TUBERCULIN SURVEY AMONG MONTREAL SCHOOLCHILDREN

Determinants of the Prevalence of Tuberculous Infection

Thesis submitted as partial fulfillment of the degree, Master of Science

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by

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THE DETERMINANTS OF TUBERCULOUS INFECTION IN MONTREAL SCHOOLCHILDREN

ABSTRACT

A tuberculin survey of all public school students in Grades 6 and 10 in a defined geographical area was conducted in the school year of 1987/88, to estimate the prevalence and the determinants of tuberculous infection. Students completed a questionnaire, and were simultaneously skin tested with PPD-T (standard) and PPD-B (Battey). Of the 2939 Grade 6 students, 2408 (81%) participated, as did 983 (60%) of the 1636 Grade 10 students. Reactions to PPD-T of 10mm or more were seen in 5.1% of the Grade 6 students, and 10.4% of the Grade 10 students. Sensitivity to PPD-B accounted for 20-30% of all tuberculin reactions in the 5-9mm range, but less than 7% of larger reactions. Prevalence of reactions was much higher in the foreign born, especially those who had immigrated from tuberculous endemic areas at a later age. Among Canadian born, BCG vaccination was an important cause of false positive reactions up to 11mm, and the annual incidence of infection had declined by 4.6% annually. Indices of socioeconomic status were significantly associated with tuberculin reactivity among the Canadian born students but potential exposure in the community, because of residence in neighbourhoods, or attendance at schools, characterized by an increased proportion of immigrants from tuberculous endemic areas, was not associated with increased prevalence of tuberculous infection.

RESUME

Un dépistage tuberculinique a eté effectue au cours de l'annee scolaire 1987-88 dans une géographique definie chez tous les eleves de 6e et 10e années des écoles publiques afin d'evaluer la prevalence et les facteurs déterminants de l'infection tuberculeuse. Les eleves ont rempli un questionnaire et subi une epreuve cutanée au PPD-T (standard), et au PPD-B (Battey). Parmi les 2939 eleves de 6e annee, 2408 (81%) ont participe, ainsi que 983 de 1636 (60%) eleves de 10e année. On a observé des reactions au PPD-T de 10mm ou plus chez 5.1% de · éleves de 6e annee et 10.4% des eleves de 10e annee. La sensibilité au PPD-B expliquait 20-30% des reactions de 5 a 9 mm, mais moins de 7% des reactions plus etendues. La prevalence etait plus élévee chez ceux qui ont immigre a un âge plus avance, des regions ou la tuberculose est toujours endemique. Chez les sujets nes au Canada, la vaccination au BCG etait une importante cause de fausses reactions positives jusqu'à 11mm, et l'incidence annuelle de l'infection avait diminue de 4.6% par annee. Les indices de statut socio-economique furent associes a l'allergie tuberculinique, chez les eleves nes au Canada, mais le fait de résider dans un quartier, ou de frequenter une ecole caracterises par une large proportion d'immigrants provenant des regions ou la tuberculose est endemique, ce qui augmente le risque d'exposition a la tuberculose, n'a pas été associe à une hausse de la prevalence de l'infection.

PREFACE

The initial idea for this project came from an investigation, conducted in early 1987 by the staff of the Montreal Chest Hospital, of the contacts at work of an immigrant with active tuberculosis. A number of problems and questions arose as a result of this investigation, such as the expected prevalence of tuberculin reactivity among young adults who were foreign born or Canadian born, and the causes of false positive reactions such as prior BCG vaccination, and sensitization to atypical Mycobacteria. From May to July 1987, the design, and methodology were formulated, and the protocol written, with suggestions and advice from Professors Becklake and Hanley. As well, Russ Wilkins offered a number of suggestions regarding questionnaire design, and the use of census data to further characterize individuals. Funding was sought from the Royal Edward Foundation, and support requested from Connaught Laboratories in providing all PPD-T and PPD-B free of charge. Approval from the Royal Edward Foundation was obtained in August, 1987, and in September from Connaught. Permission was sought from the school and health sector authorities beginning in early September, 1987. B. Vissandjee was hired as coordinator in mid-September, and data gathering was initiated by the end of September. Donna Amyot was hired in early January at which time the testing schedule was accelerated, to be completed by early May, 1988. Data entry was completed by mid-May, although verification of BCG vaccination was not completed until the end of August, 1988. Russ Wilkins provided all the census data used in this project. Data analysis was completed by December, 1988, and the writing of the report has proceeded at a variable pace since then.

Original contribution:

The design of the project is simple; namely a census survey in two age groups, in a defined geographical area. Previous tuberculin surveys, despite participation rates of less than 50%, have not characterized non-participants, and the estimates of prevalence rates and their determinants may have been biased because of these high non-participation rates. Participation was improved in this survey and detailed analysis of the potential bias due to those who did not participate, revealed that bias was unlikely. The use of census data to characterize individuals with

tuberculin reactivity is original, and biologically justified since the study question related to community factors in the transmission of this contagious disease. The use of census data also provided additional information to that which could be gathered by means of individual questionnaire. In this survey the two major causes of false positive reactions; namely sensitivity to PPD-B and BCG vaccination, have been carefully measured in an effort to provide a more precise estimate of tuberculous infection. This measurement has provided new information regarding the effect of remote BCG vaccination on tuberculin reactivity, as well as the determinants of sensitivity to PPD-B in Montreal.

The major original findings are that certain socioeconomic indices of the neighbourhood, particularly those related to the quality of housing are associated with tuberculin reactivity, although not those relating to annual income. As well, the effect of BCG vaccination after an interval of 10 to 15 years has been described in a large number of subjects. Finally this is the first study to address the question of the impact of contact with tuberculous infected immigrants in the community or schools, on prevalence of tuberculin reactivity among native born Canadian children.

Resume:

The author has received training, and is certified as a specialist physician in Internal and Pulmonary Medicine. His interest in tuberculosis began in 1981, during a two and a half year contract as a Consultant physician with the Ministry of Health in Lesotho, southern Africa. This has continued, through the development of a tuberculosis clinic at the Montreal Chest Hospital, and more recently as a Consultant for the tuberculosis control programme for the Indian population in Northern Quebec.

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CHAPTER ONE: INTRODUCTION

The incidence of tuberculosis has been slowly declining in the Western world for over a century, although it is still a major cause of morbidity and mortality in the rest of the world. Extensive investigation of this disease has improved understanding of both the pathogenesis and the epidemiology, and thereby lead to a number of effective control measures. But within this past decade the incidence of tuberculosis in the USA has ceased to decline and in certain states has increased. This increase has been seen principally in large urban centres, and the exact cause is unknown, resulting in reawakened interest in this fascinating disease. Three possible explanations for this phenomenon have been proposed. Tuberculosis has traditionally been considered a disease of poverty, and although the scientific basis for this belief is lacking, the recent rise may be due to the effect of worsening socioeconomic conditions for a large proportion of the American population. Secondly, it is increasingly evident that those who become infected with human immunodeficiency virus (HIV) are at significantly increased risk to develop active disease if they are tuberculin reactors. As the HIV epidemic spreads this may lead to a second epidemic of tuberculosis. Finally, the incidence of tuberculosis is still very high in most of the developing world, so that immigrants from these areas are at increased risk to develop reactivation of latent or dormant infection even decades after immigration. This excess morbidity contributes significantly to overall incidence even if the proportion of the population is small, but whether this also leads to increased risk of disease in the native born population is unknown.

In Quebec, as in the rest of Canada, incidence of tuberculosis has declined steadily over the past decade. However in Montreal overall incidence has remained steady over the past ten years, and has actually increased in some quartiers. This incidence ranges from 3 to 24 per 100,000 in different areas of the city, and three prevalence surveys among Montreal schoolchildren, conducted since 1974, have all found significant differences in the prevalence of tuberculous infection in different quartiers. To investigate these differences, a cross-sectional survey of the prevalence of

tuberculin reactivity was conducted among schoolchildren in Grades 6 and 10, and young adult workers, aged 18-25. The effect of prior BCG vaccination, and sensitivity to PPD-B were measured as potential causes of false positive tuberculin reactions. The determinants of tuberculous infection that were assessed included: tuberculosis rates in the country of origin of the students and their parents, and the age of immigration, socioeconomic status, and living in neighbourhoods, going to school, or working with immigrants from tuberculous endemic countries.

The survey among the schoolchildren of Grades 6 and 10 comprises the subject of this thesis.

CHAPTER TWO: BACKGROUND

2.1 PATHOGENESIS AND TRANSMISSION:

Certain unusual aspects of the pathogenesis of tuberculosis confound both understanding and control of this disease. Infection may be acquired at a young age and remain dormant without symptoms or signs, only to reactivate many years later in adult life, causing clinical illness and transmission of infection to others (Comstock 1974). Only 10% of those infected will ever develop disease, but identification of those in whom this will happen, or when, is not yet possible, so that treatment of all those infected is the only preventive treatment available. Prevention of infection through reduction of transmission would be more efficient for prevention of disease, but this would require a more complete understanding of the factors influencing transmission than is currently known.

Tuberculosis is spread almost exclusively by the airborne route by patients with active, usually cavitary, pulmonary disease (Grzybowski 1980, Riley 1962, Styblo 1980). Infection can be acquired through inhalation of a single bacillus (Riley 1962). Factors considered important in the transmission include the infectiousness of the patient (the "index case"), the susceptibility of those exposed (the "contacts"), the nature and extent of the exposure, and the environment in which exposure occurs.

Infectiousness of the index case is determined by the extent of the pulmonary disease (Chapman 1964), is increased if there are cavities (Grzbowski 1980) and is best indicated by the presence of acid fast bacilli seen on direct microscopic examination of a sputum smear (Capewell 1984, Rose 1979). In one survey, 65% of children exposed to smear positive index cases became infected compared to only 27% of children exposed to smear negative, culture positive cases (Styblo 1980). Contagiousness is also greater among younger patients, males, and those who cough more frequently (Capewell 1984). Even after considering these factors contagiousness remains highly variable. In a report summarizing a large series of contact investigations of smear positive index cases, patients could be divided into two groups: most had infected few or none of their contacts, while a smaller group were responsible for infecting a large number of contacts (Snider 1985).

Despite the fact that inhalation of only one bacillus is sufficient to become infected, tuberculosis is not considered highly contagious (Comstock 1974). In most instances of infection, exposure has been prolonged (Capewell 1984). Those living in the same household are most at risk particularly those sleeping in the same room (Rose 1979). The risk for casual contacts such as neighbours or at work has been estimated to be less than one-third that for household contacts (Capewell 1984, Rose 1979). For instance, in a Dutch survey of contacts of smear positive cases, 55% of those living in the same household were infected compared to only 5% of casual contacts (Styblo 1980).

Aquisition of infection once exposed is determined mainly by the prior infection status of the contact (Comstock 1974, Grzybowski 1980). The likelihood is reduced if they have been previously infected with atypical Mycobacteria (Edwards 1973), but is unaltered by BCG vaccination (Sutherland 1979). Theoretically all non-infected persons, irrespective of age should be equally at risk to acquire infection if exposed, but a recent analysis by Styblo refutes this concept (Styblo 1978). In 1910, the prevalence of tuberculous infection in Holland among those aged 50 years, was 86%, of whom 68% had been infected by the age of 9, and 89% by the age of 19. In 1955 the prevalence of infection had fallen to only 2.2% among those aged 50, but of those infected, two-thirds had become infected by the age of 9, and 86% by the age of 19 (Styblo 1978). It is not known if this is because younger persons are more susceptible, or simply that as children, they have household exposure to their infected parents and older relatives which ceases as they become adults. In either case if an individual is not infected at the age of 25, the probability of becoming infected subsequently is very low.

The environment in which exposure occurs is also important, as the tubercle bacillus is readily killed by drying and sunlight (Pio 1984, Riley 1970), or by ultra-violet radiation (Riley 1962). One outbreak occurred on a US ship in which one index case infected 146 others, six of whom developed active disease; the high rate of spread was attributed to the closed ventilation system in which the air was simply recirculated (Houk 1968).

Progression from primary infection to disease is affected by a number of factors, including age, gender, genetic factors, intercurrent illness,

amount of exposure and resultant dosage of infection (Grzybowski 1975) and interval since exposure. Age is the most important factor; children under 4 years are at greatest risk of developing disease, and have the highest case-fatality rates (Comstock 1974, Grzybowski 1964). Incidence is low between the ages of 8 and 13, then increases during adolescence up to the age of 25-30, is low through middle age until it rises in the last decades of life. Females are more at risk during adolescence, but in old age males predominate (Grzybowski 1964). The size of tuberculin reaction correlates with risk of subsequent disease, as was found in two large prospective studies. Among approximately 200,000 residents of Southern India (Madras 1979) and among 1.1 million US Navy recruits (Edwards 1973) followed prospectively for 4-5 years after tuberculin testing, subsequent risk of tuberculous disease was directly related to size of tuberculin reaction. The role of hereditary factors in determining risk of reactivation is unclear as there is conflicting evidence as seen in Table 1. It is only among the Inuit that there is unequivocally increased risk.

TABLE 2-1: REACTIVATION RATES FOR TUBERCULIN REACTORS
Evidence for role of genetic factors.

Location (Reference)	Year	Population	Years Followed	Race	Rate/100,000 (Annual)
Denmark (61)	1950	286,000	12	White	29
Britain (18)	1960	21,957	15	White	79
US (Navy) (44)	1958	68,824	4	White Black Hispanic	78 91 195
S. India (162)	1950	9,979	12	India	94
SE USA (30)	1960			White Black	43 76
Puerto Rico (33)	1960	82,269		White Black	91 87
Greenland (73)	1970	1,380	6	Inuit	725
Alaska (34)	1974	540	6	Inuit	936

In a Scottish survey, 11% of close contacts of smear positive cases developed disease compared to only 1.6% of casual contacts (Capewell 1984), while a similar survey found that only 0.3% of casual contacts had disease at the time of contact tracing, compared to 2-3% of household contacts (B.T.S. 1978). Of those who reactivate, 80% will do so in the first 1-2 years (Time table of TB 1948), but reactivation can occur up to 40-50 years later (Grzybowski 1964). This means that those who are infected in their youth represent a mobile reservoir of infection, who pose a risk both to themselves and their communities throughout their lives.

2.2 BACKGROUND TO THE STUDY METHODOLOGY: TUBERCULIN SKIN TESTING:

Tuberculous infection is detected by the occurrence of a significant induration in response to the intradermal injection of purified protein derivative - PPD, derived from culture of M.TB (A.T.S 1981). The tuberculin skin test has been a major tool in epidemiological research in tuberculosis, and has been validated in many different population and age groups (Snider 1982). The Mantoux test is the currently accepted standard and consists of the intradermal injection of 5 tuberculin units of PPD-T (purified protein derivative - tuberculin), with the measurement of the resulting induration 48-72 hours later (ATS 1981, Duboczy 1960). This test is both more sensitive and specific compared to other techniques such as the multi-puncture test, or Tine test (BTS 1982), but still has two major problems: variability and false positive reactions.

2.2.1 Variability:

The variability of the test is due both to biologic variation, and to human error in administration and/or reading. Chaparas found that two Mantoux tests applied simultaneously to both arms varied by 1-4 mm in 30% of 1036 subjects, and by 5mm or more in 2.5% (Chaparas 1985). In a similar study, Rudd reported 5% discordance in reaction size (Rudd 1982), but on the other hand, Donaldson found 100% concordance between reactions to two Mantoux tests placed one week apart (Donaldson 1978). This variability is greater in the elderly (Perez 1985), and the skin tests can revert to negative over time (Tager 1985, Houk 1963). Grzybowski found that, among

subjects aged 20 or younger, 22% with a positive test were negative when retested one year later (Grzybowski 1964). Others have also described this reversion (Houk 1968), and even re-reversion (Tager 1985). Errors in technique of administration, even if relatively major, will not result in major changes in reaction sizes (Rhoades 1980). On the other hand, errors in reading may result in major discrepancies of as much as 10-15mm (Bearman 1964), while in another study paired readers differed by a mean of 2.4 mm, and using a cut-off of 10 mm there was disagreement between them in 4.3% of cases (Perez 1985). In summary, misclassification errors in reading can be minimized by careful training, and by setting the criteria for a positive test high enough.

2.2.2 False positive reactions due to BCG vaccination.

Prior BCG vaccination will interfere with interpretation of the tuberculin test, because a variable number of vaccinated individuals will have a significant reaction on account of this. Table 2 summarizes the major findings of 7 investigations of the effect of BCG on tuberculin reactivity. It can be seen that post-vaccinal tuberculin reactivity is influenced by the age at which it is given, the route of administration, and the interval between vaccination and testing. In studies of persons BCG vaccinated at birth, most persons were negative, and maximal reaction varied from only 9mm (Joncas 1975), or 11mm (Lifschitz 1965) to 16mm (Marges 1965). But for those vaccinated at school entry there are no such simple guidelines. To date the longest interval from vaccination to testing has been 5 years, except for the study by Comstock who reported that among 61 Navy personnel tuberculin tested 8-17 years post-vaccination, maximal reaction was 17 mm (Comstock 1971).

TABLE 2-2: TUBERCULIN REACTIVITY IN BCG-VACCINATED SUBJECTS

Author Year	# Subjects	BCG method/age given	Age tested	%PPD 10+	Max
Lifschitz 1965	250	Puncture/Birth	1 yr	0	9
Margus	758	Intradermal/Birth	7-24 mos	7%	20
1965	241	Intradermal/13 yrs	14 yrs	14%	20
Landi	26	Intradermal/18-20 yrs	18-20 yrs	100%	
1967	24	Puncture/18-20 yrs	18-20 yrs	58%	
	437	Intradermal/15 yrs	15 yrs	99%	
	67	Puncture/15 yrs	15 yrs	65%	
	248	Puncture/15 yrs	16 yrs	65%	
			17 yrs	52%	
Guld 1968	826	Intradermal/5 yrs	10 yrs	95%	30
Comstock 1971	129	Puncture/6-17 yrs	18-20 yrs	16%	17
Joncas	68	Scarrification/birth	1 yr	42%	11
1975	86	Scarrif/birth & 6 yrs	7 yrs	78%	20
	79	Scarrification/6 yrs	7 yrs	67%	20
Landi	87	Intradermal/17-20 yrs	17-20 yrs	99%	
1983	90	Puncture/17-20yrs	19-21 yrs	49%	
Bahr	1200	Intradermal/4-5 yrs	9-10 yrs \		
1987			\	5-9: 47%	
			/	10+: 35%	
		Intradermal/4-5 yrs	13-14 yrs /		

BCG vaccination was given to more than half of those born in Quebec between 1940 and 1976 (Frappier 1971). Up to 100,000 vaccinations were given annually (PQ 1986), and many children were vaccinated two or even three times. This situation is unique in North America, and while it means that verification of vaccination status will be imperative in order to interpret the results, this also provides an ideal opportunity to study the effect of remote BCG vaccination on tuberculin reactivity.

2.2.3 False positive Tuberculin reactions due to infection with Atypical Mycobacteria:

Infections with Mycobacteria other than tuberculosis (MOTT), are a frequent cause of positive Mantoux tests in areas of the world where these infections are highly prevalent (Edwards 1974, Snider 1982). This is because the protein antigens of MOTT are similar to those of M.Tuberculosis causing cross-reactivity to PPD-T (Judson 1974, Richards 1979). Simultaneous administration of PPD-T and antigens specific for the atypical Mycobacteria allows accurate definition of the prevalence of both M.TB and MOTT (Smith 1964, Edwards 1973).

