This is to certify that the

thesis entitled

TUBERCULOSIS SCREENING IN CIALES AND MANATI,
PUERTO RICO

presented by

Sonia Arbona

has been accepted towards fulfillment
of the requirements for

Master degree in Geography

J. M. Hunter

Major professor

Date May 31, 1983

TUBERCULOSIS SCREENING IN CIALES AND MANATI, PUERTO RICO

By

Sonia Arbona

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Geography

1983

ABSTRACT

TUBERCULOSIS SCREENING IN
CIALES AND MANATI, PUERTO RICO

By

Sonia Arbona

This study was conducted to investigate under-reporting of tuberculosis cases in Ciales and Manatí. In Manatí the TB rate reported by the health authorities in 1980 was ten times higher than for Ciales, indicating the existence of more favorable conditions for the development of the disease in Manatí.

The level of infection in both municipalities was obtained through a tuberculin screen survey. A total of fifteen hundred tuberculin tests, Mantoux method, were administered on the basis of a proportionete sample by barrio. The reaction to the test and a number of socio-economic variables were recorded through a questionnaire completed for each individual tested.

Some twenty-one percent of the tested persons in Ciales reacted positively and fifteen percent in Manatí. Only slight differences in socio-economic conditions were observed. Underreporting was concluded to be a problem for the control of TB in both Ciales and Manatí, but of greater magnitude in Ciales.

To my parents Carmen and Charles Arbona for their love and assistance with this research.

ACKNOWLEDGMENTS

I wish to express my sincere thanks to the Puerto Rico Department of Health for their interest and cooperation in this study. Thanks are due to Dr. Jaime Rivera Dueño, Secretary of Health, and to Dr. Yamil Kouri, Director of the Center of Communicable Diseases.

I am particularly grateful to the Tuberculosis Control Program and its director Dr. Arturo Córdova. To the staff of the tuberculosis clinic in Manatí and to Dr. Ada Martínez, I extend my appreciation.

I would like to thank the members of my committee for their valuable suggestions, Dr. Robert N. Thomas, Professor of Geography, and especially Dr. John M. Hunter, Professor of Geography who provided invaluable assistance and guidance.

I wish to express my gratitude to Nurse Aida Acevedo for her technical contribution in the administration of the test, and to my husband and parents for their encouragement and support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

In Puerto Rico, where tuberculosis was the leading cause of death during the 1940's, measures taken by the Department of Health achieved a remarkable reduction in the prevalence of the disease. It was believed that the disease was controlled and, for all purposes, eradicated. The control measures began to weaken and in 1979 mortality and morbidity statistics revealed an unexpected increase of tuberculosis in the population.

It was necessary to reorganize the tuberculosis control program. Tuberculosis clinics for out-patient treatment were re-structured at different locations throughout the island. Each clinic had a number of municipalities assigned as its service area. Tuberculosis sections in several public hospitals were also created.

The fact that tuberculosis persisted as a public health problem in Puerto Rico, suggested that a substantial portion of tuberculosis cases were not being reported and that there was a need for education of the population concerning the first symptoms of the disease. Both problems are related to the quality of the medical services and their capacity to reach out into the community.

With the reorganization of the tuberculosis program,

adequate treatment has been offered at the clinics. But to successfully achieve the prime objective of the control program, to reduce the number of infectious cases, it is necessary to reach all sectors of the population. The tuberculosis municipality rates, which are based on the number of cases detected at the different health facilities, present a pattern that suggests better reporting exists in those municipalities where the clinics are located. Higher rates are reported there.

Underreporting is still a major problem for the control of the disease. But it seems to be a problem of a greater magnitude in selected locations, namely the municipalities without tuberculosis centers. It appears that reported rates are not accurate since they are a creation of the health services.

It is the purpose of this study to compare infection rates in two municipalities where the reported tuberculosis rates are of a low and of a high degree when compared with the rest of the island. The municipality with the higher rate has a tuberculosis clinic; the other has not.

Infection levels will give an indication of the magnitude of the transmission process in both communities. Since standards of living, and density of population, are two factors related to the prevalence of tuberculosis, variables that serve as indexes of those two factors were included in the analysis.

The principal objective of this study is to serve as an indicator of the need for better reporting of tuberculosis cases and to point out where the need is the greatest. It is expected that this study will contribute to the process of identification of the problems interfering in the effective control of tuberculosis in Puerto Rico. The whole population on the island will benefit from this.

CHAPTER I

CLINICAL ASPECTS OF TUBERCULOSIS

Agent

The most common agent of tuberculosis is the bacillus Mycobacterium tuberculosis. The microbial family of the Mycobacteria includes many microorganism with certain common properties: they are all acid fast, obligate aerobes, and all of them grow and metabolize rather slowly. Mycobacteria bovis can also cause the disease, but bovine tuberculous infections of the digestive system have been largely controlled since the advent of pasteurization of milk and the inspection of dairy herds. As far as human beings are concerned, M. tuberculosis is the most important of the mycobacterial pathogens (Wyngaarden and Lloyd, 1982).

Pathology

The infection process is usually initiated by inhalation of the bacilli in airborne droplet nuclei from sputum of infected persons. The inhaled bacillus may multiply or it may be eliminated by alveolar macrophages before it is detectable by radiograph.

M. tuberculosis can produce infection and disease in almost every tissue and organ of the body, but the most

common focus is the lung where the tubercle bacillus multiplies most rapidly (Fishman, 1980). When infection with M. tuberculosis takes place in a person who has had no previous experience with the tubercle bacillus, it is referred to as primary infection. At this point, resolution of the disease may take place to such a point that little or no residue of the infection will remain. The affected individual will become tuberculin positive, but with no further clinical significance.

Secondary tuberculosis or reinfection occurs as a result of recrudescence of an old infection from an active case, in those who have been previously infected. Nutritional status, mental and physical stress, and exhaustion modify the course of tuberculosis. Any factor that lowers resistance to infection will promote the development of tuberculosis disease in previously infected people (Youmans, 1979).

Basically, there are two ways in which pulmonary tuberculosis may have its origin: the exacerbation of an old focus already present in the lungs, or the development of a new disease process independent of the old. Pulmonary tuberculosis begins as a small patch of pneumonia surrounding a growing bacterial colony. Intense inflammation may progress to caseous necrosis derived from tubercle bacilli and dead cells. No connective tissue is found in the caseous area. In time, caseous foci may calcify or even ossify. Bacilli may grow in solid caseous areas, but are

generally inhibited by a low oxygen tension. More often the bacilli grow intracellularly in the live young macrophages of the surrounding tuberculous granulation tissue. When uncontrolled, such bacillary growth results in an extension of the caseous necrosis (Wehrle and Top, 1981).

Tuberculosis is defined as a local disease in the sense that each lesion is handled by the host as if the other lesions do not exist. Thus lesions in one area of the lung may progress, while lesions in another area may stabilize or even regress. Even parts of a single lesion may progress, while other parts remain stable. The disease as a whole often fluctuates between periods of exacerbation and remission.

There are different types of tuberculous lesions and diseases. The first type of lesion that can be seen on the chest radiograph is the encapsulated caseous or calcified nodule. The nodule usually remains inactive for the life of the patient. In the proliferative type of lesion, connective tissue contributes to its compact nature. Proliferative lesions may become chronic, with some areas undergoing fibrosis. In the exudative type, lesions are either small, or small to large areas of tuberculous pneumonia. Caseous necrosis is common. Proliferative and exudative may occur concurrently in different parts of the lungs. The lesions can be limited or extensive in scope and sometimes change from one

predominant form to the other. In miliary tuberculosis, many small tubercles of uniform size occur simultaneously in the lungs.

Caseous necrosis may liquefy when it is discharged into the bronchial tree. This process is responsible both for the spread of the disease and for infection of others (Wehrle and Top, 1981).

By coughing, the patient aerolizes the infectious material and disseminates it via the bronchial tree into various parts of the lung and to the outside world. A cavity varying in size from five millimeters to almost the size of the lung is formed when a caseous focus is evacuated into the air passages.

Tuberculosis cavitation constitutes a dominant event in progressive pulmonary tuberculosis. These lesions may never heal during the lifetime of the patient. They may enlarge or shrink or may remain in a more or less stable condition. A healed cavity, like a healed caseous focus, is seldom completely free of tubercle bacilli, which may persist for years, frequently in a dormant state. In the era previous to chemotherapy, closure of a cavity was often done by one of the forms of collapse therapy.

Progression in tuberculous lesions can be slow or rapid. The most common type of progressive tuberculosis in adults consists of slowly progressing caseous foci and/or cavities. Progression is intermittent. The advancing edge consists of fresh tubercles and of alveoli containing

fresh and organizing pneumonia. Satellite lesions are frequent and cavitation and extension via the bronchial passages are not rare (Fishman, 1980).

In most infections the clinical manifestations of tuberculosis depend on the age of the infected individual. The combination of disease in the pulmonary parenchyma and in regional lymph nodes occurs more consistently and prominently in children than in adults. In the primary tuberculous infection of the child, pulmonary parenchymal involvement is sometimes quite insignificant by clinical or radiological examination, while disease of the lymph nodes that drain the infected area is massive. Many complications of tuberculosis in the child result from local or distant spread of disease of the lymph node foci. In contrast, disease of the lymph nodes in primary infection in the adult is often so small and inapparent that it cannot be recognized clinically.

The site of tuberculosis in the lungs is different between children and adults. In the child the initial lesion can occur in any part of the lung, but most commonly in the anterior and basal segments. In the adult, even when infection is recent, the initial lesion usually affects the upper and posterior segments.

Extrapulmonary tuberculosis. The clinical manifestations of extrapulmonary tuberculosis may become apparent after long periods of quiescence. The most common forms of extrapulmonary tuberculosis are in lymph nodes,

pleura, genitourinary tract, and bone. Certain organs, such as skeletal muscles, the pancreas, thyroid gland, brain, stomach, and heart, are rarely the site of tuberculous infection. Acute miliary, meningeal, pericardial, and peritonial tuberculosis are also less common.

Tubercle bacilli reach extrapulmonary organs by at least three routes. First, in advanced pulmonary tuberculosis, secretions containing large numbers of tubercle bacilli can be carried to any of the organs that connect with the lung by canalicular passages. Tuberculosis of the larynx, oral cavity, tongue, middle ear, ileocecal region and rectum are infections that occur in this way. Tuberculosis in any of these sites almost never occurs except as complication of advanced, active pulmonary tuberculosis. Secondly, tuberculosis also occurs by extension from an adjacent structure. Tuberculosis extending from the lung to the pleura, from the cerebral cortex to the meninges, from the fallopian tubes to the peritoneum, and from lymph nodes to the pericardium, are examples of this type of spread. Thirdly, dissemination of tubercle bacilli by the bloodstream or lymphatics to distant organs results from the invasion of blood vessels or lymphatics in the lung or some other tuberculous organ. Tuberculosis of lymph nodes, bone, kidney, fallopian tube, and brain come about in this way (Pfuetze and Radner, 1966).

The clinical manifestations of tuberculosis in these diverse organs vary considerably. Although systemic manifestations in the form of fever, weight loss, and malaise are common to tuberculosis infection in any of these organs, the occurrence and severity of any particular symptom depends on the acuteness of the infection, the amount of tissue involved, and immunologic factors.

As in the lung, extrapulmonary tuberculosis responds to chemotherapy: inflammation promptly subsides, and if chemotherapy is prolonged, complete healing ensues (Wehrle and Top, 1981).

Symptoms

In chronic pulmonary tuberculosis, constitutional symptoms usually begin unnoticed and progress slowly. Some patients with pulmonary tuberculosis are asymptomatic. In others symptoms are predominantly systemic, or are attributable to concurrent tuberculosis infection of an extrapulmonary organ, or some combination of these (Youmans, 1979).

Once the disease becomes symptomatic, the principal manifestation arises from the destructive and inflammatory process in the pulmonary parenchyma. Cough and production of sputum are the most common local symptoms. The gross appearance of the sputum varies greatly and is in no way diagnostic.

Minor blood spotting is a common occurrence in

patients who have more than minimal disease. Life-threatening hemorrhage is unusual in pulmonary tuberculosis; it does occur occasionally in the untreated patient with extensive cavitary disease. Once effective chemotherapy is started, the likelihood of a large hemorrhage decreases, and is quite rare after a month of therapy. Chest pain is a signal that pulmonary tuberculosis has caused a localized pleural inflammation. The pain is usually sharp, aggravated by deep breathing and other respiratory motions, and is relieved by body postures that limit motion of the painful area (Fishman, 1980).

Fever, night sweats, weight loss, anorexia, and fatigue are common constitutional manifestations in advanced tuberculosis. Fever does not usually appear until the disease is extensive and is largely exudative. As in other infections, the temperature of the tuberculous patient varies diurnally: it is usually low or normal in the morning, rises gradually during the day, and reaches its peak in the late afternoon and evening. At night the fever falls and is often accompanied by a striking diaphoresis, the night sweat of advanced tuberculosis. In cases of untreated pulmonary tuberculosis several months of daily fever often precedes death.

Shortness of breath is an unusual symptom in pulmonary tuberculosis, unless the disease is very extensive or is complicated by other problems (Wyngaarden and Lloyd, 1982). Accurate diagnosis of tuberculosis

disease depends on bacteriologic examination, tuberculin testing and roentgenographic findings.

Treatment

In the past, much of the treatment of tuberculosis consisted of domiciliary care because the disease was usually so advanced that no other available treatment was indicated (Myers, 1951). The early concepts of treatment were empiric and, in general, based upon efforts to enhance host immunity by means of better nutrition and physical rest. Isolation of patients came to play a significant role in an effort to prevent further transmission of the disease. The outcome of this conception was the development of specialized tuberculosis institutions or sanatoria. In addition to serving as isolation centers, the sanatoria became highly specialized medical and surgical hospitals. Collapse therapy, accompanied by prolonged bed rest was the most common treatment in pulmonary tuberculosis (Youmans, 1979). The closure of tuberculosis cavities in the lung, when attainable, greatly accelerated the healing process. Since the advent of chemotherapy, surgery is rarely used in the treatment of pulmonary tuberculosis, however, it may be required in some special cases such as in massive hemoptysis (Pfuetze and Radner, 1966).

Once highly effective chemotherapy became available for the treatment of tuberculosis, the role of

patient became increasingly important. Prolonged hospitalization no longer was necessary, and outpatient chemotherapy became very important. Two major factors determine whether chemotherapy will be successful: 1) provision of an adequate drug regime for the particular patient, and 2) the reliability with which the patient takes the medication.

Chemotherapy is an antimicrobial treatment. Its effect is judged by the sterilization of lesions and the elimination of bacilli from the sputum (Fishman, 1980). As a rule, regimes should contain a combination of two or more drugs, particularly in the initial phase of treatment, otherwise failure due to the emergence of drug resistance is likely to result. In the early days of chemotherapy, patients were treated with one drug, and, if that failed, further drugs were successively substituted one at a time, with the result that these people eventually became chronic patients with organisms resistant to all the drugs they had received (Toman, 1979).

Drug resistance. Large bacterial populations contain a small proportion of organisms that are not susceptible to a particular drug. While the susceptible bacterial organisms are killed by the drug, the nonsusceptible organisms survive, and they multiply and replace the susceptible organisms.

Drug resistance due to incorrect chemotherapy is called secondary drug resistance. Primary drug resistance

is caused by infection of drug resistant organisms from another patient.

The success or failure of chemotherapy is dictated by the results of the first ninety days of treatment. Some ninety percent of patients should be culture-negative by the nineteenth day. Treatment of any patient who continues to excrete viable tubercle bacilli 120 days after the initiation of antituberculosis chemotherapy must be considered a potential and probable failure, and evidence should be sought for emerging drug resistance.

For years, drug resistance in previously untreated patients has remained at a low level in the United States and Great Britain (approximately two percent for INH and SM and substantially less for RIF, see Table 1), somewhat higher in continental Europe, and still higher in Asia, Africa, and South America. Recently much higher percentages of primary resistance have been demonstrated in Oriental and Hispanic immigrants, and in areas with large numbers of such persons, as well as in selected major urban centers in the United States. As high as ten percent primary resistance to either INH or SM has been documented. Primary resistance to RIF and EMB remains less than 0.5 percent (Toman, 1979).

Antituberculosis drugs. Antituberculosis drugs of proven excellence with minimal and controllable side effects are often referred to as first-line drugs. These include isoniazid, ethambutol, rifampin, and streptomicin,

TABLE 1

CHEMOTHERAPY DRUGS IN TREATMENT OF TUBERCULOSIS

Drugs	Dosage and Administration	More Frequent Adverse Reactions	Special Precautions and Observations	Remarks
Isoniazid (INH) (isonicotinic acid hydrazide)	Oral, 300 mg once daily for usual adult. Intramuscular, 5 to 10 mg/kg.	Hepatitis, age-related. Peripheral neuritis, dose-related. Hypersensitivity reactions.	Serious liver damage rare under 20 to 35 years of age (See Table 21-4) Neuritis only with large doses or with renal disorders.	Most useful of all anti-tb drugs. Bactericidal. (See text for incompatible drugs.)
Ethambutol	Oral, 15 mg/kg once daily. Rarely, 50 mg/kg twice weekly. Narrow range of tolerance.	Optic neuritis, rare with 15 mg/kg. Visual impairment usually temporary. Hypersensitivity rash.	Subjective visual complaints call for tests and comparison with previous Snellen chart and color discrimination.	Beware of use in renal disease. Best companion drug to INH in long-term treatment.
Rifampin	Oral, 600 mg once daily for usual adult, taken on empty stomach (10 to 20 mg/kg.)	Hepatitis, usually temporary. Adverse immunologic reactions with intermittent doses. Gastrointestinal distress.	Interrogate and observe for liver symptoms. Check liver function.	Bactericidal, useful in retreatment and initial short-term intensive treatment.

TABLE 1--Continued

Drugs	Dosage and Administration	More Frequent Adverse Reactions	Special Precautions and Observations	Remarks
Streptomycin	Intramuscular, usual adult dose 1.0 gm daily or twice weekly.	Neurotoxic (dose-related and cumulative), vestibular and auditory eighth cranial nerve. Hypersensitive reactions may be severe.	Avoid very prolonged treatment. Pretreatment audiograms desirable.	Beware of use in renal function impairment. Bactericidal, useful in retreatment and initial short term supervised intensive programs.
P-aminosalicylic acid (PAS)	Oral, 8 to 12 gm/day (200 mg/kg) in divided doses.	Gastrointestinal irritation (dyspepsia and diarrhea); drug rash.	Administer with meals; several formulations equally effective.	Failure of patient to comply is cause for failure.
Pyrazinamide	Oral, 15 to 30 mg/kg/day in divided doses.	Hepatitis--sometimes severe, rapid even fatal; hyperuricemia.	Narrow therapeutic range--a dangerous drug rarely used.	Bactericidal in combination with aminoglycosides.
Cycloserine	Oral, 0.5 to 1.0 gm/day in divided doses.	Central nervous system irritant; seizures, psychosis.	Contraindicated in epileptics and psychopathic personalities.	Weakly effective, pyridoxine may reduce risk.

