

MALARIA SURVEYS IN PORTO RICO

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That Malaria is and has been a serious public-health problem in Porto Rico for a long time is a recognized fact, but the exact extent of the disease in the Island has never yet been determined. Morbidity statistics seem to have been of little value in indicating the extent and distribution of malaria, for with the exception of doctors who have been accustomed to using the Laboratory of the Department of Health, practically no one reports cases of transmissible diseases unless these diseases are present in epidemic form. There are therefore no accurate statistics to show the incidence of the disease or its distribution and it has been necessary to rely upon the following information in order to obtain a general idea of existing conditions.

Mortality Statistics.—Since practically all burials are made in municipal cemeteries and a death certificate signed by a physician must be presented before a permit for a burial is issued probably most deaths are registered. The chart presented shows the mortality from malaria reported as well as from all other causes for the years 1910 to 1924.

Annual Mortality for Porto Rico

Year	TOTAL DEATHS		DEATH RATE	
	From all causes	From malaria	From all causes	From malaria
1910-11	26,579	2,139	23.45	1.9
1911-12	28,704	1,290	24.97	1.1
1912-13	26,034	1,160	22.35	1.0
1913-14	21,775	574	18.44	0.5
1914-15	23,664	765	10.78	0.6
1915-16	26,572	1,334	21.92	1.1
1916-17	34,939	1,939	28.45	1.6
1917-18	34,457	1,528	27.50	1.2
1918-19	39,974	1,576	31.90	1.2
1919-20	30,280	1,608	23.60	1.2
1920-21	29,396	1,503	22.20	1.1
1921-22	30,398	1,185	22.60	0.9
1922-23	28,533	922	20.80	0.7
1923-24	25,886	959	18.70	0.7
1910 Census			1,118,012	
1920 Census			1,290,809	

Death rate is death per 1,000 population.

It seems hardly worth while to attempt to explain any of the annual variations in this mortality rate although Dr. Grant in his report on surveys of Porto Rico thought he noticed a relation between mortality rates and the economic conditions of the Island. For instance, those years when salaries were high and the budgets large showed lower mortality rates. The cipher of thirteen hundred is reported as an annual total average of mortality in a population which increased from 1,100,000 to 1,300,000 in the fourteen-year period.

Mortality Statistics of Limited Value.—Several factors lessen the value of these statistics in the study of Malaria. (a) The disease does not seem unusually fatal in Porto Rico, and in any case the disability produced by attacks of malaria and not the mortality, probably represents the greatest loss due to the disease. (b) Many patients are never seen before or after death by a physician and the municipal doctor signs a certificate assigning as the cause of death the most obvious condition according to symptoms described by relatives. This is reported as being the most common fault in mortality statistics, but probably of equal or even greater importance is (c) inaccuracy of diagnosis by physicians themselves.

The clear-cut cases of Malaria are easily diagnosed by anyone, but in children especially, diagnosis in severe cases is difficult and deaths undoubtedly result from malaria when symptoms are mainly referred to some organ or system of the body as the gastro-intestinal tract. There are too many deaths reported from pernicious anemia, malnutrition and other less definite disorders to inspire much confidence in mortality statistics. In one year five hundred deaths from pernicious anemia were reported when it is commonly known by the more careful physicians that a case of pernicious anemia is rarely found in the Island. It would seem clear that severe malaria, hookworm disease and sprue are being confused with this disease. (d) There is also some confusion in translating from Spanish to English and vice versa. A word is often used in the two languages which has different meanings in each. Especially is this true with regard to "rachitis" as pointed out by Dr. Fernós the Assistant Commissioner of Health. In Porto Rico the word "*raquitismo*" does not as a rule mean "rachitis" but merely a condition in which malnutrition is a symptom. There is an excessive mortality rate reported from this condition but often no attempt is made to determine if there are any diseases such as malaria which may be the underlying cause. (e) Since municipalities as a rule

include a portion of the coast and a portion of the mountain district regions in which incidence of malaria probably differs widely, and as mortality statistics are only reported by the entire municipality the data is often misleading and many serious foci may be overlooked. Due to the continued efforts of the Department of Health many of these conditions are being corrected so that the statistics are becoming more and more reliable.

