

An Epidemiological Study of Leishmaniasis in a Plantation "Cooperativa 23 de Febrero" Newly Established in Ecuador

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Introduction

The endemic foci of leishmaniasis in Ecuador are situated from bilateral low-lands of the Andes Mountain, both Pacific and Amazon regions, to high-lands of the Andes, approximately up to 2,000 m above sea level. The disease was first reported from the Department of Esmeraldas, north-western part of the country, in 1920 by Valenzuela who found a female patient with leishmanial (dermal) ulcers on the forearm and thorax (Rodriguez, 1974). Most of the cases, thereafter, were reported from the littoral regions faced to the Pacific Ocean (Heinert, 1924; Valenzuela, 1931; Leon, 1951; Carrera, 1953; Rodriguez and Aviles, 1953; Zerega, 1961; Rodriguez, 1969; Calero and Coronel, 1981), while a few cases were from the oriental regions (Carrera, 1945; Amunarriz, 1982) where communications and medical care system are generally inadequate.

Rodriguez and Aviles (1953) reviewed 12 cases reported during 1920 and 1953, in addition to 29 own cases experienced. According to them, all the lesions but a few of nodule type were with ulcer on various parts

of patient's body including nasopharynges. The causative agent of these cutaneous and muco-cutaneous leishmaniasis in Ecuador has been considered *Leishmania braziliensis sensu lato*, based mainly on the clinical manifestations. Studies on vector sandflies, on the other hand, have rarely been undertaken up to date, although several anthropophilic species of sandflies, such as *Lutzomyia gomezi* and *Lu. trapidoi*, were recorded from various endemic areas of the disease in Ecuador (Rodriguez, 1956).

The present study was designed to clarify the prevalence of leishmaniasis in a plantation which was recently established in tropical forest.

Materials and Methods

The study was carried out in a plantation "Cooperativa 23 de Febrero", an isolated agricultural community with 132 persons, located amid the Andes. The study area (Fig. 1) is located about 6 km from Naranjal in Department of Guayas, Ecuador and 80 km by road from Guayaquil City, the biggest city in the country. The community comprised of 17 houses, all of which were of wooden structures untenable against sandfly or other blood sucking insects. Houses (Fig. 2) are scattered on a steep hillside rising from the Andes and are in dense tropical forest covering mountains about 1,000 m above sea level. The first immigration in there started from August 1977 from non-leishmanial areas. The inhabitants mainly cultivated coffee,

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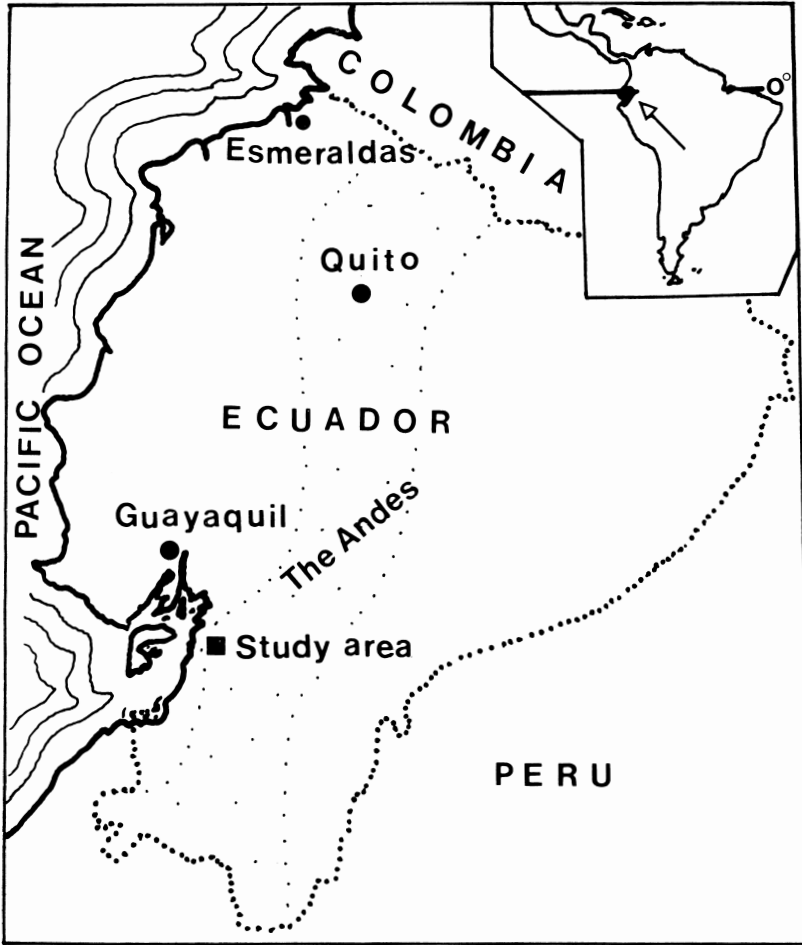