TABLE 1--Continued

Drugs	Dosage and Administration	More Frequent Adverse Reactions	Special Precautions and Observations	Remarks
Ethionamide	Oral, 250 mg 3 to 4 times daily (after meals)	Nausea, vomiting, hepatitis, hypersensitivity, depression.	Tolerance may be acquired with ascending doses.	Weakly effective, few patients can tolerate.
Capreomycin	Intramuscular, 1.0 gm daily (15 mg/kg)	Audiovestibular injury, renal damage, painful injections.	Resembles other aminoglycosides.	Weakly effective.
Viomycin	Intramuscular (see text)	Electrolyte disturbances; renal injury.	Monitor electrolytes and kidney function.	Avoid use with aminoglycosides.
Thiacetazone	Oral, 150 mg/day, larger doses if intermittent	Nausea, vomiting, dizziness, hypersensitivity.	Used only in combinations with 1 or 2 other drugs.	Not available in United States; used widely in Asia and Africa.
Kanamycin	Intramuscular, 1.0 gm 3 to 5 times weekly.	Cumulative eighth nerve damage; curare effect.	Avoid prolonged use.	Rarely indicated for tuberculosis.

SOURCE: Youmens, 1979.

listed in order of desirability. The second-line drugs have inferior potency, are less acceptable to patients, or are prone to produce dangerous or undesirable side effects, when compared with the first-line drugs.

Second-line drugs are indicated for retreatment or relapsing TB, or for initial failure when the infecting strain is not sensitive to at least two first-line drugs. These include aminosalicylic acid (PAS), pyrazinamide, cyclocerine, ethionamide, capreomycin, viomycin, thiacetazone, and kanamycin (Youmans, 1979).

However it has been said that these drugs should not be categorized as major or minor, primary or secondary, or first-line or second-line drugs, since their use in any specific patient should be for major and primary purposes. Thus, if any drug is selected, its efficacy becomes major in terms of its antibacterial role, and its impact is of paramount importance even though it may be one of the less used antituberculosis agents (Fishman, 1980).

Effective drug therapy requires the administration of appropriate drugs in sufficient doses for adequate periods. The most appropriate therapy for a given patient will be determined by the extent of the patient's disease, the likelihood that drug resistant organisms are present, social and medical problems that might complicate therapy do not exist, and the nature of the drugs themselves (Wehrle and Top, 1981).

All the effective antituberculosis drugs have one feature in common: they interfere with essential metabolic activities within tubercle bacilli in one way or another. In consequence, their antituberculosis efficacy is related to the fact that these drugs are effective only against actively metabolizing tubercle bacilli, and have no significant inhibitory or adverse action against nonmetabolizing bacterial cells. This characteristic is crucial in tuberculosis since at any single point in time, many of the tubercle bacilli present in tissue are in a resting state and thus not responsive to the drugs. Therefore, for antituberculosis chemotherapy to be effective it must be sufficiently prolonged to ensure drug concentrations that will destroy tubercle bacilli when they become metabolically active (Fishman, 1980).

The currently preferred treatment is a program of eighteen to twenty-four months administration of isoniazid and ethambutol, which has a high degree of efficacy. Unfortunately, the long duration of treatment has created other problems such as poor patient compliance, high costs, and logistic difficulties in delivery of services. These problems are especially severe in developing countries. This situation has provided the incentive for the study of drug regimes that might permit shorter durations of treatment and still produce high rates of cure.

Short course chemotherapy. It is not yet clear whether a total of one year or only six months of treatment

will yield results comparable to the traditional two-years regime. INH, 300mg, plus RIF, 600mg, daily by mouth on an empty stomach for nine months is the recommended short-course regime. EMB, 15mg per kilogram of body weight, or SM, one gram, has often been added as a third drug during the early stages of treatment. The advantage of the third drug in this combination is to make allowances for the possibility that the infecting organism is resistant to one or the other of the major drugs while awaiting sensitivity studies.

In order to allow for some lapses of self-administration of drugs, a twelve-month treatment course might be safer. An intermittent schedule following two months of initial daily therapy has proved equally effective over the same duration of treatment (Fishman, 1980).

Tuberculin Testing

The tuberculin skin test has been considered the most important tool for modern epidemiologic studies. Tuberculin skin testing can be accomplished by a variety of methods. The most commonly used technique, described by Mantoux involves the administration of an intradermal test that requires a syringe and needle thereby permitting an exact dose of PPD (Purified Protein Derivative) and a measurable reaction to be obtained. The standard dose is 0.1 ml of PPD which is equivalent to 5 TU (Tuberculin Units). This dosage is commonly designated as intermediate strength PPD. The injection is made into the skin of the

volar surface of the forearm using a calibrated tuberculin syringe and a 26 or 27 gauge needle, preferably with a chisel edge. The site of injection should be identifiable as a raised bleb; if not, the antigen has been injected subcutaneously, and the test cannot be interpreted. The reaction is recorded as diameter of the area of increased skin thickness (induration) at the site of injection 48 to 72 hours later. While this diameter often corresponds to the zone of erythema, it may not do so. Erythema per se does not constitute a positive reaction. Interpretation of the diameter of the area of induration is generally as follows:

10 mm or more - positive reaction
9 to 5 mm - doubtful reaction
4 to 0 mm - negative reaction

There are several multiple puncture tests such as the Heaf test, the Sterneedle test, and the Tine test which are simple, more convenient, and less frightening to children. However, all but large or vesiculated positive reactions must be verified with the more reliable Mantoux method.

The tuberculin skin test has limited value in diagnosing tuberculosis. A positive reaction indicates that a mycobacterium, most probably M. tuberculosis or M. bovis, has replicated in the tissues of the individual at some time, but it does not tell whether an active disease state is present. Sensitivity develops in two to ten weeks after

initial infection with the bacteria.

In children and young adults with a known recent exposure, a positive skin test has considerable diagnostic significance. A doubtful reaction raises the possibility that mycobacteria have replicated in the body, but the small reaction may be due to infection with one or several mycobacteria other than M tuberculosis. Cross reactions from infection with other mycobacteria are often indistinguishable from specific reactions due to infection from M. tuberculosis. However a negative second-strength tuberculin reaction is strong evidence against an infection with M. tuberculosis and tends to exclude tuberculosis (American Lung Association, 1981).

In diseased persons the tuberculin reaction may be falsely negative. Rubeola, infectious mononucleosis, mycoplasma, pneumonia, and influenza may depress the tuberculin reaction. Live rubeola, rubella, and poliomyelitis vaccines may also convert a tuberculin reaction to negative temporarily.

The tuberculin test may be used as a diagnostic aid to detect tuberculosis infection and to determine the prevalence of infection in groups of people. Furthermore, patterns of reaction to the test are useful in establishing priorities for follow-up and preventive therapy with isoniazid. Studies from many parts of the world have shown that, generally, the larger the tuberculin reaction, the greater the risk of developing tuberculosis (American

Lung Association, 1981).

Tuberculin testing can sometimes be of great epidemiologic value in planning programs for community control of tuberculosis by identifying areas of high prevalence of infection, and by disclosing potential cases. Periodic testing in selected high incidence areas is the best measure of trends of tuberculosis infection, and is thus a useful technique for monitoring the effectiveness of the control program (Youmans, 1979).

Prevention and Control

The prevention of tuberculosis involves one set of measures to prevent initial infection and another to prevent the development of progressive disease in people who are already infected.

Initial infection arises from breathing air contaminated with tubercle bacilli by a contagious case. An approach to the prevention of initial infection is to disinfect the air with ultraviolet radiation in places which are likely to be frequented by people with active tuberculosis. This approach is highly desirable in hospitals where tuberculosis patients are more likely to be found and where other patients with low resistance to infection share the same confined atmosphere. Since air disinfection offers protection only in sites equipped with ultraviolet devices, it can only be recommended for high risk areas and is not feasible for widespread application in the community.

The ideal plan for control of tuberculosis prevents the development of old infection into disease, or discovers each new case before transmission of infection can occur. If even the latter could be accomplished, in most cases, the decline in tuberculosis morbidity would be accelerated. In actuality, two-thirds of new cases are not discovered until the patient seeks medical attention (Fishman, 1980).

Models for case-finding has been sought which take into account cost and productivity. The most effective technique presently used is skin testing of household contacts of newly diagnosed cases, where ten to twenty percent may be newly infected, and one to two percent show clinical disease (Fishman, 1980). Routine chest radiographs of persons who are hospitalized or seen in a health care facility are productive. Especial attention should be given to older persons since they are at a higher risk of developing tuberculosis. Persons with a history of tuberculosis which was never treated with isoniazid, and tuberculin reactors who have upper lobe scarring, compatible with healed tuberculosis both have a risk of developing tuberculosis of about one percent per year.

Yearly tuberculin skin testing of nonreactors working with sick and older persons, such as hospital and nursing home personnel and welfare workers, is useful and cost-effective, if preventive therapy is given to persons showing new infections.

Vaccination. BCG vaccine (Bacillus Calmette-Guerin) has been used since 1921 to promote resistance to tuberculosis infection. The vaccine produces between twenty to eighty percent protection in groups at high risk to develop tuberculosis, but at the cost of development tuberculin positivity, sacrificing the most important indicator that infection has occurred. BCG is also of benefit in that vaccinated persons who do develop tuberculosis have less progressive disease.

Many authorities advise the use of BCG in tuberculin negative children in areas in which twenty percent or more of secondary school children are tuberculin positive. Vaccination may also be appropriate for missionary or government personnel assigned to areas of known high prevalence, in groups of health professionals with high (over twenty percent) incidence of infection, and in some military personnel (Wyngaarden and Lloyd, 1982).

Chemoprophylaxis. Agents that had proved effective in treating tuberculosis have been applied to the prevention of tuberculosis infection and disease. The only drug which has been carefully evaluated with respect to preventive therapy is isoniazid. In all the trials of preventive therapy isoniazid has been given for twelve months. However, the possibility has been raised that a shorter duration of treatment might be equally effective.

Isoniazid hepatoxicity has led to misgivings about the wisdom of using isoniazid for the preventive therapy

of tuberculosis. In contrast to the original practice of recommending that all tuberculin reactors receive isoniazid chemoprophylaxis, the current recommendations are more limited. It is only used for persons with documented new infection, for household contacts of newly diagnosed infectious cases, and for tuberculin reactors who have not been treated for tuberculosis and whose chest radiographs show lesions in the upper lobes, suggestive of tuberculosis disease (Wehrle and Top, 1981). Because of the low risk of hepatitis below middle age and because individuals with strongly positive tuberculin tests have a cumulative risk of developing tuberculosis during their lifetime, which approaches ten percent, preventive therapy should be offered to tuberculin reactors under age 35. Preventive therapy should not be considered in tuberculin reactors over 35 unless they have other risk factors, such as documented new infection or a chest lesion suggestive of tuberculosis. This recommendation is made not only because of the high mortality rate for hepatitis when it does occur, but also because the life expectancy of these individuals is less, and thus their cumulative risk of developing tuberculosis is lower.

When preventive therapy is used, the precautions recommended by the American Thoracic Society should be followed: monthly monitoring for drug toxicity, and prompt investigation of symptoms or signs suggesting hepatitis. When hepatitis is detected, isoniazid must be discontinued

at once.

The principle involved in the use of a drug such as isoniazid is exactly the same as the principle involved in the use of a vaccine such as BCG for prevention. The aim in both cases is to raise the average level of resistance of the population at risk to the development of tuberculosis disease (Youmans, 1979).

Epidemiology and Social Factors

In some areas of the world, bovine tuberculosis remains a problem and infection by ingestion of infected milk occurs. In western countries, infection is almost always initiated by inhalation of the dried residues of droplets aerolized by coughing, which may remain suspended in air for prolonged periods, and are sufficiently small to reach terminal air passages where removal is difficult and bacterial multiplication can begin. The overwhelmingly most significant source of infection is the person with active pulmonary tuberculosis prior to diagnosis and initiation of treatment. The closer the contact and the younger the age, the greater the risk. Studied epidemics in closed environments indicate that one person with active disease may contaminate the environment with droplet nuclei and infect virtually all susceptibles in the same environment, even in the temporary absence of the person himself (Fishman, 1980).

The level of urbanization probably influences tuberculosis mortality and morbidity more than any other

single factor, except for the inherent feature of selection of persons with increased natural resistance. Industrialization and urbanization increase the opportunity for transmission due to crowded living conditions. The urban focality of tuberculosis continues today, so that in the United States the highest rates are found in the ghetto areas of large cities where there is crowding of the poor and ill-nourished, with the elderly who often harbor dormant infection and may sporadically develop clinical and infectious tuberculosis (Fishman, 1980).

The inverse relationship between socioeconomic status and tuberculosis mortality has been clearly demonstrated. For persons under age thirty-five living in large cities, tuberculosis mortality in both sexes is three times higher in the lowest compared to the highest economic group. This difference increases for males over thirty-five, where the ratio may reach 6:1 (Fishman, 1980). Of importance is the recognition that it is people of low socioeconomic status who develop the disease, suggesting that crowded conditions experienced by the urbanized poor are an important factor. Poor nutrition probably has less effect, since in experimental animals, nutritional deficiencies must be extreme to reduce resistance to infection. Racial differences, particularly in urban ghettos, have been offered as an additional reason for the increased risk observed in cities and in economically deprived groups, but there are

no data to show clearly that there is any racial susceptibility to tuberculosis (Fishman, 1980). Other persons at increased risk are those with diabetes mellitus, chronic medical illness associated with debilitated states such as chronic rheumatoid arthritis, postgastrectomy status, and cancer, persons with silicosis, and those receiving immunosuppresive drugs (Weg, 1978).

CHAPTER II

HISTORY OF TUBERCULOSIS IN PUERTO RICO

Tuberculosis was probably brought to America by the European colonizers. The history of Puerto Rico has references to the disease since the beginning of the Spanish colonization in the 16th century. It reached epidemic levels especially among the Indians, and later among Africans, two population groups that had scarcely any prior contact with the bacilli (Rodríguez, Morales, Payne, 1935).

In 1875, a report by Dr. Enrique Dumont describes tuberculosis as "certainly progressive in the island of Puerto Rico," (Padró, 1955). But in the 20th century some studies began to report morbidity and mortality rates of TB in Puerto Rico. From October 1922 to April 1923, Dr. J. G. Townsend, a surgeon of the U. S. Public Health Service, carried out a tuberculosis survey in Puerto Rico. The objectives of the survey were: 1) to determine the number of active cases on the Island, their distribution and location, 2) to investigate the factors responsible for the propagation and spread of tuberculosis and, 3) to ascertain the most practical means of combating tuberculosis in the Island. Dr. Townsend reached the

following conclusions: 1) accurate estimation of morbidity was impossible, because of universal failure to report cases, 2) death records were of value, as permits were required for burial; but, it was estimated that sixty percent of the deaths due to tuberculosis were not so recorded; and, 3) the total death rate in Puerto Rico appeared to be nearly twice that of the United States, while the TB rate in ratio to the general population appeared about the same. Its distribution was not uniform, varying with towns and districts (Townsend, 1923).

Townsend reported pulmonary tuberculosis to be the predominant type, with bone, joint and gland tuberculosis rare. The rate seemed low in children, first infections apparently not developing until early adult years. Townsend considered predisposing factors as: 1) poor housing conditions, with crowding of large families, 2) exclusion of fresh air at night, 3) malnutrition, 4) bad industrial conditions, leading to spread of infection, especially in the tobacco industry, 5) poverty, 6) ignorance of the simplest sanitary precautions, 7) other diseases, especially hookworm, malaria and venereal diseases and finally, 8) lack of clinics, social service work and hospitals for tuberculous patients (Rodríguez and Janer, 1952).

During the time of Townsend's survey the economic conditions for a large proportion of the population of Puerto Rico, were such as to facilitate the development of

diseases caused directly or indirectly by poor nutrition. Laborers were poorly paid and had difficulty finding full-time employment. This situation created overcrowded housing and lack of proper diet, both predisposing causes of tuberculosis (Rodríguez and Janer, 1952). After the First World War, internal migration from rural areas to towns and cities, as well as unemployment and under-employment, created slums in practically every town on the Island. In these slums, families were large, standards of living low, and the opportunity for the spread of contagious diseases great.

The tuberculosis mortality statistics from 1923 to 1928, showed that the number of deaths from tuberculosis occurring among females was one and a half to two times greater than the number of deaths among males. This could be attributed to the indoor life usually led by the woman, and to the fact that it was the woman of the house who usually took care of the tuberculous patient, and thus had the most opportunities for contagion, from personal contact (Rodríguez and Janer, 1952).

The hurricanes of 1928 and 1932 affected tuberculosis mortality of the following years. These two hurricanes brought about great destruction of dwellings and crops, increasing overcrowding and poverty, spreading contagion. The tuberculosis death rate for the year following the hurricane of 1928 was 19 percent higher than that of 1927; the mortality for 1933 was 22.5 percent

higher than that of the year previous to the hurricane of 1932.

The tuberculosis mortality for 1933 was the highest ever recorded in Puerto Rico. It constituted fifteen percent of the total number of deaths on the Island during that year with a rate of 332.5 deaths per 100,000 inhabitants (Figure 1). In those years many of the Puerto Ricans who migrated to New York City from the slums in the Island were heavily infected with tubercle bacilli. Under the struggle for existence in a strange environment many of them developed the disease (Rodríguez and Janer, 1952).

In 1935 three tuberculosis surveys were done in Puerto Rico: a study of a coast and a mountain municipality; a study of two urban communities; and a survey of slums in San Juan. The first survey was conducted in Cataño and Adjuntas, two contrasting municipalities in relation to location, climate, occupation, overcrowding and race composition according to the U. S. Census of the Island. The coast municipality, Cataño, with a relatively large proportion of urban population, had a high tuberculosis mortality. The mountain municipality, located in the center of the Island, with a predominantly rural population, had a relatively low tuberculosis mortality. The survey of the two municipalities was undertaken to: 1) estimate the number of tuberculosis cases in two communities representing different environmental, climatic,

PUERTO RICO TUBERCULOSIS MORTALITY

1920–1950

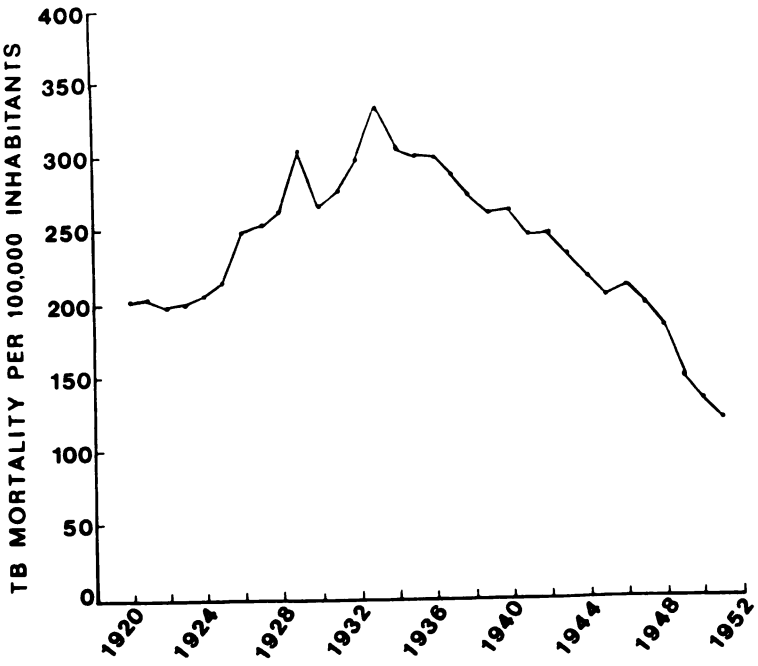

Figure 1

After Rodriguez, Janer 1952

and racial conditions; 2) to gather data regarding the extent of tuberculous infection in these communities, as revealed by the Mantoux test; 3) to determine the factors, especially those of living conditions, that facilitate infection in these communities; and, 4) to gain insight into the causes of the high tuberculosis mortality in Puerto Rico at that time (Pastor, Morales, and Payne, 1935).