Results of Hookworm and Malaria Survey in 1919 by Grant of the International Health Board.—In the course of a general survey of the Island with particular reference to hookworm disease, Grant found a malaria parasite rate of 30.5 in coast regions and one of 1.5 in the mountains. The former rate shows a decidedly high average of infection in the coast regions. During 1920 to 1923 Greene of the International Health Board was working at Aguirre and made studies of parasite rates in the neighboring towns of Guayama and Salinas. Rates varied at certain seasons of the year, but it would appear that most common parasite rates encountered were between thirty and fifty per cent. These studies give the most definite information available.

Some information of general character has been obtained in which it has been found that practically every year in Porto Rico outbreaks of malaria have developed in one part of the Island or another. In 1923 a severe localized outbreak occurred in the rural section of Aguadilla and practically everyone in that area was attacked. In 1924 there was an outbreak of the disease at Patillas and another at Dorado. This bears evidence of the widespread nature of the disease and of its seriousness.

It has also been observed that municipalities and corporations spend large sums of money annually in the purchase of medicines for the poor and that in many cases quinine forms a large part of the purchase. The sugar companies report that they are often handicapped in certain seasons of the year by the high rate of sickness due to malaria among their employees. In many regions it has been noted that malignant cases of the disease develop. In fact, during the past year a prominent continental physician nearly lost his life from a severe malignant attack of malaria. This information shows, therefore, that malaria is rather widespread throughout the coastal plains at least; that a relatively large number of deaths are reported from this disease each year, and that special studies show high parasite rates in certain regions. Malaria is probably prevalent to such an extent as to constitute, next to hookworm

disease, the most important public health problem in Porto Rico. An attempt to control this disease was made at Aguirre in the years 1921 to 1923 but outside of this there has been no systematic study of or attempt to control it in the Island.

A brief, preliminary general survey made before this study was started indicated that conditions and underlying causes vary in different regions of the Island and that methods of attack developed in one region would not necessarily be entirely applicable in another. The north coast has a much more abundant rainfall and natural drainage is blocked along a large portion of it by a barrier thrown up by wind and wave action. There are, therefore, extensive water-soaked soils. Rainfall is low on the south coast and irrigation is necessary for cane cultivation. This latter, therefore, has made breeding possible in high, dry lands and has increased the wet areas, naturally large enough, along the immediate coast where mangrove and swampy lands are abundant. For this reason studies have been made in Barceloneta, a typical area on the north coast where irrigation is not practiced, swamp lands are abundant, and the population is scattered; in Fajardo on the east coast, where lands are higher and the water present was mainly that of irrigation and rains, and where population is concentrated; in Ponce on the dry south coast where in this instance malaria was a problem in a large town and also in a rural population, irrigation being practiced and swampy lands being abundant near the ocean; and also in Aibonito where water is abundant but malaria is not so carefully reported.

At Barceloneta there is a narrow strip of fertile coastal plain two to four kilometers wide in much of which water is stagnant a greater part of the year because of rains, seepage and entrance of tides. The land is low and in many places it is banked in order to keep the cane plants out of water. The water surface in the ditches is thus enormous. The people are found thickly distributed along both sides of this plain and some houses are found in the lowlands themselves so that there is a very heavy rural population within less than one kilometer of permanent breeding areas. That the rural population is heavy can be seen from the fact that in an area of five square miles almost five thousand people were registered in the census. Rainfall averages about sixty inches a year. The monthly mean temperature varies from about 71 in January to about 80 in August or September. The lowest temperature at night rarely falls much below 60 and then only for a short period of the year.

By using thin blood films a parasite rate of 27 was found for the entire population with the highest rate of 71.4 in a small colony in the center of the cane fields and rates of 30 to 35 in the population bordering the cane fields. The spleen rate (children up to sixteen years of age) was 22.0, with the highest rate of 52.6 in the colony in cane fields. The disease was found widely distributed throughout the area, but rates were highest within a half kilometer of permanent water deposits.

At Fajardo the people live concentrated mainly in a town of six thousand people, a beach village of about one thousand people and in labor colonies of the Fajardo Sugar Company,—all in the narrow valley of the Fajardo river. Swamp lands are found only on a narrow strip of land near the ocean. Cane is planted on all available land and irrigation is practiced in a portion of the valley which borders the town on both sides. Rainfall is slightly higher than at Barceloneta as is the temperature. The main breeding areas are temporary water deposits in the fields formed during heavy rains, cane field irrigation and drainage ditches, and a few permanent water courses such as the Fajardo river, several small creeks and the swamp land near the ocean. The town is long, but as it is narrow no portion of it is more than a half kilometer from breeding areas. A parasite rate of 38 has been found with a low spleen rate of 13.5, malaria which appears to be widely distributed throughout the entire area though rates are slightly higher in labor colonies, in cane fields, and in portions of towns nearest the irrigated cane fields. The rate in the beach village is relatively high and this would appear to be the result of mosquito breeding in rain-water collections in the lowlands; for after heavy rains the entire region becomes partially flooded and water stands for a long time.