Fig. 1 Outline map of Ecuador, South America, showing study area.

yuca, sugar cane and rice after felling the surrounding primary forest; their livestock were dogs, horses, cattle, pigs, guinea pigs and domestic fowls. Most of the adult male inhabitants in the plantation used to hunt various kinds of wild animals in forest.

In September 1982, residents in the community were visited and examined dermatologically and parasitologically in order to detect leishmaniasis. In the examination, questionnaires were prepared to record immigration period, residence before immigration, occupation of each person, history of the disease and leishmanial lesions (location, size, type, number and onset), treatment and etc. Biopsy specimens were taken from the margin

of ulcerative lesions by using a surgical knife. They were then smeared onto a slide glass, making a thin film. After drying the materials at room temperature, they were stained with Wright's staining solution for microscopic examinations at the magnification of $\times 400$ or $\times 1,000$. When the smear specimens were positive, amastigotes of *L. braziliensis* s.l. were found. Leishmanial scars (Fig. 3) were rather easily differentiated from those caused by other infectious diseases or external injuries, on the basis of their typical forms, history and contacts with sandfly. The persons in the plantation, moreover, have been familiar with leishmaniasis and called "llaga de montaña" and sand-



Fig. 2 Houses surrounded by primary dense tropical forest.

flies, "manta blanca" in Spanish, respectively. Besides, all the inhabitants in the area were intelligent enough to reply to the questionnaires.

Results

Ninety-five subjects (46 males, 49 females) out of 132 inhabitants, 72.0 %, were examined and 15 of the examinees were positive for leishmanial ulcers (active leishmanial lesions) and 42, for leishmanial scars alone (cured leishmanial lesions). Of the 15 active patients, 12 (12.6 % of the examined population) revealed ulcers positive for amastigotes of *L. braziliensis s.l.* in smear specimens, and 3 (3.2 %) were diagnosed as leishmanial lesions based only on the history and signs (Table 1). These 15 persons, 7 males and 8 females, ranged from 1 to 50 years in age; 6 cases (40.0 %) occurred in 1-10 age group. The year of the immigration into the plantation "Cooperativa 23 de Febrero" varied with patients during the period between 1977 and 1981.

Of the 15 active patients, 4 (26.7 %) suffered from the disease during 3 to 9 months after immigration or birth; 3 (20.0 %), dur-

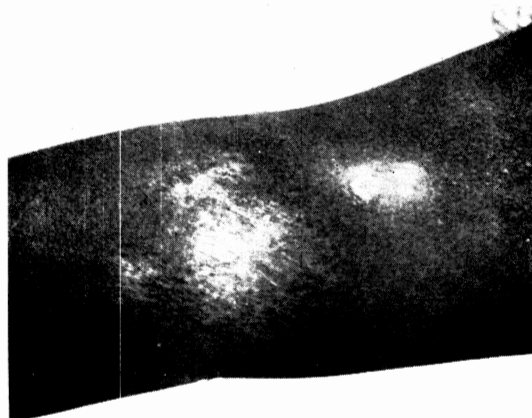


Fig. 3 Typical leishmanial scar diagnosed as cured lesion.

ing 1 to 2 years; 5 (33.3 %), during 2 to 3 years; and 3 (20.0 %), during 4 to 5 years. Almost all the present ulcerative lesions were thought to be in progressive stage at the time of examination, thus showing an ulcerating period of 1 to 6 months from the onset. Three cases, however, revealed a long lasting history, for example, 1 with 51 months, 2 with 13 or 16 months, suggesting that the disease is still progressing. These patients with leishmanial ulcers were provided with 1 to 9 lesions per person, 3.8 in average. All the lesions observed were cutaneous type; no muco-cutaneous ones were recognized in this area. Of the 15 patients, 3 had leishmanial ulcers together with scars; the patient #1 was provided with 1 ulcer and 7 scars (onset 51 months ago); the #6, 1 and 2 (3 months ago); and #10, 2 and 7 (13 months ago), respectively. In the dermatological examination of inhabitants, the lesion seemed to appear as a small, painless papule at the onset, then it developed to ulceration, metastasis and finally selfhealing. Thus, the multiple lesions observed were thought to be produced by a sequence of this process.

