

COCCIDIOIDOMYCOSIS IN SOUTH AMERICA. A REVIEW OF ITS EPIDEMIOLOGY AND GEOGRAPHIC DISTRIBUTION

by

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ABSTRACT

Argentina. Twenty-seven human cases and coccidioidin skin-test surveys have located the endemic area of coccidioidomycosis between the 27th and 40th south parallels. Climate is of the arid steppe type in the southern zone, arid hill and prairie in the intermediate zone, and arid hill and prairie plus hot tropical in the northern zone. Temperature ranges from 5° C to 29° C, vegetation is xerophytic and annual rainfall is from 300 to 500 mm.

Paraguay. On the basis of human cases and coccidioidin surveys, the endemic area has been delimited between the 19th and 24th south parallels. It was a hot, dry, windy climate with temperature reaching 45° C, an annual rainfall average of 500 mm and xerophytic vegetation.

Colombia. On the basis of two human cases and coccidioidin test surveys, an endemic area of low prevalence was confirmed in the northeast between the 10th and 12th north parallels. Altitude in this region is from 2 to 300 meters above sea level, temperature averages about 29° C. Within this region two different areas can be differentiated -- one in the north where vegetation is tropical desert brush type and rainfall ranges between 125 and 500 mm; the second in the south with grass and cotton culture and rainfall from 500 to 2000 mm.

Venezuela. Thirty-five human cases and nearly 60,000 skin tests made from east to west in the northern part of the country, where the population is concentrated, showed that the endemic area is situated between the 9th and 12th north parallels. This is an arid region with "desert soils". Altitude ranges from sea level to 800 meters, annual temperature averages 24° C and rainfall 500 mm in some places, and 29° C and less than 400 mm in others. More than 172 species of plants have been identified in the zone but cacti predominate. *C. immitis* was isolated from soil collected at a site where a patient had become infected.

Bolivia, Peru and Ecuador. MACKINNON studied a patient coming from Bolivia, but he has expressed doubt about the Bolivian origin of the infection because the patient had lived in the Paraguayan Chaco the previous year. More information is necessary to evaluate the human case mentioned in Peru by BINDER. Cases reported from Ecuador appear to have been paracoccidioidomycosis and leishmaniasis rather than coccidioidomycosis.

Many species of rodents and other wild and domestic animals share with man the possibility of infection in the four countries where the endemic areas have been confirmed.

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Detailed information on the relationships between the microflora, microfauna, higher animal and plant life and *Coccidioides immitis* in the four South American regions where this disease is endemic is scarce as is information regarding the chemical nature of the soil in which this fungus grows. We do know that soils vary from pure sand in the dunes of the northwestern Paraguayan Chaco, where