The geographic distribution and prognostic significance of reactivity to one of the atypical antigens was investigated in a large survey of US Navy recruits. All new recruits were tested with PPD-T (tuberculosis) and PPD-B (Battey), which is prepared from Mycobacterium Avium Intracellulare (MAI). Over 65% of recruits from the SE USA had significant reactions to PPD-B, compared to less than 5% in those from the Northern states (Edwards 1969). Among those with reactions to PPD-T measuring 5-11 mm (doubtful reactions), the incidence of tuberculosis over the next four years was associated with the relative sizes of reactions to these two antigens. Among individuals whose reactions to PPD-B exceeded their simultaneous reactions to PPD-T incidence of tuberculosis was significantly lower than among those whose reaction to PPD-T was equal or greater than to PPD-B. A larger reaction to PPD-B implied some protective effect of infection with MAI because the incidence of tuberculosis was even lower than among those with no reaction to either antigen. In those who had reactions to PPD-T over 11 mm, the subsequent incidence of tuberculous disease was high irrespective of the size of the accompanying PPD-B reaction (Edwards 1973).

The importance of MOTT as a cause of false positive reactions to PPD-T in Canada has been investigated in three studies: Jeanes et al surveyed over 25,000 young Canadians in the late 1960's using PPD-G (for M. Scrofulaceum), and found that reactions to PPD-G were 3-4 times more prevalent than reactions to PPD-T. Of the subjects with reactions to PPD-T of 5-9 mm, almost 50% had larger reactions to PPD-G, as did 30% of those with PPD-T measuring 10-14mm, 17% of those with PPD-T measuring 15-19, and only 5% of those with PPD-T of 20mm or more (Jeanes 1969). In the same survey 5,000

students were tested with PPD-T and PPD-B, and of these 37% of those with PPD-T of 5-9 mm had larger PPD-B, as did 14% of those with PPD-T of 10-14mm, and 5% of those with PPD-S of 15-19mm, but none of those with PPD-T over 20mm (Jeanes 1969). Among residents of British Columbia, prevalence of reactivity to PPD-G was 3-4 times higher than to PPD-T and about twice as prevalent as reactivity to PPD-B (Robakiewicz 1974). In a 1974 survey in Montreal among first Grade schoolchildren, prevalence of sensitivity to PPD-G was 5% compared to 2.5% for PPD-B and 1.4% for PPD-T. Of 21 children with PPD-T measuring 5-9mm only 5 (24%) had larger reaction to the atypical antigen. (Brickman 1974)

From these studies it is clear that as prevalence of tuberculous infection declines, the importance of MOTT as a cause of a false positive tuberculin test increases. In the studies mentioned above, this cross-reactivity was responsible for a significant proportion of reactions in the range traditionally considered 'doubtful', but was less important as a cause of larger reactions. However these studies were conducted at a time when far fewer Canadians travelled to areas endemic for MOTT such as the SE USA. Over the last two decades it has become commonplace for residents of Quebec to visit the Southern States and the effect of this travel on subsequent reactivity to atypical antigens such as PPD-B is not known. As well the prevalence of sensitivity to PPD-G among Dutch schoolchildren has risen from 3% in 1965 to almost 20% in 1985 (Bleiker 1987), a phenomenon which is totally unexplained. The epidemiology of MOTT is not well understood, and changes in the prevalence of sensitivity to atypical antigens may occur unpredictably, potentially causing a significant increase in the number of false positive reactions seen, so that dual testing remains important even in an area not considered endemic for MOTT.

2.2.4 Adverse effects:

The tuberculin test is remarkably safe. In a major review Snider concluded that there was no evidence of major allergic reactions such as anaphylaxis (Snider 1982). Approximately 1-2% of those with reactivity will have vesiculation and even ulceration, but this will heal without scarring. Lymphangitis has been reported (Morrison 1984), but there are no reports of more serious systemic or longterm effects (ATS 1981).

2.3 Background to the study methodology - Small area analysis:

A number of studies have been published recently using small area analysis to address such diverse questions as causes of cancer mortality (Davies 1980), infant mortality (Brennan 1978), or health service utilization (Roos 1984). Small area analysis can be used for descriptive studies or for testing of hypotheses (Carstairs 1987), particularly those regarding the association of ecologic, environmental, or community factors such as the association of socioeconomic status and mortality among women in Edinburgh (Alexander 1987). Another potential use would be to examine the factors, such as quality of housing, or incidence of other diseases, such as HIV infection, which affect the spread within a community of contagious diseases such as tuberculosis.

Small area analysis assigns individuals, or more specifically health events, to a unique geographical area, such as a census tract. The small area becomes the unit of analysis, and the number of health events per small area the dependant or outcome variable. Inferences on the differences in health outcomes between small areas are based on the characteristics of the entire population resident in each small area, information that is usually obtained from census data. It should be emphasized that these inferences are based on indirect information, and will be valid only if the unit of population is small and relatively homogeneous so that the census information accurately characterizes the individual in whom the health event occurred (Carstairs 1981, Davies 1980).

In the past, the use of census data was limited to broad characterization of large population groups, because the census data, and health-morbidity and mortality data were based on different population units so that the two sources of data had to be matched manually. In Canada the postal code can now be used to assign individuals to census tracts. Using the individual's postal code, information regarding that person's annual income, education, quality of housing, and other demographic and socioeconomic characteristics can be estimated with a reasonable degree of precision, using the data for the census tract, compiled by Statistics Canada. Census tracts have, on average, populations of 1500-2500 persons, (ie 3-4 city blocks), and in urban areas are reasonably homogeneous with respect to socioeconomic and demographic status (Wilkins 1985). In Quebec

the territories of the of community health units is also defined on the basis of census tracts, so that it is technically easy, as well as sociologically justified to merge the two sources of information.

The major advantage of the use of small area analysis is the ready accessibility and very low cost of the data, as it has already been collected and compiled by Statistics Canada. Information concerning attributes of socioeconomic status is sensitive, so that using a direct questionnaire is more invasive and obtrusive. As a result, respondents may be offended, or afraid and so unwilling to disclose the information. As well as further hypotheses are generated from the initial analyses, these can be assessed by requesting the necessary additional information from Statistics Canada. Finally it seems biologically sound for community data to be used in this way, because the study hypothesis relates to the impact on the residents of certain characteristics of their communities, namely the proportion of immigrants from tuberculous endemic countries.

2.4 EPIDEMIOLOGICAL MEASURES OF TUBERCULOSIS:

2.4.1 Mortality: This is the most crude measure, but obviously of great importance. For instance, in Quebec in 1985 there were approximately 800 new cases of TB and 71 deaths, giving a case fatality rate of 8.9% (MSSS,PQ 1986). However these figures may be inaccurate because of variation in reporting, inaccuracy of death certificate data (Hong Kong), and concurrent illnesses which are in fact responsible for the mortality ascribed to tuberculosis (Allan 1981).

2.4.2 Morbidity: Prevalence: Prevalence surveys in endemic areas have found radiographic evidence of active disease in as many as 1% of the adult population. Two-thirds of these, or 0.5-0.7%, will have positive sputum cultures for M. tuberculosis, and acid fast bacilli are seen on direct smear of sputum in 0.3% of the population (Fourie 1984).

Incidence: All forms of disease are most commonly reported. This ranges from 12/100,000 in Canada to 300-500/100,000 in many under-developed nations. Pulmonary disease usually accounts for 80% of incident cases, and

is often reported separately because the extra-pulmonary forms are not contagious and therefore of less public health significance. Bacillary status may be reported and refers to the proportion of those with pulmonary disease who are smear positive. The annual incidence of new infection in children is closely related to the annual incidence of smear positive pulmonary disease (Mihalescu 1989). The incidence of meningitis and miliary tuberculosis among children aged 0-4 years is a crude, but more easily measured, indicator of the risk of infection in the community.

2.4.3 Infection: Prevalence: Prevalence of infection is ascertained by tuberculin skin testing in non-BCG vaccinated populations. The induration size defined as significant will affect the prevalence found. This problem is less important in determining trends in prevalence either by means of multiple surveys simultaneously in different age groups, or by repeated annual surveys among the same age group.

Incidence: Annual incidence of infection, otherwise termed the annual risk of infection, is the most sensitive indicator of the trend of the impact of this disease in a population group (Styblo 1978). It can be determined in one of three ways:

(i) Repeat surveys in the same individuals at an interval of 3-5 years.

(ii) Multiple surveys (at least 3) in the same age group from the same population using the same technique, done annually. The log root of the proportion infected (the prevalence) gives the annual proportion infected (the annual incidence). Linear regression of the annual incidence in each group tested gives the amount of change in this annual incidence (TSRU 1985).

(iii) Simultaneous prevalence surveys in multiple age groups could also be used to calculate annual incidence of infection in each age group, and from this the change in annual incidence could be calculated using regression. However the risk of infection declines with age (Styblo 1978), as discussed earlier, confounding these calculations.

2.5 SECULAR TRENDS IN TUBERCULOSIS:

2.5.1 Low-endemic countries:

The importance of tuberculosis as a cause of mortality and morbidity in Quebec (MSSS,PQ 1981, Canada, the USA (Grzybowski 1964), and Western Europe (Horwitz 1969, Styblo 1980) began to decline over a century ago, and this has accelerated dramatically over the last 40 years. In the Netherlands the annual risk of infection declined by 4% annually from 1900-1945, and with the advent of effective antibiotic therapy this increased to 10% annually (Styblo 1980). The prevalence of tuberculous infection has also declined so that currently less than 5% of the population aged under 40 are infected (Styblo 1980). The annual risk of infection is less than 0.2% per year, and is declining by 10% annually, so that the risk should be halved every five years (Styblo 1980, TSRU 1985).

Postulated reasons for the decline in the pre-antibiotic area include: i) increasing 'herd immunity' meaning that as the most susceptible died, among those remaining who were naturally resistant the reactivation rate declined (Stead 1988), ii) Improved nutrition leading to increased resistance (Edwards 1973, Tverdal 1980), and; iii) Reduced transmission because of better housing with less crowding, better ventilation and lighting (Riley 1961, Chapman 1964). With the advent of effective antibiotic therapy after 1945, there has been a further dramatic reduction in transmission of infection which has continued to this date. Since only 10% of those infected will develop disease, for this disease to be maintained in a steady state each active case must infect at least 10 others (Styblo 1980). It has been estimated that a person with active untreated pulmonary tuberculosis will infect 10-14 others in a year (Styblo 1980), but in several large surveys in the USA and Britain, each active case infected less than one other person on average (Snider 1985, Capewell 1964, Rose 1979). Much of the decline in the prevalence of infection of tuberculosis can be explained by this low rate of transmission. The low prevalence of infection in developed nations means that the vast majority of the population is susceptible - ideal conditions for an epidemic. Lincoln reviewed all reports of outbreaks up to 1967, (Lincoln 1965), and emphasized the potential hazard of a single highly contagious case in such a large unprotected population. Recently there have been numerous reports of large

outbreaks associated with a single infectious case, which are summarized in Table 2-3. The factors leading to the extensive transmission seen in these instances are not understood, but these reports illustrate the potential impact of a single contagious case in a low prevalence area.

TABLE 2-3: OUTBREAKS OF TUBERCULOSIS

Index Case	Number of Infected Children	Adults	Comments	Year	(Ref)
Bar-man	4	27	Majority exposed in the bar only	1983	(70)
School teacher	46	-	All students in one classroom	1985	(164)
Swimming pool attendant	108	-	Contact for 1/2 hr weekly over 9 mos.	1980	(130)
Housewife	32	3	Contact at 1 party for 2-3 hours	1986	(12)
Student	12	2	All members of one extended (Asian) family	1981	(51)
Rowing club president.	-	6(2 deaths)	Social contact only	1982	(92)
Rock & Roll Band	-	many (40 with Disease)	Attendees at a single concert	1965	(6)

2.5.2 Highly endemic countries:

On the other hand in most developing countries in Asia, Africa and Central and South America, tuberculosis is still a major cause of morbidity and mortality. Incidence of disease exceeds 250/100,000, prevalence of infection exceeds 75% among those aged 25 or older, and annual incidence of infection may exceed 2% in many countries (IUAT ref # 79-88). Furthermore there has been no decline in these figures over the last 25 years. Problems in control include genetic susceptibility, poor housing and nutrition, and little or no access to medical care so that those with active, contagious disease are not being diagnosed or treated.

2.5.3 Recent trends in North America

For more than a century, the incidence of tuberculosis in the USA had been declining steadily. From 1956 until 1984 incidence declined by 5% annually (Snider 1987), but has risen in the past two successive years (CDC 1988). In New York City alone, annual incidence of new cases increased from 1100 in 1981, to 1630 in 1984, to 2223 in 1986 (Stoneburner 1987). Infection with HIV has been implicated because the majority of the excess cases have occurred in males aged 25-44, and because New York City has accounted for almost a third of all AIDS cases reported to date in the USA (Snider 1987). The incidence of tuberculous disease among children has failed to decline in Baltimore (Riley 1976), and has risen in NYC (Inselman 1981).

2.6 MONTREAL - DEMOGRAPHICS, HEALTH INDICES, AND TUBERCULOSIS RATES:

2.6.1 Demographics:

Montreal, like many other North American cities, is comprised of a number of geographically and demographically distinct communities. In 1975. the Quebec health care system was organized into health districts, or Departements de Sante Communautaire (DSC) and within these into community clinics, or Centre Locale de Sante Communautaire (CLSC). When this was done, these distinct communities were recognized and accordingly, the territory of each CLSC being defined by the geographical boundaries of the community it was to serve. Wilkins, using 1981 Canada census data, published the demographic characteristics of all 51 CLSC territories in the greater Montreal region (Wilkins 1985). Certain demographic characteristics of the populations resident in 11 of these communities, each served by a different CLSC, in central Montreal are given in Table 2-4. It can be seen that these 11 communities differ with regard to indices of socio-economic status as well as proportion of immigrants. Therefore it is possible to select communities on the basis of contrasting socioeconomic status and proportion of immigrants.

TABLE 2-4: CHARACTERISTICS OF PERSONS RESIDENT

IN 11 CLSC TERRITORIES OF MONTREAL
(Using 1981 Canada census data (From Wilkins 1985)

DSC CLSC	Poverty Index (%)	Annual Income ($)	Years of school (Yrs)	Total Pop'n (No.)	No. Immigrants S & E Europe	non-Europe
DSC St Luc						
Centre Sud	56.3	6207	8.4	34920	1140	1340
Parc Extension	43.8	5621	8.2	30765	17975	3875
La Pte Patrie	36.9	7100	8.8	64950	10250	1970
DSC MGH						
St. Henri	56.6	5644	8.1	21200	460	490
St. Louis de Parc	43.9	6228	9.0	43495	16785	4570
N. D. G.	22.2	10944	11.4	69660	11325	4895
Westmount	6.4	20454	13.1	20050	1785	945
DSC Verdun						
Pte St Charles	47.2	5406	7.9	13865	835	840
Verdun	25.0	8000	9.3	59645	1935	1005
Cote St. Paul	23.0	7557	8.7	33255	5325	395
Lasalle	15.8	8467	9.9	52810	9580	2610

Notes: Poverty Index: Percent of children living below the poverty line
Annual Income: Total income for all residents divided by total Pop'n.

2.6.2 Health Indices:

Along with these basic demographic data Wilkins also examined health indices such as infant mortality and life expectancy. He found that average life expectancy in the two poorest regions, St. Henri and Centre-Sud was 10 years less than that for Westmount, the most wealthy region (Wilkins, 1985). There were similar differences in infant mortality (Wilkins, 1985). On the basis of these disparities in socioeconomic status alone, differences in incidence and prevalence of tuberculosis may be expected in different quartiers of Montreal.

2.6.3 Tuberculosis:

Over the past decade the incidence of reported tuberculous disease has declined substantially in Quebec, although as seen in Table 2-5, this has not been the case for Montreal (PQ 1981-86). Within Montreal there is an 8-fold difference between districts in incidence of tuberculosis reported

since 1981, and in the three districts reporting the highest incidence this may be increasing.

TABLE 2-5: INCIDENCE OF TUBERCULOSIS BY HEALTH DISTRICT IN MONTREAL 1980-87

Health District (DSC)	Annual Incidence of Tuberculosis (per 100,000) 1981	1982	1983	1984	1985	1986	1987
Laval	7.3	2.0	5.5	7.3	6.7	6.0	3.0
Lakeshore	4.2	4.3	4.2	5.1	2.8	5.1	3.6
Maisonneuve	9.8	9.4	7.0	13.2	12.1	4.7	4.7
Verdun	7.0	7.5	12.5	11.1	6.5	4.3	5.9
Cartierville	9.0	8.7	10.4	11.8	10.3	12.1	9.3
Montreal Gen'l	19.4	9.2	12.8	18.5	19.5	22.0	19.0
Ste. Justine	11.3	14.8	10.7	16.0	14.7	16.3	20.7
St. Luc	14.4	10.6	20.6	13.7	20.1	21.7	22.9
Totals:							
Montreal	10.5	9.3	10.1	12.1	11.5	10.8	10.3
Quebec	10.2	10.0	9.5	9.0	8.8	7.6	6.3

(* information from Min. de Sante, PQ, 1981-1987, see references # 114-9)

Over the last 15 years, three surveys of the prevalence of tuberculous infection have been conducted among schoolchildren in Montreal. As seen in Table 2-6, each reported quite different results, due to differences in the population studied, and the technique of tuberculin testing employed. In the survey conducted by Davignon et al, prevalence was reported for foreign-born and Canadian born students together, while Cantin et al studied only Canadian-born and also excluded those who had received BCGvaccination. Godue reported prevalence for all students and Canadian born separately, but did not take BCG vaccination into account at all. Finally Davignon et al used 5 TU of RT-23 instead of the currently recommended 2 TU, which can falsely elevate the number of significant reactions (ATS 1981). All three studies found significant disparities in prevalence of tuberculin reactions in different sectors of the city. These differences were unexplained although they could have been be due to differences in SES, or proportion of immigrants from tuberculous endemic areas both in the communities and in the schools.

TABLE 2-6: TUBERCULIN SURVEYS IN MONTREAL

Author (Ref)	Year	Population	Region	Age group	Prevalence of Infection (%)
Frappier-Davignon (55)	1977/78	8,114	Verdun	5-9	2
				10-14	3.5
			Ste. Justine	5-9	11
				10-14	27
			Mtl. General	5-9	8
				10-14	17
				15-19	48
Cantin (21)	1979/80	2,238	St. Luc	5-6	1.2 *
				11-12	2.6
				16-17	6.4
Godue (58)	1981/82	691	St. Louis de Parc	5-6	2.8 (1.4) **
				11-12	6.5 (1.4)
				16-17	17.3 (2.7)
			St. Henri	5-6	0
				11-12	8.2 (6)
				16-17	10.1 (7)
			N.D.G.	5-6	0.9 (0.5)
				11-12	2.6 (0.9)
				16-17	2.9 (0)

Notes: * Only indigenous Canadians studied.
** Rate for indigenous Canadians given in parentheses

2.7 IMMIGRATION AND TUBERCULOSIS:

In Canada and the USA, immigration is a major demographic force. Over 800,000 refugees and immigrants take up permanent residence in the USA annually, probably twice that number enter illegally and millions more enter as visitors (Passes 1982). The situation in Canada is similar; over 180,000 immigrants came to Canada in 1985, most going to the large urban centres. Because of the prolonged dormant state the risk of reactivation among immigrants remains high for many years after their entry into a low-prevalence country. Age-specific incidence rates of tuberculosis among Scandinavian immigrants closely paralleled those of their age cohort in

their country of origin even 30 years after coming to Canada (Enarson 1980). The impact of this imported morbidity is considerable in low prevalence countries. In Canada tuberculosis among the foreign-born accounted for 45% of all new cases in 1985 (StatsCan 1986). In Britain immigrants from the Indian sub-continent had an incidence of active tuberculosis that was 30-45 times the national average, and so despite representing only 2% of the total population they accounted for 45% of all notified cases in 1978-1983 (MRC 1980, 1983). Incidence is highest in the first years after immigration (Ashley 1960, Enarson 1979, 1984) but among Asians who had immigrated to Britain before 1958, case rates in 1978 were still 20 times the national average (MRC 1980).