The leishmanial infections among inhabitants in the plantation are shown in Table 2 being arranged by sex and age. No remarkable difference was found in the positive rate among age groups or between sexes, though a slightly low rate (52.2 %) was recognized in 1-10 age group (not statistically

Table 1 Fifteen cases (7 males and 8 females) with active leishmanial lesions in September 1982, in "Cooperativa 23 de Febrero" a plantation newly established in the Andes region of Ecuador

Case no.	Age	Sex	Immigration year	Smears (+, -)*	Onset of lesions	Length of time from immigration to onset	Duration of lesions †	No. lesions	
								ulcers	scars
1	8	F	1977 Aug.	+	1978 Jul.	13 months	51 months	1	7
2	20	F	'77 Aug.	+	1982 Jul.	59	2	8	0
3	7	M	1978 Jun.	+	'82 Aug.	50	1	2	0
4	35	M	'78 Jun.	+	'82 Jul.	49	2	1	0
5	5	M	1979 Aug.	+	'82 Jul.	35	2	1	0
6	13	F	'79 Aug.	-	'82 Jul.	35	3	1	2
7	23	F	'79 Aug.	+	'82 Aug.	36	1	1	0
8	25	F	'79 Aug.	+	'82 Jul.	35	2	2	0
9	35	M	'79 Aug.	+	1981 Aug.	36	1	7	0
10	49	M	'79 Aug.	+	'81 Aug.	24	13	2	7
11	50	M	'79 Aug.	+	'81 May	21	16	6	0
12	1	M	1981 Dec.	+	1982 Mar.	3	6	1	0
13	6	F	'81 Oct.	-	'82 Jul.	9	2	2	0
14	10	F	'81 Oct.	+	'82 Jul.	9	2	2	0
15	29	F	'81 Oct.	-	'82 Jul.	9	2	4	0

* + : positive for amastigotes in smear specimens ; - : negative for the parasite but dermatologically diagnosed as leishmaniasis.

† Almost all the ulcers are still progressive stage at examination.

Table 2 Leishmanial infections among inhabitants in "Cooperativa 23 de Febrero", Ecuador arranged by sex and age of the onset

Age of onset in years	Male			Female			Total		
	No. examined	Total no. leishmaniasis*	%	No. examined	Total no. leishmaniasis*	%	No. examined	Total no. leishmaniasis*	%
1-10	22	11	50.0	24	13	54.2	46	24	52.2
11-20	10	8	80.0	11	7	63.6	21	15	71.4
21-30	2	1	50.0	10	7	70.0	12	8	66.7
31-	11	7	63.6	5	3	60.0	16	10	62.5
Total	45	27	60.0	50	30	60.0	95	57	60.0

* Number of persons who ever suffered leishmaniasis by 1982.

significant). These results suggested that the inhabitants would be evenly exposed to the risk of infection with leishmaniasis in this community regardless to age and sex.

The infection status in this plantation and prevalence of the disease are arranged by the immigration year (Table 3). A total of 22 (81.5%) out of 27 immigrants in 1977 finally suffered from leishmaniasis by 1982. In 1979 when a majority had immigrated into this plantation and out of these 43, 22 (51.2%) developed lesions during 3 years till 1982. These high infection rates of inhabitants indicate that there is a frequent transmission of leishmaniasis in the area. The infection rates, however, varied with immigration year without correlation between the rate and the year. Annual prevalence was demonstrated in the same table. The prevalence was expressed by dividing the number of positives by the total number of inhabitants in each year. Annual prevalence of leishmaniasis in the plantation showed a relatively low rate during the first two years of immigration. In 1977 when the first immigrants (27 persons) came into the plantation at August, only 1 (3.7%) person suffered from the disease in the same year. Thereafter, the annual prevalence during 1979 and 1982 fluctuated between the rates of 11.8% and 19.8%, 15.1% in average, indicating a relatively high prevalence rate.

