis (endemic non-filarial elephantiasis).

Most cases of podoconiosis have been reported from East and Central Africa, especially from highland areas associated with the Rift Valley geological complex in Ethiopia, Kenya, Tanzania, Rwanda and Burundi (Clark, 1948; Price, 1976a,b; De Lalla et al., 1988; Price, 1990; Kloos et al., 1992). Common features for affected areas are altitudes above 1250 m, annual rainfall above 1000 mm, average temperatures of $\sim 20^{\circ}\text{C}$, and soils of volcanic origin (Price, 1990). Characteristically the soils are red clay loams, which are very slippery and adheres to the skin when wet. The condition of podoconiosis is believed to be induced by fine mineral particles in the soil which penetrate the skin of barefoot people and through irritation of the lymphatics give rise to chronic lymphoedema (Price and Bailey, 1984; Price, 1990). The particles may be seen by histological examination of lymph node or dermis biopsies taken from affected parts of the body (Price and Henderson, 1979; De Lalla et al., 1988; Blundell et al., 1989). With an altitude of 1500–2200 m, appropriate climatic conditions and soils of predominantly volcanic origin, the environment of the study area fulfilled the criteria for endemicity of podoconiosis.

Loewenthal (1934) examined patients with chronic lymphoedema in Kampala, Uganda, but the geographical origin of the patients was unknown. In eight of the patients, it was not possible to identify a causative agent. It is possible that some of the patients had podoconiosis, as claimed in literature (Price, 1976a, 1990), but it is also well known that only a minority of patients with filarial elephantiasis have microfilariae in their blood (Estambale et al., 1994; Meyrowitsch et al., 1995; Simonsen et al., 1995; Onapa et al., 2001). The manifestations of Loewenthal's patients could therefore as well have had a filarial etiology. The present study is thus the first to univocally document podoconiosis in Uganda, and to precisely indicate a geographical location where this condition prevails. Other parts of Uganda have environmental conditions comparable to those of the present study, and may therefore also be endemic for podoconiosis. This goes for the chain of mountains to the North of Mt. Elgon (Mt. Kadam, Mt. Moroto, Mt. Napak, Mt. Morungole), as well as the highlands of South and Southwest Uganda including the Rwenzori Range. More surveys will be carried out to reveal the extent to which podoconiosis is endemic in the country.

A first step towards control of podoconiosis will be to identify and map out areas of endemicity, and to inform the health authorities that this condition is not due to filariasis but to soil particles absorbed through the feet. In communities with a high frequency of elephantiasis, the etiology should be established as filarial or non-filarial, e.g. by combining judgement of environmental conditions (altitude, soil, climate) with screening of the population for filarial antigen. Obviously, the major measure to prevent development of podoconiosis is to protect the feet from the soil by wearing of shoes. A positive effect of this measure was reported by Kloos et al. (1992) in Ethiopia, who observed that those wearing shoes were significantly less affected by podoconiosis than their bare footed counterparts. Health education should play an important role in conveying this message to the endemic populations, for whom other disease perceptions are likely to prevail.

Acknowledgements

We are grateful to the villagers, elders, Chiefs and Councilors from the study communities for their cooperation, and we acknowledge the keen interest of Dr R.O. Oketch, J.F. Towett and other Kapchorwa District health staff. The staff of the Vector Control Division in Kampala, in particular A. Auma, G. Egitat and C. Adikinyi, are thanked for their technical and secretarial support. Drs D. Okello and A. Kambugu are thanked for their participation in clinical examinations. The keen interest of Professor F.G. Omaswa (Director General of Health Services, Uganda), and his permission to publish this paper, is appreciated. The study received financial support from the Danish Bilharziasis Laboratory, Denmark.