After all variables were considered the most probable important factors in the causation of the high tuberculosis mortality and morbidity in Cataño as compared with Adjuntas were the great overcrowding of dwellings, and nearness to large centers of population where the tuberculosis incidence was high. The proportion of cases of TB in relation to the population was 2.4 percent in Cataño and 1.1 percent in Adjuntas (Pastor, Morales, and Payne, 1935).

The second survey was done in two urban zones inhabited by poor people: Barrio Obrero in San Juan, and Bayamón. Eight hundred and sixty-six homes were visited and a tuberculin test applied to each individual. All subjects reacting positively and many who did not react had X-ray pictures of the chest taken. The incidence of pulmonary tuberculosis among the population of the survey area was 2.3 percent. The survey identified as significant factors: 1) the conditions of extreme overcrowding and poverty which prevail among the inhabitants of the surveyed areas; 2) the widespread infection with M.

tuberculosis, as shown by the Mantoux test; 3) the prevalence of fibro-caseous type of pulmonary tuberculosis; and, 4) the large proportion of cases with definite tuberculous infiltrations of the lung extending below the clavicle (Rodríguez and Morales, 1935).

The third survey included four slums, which were believed to be the poorest and most crowded of San Juan: La Perla, a section of Puerta de Tierra, Melilla, Tras Talleres, and San Ciprián in Santurce, and Shanghai and San Ciprián in Barrio Obrero. The method used differed from that used in other surveys in that the regular health department personnel employed in the area were utilized, and the work of the survey was carried out without interference with the routine work. Case-finding and follow-up disclosed an estimated incidence of one percent, which is about half the incidence found in other urban areas by more critical procedures. They concluded that the methods used gave only partial information in regard to pulmonary tuberculosis but that they were useful under conditions where more accurate methods could not be used (Arruza, Payne and Rodríguez, 1935).

In 1934 the annual deaths from tuberculosis amounted to more than 3,000 in the larger cities alone (See Figure 2). The total number of beds for tuberculosis patients in government hospitals was about fourteen hundred. This number of beds was insufficient, and it was then determined

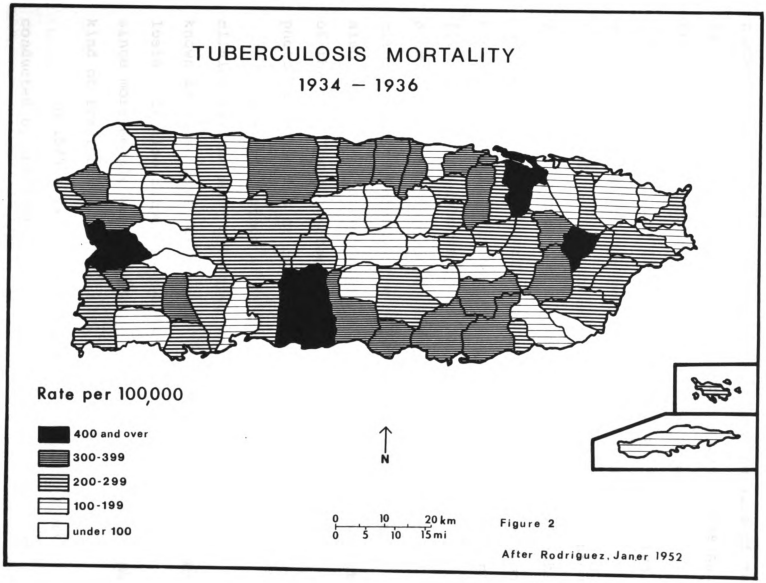

Figure 2

After Rodriguez, Janer 1952

to operationalize an extensive program for the application of collapse therapy to ambulatory patients, in order to prevent the spread of tubercle bacilli by the large number of active cases who remained at home because of the lack of sufficient hospital beds. Home isolation was not effective in preventing the spread of the disease, however, given the low living standards and overcrowding among the majority of the people on the Island. The program started in 1935, while at the same time, an intensive case-finding campaign was launched. Roentgenographic facilities were made available for free chest examinations over the Island, physicians were trained in the use of the fluoroscope, and laboratory facilities for sputum examinations were increased, and nineteen pneumothorax clinics were organized. The personnel in these clinics also carried out an epidemiologic study among the contacts of the case, testing them with tuberculin and through photofluorographies or chest X-rays.

The application of artificial pneumothorax in clinics was the most effective and inexpensive method known in those days for the control of pulmonary tuberculosis. It also helped in the case-finding campaigns since more people were attracted and were confident in the kind of treatment given (Garrido and Rodríguez, 1941).

In 1949 a vaccination trial in the Island was conducted by the Puerto Rico Departments of Health and Education and the U. S. Public Health Service. The

campaign was limited to children and designed to resemble as closely as possible the mass BCG vaccination campaigns being conducted at that time in many parts of the world. The purpose of the trial was to test two main assumptions: first, that most tuberculosis would arise from recently infected persons and that BCG vaccination would decrease their risk of developing the disease and; secondly, that healthy tuberculin reactors contribute relatively little to the tuberculosis problem (Comstock, Livesay, and Woolpert, 1974).

The program started in the poorer parts of the cities, because tuberculin sensitivity was presumed to be very high in these areas. A total of 191,827 children from one to eighteen years of age were included in the study population. They were divided into three groups: 82,269 of them could not be vaccinated because of positive reaction to tuberculin; a control group of 27,338 children who had negative tuberculin reaction and were not vaccinated; and a group of 50,634 vaccinated with BCG. The tuberculosis morbidity in all groups was recorded for twenty years. The frequency of children with reactions measuring 6mm or more in diameter increased in almost a linear fashion with age, attaining a level of nearly seventy-five percent by age eighteen for urban residents. Among them, 976 cases were estimated to have occurred without vaccination, 29 percent were nonreactors to tuberculin and hence were eligible for vaccination.

Although vaccination resulted in a twenty-nine percent reduction in tuberculosis among nonreactors, the overall reduction in tuberculosis that would have resulted from a complete vaccination program was less than nine percent.

Questions about the potency of the strains of BCG used were raised since the results were in contrast with the high degree of effectiveness reported in other studies. But even if a vaccine had been highly protective, it had no significant impact upon morbidity since most of the cases came from persons who could not have been vaccinated since they were positive tuberculin reactors (Comstock, Livesay, and Woolpert, 1974).

The efforts were then directed toward persons already infected and the contacts of tuberculosis cases. The isoniazid chemoprophylaxis trials among this group were satisfactory in terms of reduction of infection, morbidity and mortality from tuberculosis in Puerto Rico. Among the contacts who took isoniazid eighty percent of the time for ten months the reduction in morbidity was eighty-eight percent during the treatment year and sixty percent during the subsequent ten years of follow-up. On the basis of these results, beginning in 1959 the Puerto Rico Department of Health adopted isoniazid chemoprophylaxis instead of BCG as a method of tuberculosis control (Sifontes, 1961). Isoniazid was administered to contacts of newly diagnosed cases of tuberculosis, as well as to people with positive tuberculin

reaction of all ages. Today, isoniazid is recommended for those who have positive tuberculin reactions and are younger than thirty-five years of age.

Drug treatment for tuberculosis on the Island started in 1947 with streptomycin and included large numbers of people by 1952. As a result, the mortality rate for TB began to decrease markedly (See Figure 3). In 1952, TB mortality rate was 94 per 100,000, in 1953 it dropped to 47, and in 1954, it was 38. The morbidity rates for those years were 216, 186, and 152 per 100,000 for 1952, 1953, and 1954 respectively (Rodríguez and Janer, 1952).

In the 1960's the Island had six tuberculosis hospitals. Alejandro Ruiz Soler Hospital, located at Bayamon, provided specialized services to the other tuberculosis hospitals, such as surgery, autopsy, obstetrics and pediatrics. Tuberculosis ranked eighth among the principal causes of death in Puerto Rico (Puerto Rico Department of Public Health Annual Report, 1969).

In 1971 the Department of Health established a policy of integrating tuberculosis patients into general hospitals, and in consequence, most of the sanatoriums on the Island closed. The Ruiz Soler Hospital was converted into an area subregional hospital, reserving a section for individuals with tuberculosis and other pulmonary illnesses. In that year the morbidity rate was 29 and the

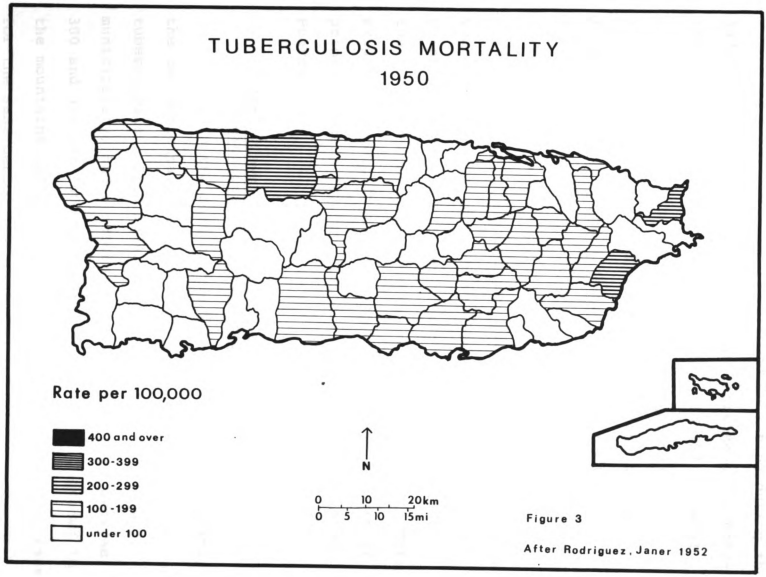

Figure 3

After Rodriguez, Janer 1952

mortality rate 7.4 per 100,000 (Puerto Rico Department of Public Health Annual Report, 1972).

The morbidity rate continued declining during the 1970's until 1980 when there was an increase of seventy-seven percent from the previous year. In 1979 several factors indicated the existence of a significant tuberculosis problem: first, eighty percent of the reported cases had the disease in the advanced stage, second, approximately thirty percent of the cases were identified at death and, third, studies made in the United States that showed high prevalence rates of tuberculosis infection among Puerto Ricans in New York also pointed toward the problem (Córdova, 1979). In 1980 the reported morbidity rate was of 26 per 100,000. This evidence definitely presents tuberculosis as a cause of primary concern for the health status of the people of Puerto Rico.

Interviews on Historical Aspects of Tuberculosis in Ciales and Manatí

As in the rest of the Island, Ciales and Manatí, the two municipalities under study, have a history of tuberculosis. From 1934 to 1936 Manatí, the coastal municipality, had a tuberculosis mortality rate between 300 and 399 per 100,000 inhabitants. Ciales, located in the mountains and a coffee producer, had a mortality rate for the same period years between 100 and 199. During these years the reported mortality rate for the entire

Island was 298. In 1950 a reduction in the tuberculosis mortality rate in Manati to between 100 and 199 put that municipality in the same position as Ciales which did not experience any change. The TB mortality rate for the Island also declined, and a rate of 128.9 was reported.

That the disease was prevalent and a cause of concern is evident in the fifty interviews made among the population of those two municipalities. There the memories of friends and relatives who died victims of tuberculosis are still fresh and vivid:

Interview #15

Male, 60 years old, resident of Cordillera, Ciales:

> I was born in Cordillera and have always lived here. When I was seven years old my father died of tuberculosis. In that neighborhood my family was only one more affected by the disease.

The population was frightened by the disease and their inability to deal with it. Misconceptions about the disease and how it was transmitted also created confusion. Early symptoms of the disease were not recognized, and were related to other diseases like bronchitis, influenza, or pneumonia. As a consequence the tuberculosis cases that were discovered usually were in the advanced stage which explains the apparently sudden death of the affected population by the disease.

Interview #10

Female, 60 years old, resident of Pesas, Ciales:

> My brother died suddenly of tuberculosis when he was very young. During his sickness nobody in

the family suspected he had TB. We believed it was bronchitis.

Tuberculosis gained the reputation of being an incurable disease. This image was modified with the introduction of chemotherapy and the subsequent decline in the mortality rate. But the idea that TB is an incurable disease still persists and places a stigma on the tuberculous person. Some people were cautious even to admit that they had a positive tuberculin reaction, as they did not want their neighbors to know.

But although people were afraid of the disease, in almost all cases they took care of the tuberculous patients in the family. They remained at home probably because of the lack of beds in the sanatoriums in Puerto Rico. Being at home suffering from tuberculosis required isolation from the rest of the family; but this was not always achieved, and in many instances undoubtedly caused the spreading of the disease to other family members. However, in an attempt to prevent transmission, anything used by the sick individual could not be used by anybody else and sometimes social ostracism was displayed. Broken homes resulted in many cases when the patient was discarded or avoided. Sometimes feelings of rejection remained for the rest of the affected individual's life.

When the mother was the patient, care of the children was a major problem. Usually relatives looked after the youngsters, but they were not allowed to visit

the mother causing anxiety in both the mother and the children.

Interview #7

Female, 55 years old, resident of Jaguas, Ciales:

> My aunt raised me. She looked after me when my mother died of tuberculosis. I don't remember her [my mother]. I was only a child and my aunt did not let me get too close to her.

Interview #11

Female, 46 years old, resident of Ciales Town:

> My mother died of tuberculosis when she was still young. My brothers and I went to live with a relative; we did not see much of my mother. When she died, my father made us promise not to tell anybody about the cause of her death.

The economic problem was an important one; it was such as to facilitate the inroads of all those diseases caused directly or indirectly by poor nutrition. On the other hand, tuberculous fathers had a difficult time trying to rest and spend the day in bed, with a wife and children to support. They continued working until they could not work any longer. At that point the disease was too advanced and generally death occurred shortly afterwards. It has been said that stress and tension both contribute to the developing of the disease and delay recovery.

In some cases the persons affected with the disease ran away from reality and tried home remedies, diagnosing themselves as having "only influenza," thereby reducing the feelings of fear. Some went even further, disbelieved

the doctor, refused treatment, and succumbed to the disease untreated.

Interview #3

Female, 59 years old, resident of Frontón, Ciales:

> My mother died of tuberculosis when she was forty years old. She did not want to take any kind of treatment for TB. She did not accept she had tuberculosis.

Interview #30

Female, 57 years old, resident of Coto Sur, Manatí:

> My grandfather died of tuberculosis. He always insisted that he did not have TB but pneumonia. I think he was frightened by the idea of having tuberculosis and did not want to admit it.

During those years without chemotherapy, what worried the patients the most was the condition of not knowing how long the illness would last, or whether they would ever recover. Even in the cases when the person was cured, the fear of reactivation persisted in his or her mind and in that of the people surrounding them.

Patients and families found it difficult to adjust themselves to various personal and economic stresses that accompany an experience of tuberculosis. First, there was the shock of the diagnosed tuberculosis, and the fear of the outcome of the disease. Tuberculosis was not only a medical problem. The patient had social, economic, psychological and educational needs. This is still true today.

It is certain that many undetected cases were spreading the disease. Children of tuberculous parents

did not have any chance to escape infection. Lack of necessary nutrients aggravated the problem. As a result, many children were tuberculin reactors and some were suffering from the disease in early adolescence. Usually when one member of the family suffered from the disease, the rest were likely to contract it.

Most of the interviewed people agreed that their first reactions to the diagnosis of tuberculosis was one of a shock, fear and depression. Some of them had intense feelings of terror and apprehension. The feeling was one of suddenly losing the security of one's family, or specifically of losing friends, jobs, financial security or even social status. One of the TB patients of those days expressed it this way: "I began worrying about my family and how they will get along without me."

The causative factor of the disease was mainly attributed to self-neglect and other irregularities in daily living habits. The main reasons were low physical resistance caused by overwork, lack of personal care, and unrestrained living.

Interview #49

Female, 70 years old, resident of Tierras Nuevas Poniente, Manatí:

> **When I first moved here, my neighbor died of tuberculosis. He was an old man who lived by himself and was almost always drunk. He caused his own sickness and death.**

Other patients who were cured had the fear of

relapse. This was related to the social isolation and helplessness suffered during the period of sickness. Many others disliked the long treatment period.

There were feelings of having done something wrong, or that the affliction or relapse was a direct consequence of sinful actions.

Interview #14

Female, 37 years old, resident of Ciales Town:

> I suspect my father has tuberculosis. His wife might have transmitted the disease to him. She was previously married to a man who right now has been under treatment for TB for a year. A few months ago she was diagnosed in New York as having tuberculosis, but she does not want to follow any treatment. Her tuberculosis is the direct result of her evil wish for her husband to contract tuberculosis.

The community or neighborhood fear of contagion also contributed to these feelings, which condemned the tuberculous to isolation, and which, in some instances, made the person feel unclean and shameful. But in many other cases, sorrow and pity were expressed by family and neighbors for the tuberculous.

Relapse or a quick decline of the sick individual was often mentioned in the interviews. As pointed out, the necessary rest was not always achieved, given the poor economic conditions of most of the families and the need for a breadwinner to support the family. But the lack of compliance with the ordered bed rest, and moderation in activities, has to be understood in the sense that it put

the individual in a position where he or she was obliged to lean heavily on others. This dependency relation was not always accepted, especially by the men, since it ran counter to their inclinations and the individual's self-image.

Interview #45

Female, 88 years old, resident of Tierras Nuevas Salientes, Manatí:

> When I was young, my father became sick with tuberculosis. He kept working for months. He said that there was no reason for him to stay in bed all day long.

Despite the educational campaigns acquainting the public with the facts of tuberculosis, and the highly effective anti-tuberculosis drugs, many persons still feel intense fear and anxiety over the possibility of contamination with the disease. This is a direct consequence of the magnitude of the problem in the past not only in Ciales and Manati but also on the rest of the Island.

It is not surprising that many deaths occurred without ever receiving medical attention. Symptoms that were warnings of possible lung involvement like a persistent cough, pain in the chest, difficult breathing, and spitting of blood, were regarded as serious enough to seek medical attention. Blood spitting was considered the most serious symptom, but a persistent cough was apparently considered somewhat less serious, and sometimes was not considered sufficiently important to require medical assistance.

Interview #26

Male, 71 years old, resident of Coto Norte, Manatí:

> My brother died of tuberculosis when there was a cure for the disease, but he never wanted to go to a doctor. He said it was a waste of time. He never received any treatment and he kept working for as long as he could.

Home remedies were used to treat tuberculosis, the most common being cod liver oil, honey, or syrup for a persistent cough, and tea and rubs of alcohol for the fever and pain in the chest.

Interview #46

Female, 70 years old, resident of Tierras Nuevas Saliente, Manatí:

> My mother died of tuberculosis thirty years ago. The only kind of treatment that she ever received was honey for the cough, and an alcohol bath for the fever. She did not have confidence in anything else.