The location of lesions (leishmanial ulcers and/or scars) was depicted in Fig. 4. The lesions were mainly located on the exposed body surface, such as face, ears and neck (21.1%), upper extremities (44.0%) and lower extremities (26.9%). This result shows that the vector sandflies in the area prefer to bite upper parts of the body exposed. The size of lesions was 12.2 ± 8.0 mm in length by 18.5 ± 11.5 mm in width ($n=85$) in leishmanial scars, while leishmanial ulcers measured 8.5 ± 5.9 mm by 10.3 ± 8.2 mm ($n=37$) each. Patients try to apply fluid of dry battery or juice of several plants on the lesions aiming at the treatment instead of authorized procedures, thus causing a bad turn. No reinfection was found with leishmaniasis in persons who once experienced the dis-

Table 3 Leishmanial infections seen among new immigrants and annual prevalence in the plantation arranged by the immigration year

Year	Infection among new immigrants		Prevalence of leishmaniasis	
	No. immigrants*	No. patients with signs†	No. inhabitants‡	No. patients with signs‡
1977(Aug.)	27	22(81.5%)	27	1(3.7%)§
1978	11	7(63.6%)	38	3(7.9%)
1979	43	22(51.2%)	81	16(19.8%)
1980	4	0(0.0%)	85	10(11.8%)
1981	7	6(85.7%)	92	12(13.0%)
1982(Sept.)	3	0(0.0%)	95	15(15.8%)

* Including newborns.

† Total number of persons who developed leishmanial ulcers and/or scars by 1982.

‡ A total population of the plantation in each corresponding year.

§ Figure in parentheses shows prevalence (%) in each year.

ease, though there were many cases with multiple lesions which would be caused by a sequence of metastasis. In a total of 57 patients with leishmanial ulcers and/or scars, 17 persons suffered from the disease in the period during 1977 and 1979; 40, during 1980 and 1982. All these patients did not show any signs of reinfection with leishmaniasis in the plantation.

Discussion

This study documents a high leishmanial infections among inhabitants in a plantation newly established in the Andes region of Ecuador. The result indicates that the transmission of leishmaniasis has been well maintained among the vector and wild reservoir host, enough to cause the infection in persons who immigrated into this area from non-leishmanial regions. Fifty-seven (60.0 %) of the 95 examinees were diagnosed as having leishmanial lesions. Fifteen (15.8 %) of the total examinees revealed leishmanial ulcers on their body surface. No marked age and sex differences of infection rates were shown in these 57 patients. In the 15 patients (active leishmanial patients), the majority showed the onset of leishmaniasis in July and August. Lainson *et al.* (1973) demonstrated that the reliable shortest incubation period of the disease was 15 days observing one of his field-workers.

In the plantation, almost all the houses are surrounded by dense tropical forest which are available as a suitable habitat of both vector and reservoir host of leishmaniasis. Adult males and females are used to engage in felling and clearing of surrounding forest with their children, in order to cultivate agricultural products. Due to the housing accommodations and these vocational activities, they would have been exposed to frequent transmission of leishmaniasis regardless to age and sex.

The length of time from immigration to onset of the disease ranged from 3 to 59 months in 15 persons with leishmanial ulcers. In a few of these patients (26.7 %) the disease developed in the period between 3 and 9 months; the remaining, during 1 to 5 years. A relatively high infection rate was observed through 1979 to 1982, as the population grows larger. This, however, might not mean the increase of a risk of transmission of leishmaniasis from person to person, since man is not considered to be a main source of the infection. Wild and/or domestic animals are considered to play an important role in the transmission (Lainson and Shaw, 1978).

In the subjects examined, a great majority of leishmanial ulcers and scars were located in the upper parts of the body exposed, suggesting a preferable biting sites of vector sandflies. Rodriguez and Aviles (1953) recorded