Screening of immigrants on arrival with chest radiographs will detect only prevalent cases. For instance, prevalence of disease on arrival in the USA among refugees from SE Asia was 1%, compared to cumulative incidence of 1.2% over the next four years (Powell 1981). In Britain such a programme detected only 68 cases per 100,000 compared to an annual incidence of over 300/100,000 in the first year after arrival (Markey 1986).

2.8 The potential impact of immigration upon tuberculosis in non-immigrants:

While it is evident that immigrants bring their tuberculosis with them the question remains: Does this excess morbidity pose a public health risk to the uninfected populace with whom these immigrants have contact in their every-day lives? Contact is mainly casual but, as Table 2-3 emphasizes, minimal exposure to a highly contagious case can result in wide transmission of infection. In one Montreal survey only 10% of those with significant tuberculin reactions had previous known exposure (Frappier 1979).

Among children born in Britain, those whose parents had immigrated from the Indian sub-continent had annual incidence of tuberculosis of 63/100,000 compared to only 3/100,000 among children of British parents (MRC 1980). This suggests that transmission is occurring in Britain, presumably through household contact with active cases. An example of this was documented by Festenstein who described an outbreak within an Asian extended family living in Britain (Festenstein 1981).

In a recent national survey in Britain excess incidence of tuberculosis was found among British born residents in certain boroughs characterized by an increased proportion of immigrants from Asia (MRC 1986).

However, these boroughs also were characterized by lower than average socioeconomic status, and when the authors controlled for this in their analysis, the apparent effect of residence in communities with a high proportion of immigrants was negligible (MRC, 1986).

2.9 SUMMARY:

Over the last 50 years tuberculosis has declined in importance as a cause of morbidity and mortality both in Quebec, and in Canada. However, incidence of disease, and prevalence of infection remain very high in many under-developed nations, and because of the long latency of tuberculosis, immigrants from tuberculous endemic areas continue to suffer from tuberculous disease even decades after immigration. Tuberculosis among the foreign born accounts for an increasing proportion of new cases seen in non-endemic countries such as Canada. The impact of this excess morbidity among immigrants from tuberculous endemic areas upon prevalence of tuberculous infection among the native born population in a non-endemic country such as Canada is not known. Investigation of this question is complicated by the multiple factors affecting transmission, the difficulties of measuring exposure, and the sensitive nature of the question.

In Montreal, as in many North American cities, immigration and disparities in socioeconomic status are major demographic forces. Within the city there are many distinct communities characterized by widely contrasting proportions of immigrants and average socioeconomic status. Incidence of tuberculosis and prevalence of tuberculous infection, also vary widely between these communities, and could be due to incidence among the foreign-born, or disparities in socioeconomic status. However this could also be due to increased incidence among Canadian born who are resident in communities with a greater proportion of immigrants from tuberculous endemic countries, because of greater risk of transmission of tuberculosis in these communities. Information is available which permits selection of communities on the basis of contrasting socioeconomic status, and proportions of immigrants so the relative impact of these factors can be identified.

Tuberculosis has received little attention because of the widespread assumption that this disease is disappearing. Unfortunately, tuberculosis is not disappearing, and may in fact be on the rise, as has been seen in certain sectors of Montreal. This has provided the impetus for this study.

CHAPTER 3: STUDY HYPOTHESIS AND QUESTIONS

3.1 STUDY HYPOTHESIS:

The prevalence of tuberculous infection among native-born Canadians is increased among those who live in communities, or attend schools characterized by an increased proportion of immigrants from regions where tuberculosis is still endemic.

3.2 PRINCIPAL STUDY QUESTION:

Is the prevalence of tuberculous infection among native-born Canadians increased among those who live in communities or attend schools characterized by an increased proportion of immigrants from tuberculous endemic regions?

3.3 OTHER STUDY QUESTIONS:

1. What is the current prevalence of infection among Canadian-born schoolchildren in Grades 6 and 10?
2. Using prevalence figures from these two age groups, is the calculated annual incidence of infection changing?
3. What is the effect of prior BCG vaccination on tuberculin reactivity?
    i) Does this vary according to the age at which it was received?
    ii) What is the effect of the interval since vaccination?
4. What is the importance of sensitivity to PPD-B (M. Avium), as a cause of false positive tuberculin reactions, and;
    i) Is there a relationship to travel to the SE USA?
    ii) Is the prevalence different among immigrants?
5. Among Canadian-born students is the prevalence of tuberculous infection greater among those whose parents immigrated from tuberculous endemic regions?
6. What is the relationship between various attributes of socio-economic status and prevalence of infection among Canadian-born students?

3.4 DEFINITIONS:

1. Mycobacterium tuberculosis: (M. TB) Causative agent for tuberculosis.
2. Tuberculous infection: Infection with M TB. This occurs as a result of

exposure and primary infection. In a prevalence survey, most persons found to be infected are asymptomatic and have latent or dormant infection. An individual who has this latent tuberculous infection has increased risk to develop active disease in the future.

3. PPD-T: Purified protein derivative prepared from pathogenic M tuberculosis organisms. This is prepared so that 0.1 ml injected intradermally will produce the same reaction as 0.1 ml of the international standard PPD-S. The terms PPD-T and PPD-S are often used interchangeably. Significant reaction to the intradermal injection of PPD-T is considered diagnostic of tuberculous infection.

3. Tuberculous endemic areas: Regions of the world where tuberculosis incidence exceeds 150/100,000, and prevalence of infection exceeds 50% at the age of 30. Using figures from WHO and the International Union Against Tuberculosis (IUAT), all countries from Asia, Africa, and Central America can be classified as tuberculous endemic. (See references # 79-88).

4. Tuberculous non-endemic areas: Regions of the world where incidence of tuberculosis is less than 40/100,000, and prevalence of infection is less than 10% among those aged 30. Using WHO and IUAT published figures all countries of Western Europe, Australia, the USA and Canada can be classified as non-endemic. 5. BCG Vaccination: Vaccination with a live attenuated Mycobacterium Bovis bacillus given to prevent those who become infected with tuberculosis from progressing to disease. For the purposes of the study only those with documentation of BCG were considered to have been vaccinated.

6. Sensitivity to PPD-B: Persons who have been exposed in the past to Mycobacterium Avium (the Battey bacillus) and are not infected with M.TB will demonstrate smaller reactions PPD-T than to PPD-B which is a purified protein derivative prepared from M. Avium. Reactions to PPD-B which are smaller than the accompanying reactions to PPD-T are considered to represent cross-reactivity to related antigens only.

6. False positive: Persons with tuberculin reactions measuring between 5-11 mm to PPD-T, with an accompanying larger reaction to PPD-B, were considered to have false positive tuberculin reactions, due to cross reactivity of related Mycobacterial antigens. In the absence of any previously published data, regarding those who had previously received BCG vaccination, no a priori decision regarding false positive criteria could be made.

CHAPTER 4: STUDY DESIGN AND METHODS

4.1 OVERALL STUDY DESIGN:

To achieve these objectives a prevalence survey was conducted among Montreal area schoolchildren in Grades 6 and 10, in the school year of 1987/88. Regions were selected on the basis of contrasting proportions of immigrants, and socio-economic status. Within these regions all public school students in Grades 6 and 10 were enumerated and those in whom parental consent was obtained underwent tuberculin testing with both PPD-S and PPD-B simultaneously. A self-administered questionnaire was given to all students. BCG vaccination was verified with vaccination booklets, and through the registry of the Institut Armand Frappier. Data from the 1981 Canada census was used for analysis of neighbourhood factors.

4.2 STUDY VARIABLES:

4.2.1 Dependant or outcome variable:

Reaction to PPD-T as measured in mm was the principal outcome variable.

4.2.2 Independant variables:

i) Reaction to PPD-B, measured in mm, from the simultaneous test on the left arm.

ii) BCG vaccination, documented in a vaccination booklet or from a central registry.

ii) Age of child, as determined from the response on the questionnaire, or the date of birth from school lists.

iii) Country of birth of child, and the prevalence of tuberculosis in that country.

iv) Age of immigration among foreign born children, from responses on the questionnaire.

v) for Canadian born students, prevalence of tuberculosis in the country of origin of the child's parents.

vi) Educational status of parents, from questionnaire, as indicator of Socioeconomic status.

vii) Work status of parents, from questionnaire, as indicator of SES.

viii) Percent of children in same census tract living below the poverty

line using postal code to identify census tract, and 1981 Canada census data.

ix) Percent of houses in census tract without central heat - an indicator of SES. (Source as per viii.)

x) Percent of houses in census tract in need of major repairs - an indicator of SES. (Source as per viii.)

xi) Percent of immigrants from all countries in census tract. (Source as per viii.)

xii) Percent of immigrants from tuberculous endemic countries in census tract. (Source as per viii.)

xiii) Percent of children who have immigrated from tuberculous endemic countries in the school attended. Taken from all students in Grade 6 or 10 in that school, using class lists.

4.3 STUDY POPULATION:

4.3.1 Selection:

4.3.1.1 Regions: Using data from the 1981 census Wilkins compiled and published demographic and socioeconomic characteristics for all 51 CLSC's of the greater Montreal area. This data was used to select 11 CLSC's in the central Montreal area on the basis of contrasting proportions of immigrants, and socio-economic conditions. In Table 2-4 (page 17) are shown the demographic and socio-economic data for the 11 CLSC's selected.

4.3.1.2 Schools: The CLSC's provided lists of all public schools within their territory. Consent was sought from both the CLSC, and the school boards for the study to be conducted in all primary schools and most of the high schools within these regions. Because the estimated sample size required was less for adolescents not all high schools were included. Schools were excluded if: i) the CLSC or the school nurse refused to cooperate, or; ii) the school board refused to give permission, or; iii) the school principal refused to allow the survey to be conducted.

4.3.1.3 Students: Once permission had been obtained from the school board (see below), and from the school, all students in Grade 6 or 10 were enumerated. Students were excluded if, at the time of testing, they

were absent because of vacation or prolonged sickness. They were included, but not tested if: i) they had been previously found positive and treated for Tuberculous infection; or, ii) they had been tested within the past year, and found to be tuberculin negative.

4.3.2 Obtaining permission from the health sector and school authorities:

4.3.2.1. Health sector: Permission was first sought in writing from the director, of each of the three DSC's, or the designated responsible person. The protocol was then reviewed and approved by the Director of Infectious Diseases Control, and the ethics review committee in each DSC. Once their permission was granted, the directors of the 11 selected CLSC's were contacted. In general, approval from these directors was given rapidly, following which the coordinators of the school health programmes were contacted. A meeting was then held with the coordinators, together with the school health nurses at the CLSC to explain the survey in detail, and to enlist their cooperation and support. In most schools, the school nurses were essential to gain an introduction to the school principal and teachers, and to enhance the credibility of the study team.

4.3.2.2. School system: Permission had to be sought from the 4 school boards responsible for schools within the study area. The Director of each board was contacted, the protocol was reviewed by their medical staff, and their ethical review committees, and approved by the general council, or board. This procedure took 3-4 months at the 2 major school boards. Once approval had been granted, each school principal was contacted, the survey explained, and their approval requested. In Protestant schools the survey had to be approved by both the parents committee, and an internal committee, before proceeding.

4.3.3 Recruitment of participants:

4.3.3.1. Primary schools: The study nurse coordinator, usually with the school nurse would visit the Grade 6 class, and give a 10-15 minute talk regarding the purposes of the survey, and requesting their participation. A covering letter, questionnaire and consent form were distributed to the students on this initial visit. These were to be brought home, read and

completed by the parents, and returned to be collected by the teacher. When it became apparent that one of the most important determinants of participation was the teacher, more effort was made to enlist their help and support in recruiting students.

4.3.3.2. High schools: In previous tuberculin surveys among Grade 10 students participation rates had been as low as 20-30%. This had been attributed to the attitudes and behaviour typical of this age group. Recognizing the difficulties of conducting a survey in this age group, a short talk was prepared, using audio-visual aids, to stress the importance of tuberculosis to their health, and to illustrate the recent changes in tuberculosis incidence in the USA. The talk did not appeal to their altruistic behaviour to participate because of the benefit of research to others, but rather to their self-motivated behaviour to detect a potentially treatable health problem. At first, this talk was given to all the students of a school together at a major assembly, but because of sub-optimal participation at these schools, the approach was modified, and talks were given to individual classes.

In two schools initial participation was particularly dismal (15%). This prompted a second stage survey in both schools. First the study team met with the school principal, nurse, and responsible teachers, to determine why this happened. All non-participants were sent a card (see Appendix), inviting them to participate when the survey was repeated. Subsequently the author visited each home-room class, to explain the survey, answer questions and concerns, and encourage participation. The questionnaire was modified in response to some suggestions by school staff (see Instruments, below, and Appendix).

4.3.4 Informed Consent:

i) Grade 6: Up to the age of 14, Quebec law requires that informed consent be obtained from the parents for participation in research projects. The consent form was sent home to the parents with each student. To ensure that the parents had actually read this, all students were requested to return the form with approval or not, together with a completed questionnaire. Parents could call either the study personnel, or

the school personnel for further information, before giving consent.

On the day of testing, if the child wanted to be tested, but there was no signed consent, the parent was contacted by telephone. If verbal consent was given and heard by 2 persons (usually the study coordinator and the school nurse), then testing was carried out, and the parent was asked to send a written consent after. On the other hand if there was written parental consent, but the child refused, then no testing was done.

ii) Grade 10: Quebec law requires that both the adolescent and the parent give written consent in order for the adolescent to participate in a research project. Accordingly the consent form was modified to include both signatures. If written consent was obtained only from the student, one of the parents was contacted by telephone for verbal consent, and if given this noted on the consent form. If parental consent was given but the student refused then no testing was done. For those students who were aged 18 or more, their written consent was sufficient.

4.4 DATA GATHERING

4.4.1 Instruments:

4.4.1.1 Skin tests:

Tuberculin testing using the Mantoux technique was performed by nurses. Using plastic disposable Insulin syringes, 0.1 ml of 5-TU (Tuberculin Units) of the test material was injected intra-dermally on the volar aspect of the forearm. Syringes were prepared no more than a half hour before administration. Standard PPD (PPD-T) was given on the right forearm, while PPD prepared from M. Avium (PPD-B) was given on the left. All test material was supplied by Connaught Laboratories of Toronto.

Reading was done 48 or 72 hours later. Those reading the tests were not blinded as to the identity of the test material, because this would have added enormously to the complexity of the study, far beyond staff and budgetary limitations. The largest diameter of induration was measured in mm using the 'ball-point' method (Sokal 1975), and recorded. Redness was not measured nor recorded. Children who were absent on the day of reading were seen to have their tests read within 72 hours, either the next day at school, or at home by one of the study personnel.

4.4.1.2 Questionnaires:

A self-administered questionnaire, developed following guidelines suggested by Woodward et al (Woodward 1979) was given to all potential participants, to be given to their parents for completion. This requested demographic data, such as address, age, country of birth of child and parents, as well as questions regarding tuberculosis, and socio-economic factors such as parental education and work. The adolescent version of the questionnaire was the same except for the changes to the consent described earlier. In the two schools where the two-stage survey was conducted, the questionnaire was modified to eliminate questions regarding parental age, education and work.

The original pediatric and adolescent questionnaires were translated into French by 2 independant translators. Their versions were compared and a consensus reached as to the best translation. This was then back translated into English, which was then compared with the original version. The pediatric and adolescent questionnaires were translated into 6 other languages: Italian, Portugese, Spanish, Greek, Vietnamese and Chinese. All these translations, except for that in Chinese, were checked independantly by another person whose mother tongue was that language.

4.4.1.3 BCG verification:

a: Vaccination booklets - After the first three months of the survey, initial review of the results revealed that comprehension of the question regarding BCG vaccination appeared to be low. Therefore in all subsequent primary schools the Grade 6 students were asked to bring their vaccination booklets with them at the time of reading of the reactions. These were reviewed to check if BCG vaccination was documented. If there was such documentation this was noted beside the reading for that child, along with the date of vaccination. If there was no BCG documented AND other childhood vaccinations were recorded (ie the booklet was felt to be a reasonably complete record of vaccinations for that child), then it was recorded that BCG was not given.

b: Registry of the Institut Armand Frappier - After the completion of the study, lists of all Canadian-born participants' names, together with their dates of birth and fathers' first names, were sent for verification from

this registry. To verify the accuracy of the registry compared to the booklets, the names and dates of birth of approximately 100 students with documented BCG in their booklets, and 100 of those who had no record of BCG vaccination in their booklet were sent to the IAF.

4.4.1.4 Other sources of information:

a: School lists: School lists of the students were used to obtain addresses, postal codes, dates of birth, and father's first names. This allowed comparison of non-participants to participants on the basis of age and census data, and verification of BCG vaccination by the IAF. Such lists were only available in primary schools of the Catholic school boards of Montreal and Verdun.

b: Postal codes: For those who completed the questionnaire and gave their address, the postal code could be found using the Canada Post directory.

c: Canada census data: Data compiled from the 1981 Canada census regarding demographic data, and socio-economic indices for each census tract in the greater Montreal area was obtained from R. Wilkins of the Montreal General DSC (Wilkins 1985). From the address and postal code each participant could be assigned to a census tract, and this allowed them to be matched to the demographic and socioeconomic data for the census tract in which they were resident.

4.4.2 Pretesting the instruments:

4.4.2.1 Skin tests:

a: Administration: The 2 study coordinators were both trained in the technique of administration and reading by one highly experienced nurse from the Montreal Children's Hospital (MCH). One of these three nurses or the author was present on all occasions for testing, to ensure consistency of technique by all the other nurses who may have assisted in this survey.

b: Reading: The 2 coordinators, the MCH nurse and the author met on several occasions to discuss and review the technique of reading. Initially the 2 coordinators were trained in reading by the nurse from the MCH, and in the first few months performed readings together or with the MCH nurse so that each reading could be verified. Whenever possible reading was done by 2 of the 4 readers. Agreement was achieved by consensus.

4.4.2.2 Questionnaires:

The pediatric questionnaire was first pretested among 10 colleagues in the Epidemiology Department, or at the Montreal Chest Hospital. The second pretest was conducted among clinic patients at the Montreal Chest and Montreal Children's Hospitals. The recruitment presentation and adolescent questionnaire were pretested together at the adolescent clinic of the Montreal Children's Hospital and after revision a second pretest was conducted at Van Horne High school. This high school, not within the study area, was used for the pretest in an extensive contact investigation of one of their students who had been diagnosed to have active pulmonary tuberculosis.

Questionnaire revision after each of these pretests was not done in any formal way. Problems with organization, comprehension or sensibilities were identified, and corrected on an ad hoc basis. There was no attempt to formally analyze the responses, nor correlate these with actual results. This was mainly because it was felt that to correlate responses with tuberculin reactivity, or census data would require such large numbers as to constitute a complete study in its own right.

4.4.3 Data management:

4.4.3.1 Test Results:

Readings of PPD-T and PPD-B were recorded on summary sheets, along with BCG status, if the vaccination booklet was available. Children with significant reactions to PPD-T were given appointments for Chest clinic at the Montreal Children's Hospital for further evaluation. Reactions were judged significant if the reaction to PPD-T was 5mm or more and not a false positive reaction due to either PPD-B or documented BCG vaccination. In children in whom the PPD-B was larger than the corresponding PPD-T, then the child was referred only if the PPD-T measured 12mm or more. If BCG vaccination was documented, then the child was referred only if the reaction to PPD-T measured over 9mm.

These readings were then transcribed onto the questionnaires prior to entry into the computer. At the same time postal codes were verified for those who had omitted this information but had given their address.

4.4.3.2 Questionnaires:

Questionnaire responses were entered directly into the computer.

4.4.3.3 BCG verification:

Data from the IAF was added directly into each participant's computer record.