Interview #6

Male, 72 years old, resident of Jaguas:

> My wife never wanted to take any medicine apart from herbal teas that she used to prepare. She died of tuberculosis when she was forty-five years old.

The problem of taking a sick person to a doctor or hospital was more serious in the municipio of Ciales than in Manatí. The distances to travel in Ciales were considerable, as well as the steep, rough paths over which the sick must be carried. This certainly also contributed to the delay in seeking medical attention.

CHAPTER III

METHODOLOGY

Problem

The tuberculosis rates in 1980 for the municipalities in Puerto Rico show that high rates almost always correspond with municipalities in which health services for tuberculosis are offered (See Figure 4). As the distance from a clinic increases, the tuberculosis rate reported decreases. Those municipalities with tuberculosis clinics are likely to have better reporting of cases than those without clinics. It is suspected that these clinics mostly serve the population of the municipalities in which they are located. Under-reporting of TB cases on the Island is a non-random phenomena. The location of a clinic selects which sector of a given area has more accurate reporting of cases.

Hypotheses

In order to investigate this problem, the following general hypotheses will be tested. The hypotheses will be accepted at a level of significance of .05.

A) Under-reporting of TB cases is greater in those municipalities without health facilities for the prevention and treatment of tuberculosis

B) The geographic variations in the reported TB rates are the result of under-reporting and not of the absence of TB cases

Methodology

Selection of the Area

After analysis of the reported rates in 1980, Ciales and Manatí were selected as the study area. Both municipalities represent a geographical transect from a mountain area to the coast (See Figure 5).

The municipality of Manatí is located in the north central plain of the Island. It had a population of 36,562 inhabitants in 1980 in an area of 46 square miles (U. S. Census, 1980). A center for the control of TB is located in Manatí Pueblo. This center serves the populations of Manatí, Ciales, Vega Baja, Barveloneta, and Morovis. The municipality of Manatí reported a TB rate of 66 per 100,000 in 1980.

Ciales, contiguous to Manatí, is located in the central mountain range of the Island. Its population consisted of 16,211 inhabitants in 1980 in an area of 66 square miles (U. S. Census, 1980). Ciales does not have health facilities for TB. All cases are referred to Manatí. The reported TB rate in 1980 was of 6.2 per 100,000.

Accessibility to the area through a highway and support from the public health unit in Manatí were elements considered in the selection of this area. Limited time,

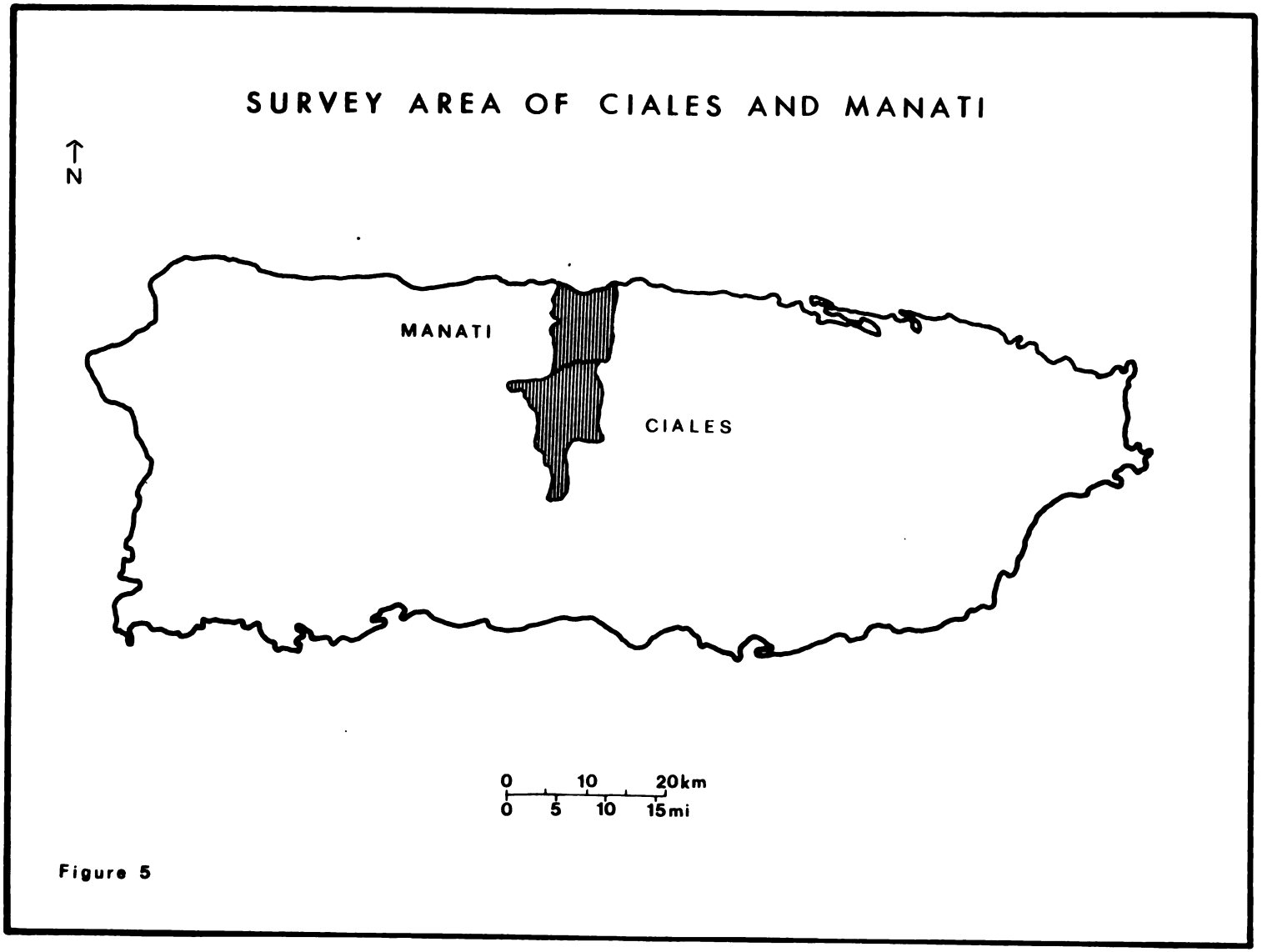
SURVEY AREA OF CIALES AND MANATI
N
MANATI
CIALES
0 10 20km
0 5 10 15mi

Figure 5

personnel, and resources in general did not allow the inclusion of other possible areas of study.

Data Collection

A tuberculin screen survey was made in order to obtain an indication of tuberculosis infection rates in the populations of Ciales and Manatí. A nurse from the tuberculosis control program injected a dose 5 T.U. (Tuberculin Units) through the Mantoux method to each person in the sample. The tuberculin was carried in a portable cooler with ice to protect it from heat and sunlight.

A questionnaire was designed to collect data for each house visited and for the persons injected in that house (Appendix B). In a typical interview the purpose of the tuberculin test was explained to the person(s) living in the selected house to be sampled. If at least one person agreed to receive the test, the nurse proceeded with the injection. At this point the questionnaire was completed with information concerning type of house construction, utilities available (piped water, electricity, flush toilet), number of persons in the house, number of rooms, and the barrio (subdivision of the municipality). A number was assigned to each house in a barrio. Each person tested had a number assigned by municipality.

All persons injected in the same house were included on the same questionnaire. If more persons than the number allowed per sheet were injected in one house, a second sheet was used. For each person injected the following information

was obtained: name, sex, nationality, years of school completed, innoculation date, treatment received for TB, present diseases, previous tuberculin testing, and previous BCG vaccination.

After forty-eight to seventy-two hours the reaction to the test was read and the size of the induration was recorded in millimeters. Reaction and reading date were included in the questionnaire. When a person injected was absent during the day of reading, his or her family was asked about the appearance of the forearm where the tuberculin was injected. These reactions were recorded as reported positive, negative, or no information, according to the description obtained.

Each person tested was given a certificate signed by the nurse stating the nature of the reaction. The positive and doubtful cases (5 mm or more) were referred to the TB center in Manati for follow-up. A list of all persons tested with their reactions, names, and addresses was given to the health clinic in Manati and to the Tuberculosis Control Program.

After all injections were administered and analyzed, fifty residents of Ciales and Manati were interviewed in order to obtain a general impression of the history of tuberculosis in those municipalities. Fears, beliefs, and practices related to the disease were ascertained during the interviews. An analysis of these interviews is included in the second chapter as part of the history of tuberculosis in Puerto Rico. All interviews are included in Appendix A.

Population and Sample

A total of fifteen hundred tuberculin tests were administered during the survey: eight hundred in Manatí, or two percent of the population in Manati, and seven hundred in Ciales, or four percent of the population in Ciales.

Following the U. S. Census classification, each subdivision was classified as being rural, an urban zone (pueblo) or a village (aldea). A number of injections were allocated to each zone and its barrios as a proportion of its population and the total number of injections assigned to the municipality (See Tables 2 and 3).

Topographic sheets with the barrios of Ciales and Manati were used to identify the boundaries of municipalities, barrios, and zones. Previous to the beginning of the tuberculin survey, field trips were made for a general reconnaissance of the area.

During the survey, those neighborhoods that showed low income characteristics, such as overcrowding and poor quality of house construction, were selected for testing. In many, especially rural barrios, differences in housing quality were not readily discernible. The location of each house visited was plotted in the map by its house number, helping to identify location at the time of the reading of the injections, and to identify the neighborhoods visited in the area.

TABLE 2

CIALES POPULATION SAMPLE

Barrio	Population	Sample	Houses
	Urban Zone		
Ciales Pueblo	1,428	67	18
Cordillera	294	13	11
Jaguas	1,860	120	45
Total	3,582	200	74
	Rural Zone		
Cialitos	1,405	53	17
Cordilerra	1,606	73	18
Fronton	1,883	92	41
Hato Viejo	1,518	65	31
Jaguas	2,330	51	19
Pesas	1,693	70	40
Pozas	1,316	62	22
Toro Negro	878	34	9
Total	12,629	500	197
Ciales Total	**16,211**	700	271

TABLE 3

MANATI POPULATION SAMPLE

Barrio	Population	Sample	Houses
Urban Zone			
Manatí Pueblo	8,352	179	69
Coto Norte	3,403	21	91
Coto Sur	5,592	111	29
Total	17,347	379	189
Villages (Aldea)			
Coto Norte (Coto Norte)	1,154	32	9
Tierras N. Poniente (La Luisa)	2,343	48	18
Tierras N. Saliente (Tierras N. Poniente)	1,494	17	6
Total	4,991	97	43
Rural Zone			
Bajura Adentro	2,127	45	16
Bajura Afuera	262	9	4
Coto Norte	3,238	125	48
Coto Sur	2,270	61	20
Rio Arriba Poniente	1,599	35	9
Rio Arriba Saliente	2,298	50	20
Tierras N. Poniente	498	12	3
Tierras N. Saliente	1,932	55	22
Total	14,224	392	142
Manatí Total	36,562	800	374

Resources and Limitations

The tuberculin tests and a graduate nurse to administer them were provided by the Department of Health through its Tuberculosis Control Program.

The survey was restricted to Ciales and Manati given the number of injections available for the study.

All injections were administered during working hours (8:00 A.M. - 5:00 P.M.) Mondays, Tuesdays, and Wednesdays. This time schedule inevitably restricted the number of males in the sample, as well as that of working females.

CHAPTER IV

ANALYSIS

The analysis of the data consists of contingency tables of the percent of individuals in each category of reaction in relation with a set of variables such as age, sex, occupation, and location. Graphs and maps were plotted for some of the tables in order to permit cartographic analysis.

Tuberculin Test Reaction by Age Group

The relationship between sensitivity to the tuberculin protein and age presents a general pattern in which, as age increases, so does the proportion of reactions greater than 10mm. This is also true individually for Ciales (Figure 6) and for Manatí (Figure 7). These relationships have a level of significance of .01.

In the younger age group no positive reaction was obtained in Ciales and only 0.7 percent of the individuals tested in this age category reacted positively in Manatí (Tables 4 and 5). Manatí has a slighly greater risk of infection with M. tuberculosis in this age group, when compared to Ciales. A closer look at the below 10 age group in Manatí shows no positive reactions for the ages 2 to 7 years of age (Table 6). This group is referred

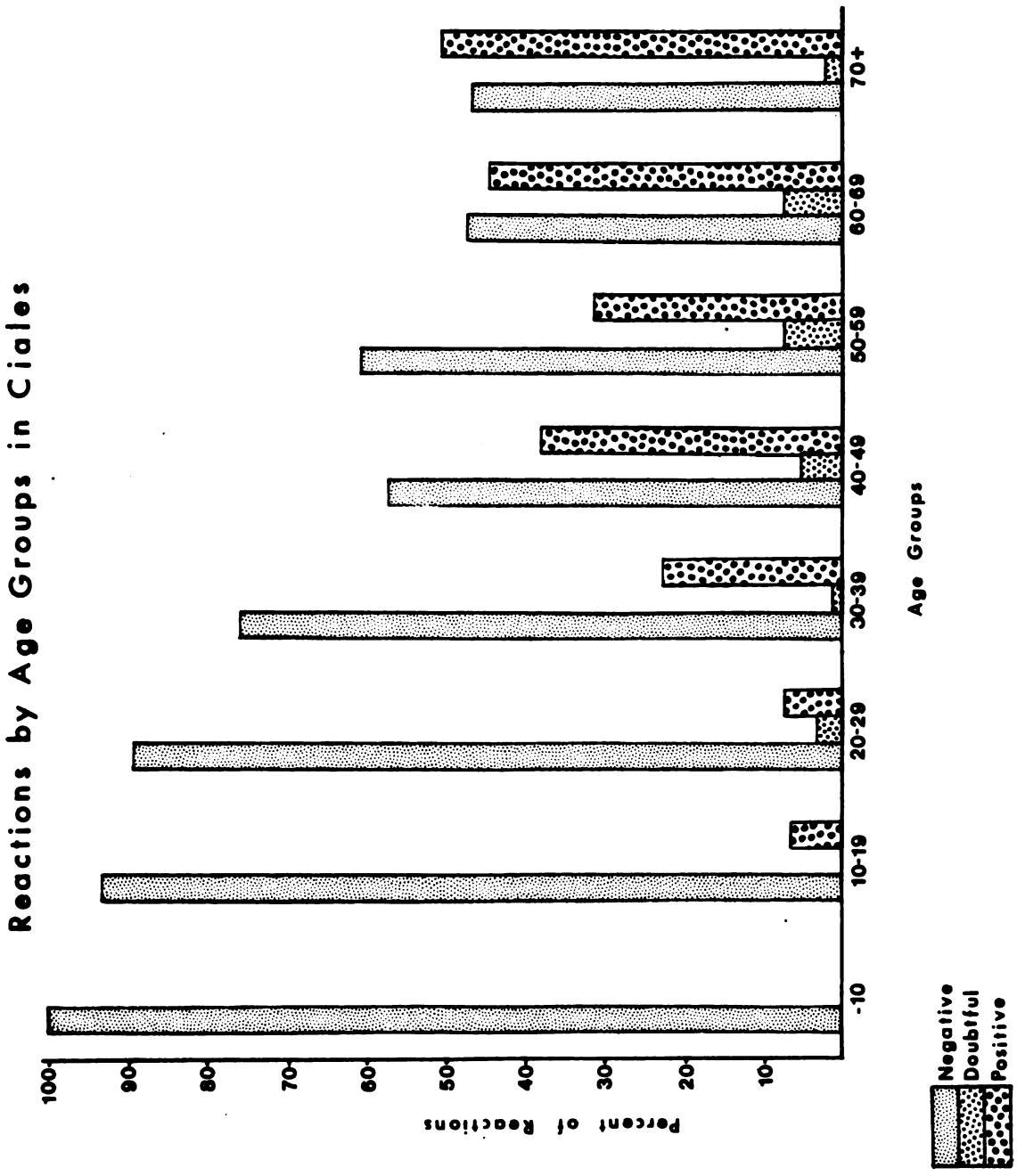
Reactions by Age Groups in Ciales
Percent of Reactions
100
90
80
70
60
50
40
30
20
10
-10
10-19
20-29
30-39
40-49
50-59
60-69
70+
Age Groups
Negative
Doubtful
Positive

Figure 6

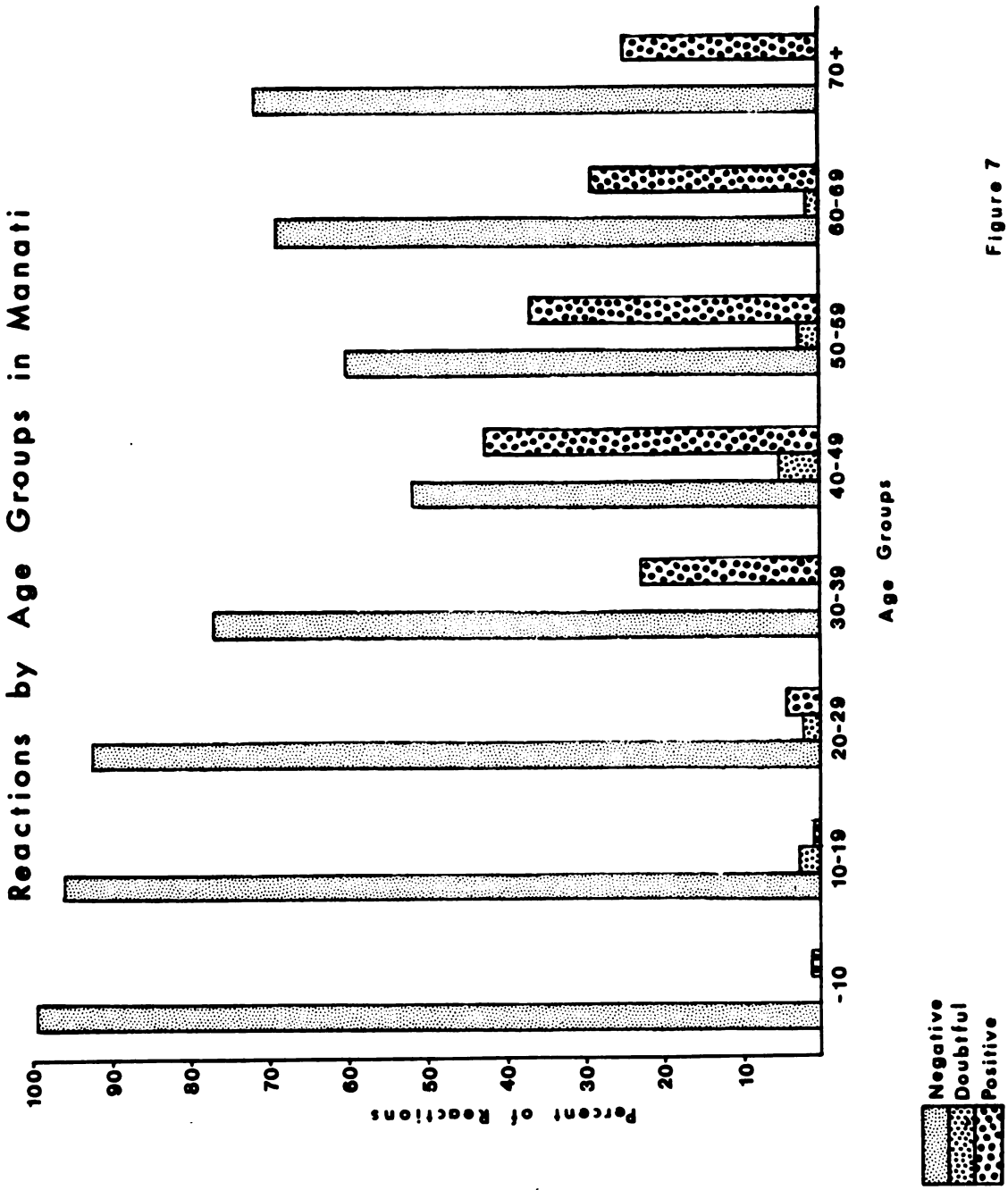
Reactions by Age Groups in Manati
Percent of Reactions
100
90
80
70
60
50
40
30
20
10
-10
10-19
20-29
30-39
40-49
50-59
60-69
70+
Age Groups
Negative
Doubtful
Positive