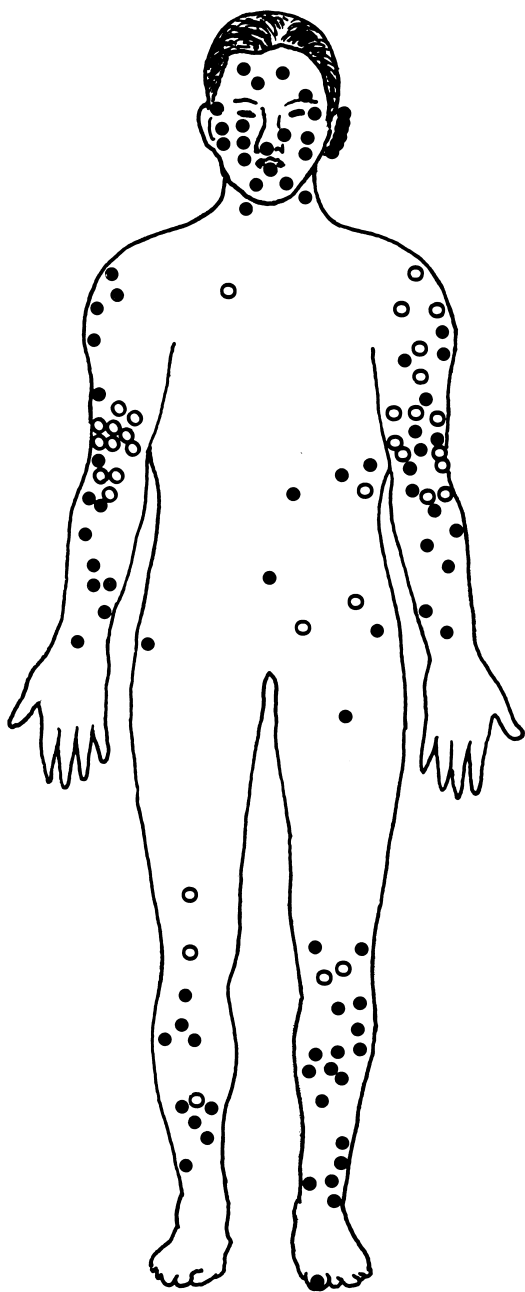


Fig. 4 Distribution of 123 leishmanial lesions (ulcers and scars) found in 57 leishmaniasis patients during 1977 and 1982. ●, lesions in ventral; ○, lesions in dorsal. The number of lesions in body surface is 26 (21.1 %) in face and neck, 25 (20.3 %) in right upper extremities and 29 (23.6 %) in left ones, 10 (8.1 %) in trunk and 12 (9.8 %) in right lower extremities and 21 (17.1 %) in left ones.

the location of 38 cutaneous lesions in 29 patients from coastal region of Ecuador; 31.6 % in face and neck, 31.6 % in upper extremities, 34.2 % in lower extremities and 2.6 % in thorax. Amunarriz (1982), furthermore, observed 22 cutaneous leishmaniasis cases in Napo, Amazon region, Ecuador in which 60.0 % of the lesion were in legs; 14.2 %, forearm; 5.7 %, elbow; 5.7 %, buttock; 5.7 %, cheek; 2.9 %, nose; 2.9 %, ears; and 2.9 %, thigh. The location of these leishmanial lesions would be influenced by both the blood sucking behaviors of vector sandfly species and the clothing habits of persons in each endemic area of leishmaniasis. Thus, the difference in the location of the lesions between Amazon and coastal regions might be explained by these reasons.

Hendricks and Wright (1979) found ulcerated lesions which persisted for 4 months to 1 year in Old and New World cutaneous leishmaniasis. Of the present 15 patients with leishmanial ulcers, 1 person revealed a long lasting ulceration for 51 months, and 2 with 13 or 16 months duration. Most of the cases, however, had duration between 2 and 6 months by questionnaires study on 42 persons with leishmanial scars.

In the present study, no person revealed a reinfection with leishmaniasis in any age groups of both sexes. This fact suggests that the primary infection may trigger the protective immunity to the successive leishmanial invasion regardless to age and sex of the persons. In many cases of this study, patients were provided with multiple lesions, up to 11 in numbers. Almost all the multiple lesions would be produced by metastasis, but not reinfection, though they might be caused in part by separate bites from infected sandflies. Recovery from any leishmanial skin lesion was generally thought to impart a firm and life-long immunity to reinfection (Lainson and Shaw, 1978).

Summary

An epidemiological study was performed on leishmaniasis in September 1982, in a plantation "Cooperativa 23 de Febrero" new-

ly established in the Andes region of Ecuador. The first immigration of inhabitants in there started from August, 1977. Fifteen (15.8 %) of the 95 inhabitants examined were diagnosed as positive for leishmaniasis with ulcers (active leishmanial lesions) on the skin. During the period between 1977 and 1982, a total of 57 (60.0 %) of 95 examinees have suffered from the disease. Regardless to age and sex, leishmanial infections occurred almost evenly. The result indicated that the transmission of leishmaniasis had been occurring in a wide range of working and housing areas in the plantation. In most of the active patients, the onset occurred in July or August. The length of time between immigration and the onset of leishmaniasis ranged from 3 to 59 months, mostly 9 to 36 months in those with active leishmanial lesions. A large number of leishmanial lesions were located on the upper parts of the body exposed.