4.4.3.4 Data entry

All questionnaire data and test results were entered directly using a D-Base III based entry programme, designed to minimize errors by setting limits for all values entered and accepting either numeric or character data where appropriate. Due to pressures of time, approximately 750 adolescent records were entered by McGill computing services, as an ASCI file without the benefit of such a DBASE programme.

4.4.3.5 Data entry verification:

This arduous task was done using the following:

PROC FREQ: all numeric values of PPD-S, PPD-B, ages of child, mother and father that seemed to exceed a normal expected range were verified from the questionnaires. Responses to other questions that were not of the correct form (Y vs N), or beyond the range of responses (1-5 for parental education) were also verified and corrected.

TRANSFORMATIONS: This was used for items such as the year of immigration of the child, mother, or father. If the year of immigration was earlier than the year of birth then these dates were verified and corrected.

COUNTRIES: Errors in entry were detected by running a frequency of all countries listed. Unrecognizable countries were verified from the questionnaire.

POSTAL CODES: Errors in entry (or incorrect originals) were detected after these had been converted to Census tracts. Those with postal codes but no CT assigned were checked. If an error was found this was corrected. If the code appeared as on the questionnaire, this was verified using the Canada Post directory, and if this was still correct then the census tract number for the postal code closest to it was entered manually.

4.5. DATA ANALYSIS

4.5.1 Overview:

The first step was to assess the possibility of bias because of non-participation, and because of differences in questionnaire completion. Then the major causes of false positive reactions were examined, and a strategy for their control devised. This done, the major determinants of tuberculin reactivity were addressed: the age, immigration status, socioeconomic factors, and finally contact with immigrants among Canadian born students. both in the schools and in the neighbourhoods. Immigration status was such an overwhelming determinant that foreign-born students were analyzed separately, and excluded from the final analysis of the determinants of tuberculin reactivity.

4.5.2 Sources of potential bias:

4.5.2.1: Participants vs Non-participants:

Among the Grade 6 children, sufficient numbers of non-participants had completed questionnaires as to allow a detailed analysis of non-participants within sub-categories of language of instruction and school-board, as well as overall. There was far less information on non-participants among the adolescents so that detailed analysis by these sub-categories was not possible. However in the 2 schools where the 2-stage survey was done, it was possible to compare the characteristics of those who participated initially to those who were recruited only after additional efforts. Only one high school provided address and dates of birth on all students, so that comparison on the basis of age and census data was possible only for this high school.

4.5.2.2 Questionnaire completion:

Insight into the characteristics of the non-respondent non-participants was provided by analysis of the differences between groups on the basis of their completion of the questionnaire. To assess if non-completion of the questionnaires reflected differences in characteristics among participants, the small number who did not complete questionnaires were compared to those who did on the basis of age, country of birth and census data since this information was obtained on all participants. Among non-participants from whom there was no response, information for some regarding address and date

of birth was available from school lists. This information could be used to compare these non-respondents to the other non-participants who did return questionnaires.

4.5.3 False positive reactions:

4.5.3.1 Effect of sensitivity to PPD-B: A false positive PPD-T due to cross reacting sensitivity to PPD-B was defined as a reaction to PPD-T measuring 5-11mm when the corresponding reaction to PPD-B was larger. For all subsequent analyses, including that for the effect of BCG vaccination, a reaction to PPD-T meeting these criteria was considered to be zero. The association of such false positive reactions to country of birth, SES and travel to the SE USA was analyzed. If the PPD-T reaction was over 11mm this was considered positive, irrespective of the size of accompanying PPD-B reaction, as this size of reaction is associated with an increased risk of tuberculosis (Smith 1987, Edwards 1973). In the analysis of factors responsible for sensitivity to PPD-B, only those with reactions to PPD-B greater than the corresponding PPD-T reaction and exceeding 4mm, were included. Among these the relationship to immigration status, country of birth, travel to the SE USA, and socio-economic status was assessed.

4.5.3.2 The effect of BCG vaccination: Because BCG vaccination could not be verified among the foreign-born, the effect of prior BCG vaccination on tuberculin reactivity was limited to the Canadian born. The three sources of data regarding vaccination status, questionnaire response, vaccination booklet, and registry of the IAF, were first compared. Simple agreement and kappa statistics were calculated for the vaccination booklets compared to the registry of the IAF. Vaccination was considered documented if the student was recorded to have had vaccination either in the booklet or by the IAF. Agreement and kappa were also calculated for questionnaire response and documented vaccination.

The effect of BCG on tuberculin reactivity was determined through comparison of the frequency distributions of tuberculin reactions among those with and without documented BCG vaccination. For the purposes of this analysis, it was assumed that vaccination did not prevent tuberculous infection, an assumption which is supported by experimental and pathological

data (Sutherland 1979). A moving three-point average was used to smooth the curves, and reactions were also grouped by 5mm increments because of small numbers at each reaction size. The frequency distributions of tuberculin reactions among vaccinated and non-vaccinated students were compared within socioeconomic strata, because students resident in disadvantaged quartiers were significantly more likely to have received BCG. For the stratified analysis, the findings of the Grade 6 and 10 students were combined, since virtually all had received BCG in the first year of life. The effect of age of vaccination, or re-vaccination, on subsequent reactivity to PPD-T could not be examined because almost all students had received BCG vaccination once only in infancy. The effect of interval on reactivity was confounded by the increasing prevalence of tuberculin reactors with age.

Because there were differences in distribution of reactions on the basis of vaccination status, a size of reaction was sought above which the frequency distributions were similar. Reaction below this size among vaccinated persons could be considered false positive due to BCG, and those above the cut-point could be considered as true positive due to tuberculous infection. The false positive and false negative rates for several possible cut-points were calculated, and from this a cut-point selected for use in all subsequent analysis.

4.5.4 Determinants of tuberculin reactivity:

4.5.4.1 Outcome variable - Tuberculin reactions: Reactions to PPD-T could be used as: i) a continuous variable using size of reactions in mm, or, ii) a dichotomous variable - significant or not, or; iii) a categorical variable - negative, doubtful, positive, strong. In this study, tuberculin reactions were rarely used as continuous variable, and then only to confirm other methods of analysis, because biologically and clinically tuberculin reactions are usually judged as significant or not. For comparison of frequency distributions, and for logistic regression the dichotomous variable was used, while for Mantel Hanszel chi square, and simple tabulation, the categorical form was used in order to include the doubtful reactions. (Colton 1974, Kleinbaum 1978).

4.5.4.2 Independant variables: The independant variables described earlier were used in the analysis in the following ways: i) Tuberculosis

rates in country of origin (of student or parents) were used as a categorical variable with three levels: low, intermediate, and high. ii) Age of the child was used as a categorical variable only. The mean age of all students in the two school levels was used to determine the age specific prevalence, annual incidence of infection, and any changes in the incidence of infection. iii) Parental education, and work were categorical variables scored from 0-6 on the questionnaire, while socioeconomic score was a continous variable calculated as the total of the four parental scores. iv) The census data regarding percent of children below the poverty line, percent of houses without central heat, and percent of houses in need of major repairs provided four continuous variables on socioeconomic status; data were also divided into quartiles and used as categorical variables. iv) The census data regarding percent of immigrants from all areas, and from tuberculous endemic areas in the neighbourhood, and the percent of immigrants from tuberculous endemic areas in the school also provided three continuous variables regarding exposure to immigrants; these were also grouped into quartiles and used as categorical variables.

The first determinant of prevalence of infection analyzed was the country of birth of the students. Prevalence was much higher among the foreign born, and the effect of BCG vaccination could not be assessed, so that all subsequent analysis was restricted to the Canadian born. Among the foreign born the relationship of reactivity to tuberculosis rates in the country of origin, and to the age immigration to Canada were assessed, using simple frequency distributions.

Analysis of the effect of age was limited to comparing the prevalence among Canadian born for the two age groups. The annual risk of infection was calculated by taking the N-th root of the prevalence for each age group, where N equalled the mean age for each group.

For the analysis of the effect on prevalence of tuberculin reactivity, of each of the various attributes of SES and of the effect of the three indices of "exposure" to immigrants from tuberculous endemic areas, all students were grouped into 4 quartiles for each independant variable. Differences between prevalence of infection in these quartiles for each variable was assessed using Mantel-Haenszel Chi Sq, and between the extreme levels with Chi Sq. When this univariate analysis was complete, an

adjusted estimate of effect of both SES factors and contact with immigrants was calculated using multivariate logistic regression. Models included variables found to be significant using the above univariate analysis, such as indicators of SES, and percent immigrants (in the neighbourhood or the schools), entered as continuous independant variables. (Colton 1974, Kleinbaum 1978)

CHAPTER 5: RESULTS IN THE GRADE SIX STUDENTS

5.1 POTENTIAL BIAS DUE TO NON-PARTICIPATION

As seen in Table 5-1, overall participation was 81.9%. Those who had documented negative Tine tests within the past year and those with a past history of treatment for tuberculosis were not tested but were included in the analysis. Together they accounted for only 1.3% of the total number of participants. Of the 11 known to have been treated, 7 had records at the Montreal Children's Hospital which were reviewed to verify and record the size of tuberculin reaction. On the day of testing, 72 of the children were absent. This represents 2.3% of the total eligible population, which may have been in excess of normal absenteeism reflecting the student's anxieties over the test. Only two were absent for reading, principally because of the extraordinary efforts made by the study personnel to trace all children tested, including visiting them at home!

TABLE 5-1: OVERALL PARTICIPATION AMONG THE GRADE 6 STUDENTS

Population eligible:			2939	
Non-participants:	Absent - testing:		72	
		reading:	2	
	Refused - Parents:		338	
		Students:	22	
	No response:		96	
		TOTAL:	531	(18.1%)
Participants:	Had prior positive PPD:		11	
	Had prior negative Tine:		21	
	Tested in study:		2376	
		TOTAL:	2408	(81.9%)

5.1.1 Information on Non-participants:

Of the non-participants, 59% returned complete questionnaires, allowing

detailed comparison to those who participated. Information regarding date of birth and address from school lists was available for another 60 (11.4%) so these students could be characterized on the basis of neighbourhood factors, from census data, and age. There was no information on 28.2% of the non-participants which represented only 5% of the total eligible population.

5.1.2 Relationship to school language and board:

Tables 5-2A and 5-2B show that there were differences in participation rates between the different school boards, and even in relation to the language of instruction. It was noted by several of the study personnel that participation rates were primarily related to the enthusiasm and support of the teachers in each class.

TABLE 5-2: PARTICIPATION RATES:

BY LANGUAGE OF INSTRUCTION, AND SCHOOL-BOARD

Table 2A: Participation rates: by language of instruction

Language (of school)	Total Pop.	Participants	Percent
English	1069	823	77.0% *
French	1870	1585	84.7% *
Total	2939	2408	

* (Difference between the two groups significant using Chi Sq, $p<.001$)

Table 2B: Participation rates: by school-board

Board	Total Pop.	Participants	#Percent
Protestant-Montreal	716	519	72.5% *
All Catholic	2224	1889	85.0% *
Catholic-Montreal	1624	1364	83.0%
Catholic-Verdun	372	313	84.5%
Catholic-Lasalle	227	212	93.3%
Total	2939	2408	

* (Difference between Protestant and Catholic significant using ChiSq, $p<.001$)

5.1.3 Questionnaire return:

Overall return of questionnaires is given in Table 5-3a. Questionnaire return by non-participants was much greater among French language and/or Catholic schools. Some of these differences may have resulted from the fact that a higher proportion of English/Protestant schools were surveyed in the first three months. Participation and questionnaire return improved in the latter half of the survey because of better organization, more attention was paid to enlisting the support of the teachers, and the adoption of a policy that all questionnaires had to be completed and returned even if parents refused consent. However, even in the last month of the survey the differences between the schools of different Boards remained.

TABLE 5-3a: QUESTIONNAIRE RETURN:

	Questionnaire		
	Complete	Short	None
Non-participants:	308	10	213
Participants:	2341	41	26
TOTAL	2649	51	239

Information on 60 of the 213 non-participants, and 19 of the 26 participants, who did not complete questionnaires was available from school lists. Comparison could be made on the basis of age, and neighbourhood factors such as the percent below the poverty line, or the percent of immigrants. As seen in Table 5-3b, there were no systematic differences in terms of these characteristics, between those who completed all (complete), or part of the questionnaire (short), or did not return a questionnaire (none).

TABLE 5-3B: CHARACTERISTICS OF SUBJECTS BY QUESTIONNAIRE COMPLETION

Non-Participants:

Characteristics	None	Short	Complete
Age child	11.8 (49) *	11.8 (10)	11.7 (304)
Poverty Index	39. (60)	38 (8)	36.2 (271)
% Immigrants	21.6 (60)	9.3 (8)	19.9 (273)

Participants:

Characteristics	None	Short	Complete
Age child	11.3 (8) *	11.6 (39)	11.6 (2309)
Poverty Index	28 (19)	39 (39)	36 (2089)
% Immigrants	15. (19)	25 (39)	19 (2089)

* (Number in parentheses refers to number for whom information was available)

5.1.4. Characteristics of non-participants compared to participants:

Overall comparison of non-participants to participants is given in Table 5-4. There were no major significant differences between these two groups. There was sufficient information available regarding non-participants so as to allow detailed comparison of them to participants within each schoolboard, and by category of language of instruction. These comparisons are shown in Appendix Tables i-vi. From these it can be seen that, while the characteristics of the students varied between school boards, there were no differences within each board between those who did and did not participate.

TABLE 5-4: CHARACTERISTICS OF NON-PARTICIPANTS COMPARED TO PARTICIPANTS

Characteristic	Non-Participants		Participants	
Number	531		2408	
CHILD				
Age	11.7	(365)*	11.6	(2379)*
Immigration status:				
Child-Can. Parents-Can.	210 = 60%		1370 = 57%	
Child-Can. Parents-Imm.	110 = 31%		743 = 31%	
Child-Immigrant	30 = 9%		294 = 12%	
Country of birth:				
Non-endemic for TB	2		30	
Intermediate for TB	2		39	
Endemic for TB	26		225	
Year of immigration:	19-82.7	(25)	19-81.2	(286)
MOTHER				
Age	38.8	(304)	38.0	(2307)
Country of birth:				
Non-endemic for TB	28		200	
Intermediate for TB	48		244	
Endemic for TB	27		366	
Year of immigration	19-70.0	(110)	19-71.6	(862)
FATHER				
Age	41.6	(284)	41.5	(2186)
Country of birth:				
Non-endemic for TB	40		232	
Intermediate for TB	52		253	
Endemic for TB	37		405	
Year of immigration	19-67.8	(120)	19-70.5	(850)
NEIGHBOURHOOD DATA:				
Poverty Index (child)	36.8	(371)	35.5	(2370)
% Immigrants (all countries)	21.8	(371)	20.2	(2368)
% Immigrants (TB endemic)	3.4	(382)	3.7	(2399)
% Dwellings without heat	22.7	(382)	25.5	(2395)
% Dwellings needing repairs	9.4	(382)	10.3	(2395)
SCHOOL DATA:				
% Immigrants from TB endemic	10.9	(533)	10.8	(2407)
RESPONSES TO QUESTIONNAIRE (% Yes)				
Past history of TB	8.9%	(315)	6.1%	(2323)
Past treatment for TB	2.5%	(315)	2.0%	(2336)
Past contact with TB	0.6%	(314)	1.1%	(2363)
BCG Vaccination	55.4%	(276)	52.5%	(2040)

* (No. in parentheses refers to number for whom information was available)

5.1.5 Non-participants - Summary:

Overall participation was 81.9%. Information was available to characterize 60% of the non-participants in detail, while some information was available to characterize a further 11%. Only 5% of the total eligible study population could not be characterized at all, because there was no information available. The only significant differences between participants and non-participants, were the language of instruction and Board of the schools attended. Comparison of non-participants to participants, on the basis of factors that may influence the prevalence of tuberculosis, revealed no significant differences both overall, as seen in Table 5-4, and within each sub-category of language and Board, as seen in Appendix tables Ai-Avi. As well there were no differences in these same characteristics when groups were compared on the basis of completion of questionnaires. Therefore the estimate of effect based on those who took part should be valid for the entire population.

5.2 CHARACTERISTICS OF PARTICIPANTS:

The characteristics of the 2408 participants are given in Table 5-4. The standard deviation for age was small, reflecting the homogeneity of age in Grade 6. On the other hand, the standard deviation for Poverty index, or percent immigrants by census tract was large. This emphasizes the wide variation in these factors which occurs in the central Montreal area, and suggests that there was a considerable range for both factors which should facilitate the estimate of their effect as determinants of the prevalence of infection. Note that individuals resident in census tracts with higher poverty index are resident in more disadvantaged neighbourhoods.

Characteristics of the participants grouped by the immigration status of themselves and their parents are shown in Table 5-5A. Children were classified as having immigrant parents if one, or both were foreign-born. There were significant differences between the immigrants, and Canadian born children in terms of age and socioeconomic status of their census tract of residence. Among the students born in Canada, those whose parents were foreign-born were of similar age compared to those with Canadian born parents, and although neighbourhood socioeconomic indices such as housing quality tended to be worse among those with Canadian born

parents, the differences were not significant. Therefore for all subsequent analyses, all Canadian born students were grouped together.

TABLE 5-5A: CHARACTERISTICS OF PARTICIPANTS GROUPED BY IMMIGRATION STATUS

Characteristics	Immigration status		
	Child-Can. Parents-Can.	Child-Can. Parents-Imm.	Child-Imm. Parents-Imm.
Number	1371	743	294
Age of child	11.7	11.5	11.8
Age of mother	37.6	38.7	38.3
Age of father	40.7	42.7	42.4
Neighbourhood data:			
Poverty Index (child)	35.0	33.8	42.1
% Immigrants (all nations)	12.0	29.5	29.7
% Immigrants (TB endemic)	2.1	5.7	6.3
% Dwellings without heat	30.3	18.1	22.4
% Dwellings needing repair	10.7	9.6	10.8

The region of birth of the immigrants is shown in Table 5-5B, from which it can be seen that the majority of foreign-born parents immigrated from Europe, while the immigrant children came from developing nations. This reflects changing immigration patterns, rather than any unusual selection.

TABLE 5-5B: REGION OF BIRTH OF FOREIGN-BORN STUDENTS AND PARENTS

Region	Child	Mother	Father
Africa	11	20	25
Arab States	3	12	11
Central America	45	68	48
S.America	20	40	39
Caribbean	33	105	104
India	18	48	53
S.E.Asia	95	130	126
N/W Europe (inc Italy)	30	199	232
S Europe (ex Italy)*	27	212	222
E Europe	11	31	30
TOTAL	294	878 **	902 ***

Notes:

* S. Europe includes Spain, Portugal, Greece, all of which have intermediate prevalence and incidence of tuberculosis, but Italy is a non-endemic country.

** 131 missing

*** 176 missing

Tuberculin reactivity was poorly correlated to responses to questions concerning past exposure to tuberculosis. As seen in Table 5-5C, only 1.1% of the respondents reported prior contact with a person suffering from active tuberculosis, but of these only 19% had significant reactivity. Over half of all respondents reported that they had received BCG vaccination, but of these only 7.7% had a signficant reaction to PPD-T. Among Canadian-born there was an excess of tuberculin reactivity among those who responded affirmatively to any of the questions, but the proportion with tuberculin reactivity was still very small, suggesting over reporting.

TABLE 5-5C: RELATIONSHIP OF TUBERCULIN REACTIVITY TO RESPONSES ON QUESTIONNAIRE

Question	Total population			Canadian born only		
	Yes	(% PPD +)	No	Yes	(% PPD +)	No (% PPD +)
Past diagnosis of TB	142	(14%)	2181	109	(7.3%)	1932 (2.0%)
Past treatment for TB	47	(15%)	2289	32	(3.1%)	2021 (2.2%)
Contact with TB	26	(19%)	2337	16	(7.4%)	2060 (2.2%)
BCG Vaccination	1071	(7.7%)	969	908	(3.7%)	870 (1.0%)

5.3 INTER-RELATIONSHIPS OF INDEPENDANT VARIABLES:

There were a number of highly significant correlations between such items as the education of the mother, work of the mother, education of the father and work of the father. The strongest correlation (R=.61) was between the education of the two parents, and for this reason the education of the father was omitted from Table 5-6. The poverty index of the census tract was correlated negatively and strongly with the education of the parents and less strongly with the work status. The lower correlation with work status may have been due to the arbitrary assignment of scores for each kind of activity (see Appendix - Questionnaire). Responses to questions regarding tuberculosis were very highly correlated. While few responded yes to these questions those who did tended to respond affirmatively to several questions.

