



A longitudinal study on cutaneous larva migrans in an impoverished Brazilian township

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Summary Background: The objective of this study was to describe the clinical pathology and seasonal variation of cutaneous larva migrans (CLM) in an impoverished community.

Method: A representative sample of the population of a poor urban neighbourhood in Fortaleza, northeast Brazil, was examined for CLM four times during a period of eleven months.

Results: In total, 4107 individuals were examined. Sixty-three individuals were diagnosed to have CLM with a total of 132 larval tracks. The prevalence varied from 3.1% (95% CI: 2.2–4.3) in the middle of the rainy season to 0.2% (95% CI: 0.0–0.9) in the peak of the dry season. This corresponds to an incidence of 1841 cases of CLM per 10,000 inhabitants per year. The male sex was significantly more often affected ($P < 0.01$). Eighty-three percent of the lesions were located at the trunk, legs or feet. Moderate or severe itching was present in all patients; 31.2% complained of insomnia due to itching, and 21% of the lesions were superinfected.

Conclusions: CLM is a common parasitic skin disease in this deprived community, it is associated with significant morbidity, and its occurrence varies according to the rainfall.

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Introduction

Cutaneous larva migrans (CLM) is a parasitic skin disease caused by the infection with larval nematodes, usually hookworms of dogs and cats.¹ As man is an incidental host, in whom larvae cannot develop further, the parasitosis is usually self-limiting. However, larvae may migrate in the epidermis for up to several months.^{2,3} Jelinek et al.⁴ observed symptoms in a patient lasting for 9 months.

Based on clinical observations, CLM seems to occur in many resource-poor communities in tropical and subtropical regions. Surprisingly, knowledge about the epidemiology of this parasitic skin disease is scanty, and reliable data on its occurrence on the community level are not available. By consequence, CLM is usually described as a rather rare disease of travellers^{2–5} as well as of certain high risk groups such as expatriated military personnel and plumbers, pipe-fitters or electricians working in crawl spaces under houses.^{1,6}

We describe for the first time longitudinal data on the occurrence and the clinical pathology of CLM

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in a poor neighbourhood in northeast Brazil. The results show that in this deprived community CLM frequently occurs, that it is associated with unexpected morbidity and that the incidence varies according to the seasons of the year, being highest during the rainy season.

Materials and methods

Study area

The study was performed in *Vicente Pinzón II*, a typical urban township in Fortaleza, the capital of Ceará State in northeast Brazil. The township is close to the beach and has a total population of about 15,000 inhabitants. Two third of the households have access to piped water. Sixty percent of the population have a monthly family income of less than two minimum wages (1 minimum wage = €70–80). Adult illiteracy is 30%, unemployment rates are high, and violence of all sorts is common.⁷ Many houses are made of recycled materials and do not have cemented floors. Waste collection is performed by the municipality, but in fact functions only at the boundaries of the slum. Therefore garbage of all sorts is scattered throughout the area. There is no public sewage system, and hygienic conditions are precarious. Many families keep dogs and cats as pet animals, and in addition, there are innumerable stray dogs and cats. Thus, the study area is comparable to the many other poor townships in northeast Brazil.

According to the observations of the physicians of the local Primary Health Care Centre, the sub-area of the township called *Morro de Sandra's* is a high-risk area for parasitic skin diseases such as tungiasis, CLM, scabies and pediculosis.

Study design

In March 2001, *Morro de Sandra's* was inhabited by 1468 individuals belonging to 327 households (mean: 4.5 individuals/household; range: 1–13 individuals/household). All households were visited at the baseline examination in March/April 2001 and for follow-up examinations in June/July 2001, September/October 2001 as well as in January 2002. The time schedule was planned such that one survey occurred in the middle of the rainy season (March/April), another one at the beginning of the dry season (June/July), the third one in the middle of the dry season (September/October) and the final one at the transition between the dry season

and the rainy season (January). Each survey was realized in the period of 4 weeks.

To reduce inter-observer bias, the clinical examination was carried out by the same two investigators (T.W. and A.M.) on all occasions. After explaining the objectives of the study and obtaining informed oral consent, each member of the family was examined for the presence of CLM. In case of absent family members, the households were revisited two more times.

Clinical examination and case definition

In a room of the house in which privacy was guaranteed, the whole body surface was thoroughly examined for CLM. According to standard guidelines, the diagnosis of creeping eruption was made clinically.^{1,5} CLM was diagnosed when the characteristic elevated linear or serpiginous lesion, with or without an erythematous-papulose lesion, was present, the latter indicating the entry site of the larva. Superinfection was diagnosed if pustules, suppuration or ulcers were seen. Patients were asked about their complaints and, if present, to classify itching into weak, moderate and severe.