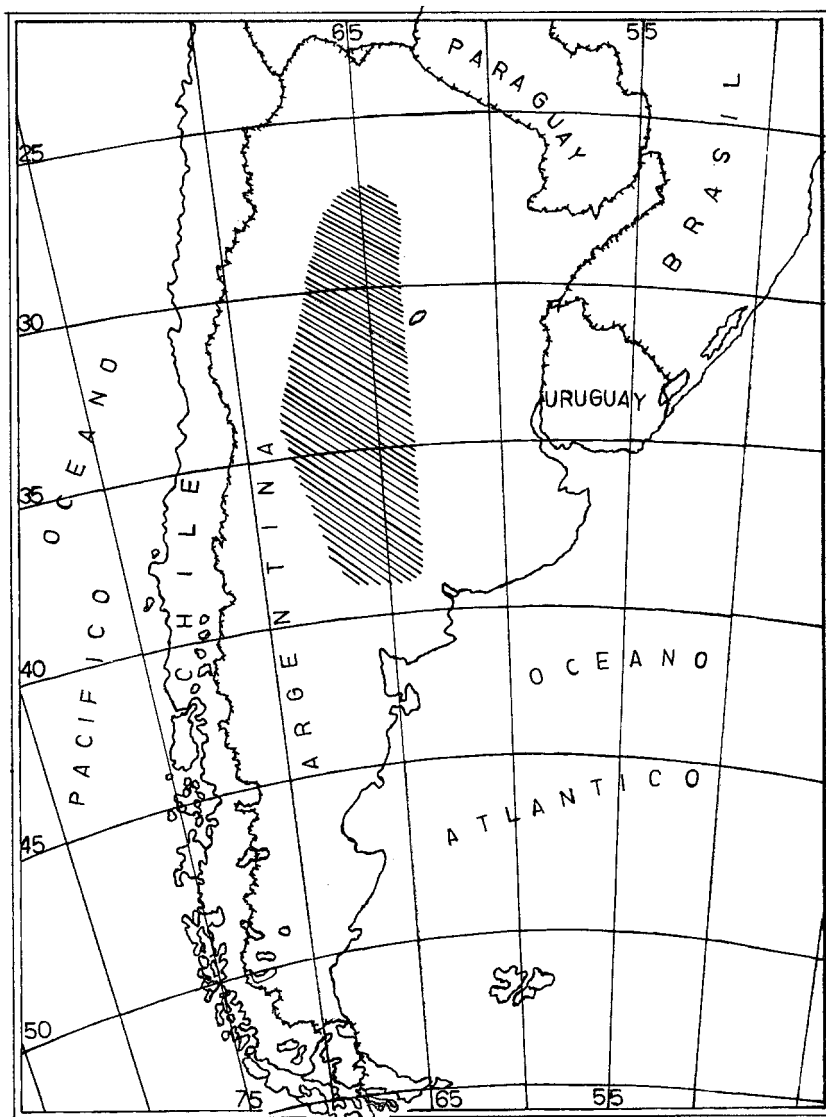


Fig. 1. Coccidioidomycosis endemic area in Argentina.

coccidioidin skin test surveys revealed a prevalence of more than 43 % positive reactors among the Guazurangues Indians (1), to almost pure clay in El Tocuyo, a town in west central Venezuela, where one case of coccidioidomycosis was diagnosed and *C. immitis* was isolated from soil (2). The following features are common to the four endemic zones: high temperature during part or all of the year; winds that vary with the zone and season from strong to weak, constant to intermittent; scarce rainfall concentrated in short periods, followed by long periods of drought, and as a consequence, sparse vegetation dominated by thorny, xerophytic plants.

These common features are the minimal ecological conditions necessary for the growth and dissemination of *C. immitis* in the zones of the countries in South America where the existence of coccidioidomycosis has been clearly demonstrated.

ARGENTINA

Since 1892, when Alejandro POSADAS discovered this disease, until the end of 1965, only 27 human cases have been registered in Argentina; there are twice as many males as females (3). On the basis of the origin of these patients and coccidioidin skin tests (4, 5, 6), the endemic area has been located between the 27th and 40th south parallels (Fig. 1).

NEGRONI (3) divides the area into the following three zones based on variations in geology and climate. A) The southern zone lies between the 39th and 40th south parallels and corresponds climatically to the dry western Pampa, with isotherm values of 5° C to 10° C in winter and 20° C to 25° C in summer. Winds blow constantly from west to east. The annual rainfall is generally less than 300 mm and confined mainly to the winter months. The climate is of the steppe type and the soil composed of sand, clay and lime. B) The northern zone lies between the 27th and 28th south parallels and partakes both of the arid hill and prairie climate and of the hot tropical one.

The isotherm varies from 25° C to 29° C in summer and 10° C to 15° C in winter. Annual rainfall is about 500 mm, and the dry season lasts nearly the whole year. The soil is made of sand and clay. For days on end winds blow down from the mountains, sometimes hot and dry and sometimes cold and in gale force. C) The intermediate zone has an arid hill and prairie climate, similar to the northern zone. In this area, as in the two others, vegetation is xerophytic and several species of rodents can be found.

PARAGUAY

On the basis of two patients from the Paraguayan Chaco with 'erythema nodosum', GOMEZ (7) proved the existence of coccidioidomycosis in this country and defined its geographical location (Fig. 2).