TABLE 5-6: CORRELATION OF INDEPENDANT VARIABLES
(Grade 6, Canadian-born only)

	Pov-C	Heat	Repairs	%-Imm	ImSchool	Educ-M	WorkM
Pov-C	-						
Heat	.44	-					
Repairs	.52	.64	-				
%-Imm	.01	-.39	-.12	-			
ImSchool	.24	-.16	.08	.42	-		
Educ-M	-.27	-.25	-.18	-.10	-.04	-	
Work-M	-.13	-.10	-.07	.03	-.02	.29	-
Work-F	-.18	-.13	-.08	.05	-.03	.22	.24

Notes:
Pov-C: Poverty-Child = % of children living below the poverty line
Heat: Percent of buildings in census tract without central heating
Repairs: Percent of buildings in census tract in need of major repairs
%-Imm: Percent of immigrants resident in census tract
ImSchool: Percent of immigrants from tuberculous endemic areas in school
Educ-M/ Educ-F: Highest educational level achieved by mother or father - from questionnaire
Work-M/Work-F: Current work status of mother/father - from questionnaire

5.4 SKIN TEST RESULTS

5.4.1 Overall:

Overall 76% of participants manifested no reaction to either antigen. 13% had small but non-significant reactions, either to one or other antigen. Table 5-7 shows the distributions of reactions to both antigens. Of the 5.6% with significant reactions to PPD-B, only one-fourth of these had reactions of 10mm or more, and very few had reactions of 15mm or more. In all 5.1% had a significant reaction (ie 10mm or more) to PPD-T, and another 3.6% had doubtful reactions, of 5-9mm. The majority of reactions to PPD-B were associated with larger simultaneous reactions to PPD-T, and therefore were felt to represent cross-reactivity, and not true sensitivity to PPD-B.

TABLE 5-7: OVERALL RESULTS OF SKIN TESTING:

PPD-T			PPD-B		
Size of PPD-T	Number	Percent	Size of PPD-B	Number	Percent
0	2005	83.7	0	2045	85.3
1-4	205	8.5	1-4	228	9.1
5-9	86	3.6	5-9	99	4.1
10-14	65	2.7	10-14	29	1.2
15+	57	2.4	15+	7	0.3
TOTAL	2408			2408	

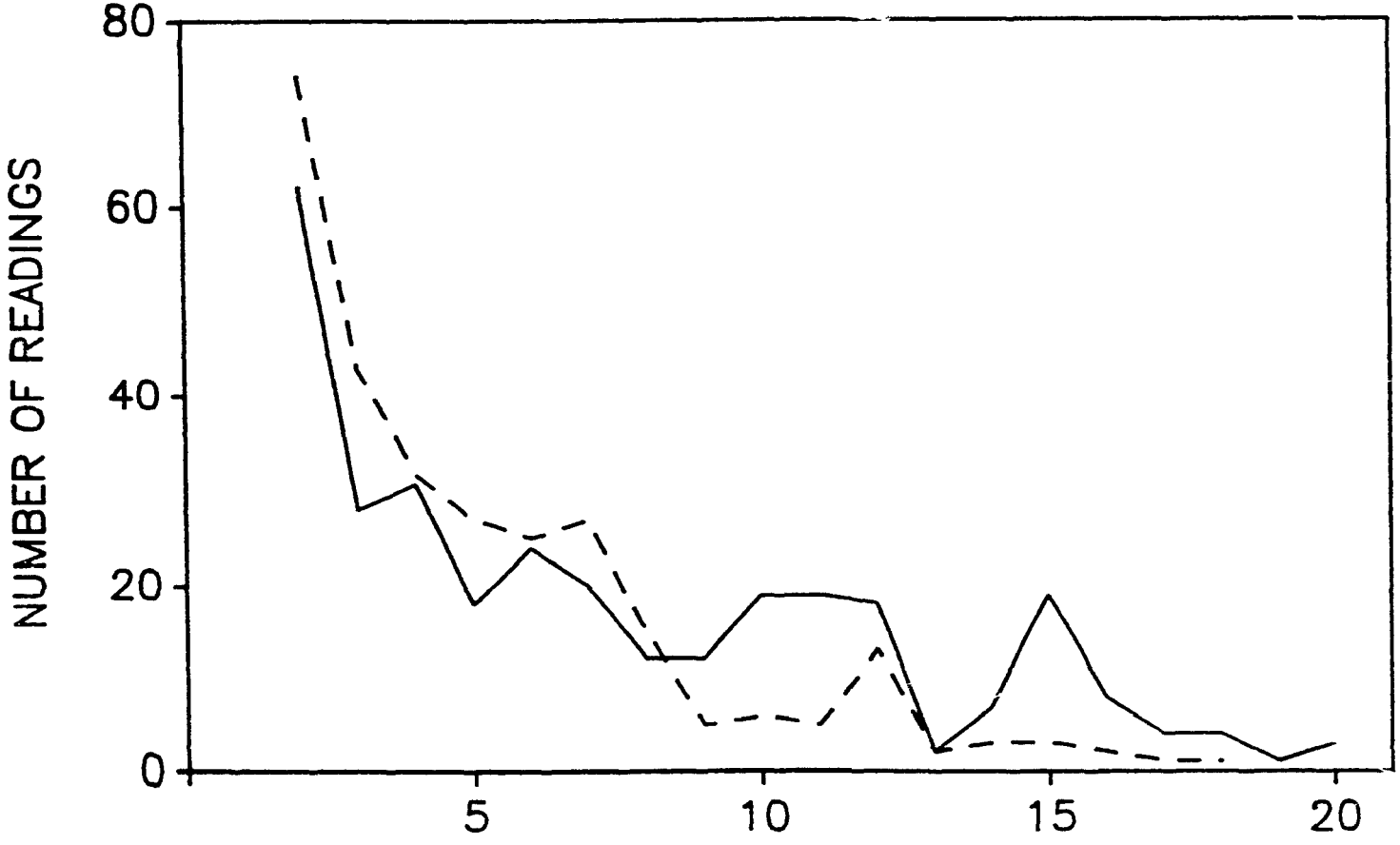
The correlation of readings for the two antigens for the Grade 6 students are shown in Table 5-8. The frequency distributions of reaction sizes in millimetres are shown in Figure 5-1. All skin test readings from Grades 6 and 10 are shown here, since the same readers were used for the two levels. There was a "middling" tendency on the part of the readers, which is evident from the concentration of readings for certain sizes compared to others. This may have been partially explained by the minimum size of reaction necessitating referral For those with no vaccination booklet, or no BCG in the booklet, any child with a reaction of 5mm or more was referred. If BCG was documented, the criterion became a reaction exceeding 9mm, while for those with larger PPD-B than PPD-T the criterion was 10mm for PPD-T. In all cases the criteria for referral were more conservative than those used in the analysis, so that while readers may have erred by a mm or two near the criteria for referral, it is unlikely that they would have been biased to read systematically above or below the criteria used for the present analysis.

The study tested several hypotheses, principally by comparing sizes or prevalences of reactions between groups that differed on the basis of a characteristic of interest. There is no reason to suppose that there would have been any differences in reading on the basis of these characteristics, so that any middling tendency or other error in reading should have been equally present for those with or without the characteristic of interest. Reading errors are most likely to affect the estimate of overall

FIGURE 5—1:

FREQUENCY DISTRIBUTION OF READINGS FOR PPD—T AND PPD—B

(GRADE 6 ONLY)



prevalence, but prevalence was used to compare the calculated annual incidence (or risk) of infection in the two age groups.

TABLE 5-8: RELATION OF REACTION SIZE TO PPD-T AND TO PPD-B
(Grade 6, all participants)

PPD-T Reaction Size (mm)	Size of reaction to PPD-B in millimetres									
	0	1-3	4	5	6	7-8	9	10	11-12	13+
0	1842 *	121	14	12	14	9	1	0	2	3
1-3	105	39	8	3	3	5	0	0	1	0
4	16	11	1	0	0	2	0	0	0	1
5	7	2	1	1	1	4	1	0	1	0
6	2	3	0	2	1	2	0	0	3	0
7-8	11	6	2	1	3	3	1	0	2	3
9	5	1	1	1	0	3	0	1	0	0
10	14	1	0	1	0	2	0	0	1	0
11-12	17	8	1	3	2	2	2	0	2	0
13+	27	5	4	3	1	10	0	5	6	5

* (Number of participants with this size of reaction to PPD-T and to PPD-B)

5.4.2 Causes of false positive tuberculin reactions:

5.4.2.1 Sensitivity to PPD-B

Of the 99 students with PPD-B reactions measuring 5-9mm shown in Table 5-7, 42 (42%) had accompanying larger reactions to PPD-T, and of the 36 with PPD-B measuring 10mm or more, 6 were believed due to cross-reactivity because of a larger PPD-T reaction. Of the total population tested, 23 children (9.7%) had a reaction to PPD-B that was larger than their simultaneous reaction to PPD-T. Sensitivity to this atypical Mycobacterial antigen was responsible for over one-fifth of reactions to PPD-T in the range traditionally considered doubtful, because of presumed cross-reac-

tivity. However, as seen in Table 5-9A this sensitivity to PPD-B was responsible for very few of the reactions in the range normally considered significant.

TABLE 5-9A: FALSE POSITIVE TUBERCULIN REACTIONS DUE TO SENSITIVITY TO PPD-B

Size of PPD-T	Total Number with Reactions to PPD-T	Number with PPD-T < PPD-B	% False Positive
0-4	2200	214	*
5-9	86	19	22 %
10-14	65	2	3 %
15+	57	0	0
TOTALS	2408	235	

* (PPD-T reactions of 0-4 are not considered significant so PPD-B can not be considered a cause of false positive reactions in this range)

Sensitivity to PPD-B was strongly associated with immigration status, as seen in Table 5-9B. Immigrant children were more likely to have sensitivity to PPD-B, particularly those from the Caribbean and Asia. Sensitivity to PPD-B was a more important cause of false positive reactions among the foreign-born, although the difference compared to the Canadian born was slight. Among foreign born students, 12 had reactions to PPD-T measuring 5-9mm, of whom 4 had larger accompanying reactions to PPD-B, whereas of 32 with tuberculin reactions of 10-14mm, only one (3%), had a larger reaction to PPD-B. On the other hand, among Canadian born children, 20% of tuberculin reactions in the 5-9mm range, and 3% of those in the 10-14mm range, could be ascribed to cross-reactivity to PPD-B. Among Canadian born, sensitivity to PPD-B was not associated with indicators of socioeconomic status, nor to travel to the South-Eastern USA, nor with documented BCG vaccination. These results are shown, in Appendix Tables A-ix, and A-xi.

TABLE 5-9B: ASSOCIATION OF SENSITIVITY TO PPD-B WITH IMMIGRATION STATUS

Size of Reaction to PPD-B	Immigration status: Canadian-born	Foreign-born
B<T	1921	253
2-4	134	24
5-9	45 (2.1%) *	12 (4.1%)
10+	16 (0.7%)	5 (1.6%)
TOTAL	2114	294

* (Number of children followed by % of the total for that immigration sub-group)

5.4.2.2 Effect of BCG vaccination (among the Canadian born students only):

It was not possible to systematically verify the BCG status among the immigrant children, because very few had vaccination booklets, and there was no access to vaccination records in other countries. Therefore the analysis of the effect of prior BCG vaccination as a cause of false positive tuberculin reactions was limited to those born in Canada, for whom vaccination records could be traced. There were three major sources of information available on BCG vaccination status among the Canadian born: vaccination booklets, the registry of the Institut Armand Frappier (IAF), and responses to the questionnaire.

Of the 766 children with vaccination booklets, 303 had documented BCG vaccination. Records could be traced for 1822 children through the registry of the Institut Armand Frappier (IAF). Of these, 458 had documented BCG vaccination. To compare these two sources of information, a random sample of 227 who had a vaccination booklet were selected, and these names were then verified through the IAF registry. As seen in Table 5-10A below, the agreement was 74%. The most likely explanation for under-reporting by the IAF is that the BCG was given as part of a vaccination campaign independant of the I.A.F.. The instances where BCG vaccination was documented by the IAF but not the booklet may have been because the vaccination was given at birth before the vaccination booklet was issued, or the vaccination booklet checked was not the original.

Of the 1778 parents who responded to the question regarding BCG vaccination on the questionnaire, over half indicated that their child had received this vaccination. Questionnaire response was compared to documented vaccination status, and is shown in Table 5-10B below. Vaccination was considered documented to have been given if either booklet or IAF registry reported that BCG had been given. As seen below over 50% responded that BCGV had been received, compared to less than 30% who had actually received BCG. Despite this questionnaire response was still significantly associated with tuberculin reactivity.

TABLE 5-10: AGREEMENT BETWEEN SOURCES OF INFORMATION ON BCG VACCINATION

Table 5-10A: Vaccination Booklet vs Institut Armand Frappier
(Canadian born only)

		VACCINATION BOOKLET		
		Given	Not Given	Total
REGISTRY OF INSTITUT ARMAND FRAPPIER	Given	77	19	96
	Not Given	40	91	131
TOTALS:		117	110	227
Agreement:	74%			
Kappa:	.48			

Table 5-10B: Questionnaire response vs All documented BCG Vaccination
(Canadian born only)

		Documented BCG Vaccination		
		Given	Not Given	Total
Response to Question	YES (Received)	341	462	803
	NO (Never)	67	668	735
Totals	(576 missing)	408	1130	1538
Agreement	65%			
Kappa	.31			

The overall comparison of tuberculin reactions on the basis of vaccination status for the 1822 students in whom BCG status could be verified is seen in Table 5-11. Reactions to PPD-T are grouped by increments of 5mm, and it can be seen that among those with BCG vaccination, there is an excess prevalence at all categories of PPD-T, although almost 94% had reactions less than 10mm. The frequency distributions, smoothed by a moving three-point average, and grouped in increments of 2 mm are shown in Figure 5-2 on page 55. The distribution approximates a Poisson distribution with a gradual decline in proportion affected at increasing sizes of PPD-T.

TABLE 5-11A: RELATIONSHIP OF TUBERCULIN REACTIVITY TO DOCUMENTED BCG VACCINATION FROM BOOKLET AND REGISTRY OF IAF

(Grade 6, Canadian born only)

PPD-T	BCG Given	BCG Not given
0-4	399 (87.1%)	1320 (97.0%)
5-9	31 (6.8%)	22 (1.6%)
10-14	18 (3.9%)	11 (0.8%)
15 +	10 (2.2%)	11 (0.8%)
TOTAL (292 missing)	458	1364

Because of concerns regarding the possible under-reporting of BCG vaccination by the IAF, the frequency distribution of reactions of vaccinated and non-vaccinated were compared among the 766 for whom the vaccination booklets were available. These results are shown in Table 5-11B, and it can be seen that while there was an excess prevalence of tuberculin reactions measuring 5-14mm among those who had received BCG, above 14mm the prevalence was similar among the vaccinated and non-vaccinated. This is an important comparison, in part because under-reporting from the records of the vaccination booklets was less than that by the IAF, and also because any differences in characteristics between children, that may have been reflected by differences in providing the vaccination booklet (a form of health behaviour), would have been eliminated, because only students who had these booklets were included in this analysis.

TABLE 5-11B: RELATIONSHIP OF TUBERCULIN REACTIVITY TO DOCUMENTED BCG VACCINATION FROM BOOKLET ALONE

(Grade 6, Canadian born only)

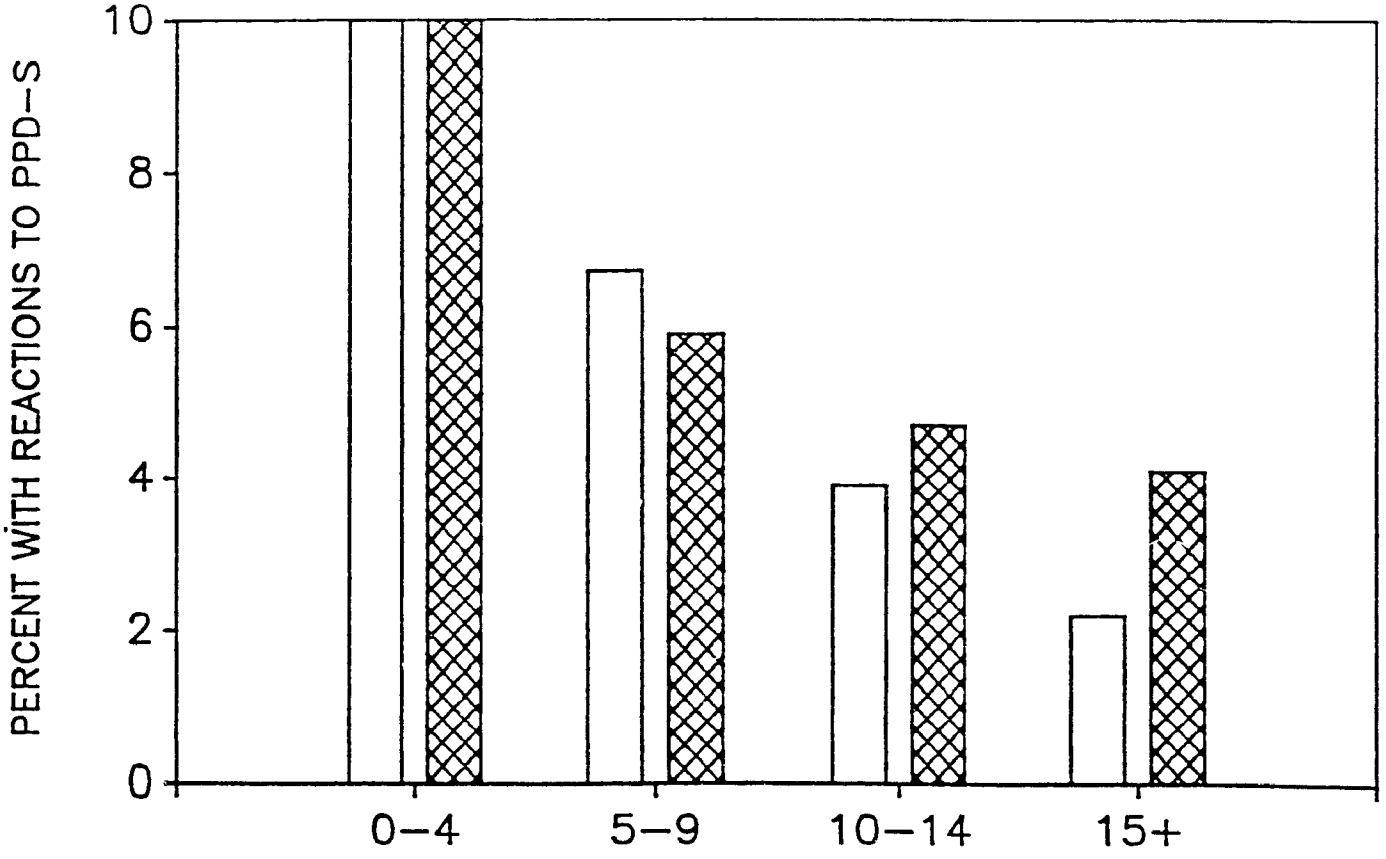
PPD-T	BCG Given	BCG Not given
0-4	259 (86.0%)	439 (95.0%)
5-9	21 (6.9%)	9 (1.9%)
10-14	16 (5.3%)	4 (0.9%)
15 +	7 (2.3%)	14 (3.0%)
TOTAL	303	463

BCG vaccination was strongly associated with indices of lower socioeconomic status. Among students resident in census areas characterized by lower than average housing quality, 35% had received BCG, compared to 14% of students resident in census areas with above average housing quality. This potentially confounded the relationship with tuberculin reactivity. To control for this, all students were first divided into two equal strata on the basis of SES indices, and within each stratum the frequency distributions of PPD-T reactions were compared between vaccinated and non-vaccinated. It can be seen from Table 5-12 below that among those who had been vaccinated, 7.2% of the poor had PPD-T over 9mm compared to only 3.2% of the more well-to-do who had been vaccinated. Similarly among non-vaccinated, 1.6% of the poor had reactions over 9 mm compared to only 1.1% of those less disadvantaged. Because of small numbers of tuberculin reactors in each stratum, and because the results were similar in the two age groups, the results from both Grades 6 and 10 students are combined in Figure 5-3, on page 56. All of the Grade 6 students, and all but 6 of the Grade 10 students had received vaccination in the first year of life. This pooling of results seems biologically justified, because in both groups the vaccine used, technique of administration and age when vaccinated were the same. Post-vaccinal tuberculin reactivity among Grade 10 students vaccinated at birth should certainly be no greater than that found among the Grade 6 students, who were also vaccinated at birth.