Ponce, a city of forty thousand people, is found at the base of the ridge of hills bordering the irrigated cane fields. About four kilometers away and on the seashore, six thousand people are crowded into a small section of swamp land. In addition there are numerous labor colonies in the cane fields and houses are found along all the main highways leading from the city. The city itself is surrounded by irrigated cane fields except for a portion in which a narrow strip of pasture land is found where the storm water from the town collects. Rainfall is low, being only about thirty-seven inches. The beach village not only borders on irrigated cane fields but touches swamp lands, irrigated pasture lands and during the excessive rains becomes more or less flooded itself. Portions of the city back in

the hills are easily one kilometer away from the poorly drained pasture lands and irrigated cane fields. The spleen rate (9.5) was lowest in this region. The portion of the city bordering on the pasture lands and cane fields had a rate of 17.4; the suburban zone, including houses which extend along main highways, a rate of 29.2; while the colonies in the field has a rate of 25.0. It was impossible to examine a representative number of blood smears, but of 686 examined, 26.8 per cent were positive with the lowest rates back in the center of the city.

Aibonito is located on the top of the mountain range at an elevation of two thousand feet. The monthly mean of temperature is 75, for August while in January it is 67.6. Night temperatures below 50 are not uncommon. Rainfall is about the same as at Barceloneta and Fajardo. The town is located on a slight slope and is almost completely surrounded by numerous small creeks which have numerous bays of stagnant water with much debris and vegetation. A parasite rate of 6 and spleen rate of 9.8 was found, showing that malaria was present but in less abundance than on the coast.

Conditions at Barceloneta are more or less typical for the greater portion of the north coast and those at Ponce more or less representative of a large part of the south coast. The people of practically the entire coast of Porto Rico are seriously infected with the disease and a parasite rate of at least twenty-five per cent can be expected in almost any part of the coast when both urban and rural population are considered. Studies at Aibonito indicate that the disease is present in the mountains but only a few young *Anopheles* larvae were ever found there, and as the population moves about to such a great extent from coast to mountain and from one coast town to another it is possible that the infections were contracted on the coast. On the coast the highest rates have always been found in the rural zones near cultivated lowlands or cane fields in which irrigation has been used or in swamp lands. The disease is also present to a large extent in urban zones. From the standpoint of morbidity the disease stands easily next to hookworm disease.

Anopheles Calbimanus would appear to be the most important vector, though at certain seasons *Anopheles Grabhamii* and *Vestitipennis* are quite abundant.

The malaria problem is intimately associated with that of agriculture and particularly with that of cane cultivation. Before much permanent work can be done in regions like Barceloneta preliminary agricultural drainage is necessary. Even after drainage it is prob-

able that irrigation will be used part of the time and control of mosquitoes will still be made difficult. Prospects would seem to be good however for obtaining appropriate and adequate drainage of a large part of these lands.

In all regions it would be advantageous to plan on some concentration of population as far away from cane fields as possible. Since most lands in these regions belong to large corporations, the country people would not lose by being compelled to transfer their homes to more healthful places. Already at Barceloneta the municipality has taken steps to provide a more healthful place for its rural population. At Ponce the problem is one of irrigation in cane fields, swamp lands, waste water from the city, and of people residing in regions difficult to sanitize. Before much permanent work can be done, the city must provide for proper disposal of its waste water and should attempt to provide adequate space outside of the swamps for the settlement of the poor.

For further study of the problem and for the initiation of the campaign of control, Fajardo presented unusual advantages. The population was already fairly well concentrated, swamp lands were not abundant and irrigation was practiced part of the time in the cane fields. The Fajardo Sugar Co. located there was very much interested in the problem and was desirous of cooperating to the fullest extent, and malaria was present to such a degree as to constitute the major public-health problem. For these reasons a vigorous campaign is in progress for the control of malaria in that part of the Island, and due to the spirit of coöperation shown on the part of municipal authorities, corporations and private residents of that vicinity, it is believed that lasting results will be obtained.