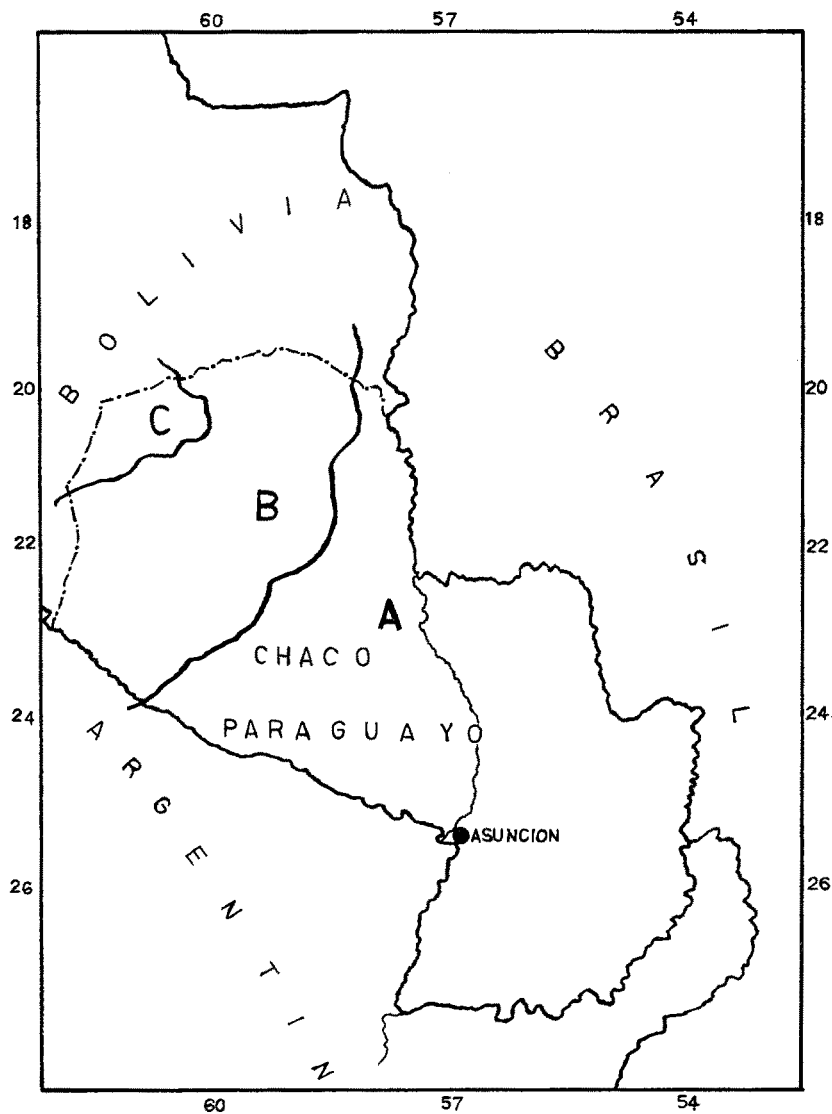


Fig. 2. Paraguayan endemic areas for coccidioidomycosis.

This area, a part of the Paraguayan Chaco, is a vast plain with very few hills and a maximum altitude of 600 m above sea level. The climate is hot with temperatures reaching 45° C and higher, arid soils, strong winds from the north a large part of the year, and most of the rainfall from October to May, with very little outside of these months.

GOMEZ (7) divided the Paraguayan Chaco into three zones based on phytogeographical considerations. A) This area has an annual rainfall of 1400 to 1600 mm, well-watered soil and tall trees and palms. B) With an annual rainfall of 475 to 675 mm this zone has a forest of small bushes, cacti and other thorny plants, but no grass. Much of the soil is , therefore, blown by the strong winds. C) This desert zone has annual precipitation less than 475 mm, sandy soil constantly moved by strong northern winds, and a very poor vegetation made up of cacti, bushes and a few trees.