FIGURE 5–2:

TUBERCULIN REACTIONS – IMPACT OF BCG VACCINATION

CANADIAN BORN ONLY: GRADES 6 AND 10 WITH BCG VACCINATION



GRADE 6: BLANK BOX

GRADE 10: HATCHED BOX

FIGURE 5–3:

EFFECT OF BCGV ON TUBERCULIN REACTIVITY

ANALYSED BY STRATA OF SOCIOECONOMIC STATUS

(GRADES 6 & 10 COMBINED)

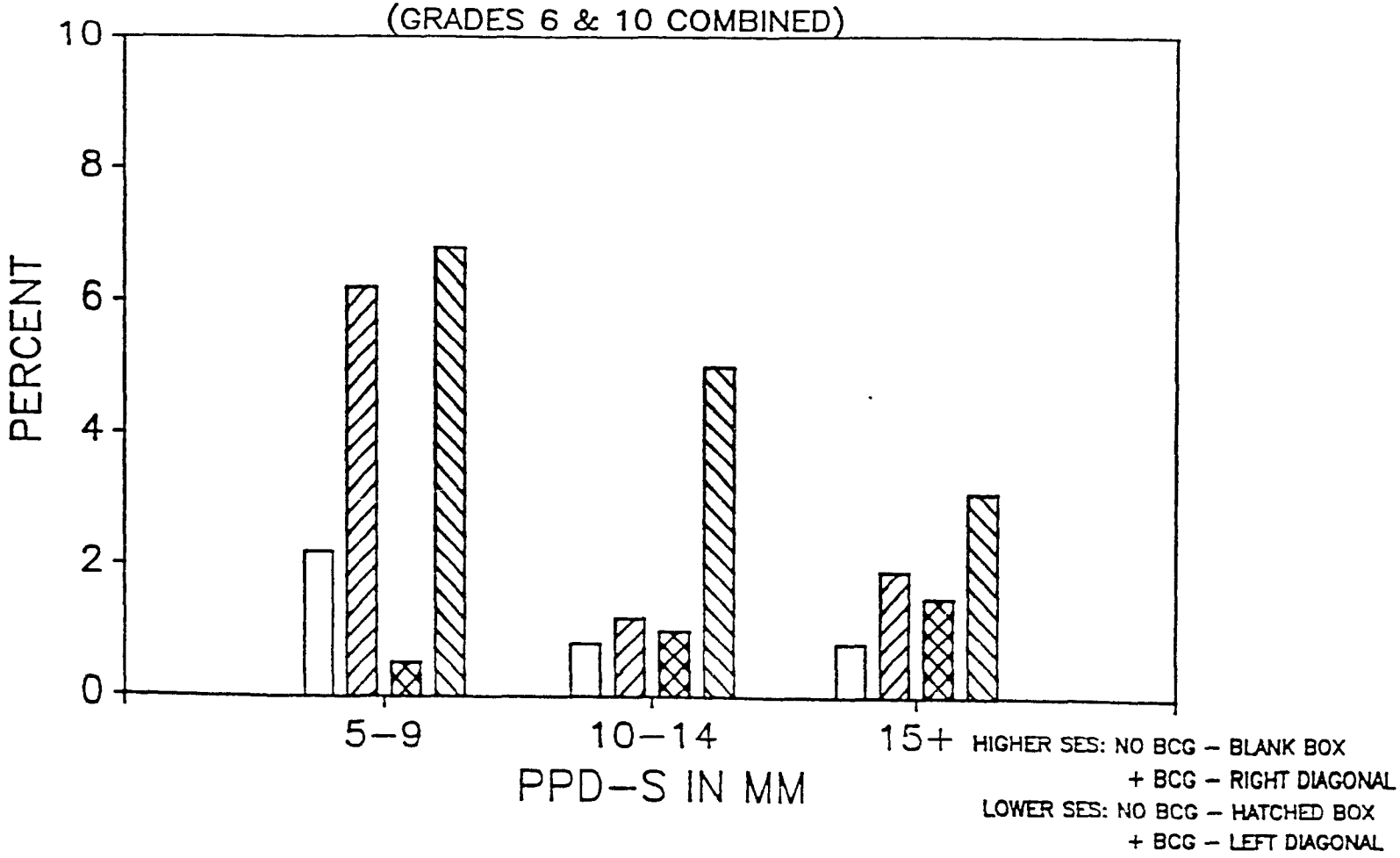


TABLE 5-12: EFFECT OF BCG VACCINATION ON TUBERCULIN REACTIVITY

STRATIFIED BY SOCIOECONOMIC STATUS
(Grade 6, Canadian born only)

	Lower SES		Higher SES	
Size of PPD-T	Vaccinated (335)	Not (647)	Vaccinated (125)	Not (768)
0-4	83.6%	97.8%	89.6%	97.0%
5-9	6.6%	0.6%	7.2%	2.5%
10-14	5.1%	0.8%	0.8%	0.4%
15+	2.1%	0.8%	2.4%	0.7%

From Tables 5-11 and 5-12 above, it can be seen that BCG was an important cause of false positive reactions. There were differences in prevalence of reactions between vaccinated students grouped on the basis of socioeconomic status, or age (Grade 6 vs Grade 10). This excess prevalence among the more disadvantaged, and the older students, was taken to represent the presence of tuberculous infection. This was added to the prevalence of reactions among the non-vaccinated to give an estimate of overall prevalence. This was used in turn to calculate sensitivity and specificity of different criteria for size of PPD-T reactions used to distinguish tuberculous infection from effect of BCG vaccination. From these, seen in Table 5-13, one can see that no cut-point is ideal, and because of the very low prevalence of tuberculous infection in this population, the specificity remains very low even at relatively higher cut-points, where the sensitivity also becomes low. However, based on this table and the results among the Grade 10 students, (see Table 6-13), a cut-point of 12mm would seem to be the best compromise. Therefore, in all subsequent analyses, among those with documented BCG vaccination, all reactions to PPD-T measuring between one and eleven mm were adjusted to equal zero.

TABLE 5-13: FALSE POSITIVE AND NEGATIVE RATES USING DIFFERENT SIZE CRITERIA TO DISTINGUISH EFFECT OF BCG VACCINATION FROM TUBERCULOUS INFECTION

(Grade 6, Canadian born only)

Cut-point of PPD-T size (mm)	Sensitivity	% False positive	Specificity
10 mm	100%	72%	28%
12 mm	81%	64%	36%
15 mm	46%	62%	38%
18 mm	23%	50%	50%
20 mm	8%	0	100%

5.4.3 Determinants of tuberculin reactivity: Immigration status of child.

Prevalence of tuberculous infection was far higher among immigrant children, who accounted for 69 of the 119 reactions (58%) of 10mm or more, as seen in Table 5-14. Among the Canadian born students, the prevalence of reactivity was similar for those whose parents were foreign born compared to those whose parents were Canadian born.

TABLE 5-14: TUBERCULIN REACTIVITY IN CHILDREN GROUPED BY IMMIGRATION STATUS:

Reaction to PPD-T	Immigration Status: Child-Can. Parents-Can.	Child-Can. Parents-Imm.	Child-Imm. Parents-Imm.
0-4	1288 (86.0%)	718 (91.0%)	217 (57.0%)
5-9	40 (3.3%)	19 (2.7%)	8 (3.0%)
10-14	28 (1.9%)	2 (0.9%)	32 (9.1%)
15 +	16 (1.2%)	4 (1.4%)	37 (10.5%)
Total	1371	743	294

Among the foreign-born children, those from areas with low incidence and prevalence rates of tuberculosis, had the lowest prevalence of tuberculin reactivity, while those from intermediate and high-prevalence areas, had higher prevalence. The absence of a consistent relationship to

tuberculosis rates in the country of origin may have been because many of the foreign born children who were students in the standard Grade 6, had immigrated many years earlier, at a younger age, and so may not have been exposed to or infected by tuberculosis before they came to Canada. The impact of age of emigration from a tuberculous endemic area, on prevalence of tuberculin reactivity, for all foreign born students of Grades 6 and 10, is shown in Figure 5-4, on page 60. The higher prevalence seen among those who were older when they immigrated implies that the majority of the tuberculin reactions seen were due to tuberculous infection rather than BCG vaccination. BCG is still routinely given in many developing countries in infancy and early childhood, but if this vaccination were the cause of the tuberculin reactions seen among the students tested, it seems unlikely that the relationship to age of emigration seen in Figure 5-4, would have been evident. Among those born in tuberculous endemic countries, further evidence that the majority of tuberculin reactions were due to tuberculous infection is that the frequency distribution of reaction sizes to PPD-T in mm was bimodal, as seen in Figure 5-5 (page 61). This is in contrast to the present findings of the frequency distribution seen among the Canadian born with BCG vaccination and is more in keeping with the frequency distribution seen among those with tuberculous infection (Comstock 1974, 1975).

Among the foreign born the overwhelming determinants of tuberculin reactivity were the tuberculosis rates in their country of origin, and the age when they emigrated. The risk of being infected here in Canada was relatively minor, and it seemed unlikely that the determinants of becoming infected here in Canada could be separated from the effect of exposure in their country of origin. Therefore all the foreign born students were excluded from all further analysis.

FIGURE 5–4:

TUBERCULIN REACTIVITY BY AGE WHEN IMMIGRATED

(FROM TUBERCULOUS ENDEMIC AREAS ONLY: GRADES 6 & 10)

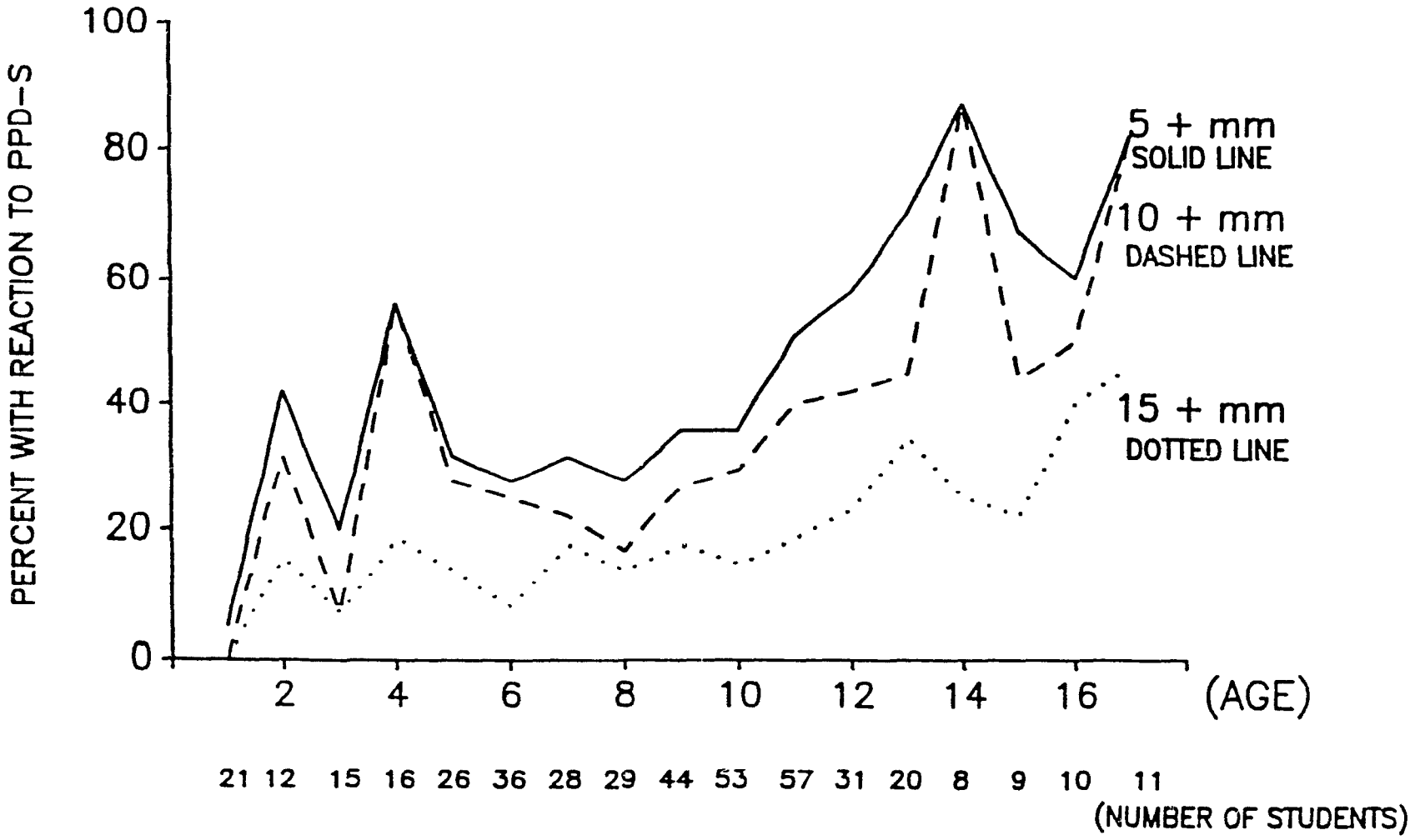


FIGURE 5–5:

TUBERCULIN REACTIVITY AMONG IMMIGRANT STUDENTS

(FROM TUBERCULOUS ENDEMIC AREAS ONLY, GRADES 6 & 10)

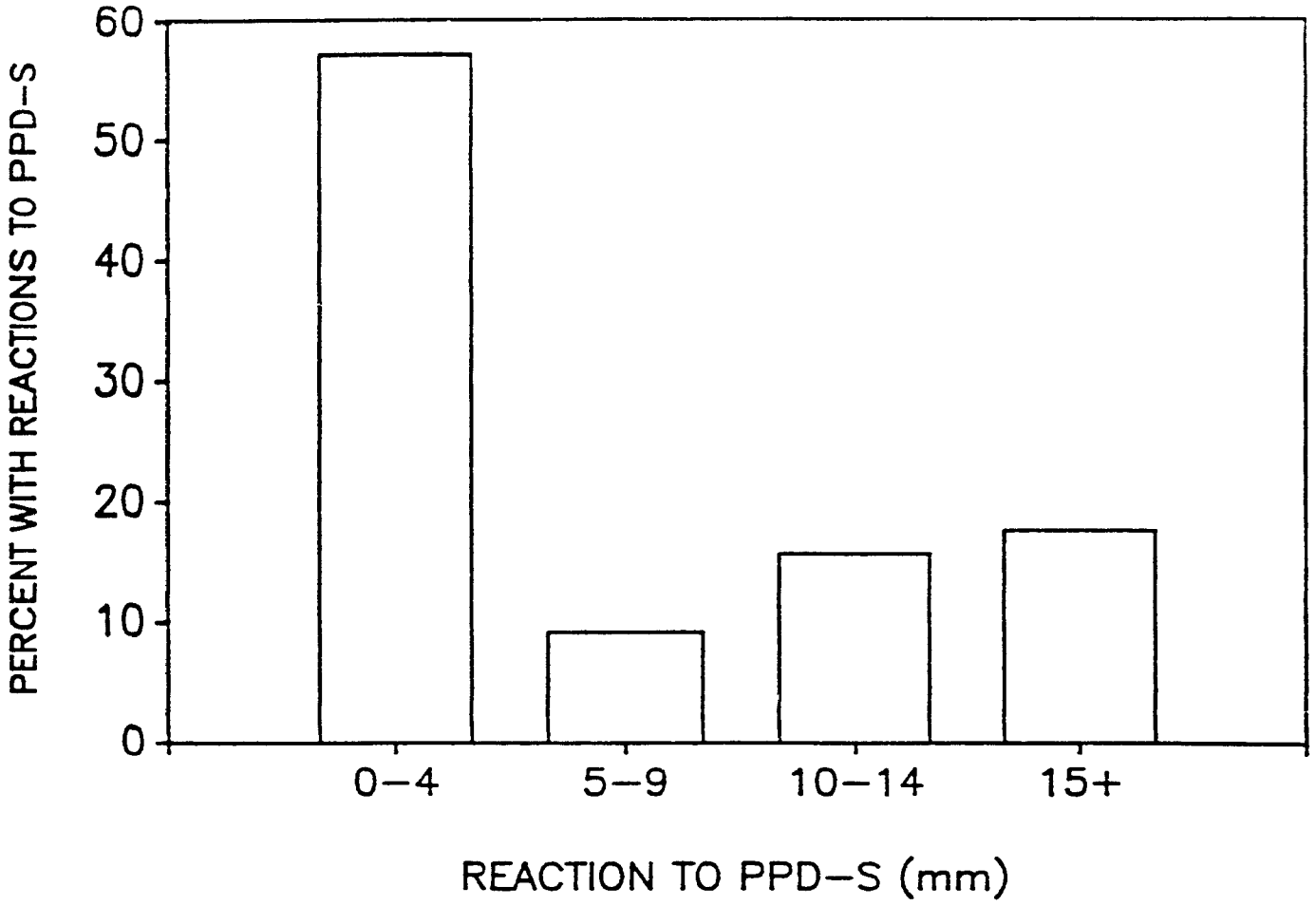


TABLE 5-15: RELATIONSHIP OF TUBERCULIN REACTIVITY AMONG IMMIGRANT CHILDREN TO PREVALENCE OF TUBERCULOSIS IN COUNTRY OF BIRTH:

(Grade 6, Child immigrant)

Reaction To PPD-T	Tuberculosis rates in country of birth of child * LOW	INTERMEDIATE	HIGH
0-4	23 (76.7%)	28 (71.8%)	166 (73.8%)
5-9	2 (6.7%)	0	6 (2.7%)
10-14	5 (16.7%)	3 (7.7%)	24 (10.7%)
15 +	0	8 (20.5%)	29 (12.9%)
TOTAL	30	39	225

* Rates taken from information published by IUAT, (See References # 79-88)

5.4.4 Determinants of tuberculin reactivity among Canadian born:

5.4.4.1 Age:

The mean age of all Canadian born Grade 6 students was 11.5 years. After adjusting for the false positive reactions due to sensitivity to PPD-B and BCG vaccination, using the criteria defined earlier, overall prevalence was 2.04%. This corresponded to an annual incidence of infection of 0.18%.

5.4.4.2 Tuberculosis rates in country of birth of parents:

As was seen earlier in Table 5-14, there was no difference in prevalence of tuberculin reactivity among Canadian-born children between those whose parents were foreign born compared to those with Canadian born parents. Among those whose parents were foreign born, there was a slight excess among those whose parents immigrated from tuberculous endemic areas, but this was not significant given the small number affected. All Canadian born students were analysed together in all subsequent analyses, because when compared on the basis of immigration status of their parents, there were no significant differences, in terms of characteristics (section 5.3, and Table 5-5A), as well as tuberculin reactivity (Tables 5-14 and 5-16).