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References

- 1) Amunarriz, M. U. (1982): Leishmaniasis. In: Salud y enfermedad, patologia tropical en la Region Amazonica. Napo, Ecuador, Edicion CICAME, pp. 71-88.
- 2) Calero, G. H. and Coronel, V. V. (1981): Estudio de la leishmaniasis cutanea en una

- 3) Carrera, C. T. (1945): Leishmaniasis cutaneo mucosa. Rev. Asoc. Med. Cuenca, 6, 23.
- 4) Carrera, C. T. (1953): Anotaciones sobre la leishmaniosis selvatica americana e cutaneo-mucosa. Rev. Ecuat. Ent. Parasit., 1, 76-90.
- 5) Heinert, J. F. (1924): Un caso de leishmaniasis cutaneomucosa. Anal. Soc. Med. Ouirurug. Guayas, 3, 450-451.
- 6) Hendericks, L. and Wright, N. (1979): Diagnosis of cutaneous leishmaniasis by *in vitro* cultivation of saline aspirates in Schneider's drosophila medium. Amer. J. Trop. Med. Hyg., 28, 962-964.
- 7) Lainson, R. and Shaw, J. J. (1978): Epidemiology and ecology of leishmaniasis in Latin-America. Nature, 273, 595-603.
- 8) Lainson, R. and Shaw, J. J., Ward, R. D. and Fraiha, H. (1973): Leishmaniasis in Brazil: IX. Considerations on the *Leishmania braziliensis* complex: —importance of sandflies of the genus *Psychodopygus* (Mangabeira) in the transmission of *L. braziliensis braziliensis* in north Brazil. Trans. Roy. Soc. Trop. Med. Hyg., 67, 184-196.
- 9) Leon, L. A. (1951): Estudio y presentacion de un caso grave de leishmaniasis tegumentaria tratado con Repodral. Rev. Kuba Med. Trop., 7, 31-37.
- 10) Rodriguez, J. D. M. (1956): Los flebotomos del Ecuador (Diptera, Rsyphodidae). Rev. Ecuat. Hig. Med. Trop., 13, 75-82.
- 11) Rodriguez, J. D. M. (1969): Leishmaniasis muco-cutanea en la provincia de Pichincha. Rev. Ecuat. Hig. Med. Trop., 26, 3-7.
- 12) Rodriguez, J. D. M. (1974): Genero *Leishmania*. In: Lecciones de parasitologia humana, 5th edit., Guayaquil: Dept. Pub., Univ. Guayaquil, Ecuador, pp. 170-185.
- 13) Rodriguez, J. D. M. and Aviles, F. N. (1953): Algunas observaciones sobre leishmaniasis cutaneo-mucosa en el Ecuador. Rev. Ecuat. Hig. Med. Trop., 10, 35-58.
- 14) Valenzuela, A. J. (1931): Leishmaniasis larvingea. Anal. Soc. Med. Quirurug. Guayas, 11, 278.
- 15) Zerega, F. P. (1961): Sobre un caso de leishmaniasis tegumentaria difusa. Rev. Ecuat. Hig. Med. Trop., 18, 17-20.

エクアドル国の一新開拓村住民におけるリーシュマニア症

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エクアドル共和国の一開拓村 *Cooperativa 23 de Febrero* (1977年8月より入植開始) において、リーシュマニア症の罹患状況を調べた。その結果、95名中15名 (15.8%) に本症による潰瘍病変 (*leishmanial ulcers*) を認めた。また入植から1982年までに、本症に感染した治癒病変 (*leishmanial scars*) 保有者42名を含めると、この村でのリーシュマニア症経験者は57名 (60.0%) にのぼり、高い浸淫であることが明らかとなった。住民の本症による感染は、全ての年齢群の男女で認められた。このような高い浸淫度は、本調査地が原生林の中に設けられた開拓村であることから、本症感染が耕作地や居住場所の区別なく、広い範囲での伝搬が成立していることによるも

のと推定される。潰瘍保有者について、入植から感染までの期間を調べてみると、患者の多くは1～3年以内、遅いものでは5年後に罹患している例もみられた。本症による潰瘍保有者の有病期間は、長いもので4年3カ月であったが、一般には2～6カ月で治癒に向う傾向にあった。今回観察された病変は全て皮膚リーシュマニア型であり、皮膚粘膜型は認められなかった。また治癒後に再感染を受けた例は見出されなかった。病変保有者について、病変の体表分布をみると、顔面、上肢を含めた体の上半身で多い傾向にあった。このことは、本調査地でのサシチョウバエが上半身の露出部を好んで吸血することを示唆する。