The western part of the Paraguayan Chaco is composed of the last two of these three zones and lies between the parallels of 19° and 24° S. and the meridians 59° and 63° W.; it is occupied almost exclusively by an indigenous, widely dispersed population. Among these natives, 43.9 percent gave positive coccidioidin skin test reactions. Among 291 North Americans working for a petroleum company, 50 percent showed a positive coccidioidin skin test.

In Asuncion, the capitol city of Paraguay, located far from the endemic region, GINES *et al.* (8) studied the sensitivity to coccidioidin of a heterogenous group of 2123 people from 2 to 70 years old, some afflicted with tuberculosis and leishmaniasis. The prevalence of positive skin test reactors in this group ranged from 0.94 percent to 4 percent.

COLOMBIA

In 1963 BENNETT & VAUGHN (9) published the results of skin tests made on animals and humans with various fungus antigens. They were trying to demonstrate the existence of various deep mycoses in a region of Colombia located between 1°, 48', and 4°, 25' north latitude. This region was characterized by altitudes from 1 m to 2300 m above sealevel, mean annual temperatures between 15.7° C and 26° C, and an annual rainfall between 1100 and 3075 mm. These investigators found no evidence of sensitivity to coccidioidin.

In 1958 SALES (10) published a report of a case of pulmonary coccidioidomycosis in Barranquilla. ROBLEDO (11) in 1965 reported on another case of pneumonia in a patient from CODAZZI, in the Department of Magdalena. *C. immitis* was identified in this patient's tissues and confirmed by animal inoculation. The confirmation of these cases and a recent coccidioidin survey (12) have established the existence of an endemic area of low prevalence in that part of Colombia (Fig. 3).

The area is located in the northeast between the 10th and 12th north parallels from 2 to 300 meters above sea level and has an average annual temperature above 29° C. It is divided into two different regions; one is in the north where vegetation is tropical desert brush and the annual rainfall is between 125 and 500 mm, and the other is in the south and has grass and cotton culture and rainfall from 500 to 2000 mm.

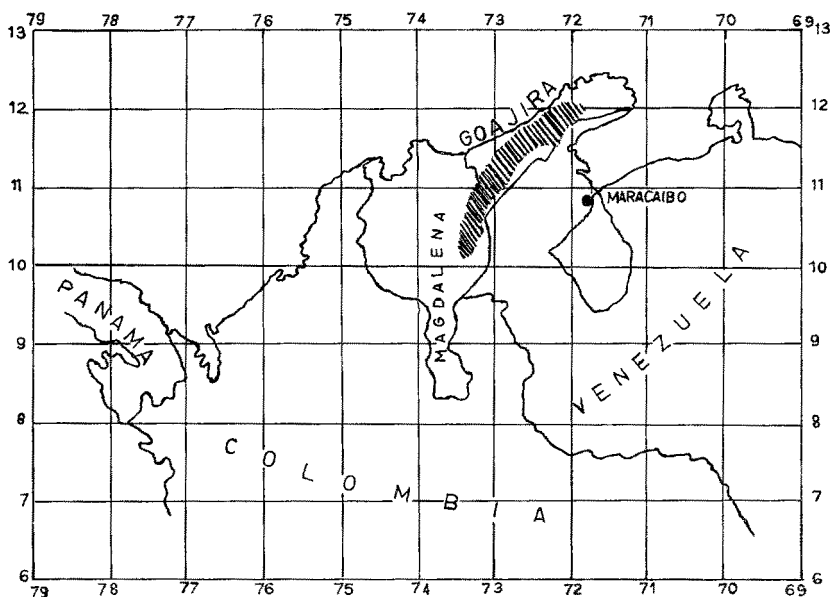


Fig. 3. Endemic coccidioidomycosis area in Colombia.

Skin sensitivity to coccidioidin was tested in 1659 persons living in seven different localities. Positive reactions varied from 3.3 % to 6.3 % according to the region from which the person came.