Figure 7

TABLE 4

MILLIMETERS OF REACTION
BY AGE GROUP FOR CIALES

	0-4 mm		5-9 mm		10+ mm		Total	
Age Group	N	%	N	%	N	%	N	%
Below 10	28	100.0	0	0	0	0	28	4.7
10-19	160	93.6	0	0	11	6.4	171	28.7
20-29	101	89.4	4	3.5	8	7.1	113	19.0
30-39	53	75.7	1	1.4	16	22.9	70	11.7
40-49	33	56.9	3	5.2	22	37.9	58	9.7
50-59	34	60.7	4	7.1	18	32.1	56	9.4
60-69	27	47.4	4	7.0	26	45.6	57	9.6
70+	20	46.5	1	2.3	22	51.2	43	7.2
Total	456	76.5	17	2.9	123	20.6	596	100.0

TABLE 5

MILLIMETERS OF REACTION
BY AGE GROUP FOR MANATI

	0-4 mm		5-9 mm		10+ mm		Total	
Age Group	N	%	N	%	N	%	N	%
Below 10	141	99.3	0	0	1	.7	142	19.9
10-19	152	96.8	4	2.5	1	.6	157	22.1
20-29	76	92.7	2	2.4	4	4.9	82	11.5
30-39	70	76.9	0	0	21	23.1	91	12.8
40-49	31	51.7	3	5.0	26	43.3	60	8.4
50-59	39	60.0	2	3.1	24	36.9	65	9.1
60-69	33	68.8	1	2.1	14	29.2	48	6.7
70+	48	71.6	0	0	19	28.4	67	9.4
Total	590	97.2	12	2.0	110	18.12	607	100.0

TABLE 6

MILLIMETERS OF REACTION BY AGE GROUP BELOW 20 FOR MANATI

Age Group	0-4 mm		5-9 mm		10+ mm		Total	
	N	%	N	%	N	%	N	%
2	17	100.0	0	0	0	0	17	2.4
3	15	100.0	0	0	0	0	15	2.1
4	23	100.0	0	0	0	0	23	3.2
5	15	100.0	0	0	0	0	15	2.1
6	16	100.0	0	0	0	0	16	2.2
7	20	100.0	0	0	0	0	20	2.8
8	18	94.7	0	0	1	5.3	19	2.7
9	17	100.0	0	0	0	0	17	2.4
10	17	94.4	1	5.6	0	0	18	2.5
11	19	95.0	1	5.0	0	0	20	2.8
12	21	100.0	0	0	0	0	21	2.9
13	13	92.9	0	0	1	7.1	14	2.0
14	12	100.0	0	0	0	0	12	1.7
15	22	95.7	1	4.3	0	0	23	3.2
16	18	94.7	1	5.3	0	0	19	2.7
17	16	100.0	0	0	0	0	16	2.2
18	8	100.0	0	0	0	0	8	1.1
19	6	100.0	0	0	0	0	6	0.8
Total	293	97.9	4	1.3	2	0.67	299	---

to as the very young who, from the epidemiological point of view, are at the highest risk for developing TB disease given that favorable conditions for disease transmission are present.

In the age group 10-19 years, 2.5 percent of the injections had doubtful reactions and 0.6 percent were positive. In adolescence the chance of developing TB is less than in the very young, but there remains a definite risk of developing the disease especially if the infection was acquired during childhood. Infection in adolescence comes chiefly from adults, often from within the extended family, but some contacts can also be made in the wider community.

Although children have benefited from the program to conquer tuberculosis, their level of security is not yet good enough. It is necessary to protect them from the tuberculous adult. Investigation of any contact child must begin immediately after a TB case has been diagnosed.

In the next age groups, both Ciales and Manatí show a gradual increase in the percent of positive reactions. Manati reaches its peak of positive reactions in the 40-49 age group. Forty-three percent of the individuals tested in that age had positive reactions. Positive reactions were almost double those of the 30-39 age group. After this peak, the percent of positive reaction declined with age. In the oldest age category, 28.4 percent of the injections reacted positively.

Both municipalities had a decrease in positive reactions in the age group 50-59. In other tuberculin testing surveys, similar results have been found in which the percentage of reactors rises steadily with age to adulthood but may show a slight decline after the age of 50 or 60 (Comstock, 1973). In Ciales the decrease in the age group 50-59 is followed by an even higher increase of reactors that reaches its peak in the oldest age category. The highest proportion of infection is found in the very old, whereas in Manatí it is found at an earlier age.

It is feasible to say that, according to the results obtained, children have been subjected to lower risk of infection than adults and that some of the older individuals may have lost their sensitivity to tuberculin. The decline in the percent of reactors after age 50 in Manati may be explained in part by the fact that the loss of responsiveness seems to accelerate with increasing age.

Most of the positive reactions occurred in persons 40 years of age and older. Probably this population group was infected with M. tuberculosis several decades ago when the infection rate was high and the chemotherapy era was in its beginnings. All of these persons are at some risk of developing tuberculosis disease. Aging is associated with a decrease in resistance which may reactivate old tuberculosis foci.

Percent of Reaction Sizes

Reactions caused by infection with mycobacteria other than M. tuberculosis (that is cross-reactions) commonly occur in tropical areas. As a consequence, what is considered a significant tuberculin reaction is not precise. In general the larger the reaction, the greater the probability that the reaction represents infection with M. tuberculosis. Cross-reactions tend to be smaller than reactions caused by tuberculous infection.

Two assumptions are made in order to estimate the proportion of persons with M. tuberculosis. First, reactions among persons infected with M. tuberculosis form a symmetric frequency distribution centering close to 15mm of induration. The second assumption is that there are no cross-reactions larger than 15mm.

The distribution of reaction size for Ciales and Manatí has its peak or central value at 20mm of induration (See Figure 8 and Table 7). A second and smaller peak is presented in the 15mm. The relatively low percentage of indurations 16mm in size indicate the possibility of erroneous measurement or observer bias favoring 5, 10, 15, and 20. Reactions that were in fact of 16mm, may have been read as 15mm. The general configuration of the distribution is, however, bimodal: a high peak of 0mm and a second peak in the 20mm of induration. Bimodal distributions are typical among populations with history of household contact with tuberculosis (American Thoracic Society, 1981).

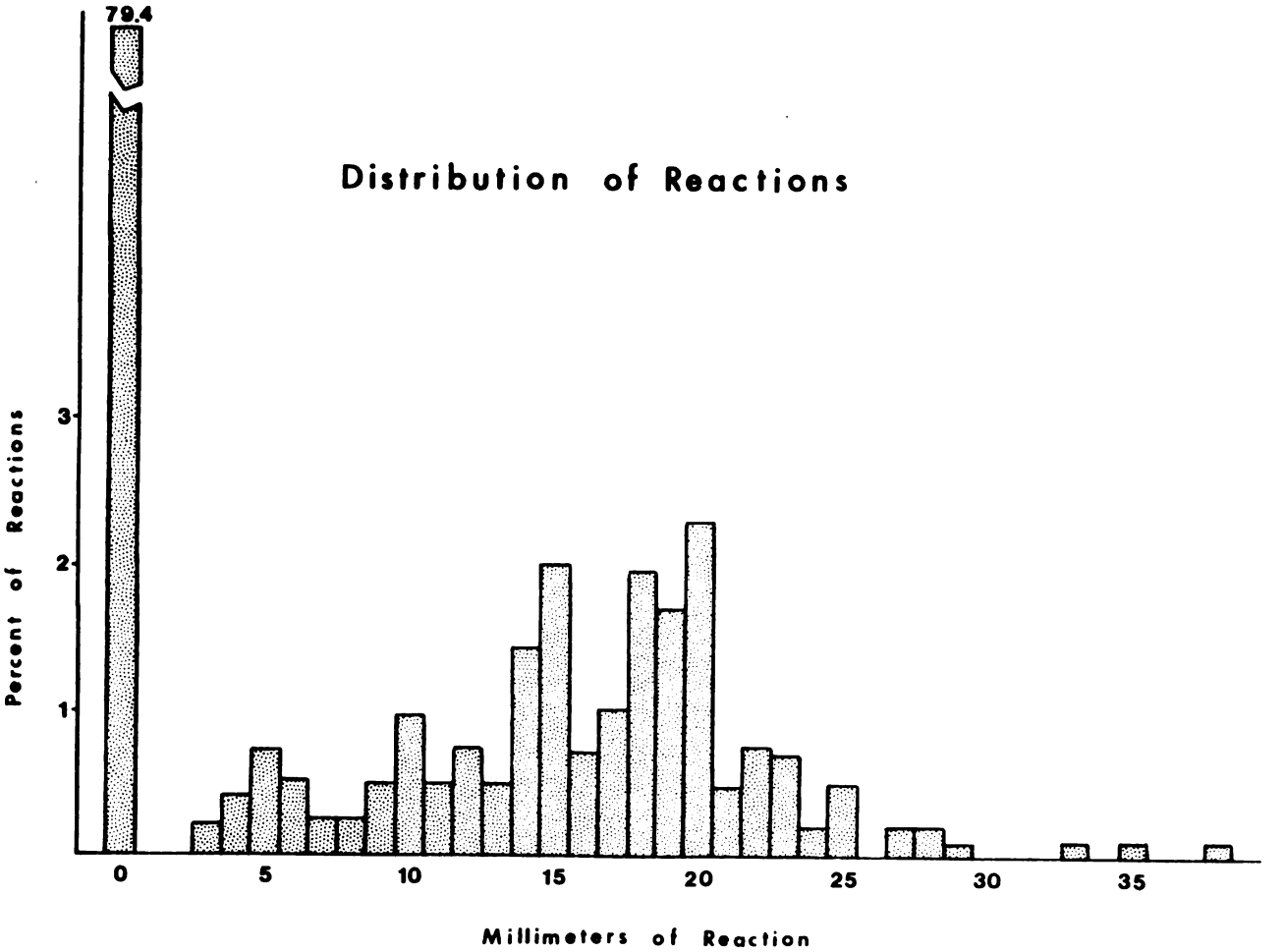
79.4
Distribution of Reactions
Percent of Reactions
3
2
1
0
5
10
15
20
25
30
35
Millimeters of Reaction

Figure 8

TABLE 7

PERCENTAGE DISTRIBUTION OF
TUBERCULIN REACTIONS
BY SIZE

Reaction (mm)	Percentage	Reaction (mm)	Percentage
0	79.40	17	1.30
3	0.20	18	1.98
4	0.40	19	1.68
5	0.76	20	2.29
6	0.46	21	0.46
7	0.23	22	0.76
8	0.23	23	0.68
9	0.54	24	0.23
10	0.99	25	0.54
11	0.54	27	0.23
12	0.76	28	0.20
13	0.54	29	0.07
14	1.45	33	0.07
15	2.20	35	0.07
16	0.68	38	0.07

Tuberculin Test Reaction by Occupation

The distribution of positive reactions by occupation shows thirty percent or more reactors in the following occupation categories: farmer, construction worker, bus driver, cosmetologist, carpenter, retail trader, mason, fisherman, waiter, salesmen, and pensioner (Table 8). In some of these occupations the number of individuals tested is minimal and does not allow any far reaching conclusions to be drawn. Those occupations are: bus driver, cosmetologist, electrician, carpenter, mason, fisherman, and waiter.

In the female occupations, a high percentage of reactors was found in the categories of housewife and pensioner. Other occupations with high reactor percentages were teacher, nursemaid, and factory worker, but the number of persons tested in those occupations was limited (Table 9). The level of significance of the relationship reaction by occupation was of .01 for both males and females.

Persons tested of 40 years of age and older represented the highest percentage of individuals in those occupations with the highest percentage of reactors. Those occupations are for males, farmer, construction worker, and pensioner (Table 10); and for females, housewife and pensioner (Table 11). The high percentage of reactors in these occupations seems to be related to the age of the

TABLE 8

TUBERCULIN POSITIVE REACTIONS
BY OCCUPATION
FOR MALES

Occupation	Number of Positive Cases	Percent Positive (10+ mm)
Unemployed	17	13.4
Farmer	12	32.4
Construction Worker	8	29.6
Student	8	4.1
Tinsmith	2	11.8
Painter	0	0
School Bus Driver	1	33.3
Pensioners	32	33.3
Industry Worker	0	0
Shoe Factory Worker	0	0
Car Junk Salesmen	0	0
Cosmetologist	1	100.0
Steel Industry Worker	1	50.0
Mechanic	1	11.1
Truck Driver	0	0
Retail Trader	1	33.3
Chemical Industry Worker	0	0
Teacher	0	0
Electrician	1	25.0
Carpenter	3	42.9
Mason	2	100.0
Fishermen	1	33.3
Chauffer (Electric Company)	0	0
Gardener	0	0
Barber	0	0
Salesmen	5	45.5
Cashier	0	0
Waiter	1	33.3
Upholster	0	0
Sculptor (Religious Images)	1	100.0
Veteran	0	0
Cook	0	0
Keeper	0	0
Store Attendant	0	0

TABLE 9

TUBERCULIN POSITIVE REACTIONS
BY OCCUPATION
FOR FEMALES

Occupation	Number of Positive Cases	Percent Positive (10+ mm)
Housewife	121	23.9
Student	4	1.6
Unemployed	2	5.7
Clothes Factory Worker	1	12.5
Cook	0	0
Store Attendant	0	0
Secretary	0	0
Teacher	1	11.1
Nursemaid	1	50.0
Pensioned	4	28.6
Cosmetologist	0	0
Administrator	0	0

TABLE 10

AGE DISTRIBUTION OF
OCCUPATION FOR MALES

Age Groups	Farmer		Construc-tion worker		Bus Driver		Aesthe-tician		Retail Trader		Mason	
	N	%	N	%	N	%	N	%	N	%	N	%
Below 10	0	0	0	0	0	0	0	0	0	0	0	0
10-19	3	0.8	0	0	1	0.3	0	0	0	0	0	0
20-29	5	2.0	9	3.6	0	0	0	0	0	0	0	0
30-39	5	2.7	6	3.2	1	0.5	1	0.5	0	0	2	1.1
40-49	2	1.5	6	4.6	1	0.8	0	0	2	1.5	0	0
50-59	6	4.5	4	3.0	0	0	0	0	0	0	0	0
60-69	7	5.9	2	1.7	0	0	0	0	1	0.8	0	0
70+	9	7.6	0	0	0	0	0	0	0	0	0	0

TABLE 10 Continued

AGE DISTRIBUTION OF
OCCUPATION FOR MALES

Age Groups	Fishermen		Waiter		Salesmen		Carpenter		Pensioned	
	N	%	N	%	N	%	N	%	N	%
Below 10	0	0	0	0	0	0	0	0	0	0
10-19	0	0	0	0	0	0	0	0	0	0
20-29	0	0	0	0	0	0	0	0	1	0.4
30-39	0	0	2	1.1	3	1.6	2	1.1	3	1.6
40-49	1	0.8	1	0.8	2	1.5	1	0.8	4	3.1
50-59	1	0.8	0	0	5	3.8	1	0.8	10	7.5
60-69	1	0.8	0	0	0	0	2	1.7	26	22.0
70+	0	0	0	0	1	0.8	1	0.8	52	44.1

TABLE 11

AGE DISTRIBUTION
OF OCCUPATIONS
FOR FEMALES

Age Groups	Housewife		Pensioned		Nursemaid		Factory Worker	
	N	%	N	%	N	%	N	%
Below 10	0	0	0	0	0	0	0	0
10-19	16	4.3	1	0.3	0	0	0	0
20-29	104	41.9	2	0.8	1	0.4	1	0.4
30-39	114	61.0	0	0	0	0	4	2.1
40-49	50	61.1	1	0.8	0	0	2	1.5
50-59	83	62.4	0	0	1	0.8	0	0
60-69	62	52.5	5	4.2	0	0	1	0.8
70+	47	39.8	5	4.2	0	0	0	0