Data analysis

Data were entered twice into a database using Epi Info software package (version 6.04d) and checked for errors which might have occurred during data entry. Ninety-five percent confidence intervals of point prevalences and odds ratios were calculated using the respective Epi Info modules. The χ^2 test was used to determine the differences of relative frequencies. To compare the number of larval tracks between groups, the Wilcoxon (Mann-Whitney) test was used. Based on the assumption that the period of a survey does not have an influence on the age distribution, the localization of lesions and the pattern of symptoms, the data of the four surveys were pooled for analysis of these variables.

Incidence (*I*) was calculated according to the formula $I = P/D$, where *P* is the prevalence and *D* the average duration of disease.⁸ This approximation is justified, as the population remained stable during the survey period, and the prevalence was low.⁸ A period of one month was used as the average duration of disease (*D*).

Monthly precipitation and temperature data of Fortaleza Municipality were obtained from the Meteorological Foundation of Ceará State (*Fundação Cearense de Meteorologia* [FUNCEME], Fortaleza, Brazil).

Table 1 Period prevalence of cutaneous larva migrans in an endemic area in northeast Brazil, stratified by age.

Age group	March/April 2001		June 2001		September 2001		January 2002	
	Examined	Positive (%)	Examined	Positive (%)	Examined	Positive (%)	Examined	Positive (%)
0-4	248	5 (2.0)	227	12 (5.3)	180	0	172	2 (1.2)
5-9	168	5 (3.0)	171	5 (2.9)	136	0	140	0
10-14	177	8 (4.5)	173	2 (1.2)	132	1 (0.8)	120	1 (0.8)
15-19	126	2 (1.6)	123	0	82	0	80	0
20-39	309	15 (4.9)	335	0	215	0	244	1 (0.4)
40-59	115	2 (1.7)	116	1 (0.9)	79	0	97	0
≥60	42	0	40	0	25	1 (4)	35	0
All	1185	37 (3.1) ^a	1185	20 (1.7) ^b	849	2 (0.2) ^c	888	4 (0.5) ^d

^a 95% CI: 2.2-4.3.^b 95% CI: 1.1-2.6.^c 95% CI: 0.0-0.9.^d 95% CI: 0.1-1.2.

Ethical considerations

Permission to undertake the study was obtained from the Health Secretary of Fortaleza Municipality. Community associations of the slum (*associações dos moradores*) gave their consent to the study. Prior to the study, meetings with community health workers and community leaders were held in which the objectives were explained. Informed oral consent was obtained from each patient after explaining the objectives. In the case of minors, the carers were asked for consent. According to national guidelines, all patients with CLM were treated adequately with topical thiabendazole 5%, applied twice per day for seven days. Bacterial superinfection was treated with neomycin ointment.

Results

In total, 4107 examinations were undertaken. One thousand eight hundred and twenty-three (44.4%) individuals were of male sex and 2284 (55.6%) of female sex. They belonged to 301 (92.1%) of the 327 existing households in the study area.

Sixty-three individuals (1.5, 95% CI: 1.2-2.0) were diagnosed with CLM. Altogether, they presented 132 larval tracks (range: 1-17; median: 1). There was no significant difference in prevalence between age groups ($P > 0.05$; Table 1).

Consistently, the condition was more common in males than in females (Fig. 1). However, the difference was only statistically significant after data of the four surveys were pooled (OR = 2.2; $P < 0.01$). Despite the higher prevalence of CLM in men, the number of larval tracks per individual did not show any difference between males and females ($P = 0.8$).

The localization of larval tracks in the 63 infested individuals is depicted in Table 2. The majority of the lesions were located at the trunk (36.5%), legs (25.4%) and feet (20.6%).

The predominant symptom was itching, which occurred in all 63 patients. Twenty-seven patients (42.9%) classified the itching as moderate and 36 (57.1%) as severe. Thirty-one percent of patients complained of insomnia due to the itching, and in 21% bacterial superinfection was present. Vesicle and bulla formation, peripheral lymphadenopathy or fever were not observed.