VENEZUELA

In 1949 CAMPINS, SCHARYJ & GLUCK (13) reported the first Venezuelan case of coccidioidomycosis. Since then, 35 cases have been confirmed (14) and nearly 60,000 coccidioidin skin tests have been made from east to west in the northern part of the country, where the majority of the population is concentrated (15, 16, 17). Most of the patients were residents of villages or towns in the adjacent northwestern states of Lara, Falcon and Zulia (Fig. 4). The highest percentages of positive tests in the first two states mentioned, where about 16,000 coccidioidin skin tests have been made, were 46.4 % in a village in the state of Lara and 23.9 % in another village in the state of Falcon.

Tests have not been made on the population of Maracaibo, the capital city of the state of Zulia, and its surroundings, but four cases have been diagnosed there. One of them, a three-year old child, lived in that city until his death. More than 5,000 tests were made in another region of that state — the Peninsula of Goajira, facing the area studied by ROBLEDO *et al.* (12) in Colombia. There the highest percentage of positive tests was 3.2 %.

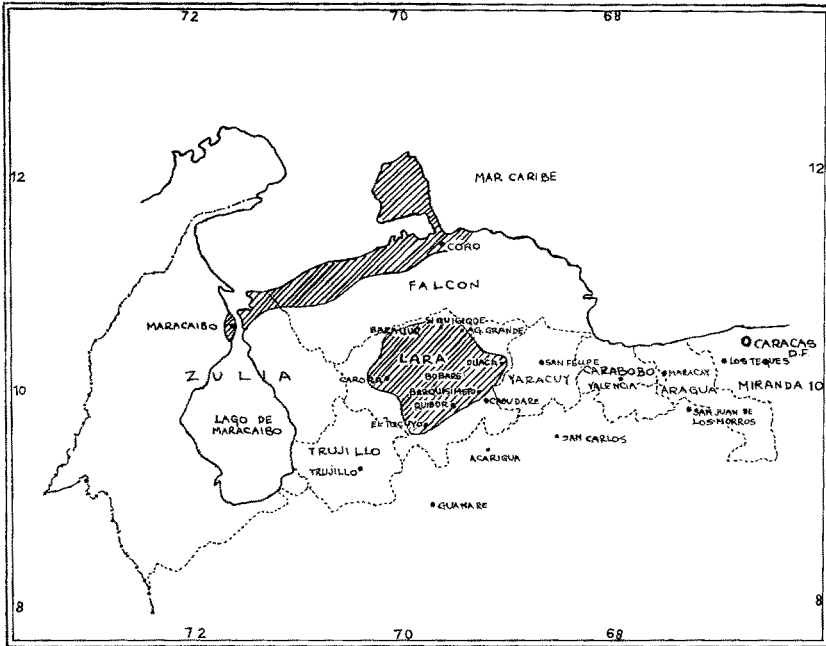


Fig. 4. Distribution of coccidioidomycosis areas in Venezuela.

The regions of the states of Lara, Falcon and Zulia, where the patients contracted the illness, are arid, generally having characteristics of the so-called 'desert soils'. Cacti predominate the vegetation (Fig. 5). More than 172 species of plants classified within 45 families have been identified in those regions (18). The most common among the cacti are *Cereus griseus* (cardon de dato), *Cereus defociens* (cardon de lefaria), *Cephalocereus moritzianus* (cardon de guanajo), *Opuntia caracasana* (tuna brava o cabrera), and *Opuntia caribaea* (tuna guazabara), and among the legumes are *Prosopis juliflora* (cuji), *Poponax flexuosa* (froeda o cuji hediondo), *Cericidium prae-cox* (yabo, very similar to palo verde and of the same genus), *Cassia emarginata* (platanico) and *Pithecolobium dulce* (yacure). The altitude of these regions ranges from sea level to 800 meters. The average annual temperature ranges from 24° C to 29° C. Seasonal variations of 2 to 3° C are relatively insignificant; however, daily oscillations (7 to 10° C) between the warmest hours of the day and the coolest are relatively large. Annual rainfall averages about 600 mm in the regions of the state of Lara, 400 mm in the city of Maracaibo and less than 400 mm in the dry plains of the state of Falcon.