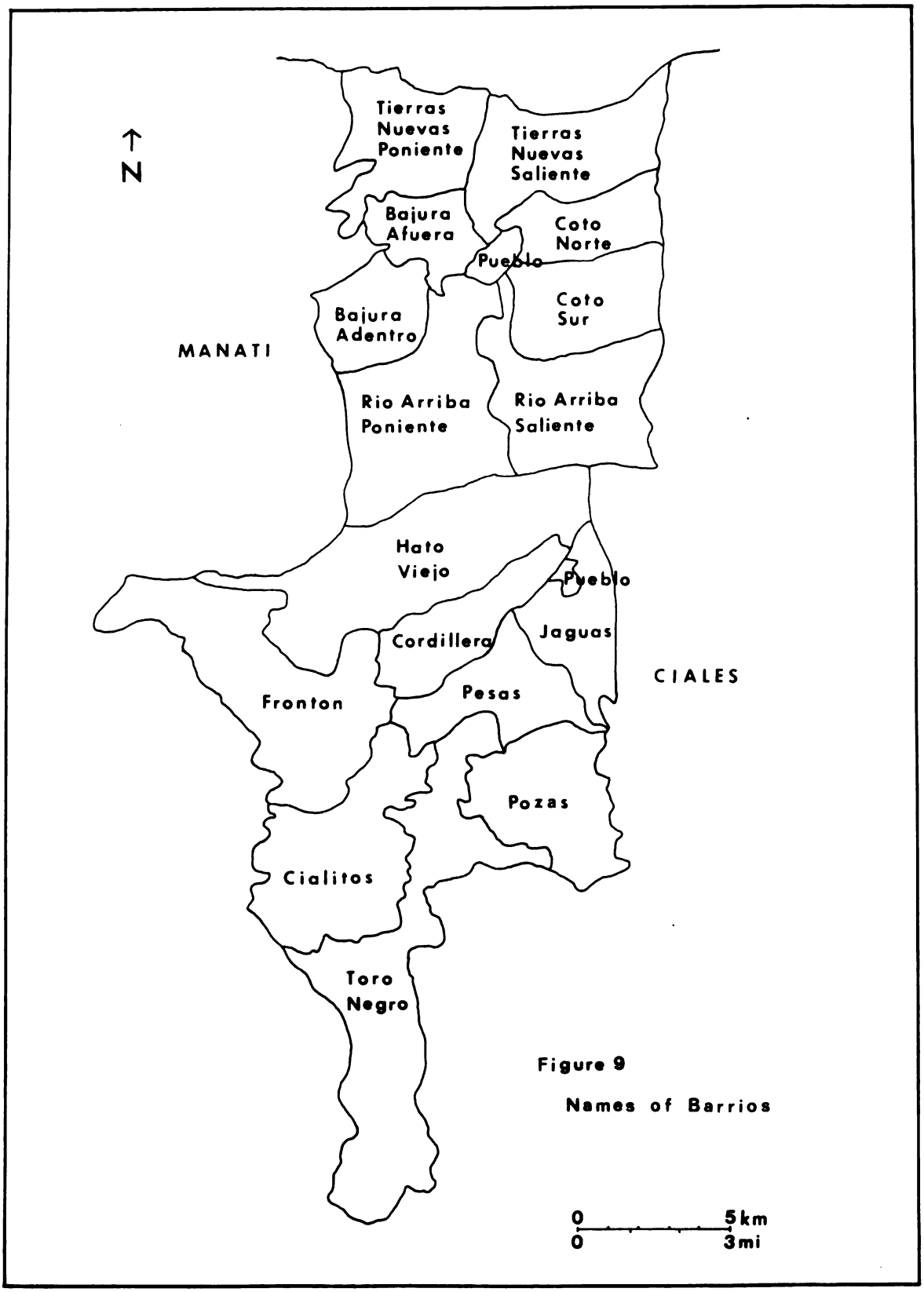

Figure 9

Names of Barrios

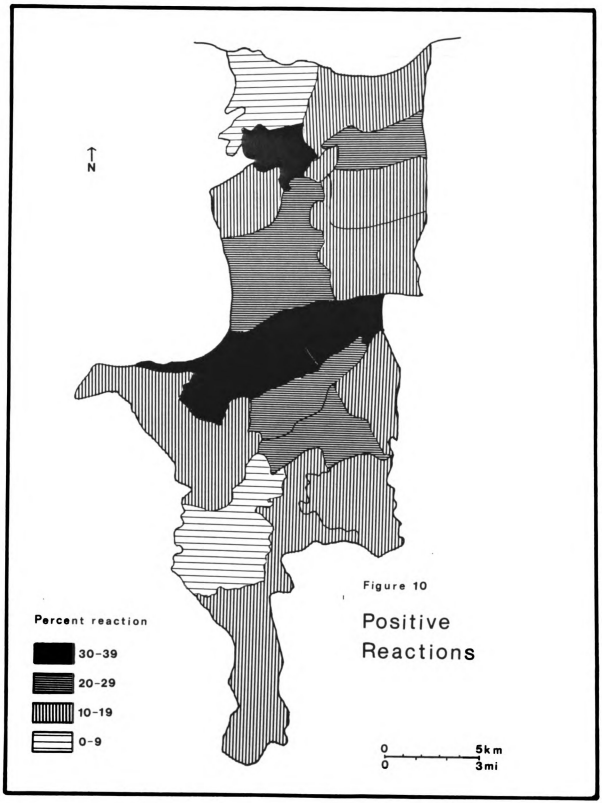

Figure 10

Positive Reactions

TABLE 12

DISTRIBUTION OF REACTIONS
BY BARRIOS FOR CIALES

Barrio	0-4 mm		5-9 mm		10+ mm		Total	
	N	%	N	%	N	%	N	%
Hato Viejo	34	56.7	3	5.0	23	38.3	60	10.1
Fronton	57	75.0	6	7.9	13	17.1	76	12.8
Pozas	37	78.7	3	6.4	7	14.9	47	7.9
Jaguas	122	80.8	2	1.3	27	17.9	151	25.3
Peses	40	69.0	1	1.7	17	29.3	58	9.7
Cordillera	54	70.1	0	0	23	29.9	77	12.9
Pueblo	41	82.0	1	2.0	8	16.0	50	8.4
Cialitos	45	95.7	1	2.1	1	2.1	47	7.9
Toro Negro	26	86.7	0	0	4	13.3	30	5.0

TABLE 13

DISTRIBUTION OF REACTIONS
BY BARRIOS FOR MANATI

	0-4 mm		5-9 mm		10+ mm		Total	
Barrio	N	%	N	%	N	%	N	%
Coto Norte	128	79.0	1	0.6	33	20.4	162	22.8
Coto Sur	132	85.7	3	1.9	19	12.3	154	21.6
Rio A. Saliente	33	78.6	1	2.4	8	19.0	42	5.9
Rio A. Poniente	22	73.3	1	3.3	7	23.3	30	4.2
Pueblo	129	83.2	3	1.9	23	14.8	155	21.8
Bajura Atuera	6	66.7	0	0	3	33.3	9	1.3
Bajura Adentro	35	89.7	0	0	4	10.3	39	5.5
Tierres N. Saliente	56	83.6	3	4.5	8	11.9	67	9.4
Tierres N. Poniente	49	90.7	0	0	5	9.3	54	7.6

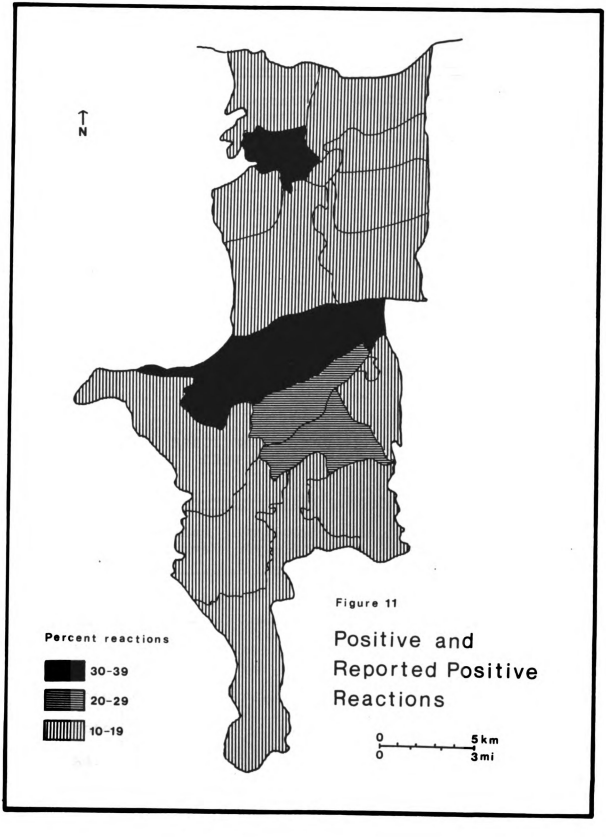

Figure 11

Positive and Reported Positive Reactions

TABLE 14

REACTIONS NOT READ
FROM CIALES

Barrio	Reported Positive		Reported Negative		No Information		Total	
	N	%	N	%	N	%	N	%
Hato Viejo	1	16.7	4	66.7	1	16.7	6	5.7
Fronton	3	18.8	7	43.8	6	37.5	16	15.1
Pozas	0	0	5	83.3	1	16.7	6	5.7
Jaguas	2	6.7	23	76.7	5	16.7	30	28.3
Pesas	0	0	8	66.7	4	33.3	12	11.3
Cordillera	0	0	6	66.7	3	33.3	9	8.5
Pueblo	0	0	11	64.7	6	35.3	17	16.0
Cialitos	5	83.3	1	16.7	0	0	6	5.7
Toro Negro	0	0	2	50.0	2	50.0	4	3.8

TABLE 15

REACTIONS NOT READ
FROM MANATI

Barrio	Reported Positive		Reported Negative		No Information		Total	
	N	%	N	%	N	%	N	%
Coto Norte	0	0	12	80.0	3	20.0	15	16.9
Coto Sur	1	5.6	15	83.3	2	11.1	18	20.2
Río A. Saliente	0	0	5	62.5	3	37.5	8	9.0
Río A. Poniente	0	0	6	100.0	0	0	6	5.6
Pueblo	2	8.7	9	39.1	12	52.2	23	25.8
Bajura Ad.	1	14.3	5	71.4	1	14.3	7	7.9
Tierres N. Saliente	1	20.0	4	80.0	0	0	5	5.6
Tierres N. Poniente	2	25.0	5	62.5	11	12.5	8	9.0

individuals occupied in them. The unemployed, who constitute a high percentage of the population, are not related to positive reaction to the test. An analysis of their age structure reveals that their highest percentages fall within the 20-29 years age group. As discussed, the younger age groups have the lowest percentage of reactors.

Tuberculin Test Reactions by Barrio

The distribution of percentages of reactors in the barrios of Ciales and Manati is shown in Figure 10, Tables 12, and 13. A very different pattern occurs when the reactions that were not read, but were reported positive are added (Figure 11, Tables 14 and 15). The reported positive reactions are relatively reliable classifications since the inexperienced person will underestimate the reaction to the test, therefore, the reactions reported positive, were probably large enough to be noticed by the persons in contact with the individual tested.

Hato Viejo in Ciales, and Bajura Afuera in Manati are the barrios with the highest percentage of reactors (Figures 9-11). In sector Cumbre in Hato Viejo, one of the five sectors visited during the survey in that barrio, 62.5 percentage of the persons tested reacted to the test with 10mm or more of induration. In that sector a 40 year old female was interviewed. She was an ex-tuberculosis patient twelve years ago. She has been living in Cumbre for fifteen years. Her husband and neighbors, reacted

positive to the test, including a 22 year old male. Infection in this neighborhood with M. tuberculosis may have had its focus in the ex-TB patient. This neighborhood in Cumbre accounts for the high percentage of reactors in Hato Viejo. Bajura Adentro, in Manatí has a small population and the number of injections administered in that barrio were therefore small and no meaningful conçlusion can be drawn from such a sample. But it follows the general distribution pattern with higher percentages of reactions in the older age groups. The reactors in Bajura Adentro were in the 60-69 age group.

The remaining barrios in Ciales and Manatí, with the exceptions of Cordillera and Pesas have percentages of reactors of between 10-19 percent and present no difference in the rate of tuberculosis infection between Ciales and Manatí. The total percentage of reactors in Ciales was 20.6 and in Manatí 15.5 percent. In contrast to these results, Manatí reports a TB rate ten times that of Ciales, suggesting underreporting of tuberculosis cases particularly in Ciales.

Tuberculin Test Reactions by Sex

The general percentage of tuberculin reactors in the sample was 19.7 percent for males, and 17.2 percent for females (See Table 16). The distribution of reactors by sex and age shows a slight difference between the sexes and a general increase of reactors with age (See Figure 12,

Tables 17, and 18). It was expected to have an excess of male reactors in the older age groups. This is typically the pattern since males are more likely to have a wider range of contacts outside the home, increasing the opportunity to come in contact with a person with tuberculosis disease. A larger number of females were tested. Injections were administered during working hours when most of the males were not at home. The number of working females was also reduced for the same reason.

Tuberculin Test Reaction by Rural and Urban Location

Tuberculosis cases are usually higher in urban areas. Urban living and concentration of people, increases the risk of becoming infected with tuberculosis. This difference may not be related to the quality of housing, although lifestyle may be a contributory factor. In Puerto Rico, tuberculosis has been historically higher in urban areas. The analysis of the sample presents rural areas having the higher percentage of reactors, 19.8 percent in rural areas and 14.5 percent in urban areas (Figure 13 and Table 19). Higher percentages for rural areas are also found in Ciales (Table 20) and in Manatí (Table 21). This pattern is in accordance with the tuberculosis rates reported in the municipalities of the Island in 1980. Municipalities classified as being rural have equal or higher rates as those classified as urban municipalities. Employment of rural labor force in urban areas, increasing

TABLE 16

DISTRIBUTION OF REACTIONS
BY SEX

Sex	0-4 mm		5-9 mm		10+ mm		Total	
	N	%	N	%	N	%	N	%
Male	412	79.5	9	1.7	97	18.7	618	44
Female	634	80.2	20	2.5	136	17.2	790	56

TABLE 17

DISTRIBUTION OF REACTIONS BY
AGE GROUP FOR FEMALES

Age Group	0-4 mm		5-9 mm		10+ mm		Total	
	N	%	N	%	N	%	N	%
Below 10	92	100	0	0	0	0	92	11.6
10-19	168	96.0	2	1.1	5	2.9	175	22.2
20-29	120	92.3	4	3.1	6	4.6	130	16.9
30-39	97	81.5	1	0.8	21	17.6	119	15.1
40-49	41	51.3	5	6.3	34	42.5	80	10.1
50-59	49	60.5	5	6.2	27	33.3	81	10.3
60-69	35	55.6	3	4.8	25	39.7	63	8.0
70+	32	64.0	0	0	18	36.0	50	6.3

TABLE 18

DISTRIBUTION OF REACTIONS BY
AGE GROUP FOR MALES

Age Group	0-4 mm		5-9 mm		10+ mm		Total	
	N	%	N	%	N	%	N	%
Below 10	77	98.7	0	0	1	1.3	78	15.1
10-19	144	94.1	2	1.3	7	4.6	153	29.5
20-29	57	87.7	2	3.1	6	9.2	65	12.5
30-39	26	61.9	0	0	16	38.1	42	8.1
40-49	23	60.5	1	2.6	14	36.8	38	7.3
50-59	24	60.0	1	2.5	15	37.5	40	7.7
60-69	25	59.5	2	4.8	15	35.7	42	8.1
70+	36	60.0	1	1.7	23	38.3	60	11.6

TABLE 19

DISTRIBUTION OF REACTIONS BY SECTORS
FOR CIALES AND MANATI

Sector	0-4 mm		5-9 mm		10+ mm		Total	
	N	%	N	%	N	%	N	%
Rural	648	77.6	22	2.6	165	19.8	835	63.8
Urban	319	83.9	6	1.6	55	14.5	380	29.1
Aldea	79	84.9	1	1.1	13	14.0	93	7.1

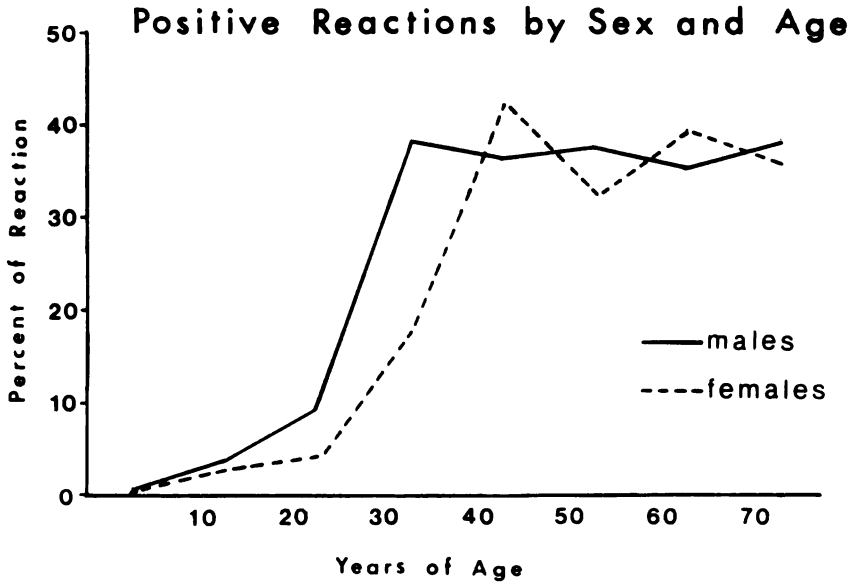

Figure 12

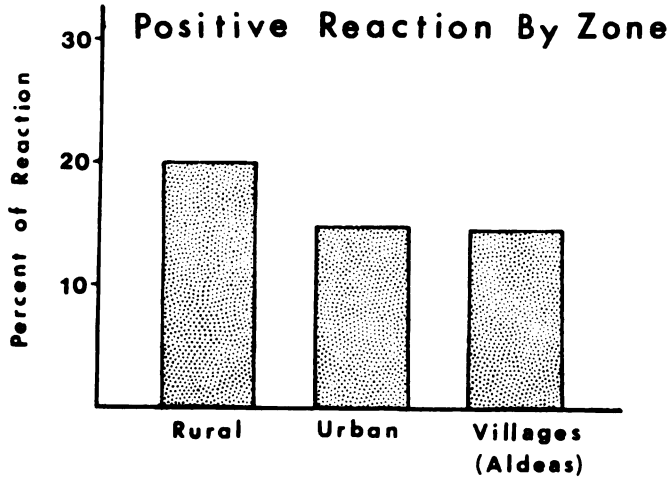

Figure 13

TABLE 20

DISTRIBUTION OF REACTIONS BY
SECTOR FOR CIALES

	0-4 mm		5-9 mm		10+ mm		Total	
Sector	N	%	N	%	N	%	N	%
Rural	377	75.7	16	3.2	105	21.1	488	83.6
Urban	79	80.6	1	1.0	18	18.4	98	16.4

TABLE 21

DISTRIBUTION OF REACTIONS BY
SECTOR FOR MANATI

	0-4 mm		5-9 mm		10+ mm		Total	
Sector	N	%	N	%	N	%	N	%
Rural	364	82.2	8	1.8	71	16.0	443	62.2
Urban	147	83.5	3	1.7	26	14.8	176	24.7
Aldea	79	84.9	1	1.1	13	14.0	93	13.1

the opportunities for infection among rural residents can be a partially explanatory variable.

Tuberculin Reaction by House Type

In all three categories of housing construction the percentage of reactors is between 18 and 19 percent, showing no relationship between percent of reactors and type of housing (Table 22) as indicated by the level of significance of .49. Other variables related to the quality of housing are the available utilities such as electricity, piped water, and flush toilet. All of the houses in the sample had electricity and running, piped water. Only 6.1 percent of the persons lived in houses that did not have toilet facilities (See Table 23). The high percentage of houses with utilities is the result of Government efforts to bring electricity and piped water to rural areas. The fact that most of the houses had flush toilets, electricity and piped water put most of the houses at the same level of quality.

Tuberculin Reaction and Number of Persons Per Room

For most of the sample, tuberculin sensitivity was found to be negatively related to the number of persons per room in the house (See Table 24). Unexpectedly, the highest percent of reactors was found at the lowest room density. The level of significance obtained was 0.01. Age is an influence in this relationship. An analysis of the age composition shows that 66 percent of the persons living at less than one person per room were aged 40 years

TABLE 22

DISTRIBUTION OF REACTION BY
HOUSE TYPE FOR CIALES
AND MANATI

	0-4 mm		5-9 mm		10+ mm		Total	
House Type	N	%	N	%	N	%	N	%
Concrete	611	80.6	13	1.7	134	17.7	758	58.0
Concrete/ Wood	69	76.7	4	4.4	17	18.9	90	6.9
Wood	366	79.6	12	2.6	82	17.8	460	35.2

TABLE 23

DISTRIBUTION OF FLUSH TOILETS
BY HOUSE TYPE

	Concrete		Concrete/ Wood		Wood		Total	
Availability	N	%	N	%	N	%	N	%
yes	868	61.5	97	6.9	447	31.7	1412	93.9
no	6	6.6	11	6.6	74	81.3	91	6.1

and older (See Table 25). The room density with the lowest percent of reactors, two persons per room, has only 20.2 percent of its inhabitants in that age group (See Table 25).