References

- Blundell, G., Henderson, W.J., Price, E.W., 1989. Soil particles in the tissues of the foot in endemic elephantiasis of the lower legs. *Ann. Trop. Med. Parasitol.* 83, 381–385.
- Clark, M., 1948. Lymphostatic verrucosis in the Fort Hall District of Kenya. *Trans. R. Soc. Trop. Med. Hyg.* 42, 287–290.
- De Lalla, F., Zanoni, P., Lunetta, Q., Moltrasio, G., 1988. Endemic non-filarial elephantiasis in Iringa District, Tanzania: a study of 30 patients. *Trans. R. Soc. Trop. Med. Hyg.* 82, 895–897.
- Estambale, B.B.A., Simonsen, P.E., Knight, R., Bwayo, J.J., 1994. Bancroftian filariasis in Kwale District of Kenya. I. Clinical and Parasitological survey in an endemic community. *Ann. Trop. Med. Parasitol.* 88, 145–151.
- Loewenthal, L.J.A., 1934. On the probable inclusion of several diseases in the title 'mossy' foot. *Ann. Trop. Med. Parasitol.* 28, 47–62.
- Kloos, H., Kello, A.B., Addus, A., 1992. Podoconiosis (endemic non-filarial elephantiasis) in two resettlement schemes in western Ethiopia. *Tropical Doctor* 22, 109–112.
- McMahon, J.E., Marshall, T.F., Vaughan, J.P., Abaru, D.E., 1979. Bancroftian filariasis: a comparison of microfilarial counting techniques using counting chambers, standard slides, and membrane (nucleopore) filtration. *Ann. Trop. Med. Parasitol.* 75, 415–431.
- Meyrowitsch, D.W., Simonsen, P.E., Makunde, W.H., 1995. Bancroftian filariasis: analysis of infection and disease in five endemic communities of north-eastern Tanzania. *Ann. Trop. Med. Parasitol.* 89, 653–663.
- Michael, E., Bundy, D.A.P., 1997. Geographical mapping of lymphatic filariasis. *Parasitol. Today* 13, 472–476.
- Onapa, A.W., 2000. Simonsen, P.E., Pedersen, E.M., Okello, D., 2001. Lymphatic filariasis in Uganda: Baseline investigations in Lira, Soroti and Katakwi Districts, *Trans. R. Soc. Trop. Med. Hyg.*, in press.
- Ottesen, E.A., Duke, B.O.L., Karam, M., Behbehani, K., 1997. Strategies and tools for the control/elimination of lymphatic filariasis. *Bull. WHO* 75, 491–503.
- Price, E.W., 1976a. The association of endemic elephantiasis of the lower legs in East Africa with soil derived from volcanic rocks. *Trans. R. Soc. Trop. Med. Hyg.* 70, 288–295.
- Price, E.W., 1976b. Endemic elephantiasis of the lower legs in Rwanda and Burundi. *Trop. Geogr. Med.* 28, 283–290.
- Price, E.W., 1990. Podoconiosis. Non-filarial elephantiasis. Oxford University Press, Oxford.
- Price, E.W., Henderson, W.J., 1979. Silica and silicates in femoral lymph nodes of barefooted people in Ethiopia with special reference to elephantiasis of the lower legs. *Trans. R. Soc. Trop. Med. Hyg.* 73, 640–647.
- Price, E.W., Bailey, D., 1984. Environmental factors in the etiology of endemic elephantiasis of the lower legs in Tropical Africa. *Trop. Geogr. Med.* 36, 1–5.
- Service, M.W., 1993. Mosquito ecology. Field sampling methods, 2nd edition, Elsevier Applied Sciences, London.
- Simonsen, P.E., Meyrowitsch, D.W., Makunde, W.H., Magnussen, P., 1995. Bancroftian filariasis: the pattern of microfilaraemia and clinical manifestations in three endemic communities of North Eastern Tanzania. *Acta Trop.* 60, 179–187.
- Uganda Government, 1970. Mbale-soils. Sheet No. NA-36-II. Department of Lands and Surveys, Uganda.
- WHO, 1999. Building partnerships for lymphatic filariasis. Strategic plan. Document no. WHO/FIL/99.198. World Health Organization, Geneva.