BOLIVIA, PERU AND ECUADOR

The location of the Paraguayan endemic zones of coccidioido-

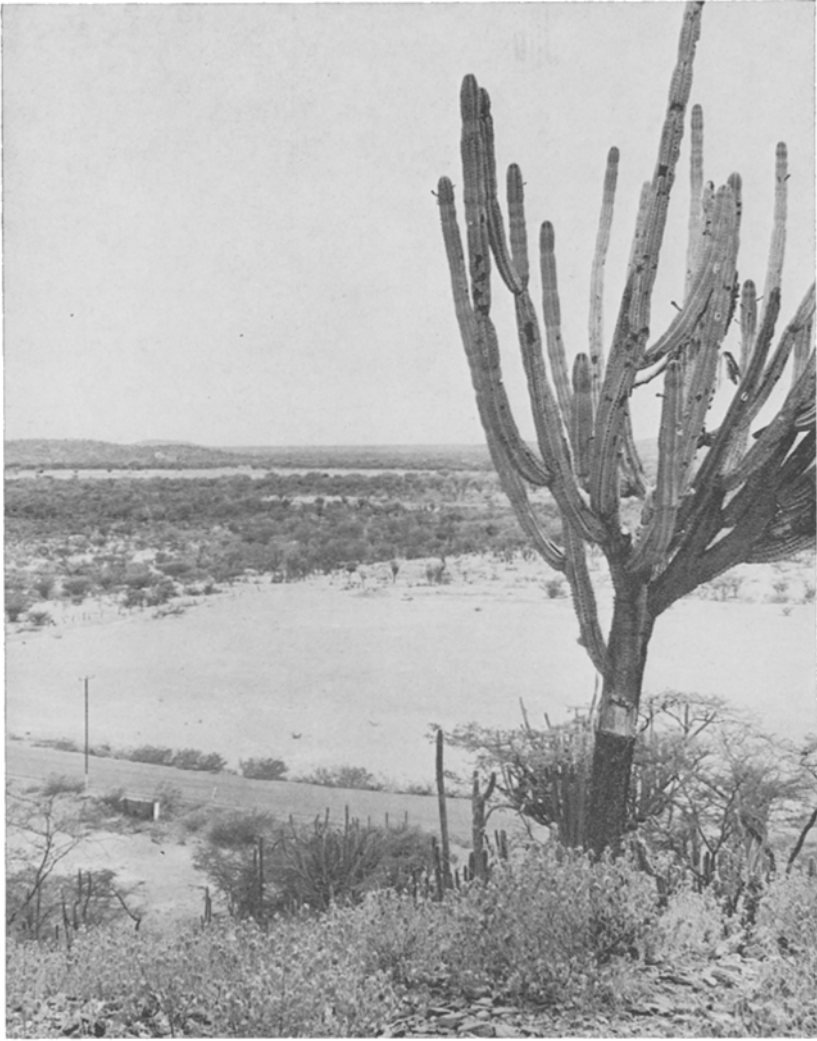


Fig. 5. Xerophytic vegetation in the state of Lara, Venezuela.

mycosis near the border of Bolivia and the report by MACKINNON (19) of a case which came from Bolivia suggest the existence of an endemic zone of the disease in this country. However, the patient studied by MACKINNON had previously lived in the Paraguayan Chaco where he had developed a cervical adenitis whose etiology was not established. A year later this patient consulted a doctor for oral lesions which were diagnosed as coccidioidomycosis. For these reasons MACKINNON expressed doubt in a recent personal communica-

tion about the Bolivian origin of the infection described in his paper (19). Based on MACKINNON's publication, other authors have suggested the possibility of the presence of coccidioidomycosis in Bolivia, but additional data are not available to confirm this. With respect to the cases cited by BINDER (20) in Peru, more information seems necessary to establish the existence of the disease in that country; and according to AJELLO (21), the reports of coccidioidomycosis in Ecuador appear to have been misdiagnosed cases of paracoccidioidomycosis and leishmaniasis.

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