Period prevalences are depicted in Table 1. CLM showed a considerable seasonal variation, the prevalence being highest in the rainy season (March/April, 3.1%) and lowest in the middle of the dry season (September/October, 0.2%, Fig. 2). Prevalences differed significantly between March/April and June/July ($P = 0.02$), between March/April and September ($P < 0.001$) as well as between March/April and January ($P < 0.001$). In September/October, the peak of the dry season, only four individuals were found with CLM. The prevalence in September/October differed significantly from that in June/July ($P < 0.01$). There was

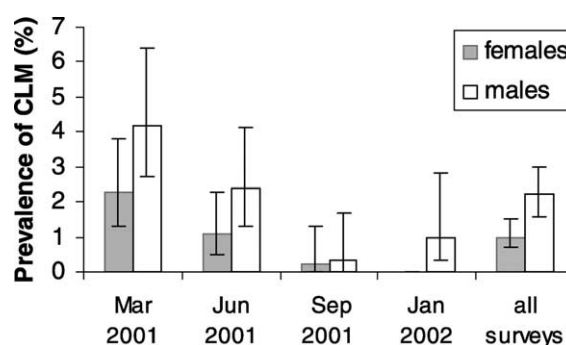


Figure 1 Period prevalences of cutaneous larva migrans in an endemic area in northeast Brazil, stratified by sex. Vertical bars indicate 95% confidence intervals.

Table 2 Localization of larval tracks in 63 patients with cutaneous larva migrans.

Localization ^a	n (%)
Trunk	23 (36.5)
Legs	16 (25.4)
Feet	13 (20.6)
Buttocks	6 (9.5)
Arms	6 (9.5)
Head	4 (6.4)
Hands	4 (6.4)
Genitals	2 (3.2)

^a Simultaneous infection on more than one body part occurred.

no significant difference between September/October and January ($P = 0.4$).

The incidence ranged from 20 cases per 10,000 individuals per month in the dry season to 310 cases per 10,000 inhabitants per month in the rainy season. The approximated annual incidence rate is 1841 cases per 10,000 inhabitants per year.

The monthly mean temperature varied from 25.7 °C in July to 27.3 °C in January and December.

Discussion

CLM is considered to be a rather rare disease, and most cases described so far concerned travellers returning from holidays in subtropical and tropical regions.²⁻⁵ Estimates on disease occurrence have been mainly inferred from outpatients consulting dermatological or primary health care clinics,⁹⁻¹³ or from small outbreaks.^{6,14-17} It is doubtful, whether such approaches, which usually were based on the retrospective analysis of medical

records, can generate valid data on the prevalence of a parasitic skin disease in the community.

Some population-based studies on skin diseases indicate low prevalences of CLM in resource-poor communities. However, these studies were carried out in rural areas¹⁸⁻²⁰ and/or were cross-sectional studies not taking into account the seasonal dynamics of CLM.^{18,20,21} Our data show clearly that CLM is prevalent in an urban slum in northeast Brazil, but that incidence rates follow a particular pattern of seasonality. Hence, if cross-sectional studies are carried out coincidentally when incidence is low, a false impression on the occurrence of CLM will result.

The annual incidence of CLM in our study area (1841 patients per 10,000 inhabitants per year) is much higher than that of other infectious diseases common in northeast Brazil. Dengue fever, for example, reached incidences of 38 and 25 per 10,000 inhabitants/year in Ceará State in the years 1987 and 1990, respectively. These were the years with the heaviest epidemics recorded so far in Ceará State.²²

Our study indicates higher attack rates in males. This can be explained by the observation that boys and men behave differently than girls and women. Whereas men pass most the time outside the houses, females, stay most of the day inside (J. Heukelbach, unpublished observation). As infection with hookworm larvae is supposed to occur mainly outside the houses, the different risks for exposure between men and women may explain the difference in attack rates.

All patients complained of moderate or severe itching, and about a third stated that the itching caused insomnia. Although we cannot exclude that insomnia might have been due to other reasons, it is conceivable that the intensively pruritic lesions provoked sleep disturbances, particular because

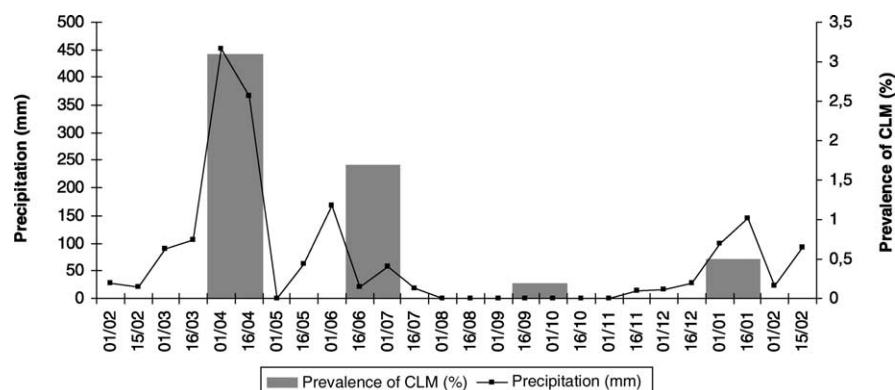


Figure 2 Seasonal variation of prevalence of cutaneous larva migrans and biweekly precipitation from January 2001 to February 2002 in Fortaleza, northeast Brazil.