TABLE 24

DISTRIBUTION OF REACTIONS BY
DENSITY FOR CIALES
AND MANATI

Persons Per Room	0-4 mm		5-9 mm		10+ mm		Total	
	N	%	N	%	N	%	N	%
Below 1	65	57.0	4	3.5	45	39.5	114	8.7
1	743	81.4	17	1.9	153	16.8	913	69.8
2	217	85.8	8	3.2	28	11.1	253	19.3
3	19	82.6	0	0	4	17.4	23	1.8
4	2	50.0	0	0	2	50.0	4	0.3
5	0	0	0	0	1	100.0	1	0.1

TABLE 25

NUMBER OF PERSONS PER ROOM
BY AGE GROUPS

Age Group	Below 1		1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%	N	%
Below 10	0	0	154	81.5	35	18.5	0	0	0	0	0	0
10-19	19	5.1	241	64.1	98	26.1	15	4.0	3	0.8	0	0
20-29	17	6.8	174	69.3	55	21.9	5	2.0	0	0	0	0
30-39	6	3.2	147	78.6	33	17.6	1	0.5	0	0	0	0
40-49	15	11.5	91	69.5	21	16.0	3	2.3	1	0.8	0	0
50-59	15	11.3	101	75.9	16	12.0	1	0.8	0	0	0	0
60-69	31	26.3	78	66.1	9	7.6	0	0	0	0	0	0
70+	21	17.8	85	72.0	10	8.5	1	0.8	0	0	1	0.8

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study has been concerned with screening for tuberculosis infection in the municipalities of Ciales and Manatí. Its aim has been to identify tuberculin reaction rates to see how they compare with the reported tuberculosis morbidity rates in those municipalities.

A review of the history of tuberculosis on the Island pointed out the magnitude of the disease problem in the past. The attempts of the public health authorities to control the disease have been well oriented, and very successful. The reduction of TB rates of mortality and morbidity can be considered as a major step toward the control of tuberculosis in Puerto Rico. But the detection of cases has not been as effective, thus allowing the transmission of tuberculosis to continue.

The data analyzed supported the research hypotheses. In Ciales, the municipality with the lower tuberculosis rate reported of the two municipalities, and the one without a health center for the control of tuberculosis, the higher percent of reactors to the tuberculin test was obtained. The percent of reactors for both municipalities were

twenty-one percent for Ciales and fifteen percent for Manatí.

Both Ciales and Manatí had an increase in their reaction rates with advanced age. The high rate of tuberculosis infection previous to, or a little after the beginning of the chemotherapy era, may explain the higher percentage of reactors in groups of people forty years of age and older.

The percent of reactors in relation to other variables was also related to the age composition of the groups of persons tested in the different categories. Variables such as occupation and room density are the best two examples.

The distribution of reactors in the barrios of Ciales and Manatí presented no specific pattern. Certainly no difference in the percent of reactors in those barrios close to the TB center and those distant from it, was found. This suggests that underreporting of TB cases may also be a health service problem in Manati, where the center is located.

Rural reactors percentages were higher than the urban percentages in both municipalities. The answer to this historical inversion cannot be given in this study, but an urban health care services effect is suggested.

As a group, males had a slightly greater percentage of reactors. No significant variations in the age distribution of reactors in both sexes was found. This represents

a change from previous surveys in which an excess of male reactors in the older age groups was obtained.

The percent of reactors was not related to the type of house construction. Availability of running piped water and electricity in all the houses, and flush toilet in almost all of them, made housing quality relatively uniform throughout the sample.

Recommendations

Wherever a scheme exists to eliminate tuberculosis, most of the attention should be focused upon decreasing the number of infectious cases. If the latter increase, the total number of tuberculosis cases subsequently increases. Although a priority of the tuberculosis control program in Puerto Rico is to reduce the spread of tuberculosis in the community, some additional procedures are suggested to ensure that more infectious cases are found and at an earlier stage.

A well organized outpatient treatment is the basis for the control of the disease. It can undertake health education measures to teach the early signs of tuberculosis, the importance of early detection and the need for prolonged treatment. The knowledge is also relevant that the disease is curable and that discovery of tuberculosis no longer automatically leads to isolation. The great majority of the population should have ready access to TB centers. Perhaps, it will be necessary to establish new centers for outpatient care. Mobile units can be introduced in the health system

to complement service of the centers.

Education of the public should be aimed primarily at those who would not normally come for treatment. With the assistance of social workers, propaganda can be distributed to make both the sufferer and the community aware of the significance of the disease-related symptoms. The public should be as well informed of the tuberculin test as a public health procedure as they are about immunization against other communicable diseases.

The tuberculin testing of children is an important measure already taken on the Island. But tubercle bacilli have taken refuge among older people in higher proportion than in any other segment of the population. The requirement of the tuberculin test for the issuance of health certificates certainly increases the number of persons tested with tuberculin. Periodic tuberculin surveys among different sectors of the population can help in the detection of TB cases among individuals that are not in the need of such certificates.

In any community the epidemiological situation of tuberculosis is always changing. An effective tuberculosis control program should have the mechanisms to detect those changes.

APPENDIX A

INTERVIEWS ON HISTORICAL ASPECTS OF TUBERCULOSIS IN CIALES AND MANATI

APPENDIX A

INTERVIEWS ON HISTORICAL ASPECTS OF TUBERCULOSIS IN CIALES AND MANATI

INTERVIEW 1

8/9/82

Municipio: Ciales

Barrio: Pozas

Sex: Female

Age: 75

My son died of TB 35 years ago. He was only 20 years old. I took care of my son until he died. He was my only child. It was a very common disease in those times, but I have never accepted that my boy died so young.

Tuberculosis can be cured today with some drugs. I don't know how the disease is transmitted.

INTERVIEW 2

8/9/82

Municipio: Ciales

Barrio: Pozas

Sex: Male

Age: 62

Forty years ago my family was living in Pozas. In those times, tuberculosis was very common and frightening. We considered ourselves lucky because in our family nobody had had tuberculosis. With the pass of the years, new medicines for tuberculosis were discovered, and the disease ceased to take so many lives. Sixteen years ago my family had its first TB case. My brother, 45 years old, had diagnosticated tuberculosis. Fortunately the treatment for the disease is very effective and my brother was cured.

Tuberculosis is transmitted by a bacilus when the sick person coughs or talks. The disease can be cured with drugs.

INTERVIEW 3

8/8/82

Municipio: Ciales

Barrio: Frontón

Sex: Female

Age: 59

My mother died of tuberculosis when she was 40 years old. She refused any kind of treatment and always said that she did not have tuberculosis. Her grandmother died of tuberculosis and she was very close to her. She just did not want to think that she was going to die of the same disease.

Tuberculosis is transmitted by close contact with the sick person and can be cured with medicines.

INTERVIEW 4

8/8/82

Municipio: Ciales

Barrio: Jaguas

Sex: Female

Age: 79

My sister died of tuberculosis when she was 50 years old, about 30 years ago. Her husband had died one year before in Cialitos where they were living. I took care of their children.

Tuberculosis can't be cured and is transmitted by coughing.

INTERVIEW 5

8/9/82

Municipio: Ciales

Barrio: Pesas

Sex: Male

Age: 73

My brother spent nine months in a sanatorium where he died. This happened in 1949. He always looked healthy and strong before he got the disease. During his sickness, he did not look like my brother anymore. His wife had tuberculosis also ten years ago, but she received treatment and was cured.

I know that tuberculosis can be cured with some medicines, but I don't know how it is transmitted. Some people said it is through the clothes of the sick person.

INTERVIEW 6

8/4/82

Municipio: Ciales

Barrio: Jaguas

Sex: Male

Age: 72

My wife died of tuberculosis thirty years ago when she was 45. She refused to take any medicine apart from herbal teas that she used to prepare. She always said that all she needed to do was rest and that she was weak because she was working in the house all the time.

You can get tuberculosis when you don't eat well, and in most cases it kills.

INTERVIEW 7

8/4/82

Municipio: Ciales

Barrio: Jaguas

Sex: Female

Age: 45

My aunt raised me. She looked after me when my mother died of tuberculosis. I don't remember her. I was

only a child, and my aunt did not let me get too close to her. Some years ago my aunt developed tuberculosis. She was immediately put under treatment and now she is cured. Every year she gets a chest X-ray, as it was suggested by the doctor.

INTERVIEW 8

8/4/82

Municipio: Ciales

Barrio: Jaguas

Sex: Male

Age: 62

Two of my cousins died of tuberculosis forty years ago. They were teenagers. They always looked pale and sick and almost all the time had cold and fatique. Nobody was surprised that they were coughing all the time and had that sick look on their faces. The family had so many problems at that time that the weakness of my cousins was only one more. When one of them died, the family then knew he had tuberculosis. They also knew his brother was going to have the same end. He died two months later.

Tuberculosis is a transmissible disease, but I don't know how it is transmitted. Today it can be cured with medical attention.

INTERVIEW 9

8/4/82

Municipio: Ciales

Barrio: Jaguas

Sex: Female

Age: 26

My ex-husband had diagnosticated tuberculosis two years ago. I was still married to him. He was put under treatment for 18 months, but he did not finish. He said that he was tired of taking pills every day; plus he felt considerably better after a few months. I tried to make him finish with the treatment because the doctor told me this was very important. As always, he did not listen. I don't know how he is now because I divorced him.

Last month I was tested with tuberculin and had a chest X-ray. The doctor told me I had tuberculosis. Now, I am under treatment for 18 months. I want to be cured. I am going to finish the treatment.

The disease is transmitted when the sick person coughs, talks, sneezes, the person should cover the mouth as a way to prevent transmission. Once the person is under treatment for four weeks, the disease ceases to be infectious.

INTERVIEW 10

8/9/82

Municipio: Ciales

Barrio: Pesas

Sex: Female

Age: 60

My brother died of tuberculosis 30 years ago when he was a teenager. When he was sick nobody in the family realized he had TB. He was coughing all the time and looked pale and weak. We believed it was bronchitis. He was taken to the doctor who identified the disease as being tuberculosis, and the doctor prescribed some pills for him to take over a long period of time every day. As soon as he began to take those pills, he began to feel better. So, he decided not to take them anymore. One year later he was looking bad again, and he died a little after.

Tuberculosis can be cured sometimes with medicines. I don't know how it is transmitted.

INTERVIEW 11

8/4/82

Municipio: Ciales

Barrio: Ciales Town

Sex: Female

Age: 46

My mother died of tuberculosis when she was still young. My brother and I went to live with a relative. We did not see my mother much. When she died, my father made us promise not to tell anybody about the cause of her death.

Today tuberculosis can be cured but I don't know what is the treatment.

INTERVIEW 12

8/9/82

Municipio: Ciales

Barrio: Pozas

Sex: Female

Age: 45

My sister died of tuberculosis when she was 14 years old. Few years before my grandmother had died of TB. My sister loved her very much and was always in her company. It is possible that my sister got the disease from my grandmother. The family was living in Barranquitas when all this happened.

Tuberculosis is transmitted by coughing. Some people use honey for the cough, but it doesn't cure tuberculosis. A prescribed medicine is necessary.

INTERVIEW 13

8/3/82

Municipio: Ciales

Barrio: Cordillera

Sex: Female

Age: 68

My mother was a TB patient ten years ago. Now, she is cured. My neighbor Rufino Cardona died of tuberculosis last year. He was 65 years old. We all used to visit him and did not know he had tuberculosis. When my mother was sick, nobody came to visit us. The neighbors were afraid to catch tuberculosis, and we had a hard time trying to make them believe she was cured. I am not afraid of tuberculosis. It is not a good thing to have, but it can be cured. It is not like in the past.

INTERVIEW 14

8/3/82

Municipio: Ciales

Barrio: Ciales Town

Sex: Female

Age: 37

I suspect my father has tuberculosis. His wife might have transmitted the disease to him. Thirty years ago, she was married to a man who right now has been under

treatment for TB for a year. Few months ago she had tuberculosis diagnosticated in New York, but she does not want to follow any treatment. Her tuberculosis is the direct result of her evil wish for her husband to contract tuberculosis.

The disease is transmitted when a person coughs or talks and can be cured with adequate medicines.

INTERVIEW 15

8/3/82

Municipio: Ciales

Barrio: Cordillera

Sex: Male

Age: 60

I was born in Cordillera and have always lived here. When I was seven years old my father died of tuberculosis. In that neighborhood my family was only one more affected by the disease. Other members of the family that were not living with us also died of tuberculosis.

Tuberculosis is transmitted through the personal contact with the sick person. It can also be transmitted by touching personal belongings. A person with tuberculosis should be isolated to avoid transmission. The disease can be cured only in some cases.

INTERVIEW 16

8/8/82

Municipio: Ciales

Barrio: Jaguas

Sex: Male

Age: 52

I was separated from my mother when I was five years old. She had tuberculosis and was only 25 years old. I don't know who my father is. I went to live with my grandparents. My mother was living alone attended by members of the family who took turns to care for her. I used to go to visit her, but I was only permitted to talk with her through a window in her bedroom. Sometimes she was too weak to talk. One day she died after years of suffering.

I don't know how the disease is transmitted, but I know that it can be cured with some drugs. There are not so many persons with tuberculosis these days.

INTERVIEW 17

8/8/82

Municipio: Ciales

Barrio: Jaguas

Sex: Female

Age: 51

My uncle died of tuberculosis last year. He did not finish his treatment. He is not the first member in the family to die of tuberculosis. Thirty-five years ago the family lost two of its members who were victims of the disease.

Tuberculosis is transmitted by the bacteria of the tuberculosis when the sick person talks or coughs. The disease can be cured with drugs.

INTERVIEW 18

8/8/82

Municipio: Ciales

Barrio: Hato Viejo

Sex: Female

Age: 68

Both of my parents died of tuberculosis. Three years after my father died, my mother died. I was three years old. I don't remember them. I lived with my uncle. In those years, almost every family had one member with tuberculosis. There were no cures for the disease, and everybody was afraid to get it.

I don't know how the disease is transmitted, but close personal contact seems to help. New medicines are used now for the treatment and cure of the disease.

INTERVIEW 19

8/3/82

Municipio: Ciales

Barrio: Jaguas

Sex: Female

Age: 78

My mother died of tuberculosis forty years ago. At that moment, my mother was fifty years old. I took personal care of her. I have always been strong. I have never had tuberculosis.

Tuberculosis is a disease transmitted by cough, sometimes is sufficient to talk to a sick person to get the disease. Tuberculosis can be cured with good nutrition and medicines.

INTERVIEW 20

8/7/82

Municipio: Ciales

Barrio: Cordillera

Sex: Female

Age: 49

My sister is a tuberculosis patient. She has been under treatment for a year. She lives in Cordillera too. In our family she is the first case of tuberculosis. When the doctor told her she had TB, she came to me crying and very nervous. It took a while for her to accept she had

tuberculosis. We all felt better when the doctor told us that the treatment is effective and she can be cured. At this point she feels better, not as weak as she was feeling before. She has less than one year to go to finish the treatment.

Tuberculosis is transmitted by coughing. Can be cured if it is discovered on time.

INTERVIEW 21

8/7/82

Municipio: Ciales

Barrio: Frontón

Sex: Female

Age: 76

Three of my brothers died of tuberculosis. The family was living in Frontón. In ten years, we lost them. They were 35, 40 and 45 years old. All of them had families, and the three widows had tuberculosis also. But, they received treatment. One of them finished treatment two years ago.

I think that tuberculosis is transmitted when you live with a person who has the disease. The cure is possible if the person follows the treatment.

INTERVIEW 22

8/7/82

Municipio: Ciales

Barrio: Cordillera

Sex: Female

Age: 67

My brother Tomás died of tuberculosis thirty years ago. He was 25 years old and lived in Jaguas with his wife. He was the first case of tuberculosis in my family. Five years after his death my husband had tuberculosis. I was very afraid thinking that he was going to die. But he was put under treatment over a long period and he was cured.

Tuberculosis is transmitted by the personal contact with the sick. The disease can be cured with medicines.

INTERVIEW 23

8/6/82

Municipio: Ciales

Barrio: Pesas

Sex: Male

Age: 69

My father's two brothers died of tuberculosis about 45 or 50 years ago. They were living with their families in Utuado. We were living there too, but when

they died my father did not want to stay in Utuado any more. He said that the coolness of the mountains made his brothers sick. We moved to Vega Baja and there were people dying of tuberculosis too. Twenty years ago, I came to Ciales with my family and the neighbors were telling me about all the people who had tuberculosis here. It seems that the whole island had tuberculosis.

Tuberculosis is transmitted when a sick person coughs. It can be cured with medicines and a long treatment.

INTERVIEW 24

8/9/82

Municipio: Ciales

Barrio: Pozas

Sex: Female

Age: 80

When I was a teenager, my father died of tuberculosis. During his sickness, he was living with us in the same house, but he spent most of the time in his bedroom. I remember there was a separate glass, plate, a set of forks, spoons, and knives just for him. My mother didn't let me get too close to him. She was afraid I was going to catch the disease. My father's sickness lasted two years. He died in the house. The day of the funeral another person was buried victim of

TB too.

Tuberculosis is transmitted by the close contact with the sick person. The disease can't be cured.

INTERVIEW 25

8/7/82

Municipio: Ciales

Barrio: Cialitos

Sex: Female

Age: 71

My husband and I were living in Cialitos 33 years ago when he died of tuberculosis. In the 40's, we did not have good treatment for TB. My husband spent six months in a sanatorium where he died. I visited him every day. The hospitals were full with tuberculosis cases.

Tuberculosis is transmitted if you live in close contact with the sick person. Today it can be cured. There are not hospitals for tuberculosis any more.

INTERVIEW 26

8/10/82

Municipio: Manatí

Barrio: Coto Norte

Sex: Male

Age: 71

My brother died of tuberculosis when there was a cure for the disease but he never wanted to go to a doctor. He said it was a waste of time. He never received any treatment, and he kept working for as long as he could. Tuberculosis can be cured with medicines. Nobody should die of tuberculosis anymore. I don't know how it is transmitted.

INTERVIEW 27

8/10/82

Municipio: Manatí

Barrio: Coto Norte

Sex: Female

Age: 68

My cousin died when she was thirty years old. When the TB was diagnosticated in her, she was put under treatment. She had to take some pills every day. But she didn't take the medicine as instructed. She didn't eat well and didn't take care of herself. Sometimes I wonder if she wanted to kill herself.

Tuberculosis can be cured with some medicines, but the sick person has to cooperate and follow the treatment.

INTERVIEW 28

8/10/82

Municipio: Manatí

Barrio: Coto Norte

Sex: Male

Age: 60

When we were living in Fajardo, twenty years ago, my wife had tuberculosis. I was very afraid because my mother died of tuberculosis when I was a child. But my wife was put under medical treatment for two years and she was cured. During those two years, she had to take a drug with a strange name every day. She wanted to live for our children, and eventually she finished the treatment. Now she has a chest X-ray taken every year, and she is healthy.

Tuberculosis is transmitted by coughing. It can kill, but with treatment can be cured.

INTERVIEW 29

8/10/82

Municipio: Manatí

Barrio: Coto Norte

Sex: Male

Age: 86

My wife was a TB patient twenty years ago. She was cured because luckily by the time she got sick there was cure for tuberculosis. Now she has medical examination every year. Other members of her family in Aguadilla had tuberculosis but for some of them the cure didn't get on time.

Tuberculosis is transmitted when a sick person coughs or sneezes. The disease can be cured with special drugs for tuberculosis.

INTERVIEW 30

8/10/82

Municipio: Manatí

Barrio: Coto Sur

Sex: Female

Age: 57

My grandfather died of tuberculosis fifteen years ago. He always insisted that he did not have TB, but pneumonia. For that reason, he did not want to receive any treatment for tuberculosis. I think that he was afraid to have the disease and did not want to recognize that he had it.

Tuberculosis is transmitted when the sick person coughs. The disease can be cured under medical supervision.