TABLE 5-16: RELATIONSHIP OF TUBERCULIN REACTIVITY

TO COUNTRY OF BIRTH OF PARENTS

(Child Canadian-born, Parents immigrant)

Reaction to PPD-T	Tuberculosis rates in country of birth of parents * LOW	INTERMEDIATE	HIGH
0-4	299 (96.5%)	197 (98.0%)	178 (96.2%)
5-9	9 (2.9%)	4 (2.0%)	4 (2.1%)
10-14	0	0	1 (0.6%)
15+	2 (0.6%)	0	2 (1.1%)
TOTAL: **	310	203	185

* Rates taken from information published by IUAT, (References # 79-88)
** For 45 students the country of birth of both parents was missing.

5.4.4.3 Effect of socioeconomic factors:

The relationship to tuberculin reactivity of parental education level, and work-status as determined from questionnaire responses, are shown in Table 5-17. There was a consistently higher prevalence among children of parents with the lowest score in each category. When the prevalence among those in the lowest category was compared to the prevalence among those in all other categories combined, the differences were of borderline significance ($.1 < p < .2$ in all four categories, using Chi square). It should be noted that in coding the data, the lowest score for educational level was assigned if the parent was absent or deceased. Therefore the relationship between tuberculin reactivity and no parental education, seen in Tables 5-17A & B, was in reality the same association with mono-parental families seen in Tables 5-17C and 5-17D. Children of mono-parental families are on average significantly more disadvantaged than those of families where both parents are present. Among children of mono-parental families prevalence of tuberculin reactivity was higher, although this failed to reach conventional levels of statistical significance. After accounting for parental absence, there was no such association with level of parental education.

TABLE 5-17: PARENTAL FACTORS AS DETERMINANTS OF TUBERCULIN REACTIVITY

(Grade 6, Canadian-born only)

Table 5-17A: Maternal Education

	None	Primary	High School	CEGEP	University
PPD-T Pos	4 (3.5%)*	3 (0.8%)	22 (2.1%)	8 (2.7%)	5 (1.9%)
PPD-T Neg	109	373	1040	294	255

Table 5-17B: Paternal Education

	None	Primary	High School	CEGEP	University
PPD-T Pos	10 (4.2%)*	2 (0.5%)	17 (1.9%)	8 (3.1%)	5 (1.6%)
PPD-T Neg	226	399	882	252	312

Table 5-17C: Maternal Work-Status

	Absent	Housewife	Unemployed	Student	Working
PPD-T Pos	5 (4.6%)*	18 (2.0%)	0	0	19 (1.8%)
PPD-T Neg	103	874	4	67	1023

Table 5-17D: Paternal Work-status:

	Absent	Housekeeper	Unemployed	Student	Working
PPD-T Pos	12 (4.6%)*	1 (1.3%)	0	2 (1.9%)	27 (1.7%)
PPD-T Neg	317	75	22	100	1557

* (Percent of those in each category with significant reaction to PPD-T)

All students were grouped into quartiles according to the level of SES indices, obtained from census data, and the prevalence in each quartile compared. Using the Mantel-Haenszel Chi-Sq test, the differences were of borderline significance for two indices of housing quality (p=.06 for heat,

p = .07 for repairs). Using ANOVA, and treating PPD-T reactions as a continuous variable the differences between the quartiles were significant ($p < .01$).

TABLE 5-18: NEIGHBOURHOOD SOCIOECONOMIC DETERMINANTS OF TUBERCULIN REACTIVITY

(Grade 6, Canadian born only)

Table 5-18A: Relationship to Housing Quality - % With Central Heating

PPD-T	Distribution by Quartiles MOST 1	2	3	LEAST 4
Negative	499	509	518	500
Doubtful	15	7	8	14
Positive	7	5	9	11
TOTAL *	521	521	535	525

* (For 12 students this information was missing)

Table 5-18B: Relationship to Housing Quality - % needing Major Repairs

PPD-T	Distribution by Quartiles LEAST 1	2	3	MOST 4
Negative	490	489	522	506
Doubtful	11	13	14	6
Positive	6	8	5	12
TOTAL *	507	510	541	524

* (For 32 students this information was missing)

5.4.4.4 Effect of contact with immigrants:

The relationship of reactivity to PPD-T to contact with immigrants among Canadian born students is shown in Table 5-19. The prevalence of tuberculin reactivity was not higher among those who lived in neighbourhoods

or attended schools characterized by a higher proportion of immigrants, compared to those resident in neighbourhoods or attending schools characterized by a lower proportion of immigrants. No differences in tuberculin reactivity were demonstrable when immigrants from all regions were used as the index of exposure, nor when the index was restricted to those from tuberculous endemic areas. In fact, there appeared to be an inverse relationship. This may have been due to the fact that some of the most disadvantaged areas selected for study were characterized by a very low proportion of immigrants; the same was true for the schools in these areas. On the other hand, some of the neighbourhoods with a high proportion of foreign-born were more affluent. Multivariate analysis was used to assess the independant effects of socioeconomic status, and contact with immigrants; this will be presented in Chapter 7, because the results from both Grades 6 and 10 were combined for this analysis.

TABLE 5-19: RELATIONSHIP OF TUBERCULIN REACTIVITY

TO CONTACT WITH IMMIGRANTS:

(Grade 6, Canadian-born only)

Table 5-19A: Relationship to % Immigrants (all) in the neighbourhood

PPD-T	Distribution by Quartiles			
	LEAST			MOST
	1	2	3	4
Negative	481	517	488	521
Doubtful	15	10	11	8
Positive	12	9	7	3
TOTAL *	508	536	506	532

* (For 32 students this information was missing)

Table 5-19B: Relationship to % Immigrants from TB endemic areas in the Neighbourhood

PPD-T	Distribution by Quartiles LEAST 1	2	3	MOST 4
Negative	484	528	507	510
Doubtful	17	10	6	12
Positive	13	5	8	6
TOTAL *	514	543	521	528

* (For 8 students this information was missing)

Table 5-19C: Relationship to % of Students from TB endemic areas in the Schools

PPD-T	Distribution by Quartiles LEAST 1	2	3	MOST 4
Negative	528	536	461	511
Doubtful	18	14	5	9
Positive	11	8	4	9
TOTAL	557	558	470	529

5.5 SUMMARY

Overall participation among the Grade 6 students was 80.9%. Information was available on over 80% of the non-participants, and this enabled detailed characterization and comparison with those who participated. There were significant differences with regard to school board and language of instruction, but comparison of non-participants to participants within each of these sub-groups as well as overall, revealed no significant differences in terms of characteristics that may have affected prevalence of tuberculous infection. Of those tested, 3.6% had reactions to PPD-T of 5-9mm, and 5.1% had reactions of 10mm or more. Sensitivity to PPD-B accounted for approximately one-fifth of reactions of 5-9mm, but very few of the larger

tuberculin reactions. Among the foreign born, prevalence of tuberculin reactivity was increased, particularly among those who had immigrated to Canada at a later age, from countries where tuberculosis rates are still high. Among Canadian born, almost 22% had received BCG vaccination, principally those resident in more disadvantaged quartiers, and was responsible for a significant number of false positive reactions, although very few of these were larger than 12mm, and probably none greater than 15mm. Overall prevalence was 2.04%, equivalent to an annual incidence of infection of 0.18%. The major determinant of infection was socioeconomic status, of which the best indicators were those that reflected housing status, and absence of one parent. Possible community exposure to tuberculosis, either through residence in communities or attendance at schools characterized by an increased proportion of immigrants from tuberculous endemic areas, was not associated with an increased prevalence of tuberculin reactions.

CHAPTER 6: RESULTS AMONG THE GRADE TEN STUDENTS

6.1 POTENTIAL BIAS DUE TO NON-PARTICIPATION

The original estimate of the required sample size was 1500 students. Lower participation rates had been experienced on previous surveys among this age group, so it was anticipated that participation was unlikely to exceed 75%. Therefore the original estimate for the total target population required was set at approximately 2000 students. However, because of delays in obtaining school board approval, three schools in which the survey was planned were dropped. As well in one school the principal refused to allow the survey to be conducted because of poor scolastic performance by the Grade 10 students, who numbered over 200. Although the loss of the potential participants is important because of potential loss of statistical power, their exclusion from the study should not bias the results, because the reasons for non-participation were unrelated to the study objectives.

This left an eligible population of 1636 students, of whom 983 participated (60.2%). As with the Grade 6 students, very few of those tested did not have readings, because of extensive efforts by study personnel to trace every student tested. Among the non-participants the great majority were non-respondents. Little was known of the reasons for non-participation among these non-respondents, because the testing was usually done in a central location, and not on a class by class basis.

TABLE 6-1: OVERALL PARTICIPATION AMONG THE GRADE 10 STUDENTS

Population eligible:		1636	
Non-participants:	Absent - testing:	21	
	reading:	3	
	Refused - Parents:	24	
	Students:	15	
	No response:	606	
	TOTAL:	653	(39.8%)
Participants:	Had prior positive PPD:	4	
	Had prior negative Tine:	2	
	Tested in study:	977	
	TOTAL:	983	(60.2%)

6.1.1 Information on non-participants:

In contrast to the Grade 6 students, there was very little information available on non-participants. Only 29 completed questionnaires, while age and postal code information was available from school lists for an additional 66 only. There was no information available for 568 students, or 34.7% of the total eligible population. Among the non-participants, those attending Protestant and/or English language schools returned the least number of questionnaires. Fortunately there were special situations in three of the high schools which provided some insight into the characteristics of the non-participants. In two English Protestant schools, because of very low participation on the initial scheduled survey, a 2-stage survey was conducted, as was discussed in Chapter 4. The characteristics of those who participated in the first stage could be compared to those of the students who participated only after extensive additional recruiting efforts. This was an important comparison because both were English Protestant schools, and so represented the largest group of non-respondents. In one English Catholic school, a school list with dates of birth and addresses for all students, was obtained. This allowed comparison of participants and non-participants within this school on the basis of age and census data.

6.1.2 Relationship to language of instruction and school-board:

As with the Grade 6 students, the rate of participation in each school ranged from as little as 34% to as high as 74%. There were large differences in the participation rates in different school-boards; 50% for the Protestant schools compared to 65% for all Catholic schools. Similarly participation was 53% in the English language schools, compared to 70% in the French language schools. Participation was highest in the schools in Verdun, and as with the Grade 6 students, appeared to correlate with the degree of approbation and enthusiasm of the teachers, and vice-principals who were responsible for the Grade 10 level.

TABLE 6-2: PARTICIPATION RATES: BY LANGUAGE OF INSTRUCTION AND SCHOOL-BOARD

Table 6-2A: Participation rates: by language of instruction

Language	Eligible	Participants	Percent
English	1005	529	52.6% *
French	631	454	70.7% *
Total	1636	983	

* (Difference between the two groups significant using Chi Sq, p<.001)

Table 6-2B: Participation rates: by school-board

Board	Eligible	Participants	Percent
Protestant-Montreal	613	312	50.7% *
All Catholic	1023	671	66.0% *
Catholic-Montreal	732	468	64.0%
Catholic-Verdun	291	203	69.6%
Total	1636	983	

* (Difference between Catholic and Protestant significant using ChiSq, p<.001)

6.1.3 Questionnaire return:

Questionnaire return by participants as well as non-participants are shown in Table 6-3A. Among the participants, those who did not complete a questionnaire were students who decided at the last moment on the day of testing to participate These adolescents signed the consent, a telephone consent was then obtained from one of their parents, but the questionnaire was not completed, because of pressure of time. With the exception of the students in the two schools where the two-stage survey was conducted, the students who completed only part of the questionnaire (classified as 'short'), were also those who decided at the last moment to participate.

Therefore, in order to gain insight into the non-respondents it seemed valid to compare the participants who returned completed questionnaire to participants who returned incomplete questionnaires, or no questionnaire at all. This group represented students whose health behaviour was similar to that of the non-respondents, and their characteristics are shown in Table 6-3A, below. To provide additional insight into the characteristics of the

non-respondents, students with similar non-participating behaviour were compared on the basis of questionnaire completion. These comparisons are shown in Table 6-3B. Among participants, those who did not complete questionnaires tended to come from richer neighbourhoods with more immigrants, while among non-participants the opposite was true. None of the differences seen in this table were significant.

TABLE 6-3A: QUESTIONNAIRE RETURN BY PARTICIPANTS AND NON-PARTICIPANTS

Status:	Questionnaire completion:			
	None	Short	Complete	Missing
Non-participants	66	6	23	558 *
Participants	53	162	765	3 **
TOTAL	119	168	788	561

* (Refers to students for whom no information was available)
** (Questionnaires lost!)

TABLE 6-3B: COMPARISON OF PARTICIPANTS AND NON-PARTICIPANTS

ON THE BASIS OF THEIR COMPLETION OF QUESTIONNAIRES

Status Characteristic	Questionnaire completion: None	Short	Complete
Non-participants:			
Age child	16.5 (66)*	16.8 (6)	16.7 (22)
Poverty Index	35.7 (29)	32.7 (6)	29.1 (19)
% Immigrants	18.1 (29)	10.7 (6)	18.6 (19)
Participants:			
Age child	16.5 (48)	16.3 (162)	16.1 (760)
Poverty Index	38.1 (6)	31.2 (125)	32.9 (700)
% Immigrants	19.1 (6)	17.0 (125)	18.6 (700)
Immigration Status:			
Child-Can, Parents-Can	60%	60%	45%
Child-Can, Parents-Imm	19%	23%	32%
Child-Imm, Parents-Imm	21%	17%	23%

* (Number for whom this information was available)

6.1.4 Characteristics of Non-participants compared to Participants:

In all, there were 94 non-participants for whom some information was available. Their characteristics are compared to those of the 983 participants in Table 6-4B. There were no major differences in demographic data, nor neighbourhoods of residence, based on census data. As well, there were no significant differences with regard to responses to questions regarding past history/exposure to tuberculosis, although the non-participants were somewhat more likely to respond that they had received BCG vaccination.

In the 2 schools in which a 2-stage survey was done, those who participated only after the additional recruiting efforts in the second stage, tended to live in poorer neighbourhoods, with higher proportion of immigrants, compared to those who participated in the original survey, as seen in Table 6-4A, but these differences were not significant. In the one school in which census data could be used to characterize all non-participants they did not differ significantly from participants in terms of age, or the characteristics of the neighbourhoods such as poverty level, or percent of immigrants.

TABLE 6-4A: CHARACTERISTICS OF PARTICIPANTS IN THE TWO SCHOOLS WHERE THE 2-STAGE SURVEY WAS CONDUCTED:

Characteristic of participants	First Stage	Second Stage
Number	31	82
Age of student (mean)	16.2	16.4
Poverty Index (mean)	26	29.7
Immigration status:		
Child-Can & Parents-Can.	12 = 39%	26 = 32%
Child-Can & Parents-Imm.	9 = 29%	38 = 46%
Child-Immigrant	10 = 32%	18 = 22%

TABLE 6-4B: CHARACTERISTICS OF PARTICIPANTS COMPARED TO NON-PARTICIPANTS

Characteristic	Participants (N=983)		Non-Participants (N=653)	
CHILD				
Age (years)	16.1	(969)*	16.6	(92)*
Immigration status:				
Child-Can. Parents-Can.	478 = 60%		49 = 75%	
Child-Can. Parents-Imm.	285 = 29%		7 = 11%	
Child-Immigrant	218 = 22%		9 = 14%	
Country of birth:				
Non-endemic for TB	32		0	
Intermediate for TB	19		1	
Endemic for TB	166		7	
Year of immigration:	19-80.1	(204)	85.1	(8)
MOTHER				
Age (years)	43.4	(705)	43.0	(20)
Country of birth:				
Non-endemic for TB	124		2	
Intermediate for TB	93		4	
Endemic for TB	231		6	
Year of immigration	19-70.6	(352)	73.3	(10)
FATHER				
Age (years)	46.8	(647)	47.4	(16)
Country of birth:				
Non-endemic for TB	120		3	
Intermediate for TB	98		5	
Endemic for TB	207		5	
Year of immigration	19-68.9	(338)	75.6	(11)
NEIGHBOURHOOD DATA:				
Poverty Index (child)	32.6		33.1	
% Immigrants (all countries)	18.4		17.5	
% Immigrants (TB endemic)	3.9		2.6	
% Dwellings without heat	22.5		23.1	
% Dwellings needing repairs	9.5		9.0	
RESPONSES TO QUESTIONNAIRE (% yes)				
Past history of TB	2.0%	(913)	0	(26)
Past treatment for TB	5.1%	(909)	7.0%	(28)
Past contact with TB	2.3%	(913)	0	(20)
BCG Vaccination	28.4%	(822)	42.5%	(26)

* (No. in parentheses refers to number for whom information was available)

Because information to characterize the non-participating adolescents was so limited, a detailed analysis of those who did not participate within the sub-categories of school Board and language of instruction was not

possible. The characteristics of the participants grouped by Board and language of instruction are shown in Appendix Tables Avii-Aviii. The Verdun board represented a small and relatively homogeneous population that was well defined geographically because most students going to Verdun schools lived in Verdun. Therefore this Board appeared quite distinct from the other two, but as the rate of participation was highest in this Board the concern over potential bias was less. There were differences between the English and French language schools related to immigration in that more recent immigrants predominated in the French schools, but this is more likely a reflection of the peculiarities of the language legislation in Quebec, than differential participation by immigrants in different schools. There were major differences of socioeconomic status between the students of Catholic compared to Protestant schools, and English compared to French language schools but there appeared to be no differences between those who did and did not participate within each of these sub-groups.

6.1.5 Non-Participants - Summary:

Overall participation was 60.2%. Of the 653 students who did not participate, for only 94 was sufficient information available for a detailed comparison with the 983 participants. However special circumstances within three schools allowed additional insight into the non-respondents, as did comparison on the basis of questionnaire completion. On the basis of these three comparisons of participants to non-participants, there appeared to be no major differences between those who did and did not participate, in terms of the characteristics believed to be determinants of the prevalence of tuberculosis. Therefore the rate of participation of 60.2% should not have created undue bias, and the estimation of effect based on the findings in the participants should be valid for the entire target population.

6.2 CHARACTERISTICS OF PARTICIPANTS:

The characteristics of the 983 participants are given in Table 6-4B. The standard deviation for age was greater among the Grade 10 students than for the Grade 6 students. The standard deviation for neighbourhood factors such as poverty index, proportion of immigrants and indicators of housing quality was similarly large, reflecting the great variation in terms

of these characteristics between neighbourhoods in Montreal. Among the Grade 10 students 22% were foreign-born, and average Poverty index was 32.6, and percent immigrants was 18.4 for the place of residence. This compares with 12% foreign-born among Grade 6 students, with averages of 35.5 and 22.2 for the same two neighbourhood indices respectively. The greater proportion of foreign born may have been due more to the much lower participation by the Canadian born in Grade 10, while the participation rate among the foreign born was similar to that in Grade 6. The similarities of neighbourhood data between the two Grades, is reassuring since the populations were from schools located in the same geographical areas, and both Grades should have been representative of these same areas.

The characteristics of the participants grouped by immigration status are shown in Table 6-5A. Among Canadian-born children, those whose parents were immigrants tended to live in neighbourhoods which were slightly (but not significantly) less poor with a significantly greater proportion of immigrants. Immigrant parents tended on average to be older, with slightly less education. These differences were small, and so in subsequent analysis all Canadian born adolescents were considered together. Among the foreign-born adolescents, the majority immigrated from tuberculous endemic regions, whereas foreign-born parents of Canadian-born adolescents tended to have immigrated from Europe.