itching seems to be more intense at night (J. Heukelbach, unpublished observation). Itching is also a constant finding in returned travellers and occurs in almost all cases.^{2-5,23,24}

In addition, 21% of lesions were superinfected, presumably as a result of scratching. This number of secondary infections is the highest reported so far. In the case series published, bacterial superinfection of lesions were rarely reported^{2,23} or wholly absent.^{3,5} It is obvious that in our study area, where hygienic conditions are precarious, superinfection should be more common than in typical travellers mainly staying in hotels and holiday resorts.

These data show that CLM causes significant morbidity on the population level. However, we did not observe any vesiculo-bullous lesions in our patients. Other researchers described this type of rash in 9-15% of cases.^{3,5}

Interestingly, the distribution of sites of infection was different from the case series in travellers. Most lesions of travellers are located at the feet, buttocks and thigh-areas which come into contact with contaminated sand while walking or sitting on the beach.^{2-5,23,24} Whereas travellers mainly get infected at the beach, inhabitants of a slum rarely frequent beaches for sunbathing and infect themselves during their day-to-day activities. Thus, although the slum is situated near the beach, infection at the beach does not seem to play an important role in our study population.

Many larval tracks were located on body regions which normally do not come into contact with soil. It can be assumed that in these cases infection occurred through hammocks, bed sheets, clothes or towels contaminated with animal faeces. Clothes, which in the slum are hung up for drying on walls or fences, and accidentally touch the ground, might be infested by crawling larvae. Quite frequently women put also the washing directly on the sandy soil for drying.

Key informants of the township reported a seasonal variation in the occurrence of CLM. A similar observation has been made in the Sudan where local people associated the occurrence of CLM with rain.²⁵ In fact, in Sudan the designation for CLM 'nada' means 'wet soil'. However, so far such anecdotal observations have never been validated.

Our data clearly shows that a correlation exists between rainfall and occurrence of CLM. Whereas prevalence was 3.1% in the middle of the rainy season, it fell to 0.2% in the dry season ($P < 0.001$). Presumably, the seasonal variation of CLM is related to the biology of the parasite. *Ancylostoma* eggs hatch some days after the faeces have been deposited. Eggs and larvae survive longer in wet

soil than in dry soil.²⁶ A recent report from Italy has shown that in a human environment third stage larvae may remain infective for several days.²⁷ In consequence, in the dry season, the risk of desiccating and hence of death of the embryonated eggs and larvae is much higher than in the rainy season. After about seven days, larvae develop into the third stage and are able to penetrate.²⁸

It is assumed that rainfall leads not only to an increase of prevalence of CLM in man but also of hookworm disease in dogs and cats, which in turn should also increase the risk of infection in humans with a delay of four weeks. Conceivably, heavy rainfalls disperse ova and larvae in the environment, thereby augmenting the surface of soil, on which exposure could occur.

As in the study area the annual variation of the mean temperature is very small, it is unlikely that temperature differences played a significant role for the seasonal variation of incidence.

This study is a paradigmatic example that what is considered an exotic nuisance from the perspective of Western travel medicine turns out to be a common disease associated with unexpected morbidity in a population living in the endemic area. The study also shows that the importance of a parasitic skin disease on the community level can only be determined if prevalences are assessed at different periods of the year. If a cross-sectional study had been undertaken in the dry season, the occurrence of CLM would have been underestimated by a factor of 15.

It is concluded that CLM is a common parasitic skin disease in a deprived community in northeast Brazil associated with significant morbidity which deserves attention on the individual as well as on the public health level. As the study area is a typical urban township in this part of Brazil, it can be assumed CLM occurs also in other communities with similar epidemiologic characteristics. Due to the innumerable number of stray dogs and cats in such poor neighbourhoods, a deficient public veterinary health system and financial constraints, control of CLM is a difficult task.²⁹ However, using health education and community participation in treatment of the animal reservoir, reduction of disease occurrence seems feasible.³⁰

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