INTERVIEW 31

8/11/82

Municipio: Manatí

Barrio: Coto Sur

Sex: Female

Age: 72

My daughter was a TB patient ten years ago. She received treatment with antituberculosis drugs and now she is cured. At the beginning she did not know she had tuberculosis, but she was feeling weak and had fever without any other symptoms. When she went to the doctor the last thing she expected to hear was tuberculosis. We thought this was a disease of the past. It is surprising to know that there are still people with this disease on the island.

Tuberculosis is a disease transmitted by a bacilus when a sick person coughs, talks or sneezes. The disease can be cured with antituberculosis drugs.

INTERVIEW 32

8/11/82

Municipio: Manatí

Barrio: Manati Town

Sex: Male

Age: 69

My parents were living in Monte Bello (Toro Negro) when they died of tuberculosis. My father died first, and two years later, my mother died. They were under treatment for a period of time, but it seems that it wasn't the best treatment. They died anyway. My sister who was living with them told me that sometimes they refused to take the medicine because they were cured already and tired of the medicine.

I don't know how the disease is transmitted. I don't think that the disease has any cure.

INTERVIEW 33

8/11/82

Municipio: Manatí

Barrio: Coto Sur

Sex: Female

Age: 80

I lost two sons who had tuberculosis. We were living in Ponce at the time. In a period of five years, they both died. They were in their twenties. In the 1940's, the treatment for tuberculosis did not exist. The common practice was to put the person in a clean place, feed her or him and pray. The advancement of medicine didn't get here on time to save my two sons. But I know that other people were more lucky and are cured now.

Tuberculosis can be mortal without treatment. This disease is transmitted when the sick person coughs.

INTERVIEW 34

8/11/82

Municipio: Manatí

Barrio: Manatí Town

Sex: Female

Age: 67

My husband was a tuberculosis patient fourteen years ago. He received treatment from the clinic in Manati and now he is cured. I have been in contact with tuberculosis since my childhood. Two of my uncles died of tuberculosis when I was a child. One of them was living in Ciales and the other in Utuado. My husband enjoyed better times since he was able to receive treatment and be cured.

Tuberculosis is transmitted when a sick person coughs. The treatment with drugs is very effective.

INTERVIEW 35

8/16/82

Municipio: Manatí

Barrio: Rio Arriba Saliente

Sex: Female

Age: 85

I had eleven brothers and sisters, four of whom died of tuberculosis when they were young. It was a very common disease, and I know that many of my neighbors at that time had it. The symptoms were always the same: the person looked thin and pale, had fever every day and was coughing all the time, sometimes with blood. I am glad that now there is a cure for the disease. It is a bad thing to have.

Tuberculosis is transmitted when a sick person coughs or talks. It can be cured with antituberculosis drugs.

INTERVIEW 36

8/11/82

Municipio: Manatí

Barrio: Manatí Town

Sex: Male

Age: 86

I was born in this town and I have been living here all my life. In the past, I have lost neighbors and good friends all of whom were victims of tuberculosis. In the past, so many people were dying of tuberculosis that I thought I was going to be one of them at some point. The tuberculosis problem was aggravated by the economical situation. Many people did not have anything to eat. I always managed to feed my family. Sometimes, we only had beans and cornmeal but we were eating.

Maybe that is the reason why none of us got TB.

I am not familiar with how the disease is transmitted. I know that there is a treatment for TB, but I don't know how it is. I think that a good nutrition helps.

INTERVIEW 37

8/12/82

Municipio: Manatí

Barrio: Manatí Town

Sex: Male

Age: 89

I lost my wife thirty years ago to tuberculosis. Her cause of death was identified at that moment. She never wanted to go to a doctor and kept working until the end. My son, who is 67 now, was a TB patient fifteen years ago. He received treatment and is cured.

Tuberculosis can be cured if it is discovered on time. The drugs used in the treatment for tuberculosis are very effective. The disease is transmitted by coughing.

INTERVIEW 38

8/12/82

Municipio: Manatí

Barrio: Manatí Town

Sex: Male

Age: 78

We have never had any tuberculosis case in our family, but our friends and neighbors have died of the disease. I took care of my best friend when she got sick with tuberculosis forty years ago. She was living in Vega Alta, and I used to go there from Manati every day. She was very thin and weak. It was a desperate situation to me to see her dying and to not be able to do anything about it. Here in Manati, we lost friends, and I think the situation was the same on the whole island.

Tuberculosis can be transmitted by the contact with the sick person's belongings. It is also transmitted by coughing. In some cases the disease can be cured with medicines.

INTERVIEW 39

8/13/82

Municipio: Manatí

Barrio: Manatí Town

Sex: Female

Age: 26

My cousin died of tuberculosis ten years ago. She was only twenty-five years old. She was under treatment, but apparently she didn't finish it. My grandmother had TB also, but she finished her treatment, and now she is cured.

Tuberculosis is transmitted by the tuberculosis bacilus when the sick person coughs or talks. It can be cured with drugs if the person finishs the treatment.

INTERVIEW 40

8/13/82

Municipio: Manatí

Barrio: Tierras Nuevas Poniente

Sex: Female

Age: 90

I have always lived here. I can tell you that many years ago everybody had at least one member of the family sick with tuberculosis. There was no treatment for the disease, and many people died. We lacked the proper diet which didn't help. I survived those years and consider myself lucky. Today I live alone, close to the place where I lost my husband fifty years ago. He was another case of TB.

Tuberculosis can be cured if discovered in the early stages. I don't know what kind of medicines are used for that disease and I don't know how it is transmitted.

INTERVIEW 41

8/13/82

Municipio: Manatí

Barrio: Bajura Adentro

Sex: Male

Age: 71

My father and my brother died of tuberculosis. My father died in 1943, and my brother died twenty years ago. When my father died, there was no treatment for the disease. Not many people survived. But when my brother died antituberculosis drugs were already used. As many people, he never had time to go to a doctor. It was a waste of time for him. When he decided to go, it was too late then.

He wasn't living in Manatí. He was living in Ciales with his family.

Tuberculosis is transmitted when the sick person coughs or talks. The disease can be cured with antituberculosis drugs.

INTERVIEW 42

8/13/82

Municipio: Manatí

Barrio: Bajura Adentro

Sex: Female

Age: 69

My oldest brother died of TB forty years ago. He spent six months in a sanatorium and then two months in my house where he died. My husband and I were living in Jayuyas, and we took care of him. He didn't have anybody else. I think he got the disease from his fiance who died one year before he did. In those years, TB was a terrible disease.

Tuberculosis almost always is fatal, but in some cases it can be cured with drugs for tuberculosis. I don't know how the disease is transmitted.

INTERVIEW 43

8/14/82

Municipio: Manatí

Barrio: Bajura Adentro

Sex: Male

Age: 94

My brother and a cousin died of tuberculosis. They were in their thirties and were healthy looking people. Their deaths were very close in time. It was a tragic year for the family. I think it was 1938. We never knew why it happened. They spent one year in New York working, but things did not work out the way they expected, and they came home. They were looking pale when they came, but we thought it was the lack of sunshine that made them look pale. Soon, it was discovered they had tuberculosis.

We could not do much, and three years later they died.

I am not familiar with the mode of transmission, but I do know there are some medicines that can cure TB if they are taken consequently.

INTERVIEW 44

8/14/82

Municipio: Manatí

Barrio: Bajura Adentro

Sex: Female

Age: 73

My mother died of TB forty years ago. She was fifty years old at that time, and we were living in San Juan. The situation was very difficult for us. My husband was unemployed, and my father was sick. He suffered a heart attack. Everybody was in the same situation. We considered to go to New York, but I knew the cold weather was not going to be good for my mother who always looked very sick. I did not know for sure what she had, but I began to suspect TB. Some way she managed to live five years more, but eventually she died.

Tuberculosis is transmitted by the close contact with the sick person. The disease can't be cured.

INTERVIEW 45

8/14/82

Municipio: Manatí

Barrio: Tierras Nuevas Salientes

Sex: Female

Age: 88

When I was young, my father became sick with tuberculosis. He kept working for months. He said there was no reason to stay in bed all day long. Tuberculosis was a real problem on the island.

I don't know how the disease is transmitted. It can be cured with medicines for tuberculosis.

INTERVIEW 46

8/15/82

Municipio: Manatí

Barrio: Tierras Nuevas Saliente

Sex: Female

Age: 70

My mother died of tuberculosis thirty years ago. The only kind of treatment that she ever received was honey for the cough, and sometimes alcohol frictions for the fever. She did not have confidence in anything else.

Tuberculosis can be transmitted by touching the clothes of a person with tuberculosis. The disease can be cured but I don't know how.

INTERVIEW 47

8/15/82

Municipio: Manatí

Barrio: Tierras Nuevas Ponientes

Sex: Female

Age: 78

My husband died of tuberculosis when he was forty. He never was a strong individual. He always had some kind of ailment. We did not pay too much attention to his sickness which lasted years. We did not know how serious it was. At his death we discovered that he was another case of tuberculosis.

Tuberculosis is transmitted by coughing. It can be cured with some drugs.

INTERVIEW 48

8/15/82

Municipio: Manatí

Barrio: Tierras Nuevas Ponientes

Sex: Female

Age: 80

My husband had tuberculosis twenty years ago. He received treatment, and now he is cured. When he was a child, his father died of tuberculosis. For that reason, we were afraid of the disease. But luckily my husband

could benefit from the advances in medicine. Today, he has to have a chest X-ray every year.

I don't know how the disease is transmitted. It can be cured with antituberculosis drugs.

INTERVIEW 49

8/16/82

Municipio: Manatí

Barrio: Tierras Nuevas Poniente

Sex: Male

Age: 70

When I first moved here in the 1950's my neighbor died of tuberculosis. He was an old man who lived by himself and was almost always drunk. He caused his own death. Other people in the community had tuberculosis but they were cured. They did not die of tuberculosis.

Tuberculosis is a transmissible disease that can be cured with drugs for tuberculosis. I am not sure I know how it is transmitted.

INTERVIEW 50

8/16/82

Municipio: Manatí

Barrio: Rio Arriba Saliente

Sex: Female

Age: 74

APPENDIX B

QUESTIONNAIRE

My husband died of tuberculosis twenty-five years ago. He was fifty years old at that time. He did not want to go to the doctor. I was very afraid because I knew his father had died of tuberculosis, and I recognized the symptoms. He did not listen to me and died in our house in the town of Ciales.

Tuberculosis can be transmitted by the close contact with the sick person. The disease can be cured with medicines for tuberculosis.

Cuestionario: Prueba de Tuberculina
(Figure 6)

municipio barrio calle número

Vecindario:

Cararterísticas residencia:	categoría estructura	tuberías (agua)	inodoro	electri-cidad	Núm. cuartors	Núm Personas

Número de caso _____
Nombre _____
Nacido P.R., si___, no___,_____.
Años en residencia actual_____
Residencias anteriores_____, _____
Años de escuela completados_____
Ocupación_____
Fecha de inoculación_____
Reacción:_____mm (NIP),_____
Tratado por TB_____, por otra enfermedad_____
_____
Vacunado: sarampión___, paperas___, polio___
Seguimiento:

Número de caso _____
Nombre _____
Nacido P.R., si___, no___,_____
Años en residencia actual _____
Residencias anteriores_____, _____
Años de escuela completados_____
Occupación_____
Fecha de inoculación_____
Reacción:_____mm (NIP),_____
Tratado por TB___, por otra enfermedad___
_____
Vacunado: sarampión__, paperas__, polio__
Seguimiento:

BIBLIOGRAPHY

Amadeo, J., "A Reevaluation of the Significance of Allergy in Tuberculosis," Boletín de la Asociación Médica de Puerto Rico, No. 3, 1952, pp. 384-391.

American Lung Association, Tuberculin Skin Test, 1981.

Arruza, J., Payne, G.C., Rodríguez Pastor, J., "Tuberculosis Survey in Puerto Rico, III. A Survey of Slums in San Juan," Puerto Rico Journal of Public Health and Tropical Medicine, Vol. 9, 1935, pp. 533-537.

Bates, J.H., "Provocative Concepts of Tuberculosis," Chest, Vol. 68, No. 3, September, 1975, pp. 475-479.

Benenson, A. (editor), Control of Communicable Diseases, 12th edition, American Public Health Association, 1977.

Bulla, A., "Global Review of Tuberculosis," WHO Statistics Reports, Vol. 30, 1977, pp. 2-10.

Cody, L.L., Nursing in Tuberculosis, 2nd edition, Saunders, Philadelphia, PA, 1961.

Cohen, A.C., The Drug Treatment of Tuberculosis, C.C. Thomas, Springfield, IL, 1966.

Comstock, G.W., Livesay, V.T., Woolpert, S.F., "Evaluation of BCG Vaccination Among Puerto Rican Children," American Journal of Public Health, Vol. 64, Jan.-June 1974, pp. 283-291.

Comstock, G.W., "False Tuberculin Test," Chest, Vol. 68, No. 3, September 1975, pp. 465-469

Córdova, A., Normas Para el Manejo Hospitalario y Ambulatorio de Pacientes con Tuberculosis en las Facilidades del Departamento de Salud, 1979.

De La Pila, M., "Lo Que Dicen Nuestras Estadísticas Acerca de la Tuberculosis en Puerto Rico," Boletín de la Asociación Médica de Puerto Rico, No. 3, 1950, pp. 373-384.

Edwards, P.Q., "Screening for Tuberculosis," Chest, Vol. 68, No. 3, September 1975, pp. 451-455.

Fernós Isern, A., "Urban Growth and Public Health in Puerto Rico," Puerto Rico Health Review, No. 4, 1925, pp. 3-9.

Figueroa, R.E., Zach, M., "Primary Drug Resistance Tuberculosis in Puerto Rico," Boletín de la Asociación Médica de Puerto Rico, No. 4, 1973, pp. 262-266.

Fishman, A.P., Pulmonary Diseases and Disorders, Vol. 2, McGraw Hill Company, New York, 1980.

Garrido, E., Rodríguez, J., "Collapse Therapy as a Public Health Measure in Tuberculosis," Boletín de la Asociación Médica de Puerto Rico, No. 4, April 1941, pp. 129-138.

Glassroth, J., Robins, A.G., Snider, D.E., "Tuberculosis in the 1980's," New England Journal of Medicine, Vol. 302, April-June 1980, pp. 1441-1448.

Haranghy, L., Szmenge, C., Pathology of Tuberculosis in an Old Age, Budapest, Akedemiai, Kiado, 1974.

Hardy, M.A., Schmidek, H.H., "Epidemiology of Tuberculosis Aboard a Ship," Journal of the American Medical Association, January, Vol. 203, No. 3, 1968, pp. 109-113.

Heiman, H., "Tuberculosis Control Activities of the Health Department," Boletín de la Asociación Médica de Puerto Rico, No. 3, September 1955, pp. 363-365.

Jindani, A., "Short-Course Treatment in Pulmonary Tuberculosis," East African Medical Journal, Vol. 52, No. 9, September 1975, pp. 472-480.

Kopanoff, D.E., Kilburn, J.O., Glassroth, J.L., Snider, D.E., Farer, L.S., Good, R.C., "A Continuing Survey of Tuberculosis Primary Drug Resistance in the United States: March 1975 to November 1977," American Review of Respiratory Diseases, Vol. 118, 1978, pp. 485-442.

Lowell, A.M., Edwards, L.B., Palmer, C.E., Tuberculosis, Harvard University Press, Cambridge, 1969.

Miller, F.J., Seal, R.M.E., Tayler, M.D., Tuberculosis in Children: Evolution, Control, Treatment, Little Brown, Boston, 1963.

Myers, A.J., Tuberculosis Among Children and Adults, 3rd edition, Springfield, IL, 1951.

Padró, F., "En Torno al Programa de Tuberculosis," Boletín de la Asociación Médica de Puerto Rico, No. 3, June 1955, pp. 226-232.

Pfuetze, K.H., Radner, D.B. (editors), Clinical Tuberculosis, C.C. Thomas Publisher, Springfield, IL, 1966.

Phillips, S., Current Problems in Tuberculosis, Springfield, IL, 1966.

Pio, A., Western, K., "Tuberculosis Control in the Americas: Current Approaches," PAHO Bulletin, Vol. 10, 1976, pp. 227-231.

Powell, K.E., Meador, M.P., Farer, L.S., "Foreign-Born Persons with Tuberculosis in the United States," American Journal of Public Health, Vol. 71, No. 11, 1981, pp. 1223-1227.

Puerto Rico Department of Public Health Annual Reports, 1960-1961, 1961-1962, 1964-1965, 1966-1967, 1968-1969, 1969-1970, 1972-1973, 1977.

Reichman, L.B., O'Day, R., "Tuberculosis Infection in a Large Urban Population," American Review of Respiratory Diseases, Vol. 117, 1978, pp. 705-712.

Rodríguez Pastor, J., "Epidemiology of Tuberculosis in Puerto Rico," Puerto Rico Review of Public Health and Tropical Medicine, Vol. 4, No. 10, 1929, pp. 431-443.

Rodríguez Pastor, J., Janer, J.L., "Tuberculosis in the Island of Puerto Rico," Puerto Rico Journal of Public Health and Tropical Medicine, Vol. 23, 1952, pp. 132-153.

Rodríguez Pastor, J., Morales, P., Payne, G.C., "Tuberculosis Surveys in Puerto Rico, I. A Study of a Coast and Mountain Municipality, Puerto Rico Journal of Public Health and Tropical Medicine, Vol. 9, 1934-35, pp. 451-479.

Sartwell, P.E., (editor), Preventive Medicine and Public Health, 10th edition, Appleton-Century-Crofts, New York, 1973.

Shennan, D.H., Tuberculosis Control in Developing Countries, Williams and Wilkins Company, Baltimore, 1968.

Sifontes, J.E., "Tuberculosis in Infants and Children," Boletín de la Asociación Médica de Puerto Rico, Vol. 48, No. 3, March 1953, pp. 89-107.

Sifontes, J.E.,"Prevencion de Tuberculosis, Isoniacida o Vacunación," Boletín de la Asociación Médica de Puerto Rico, Vol. 53, May 1961, pp. 171-174.

Sifontes, J.E., Vicens, C.N., "Tuberculosis Infection in Puerto Rico," Boletín de la Asociación Médica de Puerto Rico, Vol. 54, No. 12, 1962, pp. 399-407.

Sifontes, J.E., Mayol, P.M., Rivera, J.E., "Prevención y Manejo de la Tuberculosis en los Niños," Boletín de la Asociación Médica de Puerto Rico, No. 5, November 1981, pp. 522-530.

Toman, K., Tuberculosis Care - Finding and Chemotherapy, WHO, Geneva, 1979.

Townsend, J.G., "Tuberculosis Survey of the Island of Puerto Rico," Public Health, No. 138, Government Printing Office, Washington D.C., 1923, pp. 66-77.

Weg, J., Tuberculosis and Other Mycobacterial Diseases, American Lung Association, 1978.

Wehrle, P.F., Top, F.H., Communicable and Infectious Diseases, 9th edition, C.V. Mosby Company, St. Louis, 1981.

Wyngaarden, J.B., Smith, L.H., Jr., (editors), Cecil Textbook of Medicine, 16th edition, W.B. Saunders, Philadelphia, PA, 1982.

Youmans, G.P., Tuberculosis, Saunders, Philadelphia, 1979.