TABLE 6-5A: CHARACTERISTICS OF PARTICIPANTS GROUPED BY IMMIGRATION STATUS
(Grade 10, All participants)

Characteristics	Immigration status		
	Child-Can. Parents-Can.	Child-Can. Parents-Imm.	Child-Imm. Parents-Imm.
Number	481	284	218
Age of child	16.1	16.0	16.5
Age of mother	42.3	45.1	43.1
Age of father	44.8	49.3	47.3
Neighbourhood data:			
Poverty Index (child)	33.6	29.3	35.2
% Immigrants (all nations)	11.1	26.0	24.5
% Immigrants (TB endemic)	2.4	4.6	6.2
% Dwellings without heat	29.4	16.6	15.5
% Dwellings needing repair	10.2	8.8	8.6

The prevalence of tuberculin reactivity was considerably greater than the average, among those who responded affirmatively to questions regarding tuberculosis contact, diagnosis or treatment. For example over half of those who gave a history of prior diagnosis of tuberculosis had a significant reaction. However the proportion of reactors would have been expected to have been even higher if all responses had been correct.

TABLE 6-5B: RELATIONSHIP OF TUBERCULIN REACTIVITY TO RESPONSES TO QUESTIONNAIRE

(Grade 10, All participants)

Question	Total population				Canadian born only			
	Yes	(%PPD +)	No	(%PPD +)	Yes	(%PPD +)	No	(%PPD +)
Past diagnosis of TB	19	(52.7)	894	(9.4)	3	(0)	708	(4.7)
Past treatment for TB	45	(33.3)	864	(9.1)	24	(16.7)	682	(4.3)
Contact with TB	21	(28.8)	892	(9.9)	14	(14.3)	695	(4.5)
BCG Vaccination	230	(16.1)	592	(9.6)	172	(8.7)	440	(4.1)

6.3 INTER-RELATIONSHIPS OF INDEPENDANT VARIABLES:

The foreign-born students were a very distinct group, in whom the principal determinant of tuberculin reactivity was the likelihood of exposure to tuberculosis in their country of origin. For this reason they were excluded in the subsequent analysis of the determinants of infection, such as demographic, socioeconomic and neighbourhood factors, and the correlation of the independant variables used for this analysis was similarly restricted to the Canadian born only. The strongest correlation was between the educational levels of the mother and father ($r=.74$). For this reason only the educational level of the mother is shown in Table 6-6. There were a number of strong correlations between various indices of socio-economic status, such as parental education, and work-status, and the census data such as percentage of children living below the poverty line. As well, indices of housing quality, such as the percentage of buildings without central heat or in need of major repairs were highly correlated with income levels. The neighbourhood indices of lower socioeconomic status were not

correlated with the percent of immigrants in these neighbourhoods, nor in the schools. This lack of correlation should allow analysis of the independant effects of socioeconomic status and contact with immigrants on prevalence of tuberculous reactivity. Although very few answered affirmatively to the questions regarding tuberculosis history, there was a high level of concordance of responses to questions regarding contact, diagnosis and treatment.

TABLE 6-6: CORRELATION OF INDEPENDANT VARIABLES
Grade 10, Canadian-born only

	Pov-C	Heat	Repairs	%-Imm	ImSchool	Educ-M	Work-M
Pov-C	-						
Heat	.44	-					
Repairs	.59	.60	-				
%-Imm	-.07	-.48	-.15	-			
ImSchool	-.03	-.41	-.03	.27	-		
Educ-M	-.17	-.06	.01	-.11	-.07	-	
Work-M	-.06	.01	-.03	.01	-.01	.46	-
Work-F	.01	.02	.01	.04	-.04	.40	.45

Notes:
Pov-C: % of children in families below poverty line, in census area.
Heat: Percent of buildings in census area without central heating.
Repairs: Percent of buildings in census area in need of major repairs.
%-Imm: Percent of residents in census area that were foreign-born.
ImSchool: Percent of students in school, who were born in TB endemic countries.
Educ-M: Highest educational level achieved by mother, from questionnaire.
Work-M/F: Current work-status for mother/father; from questionnaire.

6.4 RESULTS OF SKIN TESTING

Overall, 10.4% of the adolescents tested had significant reactions measuring 10mm or more to PPD-T, and a further 3.5% had reactions in the 5-9mm, or "doubtful" range. Significant reactions to PPD-B were seen in 7.0% of the adolescents, compared to only 1.5% among the Grade 6 students.

TABLE 6-7: OVERALL RESULTS OF SKIN TESTING:
(Grade 10, All participants)

	PPD-T			PPD-B	
Size of PPD-T	Number	Percent	Size of PPD-B	Number	Percent
0	738	75.1%	0	766	77.9%
1-4	104	10.6%	1-4	104	10.6%
5-9	34	3.5%	5-9	44	4.5%
10-14	49	5.0%	10-14	51	5.2%
15+	53	5.4%	15+	18	1.8%
TOTAL	983			983	

In Table 6-8 are shown the correlation of readings for PPD-T and PPD-B. The frequency distributions of readings for the two antigens are shown in Figure 6-1, on page 80. As was found with the Grade 6 students there was a 'middling' tendency, but there does not appear to have been much bias in reading related to the criteria for referral for clinical evaluation at the Montreal Children's Hospital. For instance, 15 students had reactions of 4 mm, meaning they were not referred, while 12 had reactions of 5 mm, which necessitated referral. Similarly 9 students had readings of 9 mm, and if they had received BCG vaccination they were not referred, while 16 had readings of 10 mm and would have been referred regardless of their vaccination status. As with the Grade 6 students, the middling tendency represents a lack of precision in reading, and introduces random error, but did not appear to be associated with any systematic bias to read above or below certain sizes. In the analysis the prevalence of tuberculin reactivity was compared between students grouped on the basis of various possible determinants of tuberculous infection. Therefore this imprecision of measurement should not bias the inferences made, although it may reduce the ability to find a significant association if one exists.

FIGURE 6–1:

FREQUENCY DISTRIBUTION OF READINGS FOR PPD–T AND PPD–B

(GRADE 10 ONLY)

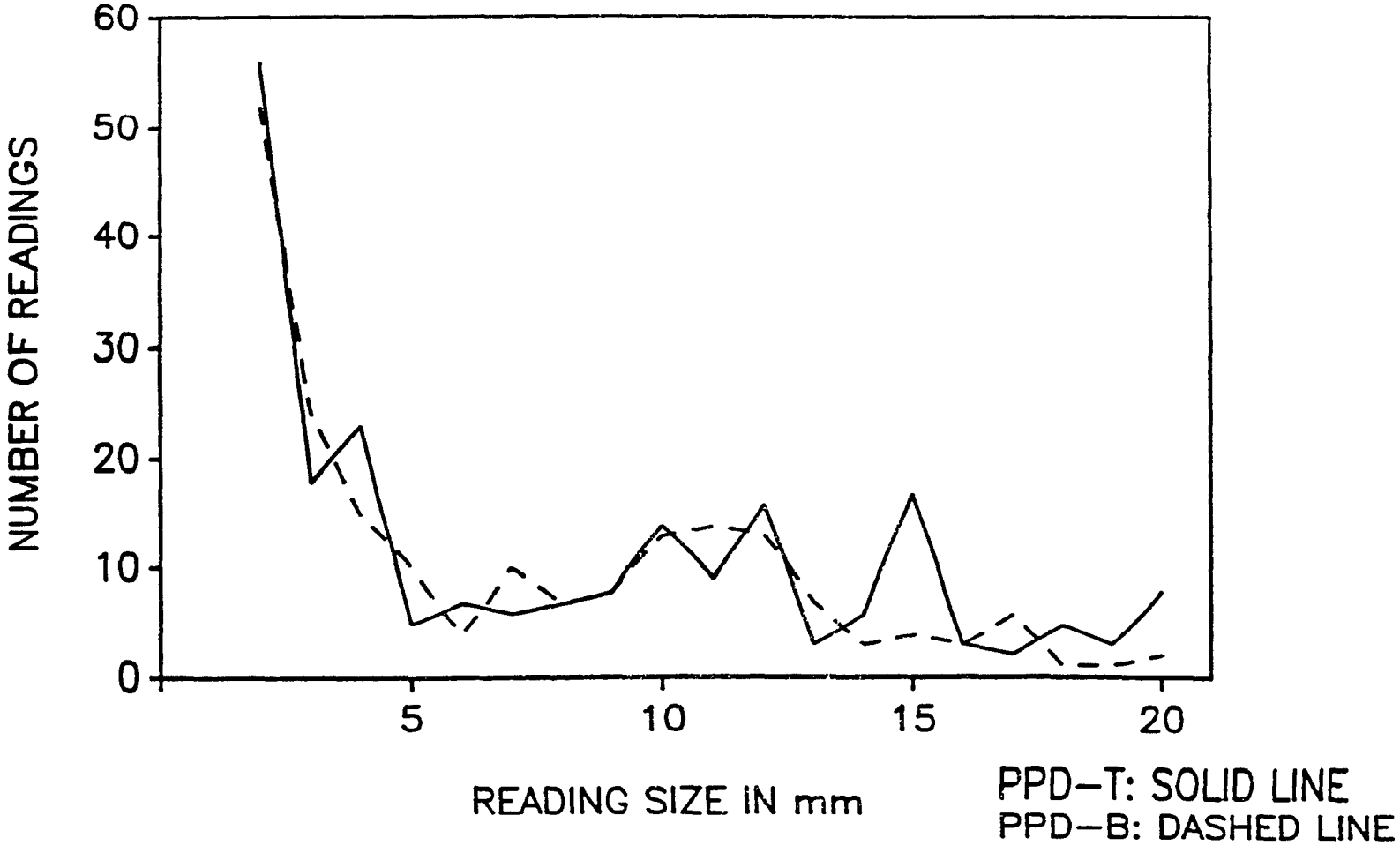


TABLE 6-8: RELATION OF REACTION SIZE TO PPD-T AND TO PPD-B
(Grade 10, All participants)

Reaction to PPD-T in mm.	Reaction to PPD-B in millimetres									
	0	1-3	4	5	6	7-8	9	10	11-12	13+
0	659*	43	9	4	2	4	2	2	6	2
1-3	44	36	0	1	0	3	0	2	0	0
4	16	3	1	0	0	0	0	1	1	0
5	2	0	0	2	0	0	1	0	0	0
6	4	0	0	0	0	0	0	0	2	1
7-8	4	1	1	1	0	1	1	0	4	1
9	1	0	1	0	1	1	1	0	3	0
10	10	0	0	1	0	0	0	0	0	3
11-12	9	0	3	0	0	1	2	4	2	4
13+	14	5	0	2	1	8	1	4	9	18

* (Number of subjects with the two readings for PPD-T and PPD-B)

6.4.2 Causes of false positive tuberculin reactions:

6.4.2.1 Sensitivity to PPD-B

Overall, as was seen in Table 6-7, 44 of the adolescents had reactions to PPD-B measuring 5-9 mm. Of these 24 (55%) could be ascribed to cross-reactivity with tuberculin antigen, because the accompanying reaction to PPD-T was equal or larger. Similarly, of the 69 reactions to PPD-B measuring 10 mm or more, 35 (51%) could be ascribed to cross-reactivity with PPD-T. As seen in Table 6-9A, of those with doubtful PPD-T reactions, 38% could be attributed to cross-reactivity to PPD-B and so could be considered false positive, as were 14% of those with PPD-T reactions of 10-14mm. Of those students with reactions to PPD-T measuring 15mm or more, only two had a simultaneous reaction to PPD-B that was greater. Both students had immigrated from areas endemic for both of these Mycobacteria, so this dual reaction most likely represents exposure and infection with both Mycobacterial species.

TABLE 6-9A: FALSE POSITIVE TUBERCULIN REACTIONS DUE TO SENSITIVITY TO PPD-B
(Grade 10, All participants)

Size of PPD-T (mm)	Total Number with Reactions to PPD-T	Number with PPD-T < PPD-B	% False Positive
0-4	847	93	*
5-9	34	13	38%
10-14	49	7	14%
15+	53	2	4%
TOTALS	983	115	

* (PPD-T reactions of 0-4 are not considered significant so PPD-B cannot be considered to have caused 'false positive' reactions in this size range)

As seen in Table 6-9B, foreign-born students were significantly more likely to demonstrate sensitivity to PPD-B, and therefore to have false positive PPD-T reactions, on this basis. Among immigrant students, sensitivity to PPD-B accounted for 40% of all reactions to PPD-T measuring 5-9 mm, and 16% of all reactions measuring 10-14 mm. Among Canadian born students, reactions to PPD-B accounted for 31% of all reactions in the 5-9 mm range and only 6% of all reactions in the 10-14 mm range. The prevalence of sensitivity to PPD-B was greater among those from tropical countries, but was not directly related to prevalence of M. Tuberculosis in their country of birth. For example, in most Caribbean countries (except Haiti) tuberculosis rates are low and M. Avium appears endemic. Among Caribbean-born adolescents tested in this study, none were tuberculin reactive, while 20% demonstrated sensitivity to PPD-B.

TABLE 6-9B: ASSOCIATION OF SENSITIVITY TO PPD-B TO IMMIGRATION STATUS
(Grade 10, All participants)

Size of Reaction To PPD-B (mm)	Immigration status of student: Canadian-born	Foreign-born
PPD-B < PPD-T	685	182
2-4	51	10
5-9	14 (1.8%) *	6 (2.8%) *
10+	14 (1.8%)	20 (9.1%)
TOTAL	765	218

* (Percent of total number of students in that immigration category)

Among Canadian born adolescents, sensitivity to PPD-B was not associated with BCG status, (See Appendix Table x), nor with indices of socioeconomic status. As well there was no relationship to travel to the SE USA (shown in Appendix Table xii). For all subsequent analyses, if the reaction to PPD-B exceeded that of the reaction to PPD-T and the reaction to PPD-T was less than 12 mm, then the PPD-T was adjusted to equal zero.

6.4.2.2 Effect of BCG vaccination (among Canadian born only):

As with the Grade 6 students, the foreign-born Grade 10 students were excluded from the analysis of the effect of BCG vaccination on tuberculin reactivity, because vaccination status could not be verified. In the first two high schools surveyed, less than 5% of the participants furnished their vaccination booklets. Based on this experience, and the advice of the school health nurses responsible for the subsequent schools, the review of vaccination booklets was abandoned. It was felt that the response rate was so low that the review of the few provided might create undue bias. Therefore, only two sources of information for verification of BCG vaccination status among the Canadian-born adolescents were used; namely, questionnaire response and the central registry of BCG vaccination, kept by the Institut Armand Frappier. Records could not be traced for 80 of the adolescents, while only 552 provided a response on the questionnaire. Of those who said they had been vaccinated, documentation of vaccination was found for 58.5%, and of those with documented BCG vaccination, only 60% responded that they had previously received it. Despite this, the overall level of agreement was 74%, with kappa of 0.41 between these two sources of information. This is better than the agreement of questionnaire response to documented BCG which equalled 65%, with kappa of 0.31, among the Grade 6 students. This difference may have been related to the fact that the adolescents completed their own questionnaires and may have been more precise, than the parents of the Grade 6 students who completed the questionnaires on behalf of their children.

TABLE 6-10: AGREEMENT BETWEEN SOURCES OF INFORMATION ON BCG VACCINATION
(Grade 10, Canadian born only)

		BCG Vaccination recorded by the IAF		
		Given	Not Given	Total
Response to Question	YES (Received)	89	63	152
	NO (Never)	58	262	320
TOTALS	(293 missing)	147	325	472
Agreement:	74%			
Kappa:	0.41			

All but 6 of the 170 students who had documented BCG vaccination had received this in the first year of life. None had been vaccinated more than once. The prevalence of tuberculin reactivity among those with documented BCG vaccination status is shown in Table 6-11. Significant tuberculin reactions were seen in 10.3% of those who had received BCG, compared to only 3.9% among the non-vaccinated.

TABLE 6-11: RELATIONSHIP OF TUBERCULIN REACTIVITY
TO DOCUMENTED BCG VACCINATION
(Grade 10, Canadian born only)

Reaction to PPD-T (mm)	BCG Vaccination	
	Given	Never given
0-4	144 (83.5%)	496 (96.0%)
5-9	11 (6.1%)	3 (0.6%)
10-14	8 (5.5%)	9 (1.8%)
15 +	7 (4.9%)	7 (2.1%)
TOTAL (80 missing)	170	515

Of the students who lived in neighbourhoods characterized by poorer quality housing, 38% had been BCG vaccinated compared to only 11% of those resident in less disadvantaged neighbourhoods ($p<.001$). Similarly, 32% of those resident in neighbourhoods with below average income had been vaccinated compared to 19% of those resident in neighbourhood with above

average income ($p<.05$). Therefore the frequency distributions of reactions to PPD-T were compared between students, stratified by these socioeconomic indices, grouped on the basis of their BCG vaccination status. This is shown for students stratified by housing indicators, in Table 6-12. The prevalence of tuberculin reactivity was higher in the more disadvantaged group, comparing those who had received BCG as well as those who had not. In the group with better housing there were no differences in the prevalence of reactions above 14mm between those who had, and had not received BCG vaccination. When the students were stratified on the basis of average income levels in their neighbourhoods, the findings were similar. Among the BCG vaccinated the proportion with reactions over 14 mm was 6% among those from the lower income stratum, compared to 1.4% in the upper income stratum. Among all non-vaccinated students in both strata, 1.5% had reactions of 15mm or more.

TABLE 6-12: EFFECT OF BCG VACCINATION ON TUBERCULIN REACTIVITY - STRATIFIED BY SOCIOECONOMIC STATUS

(Grade 10, Canadian born only)

Reaction to PPD-T (mm) (Number)	Lower SES Vaccinated (133)	Lower SES Not (219)	Higher SES Vaccinated (37)	Higher SES Not (296)
0-4	82.7%	96.8%	94.6%	97.2%
5-9	6.8%	0	2.7%	1.7%
10-14	4.5%	1.4%	2.7%	1.7%
15+	5.3%	3.0%	0	1.0%

These results, combined with those from the Grade 6 students, were shown graphically in Figure 5-3, on page 56. BCG vaccination was an important cause of false positive reactions. Of the tuberculin reactions seen among those previously vaccinated, not all could be attributed to BCG. In order to determine the maximal size of reaction to PPD-T that could reasonably be attributed to BCG, a table of false negative and positive rates that would result from different cut-off points was calculated. The following assumptions were made in these calculations:

i) BCG vaccination does not prevent tuberculous infection. This is

based on both experimental and pathological evidence (Sutherland 1979); ii) Among those truly infected with tuberculosis, tuberculin reactions will be similar for vaccinated and non-vaccinated (Groth-Petersen 1974); iii) Among the non-vaccinated, all tuberculin reactions of 5 mm or more, after adjustment for sensitivity to PPD-B, represent true infection with tuberculosis. This latter assumption is based on evidence from earlier surveys (Smith 1964, Edwards 1973); and, iv) Any excess prevalence among the Grade 10 vaccinated students compared to the vaccinated Grade 6 students of the higher SES stratum, represented tuberculous infection. This was based on the assumption that if all students were vaccinated in infancy, the prevalence of tuberculin reactivity due to vaccination at the age of 16 should be less, and certainly should not be greater than at the age of 11.

Results of these calculations are shown in Table 6-13. From this it can be seen that there is no ideal cut-off point. At each reaction size there is a high rate of false positive reactions except at 20mm, at which level the sensitivity is low. However at 12mm there is reasonable sensitivity with reasonable specificity so that this appeared to provide the best compromise. Therefore for all subsequent analyses, among those who had received BCG vaccination, if the reaction to PPD-T measured between 1-11mm, then the PPD-T was adjusted to equal zero.

TABLE 6-13: FALSE POSITIVE AND NEGATIVE RATES FOR DIFFERENT SIZE CRITERIA FOR EFFECT OF BCG VACCINATION ON TUBERCULIN REACTIVITY:

(Grade 10, Canadian born only)

Cut-point for Size of PPD-T (mm)	Sensitivity	% False positive	Specificity
5 mm	100%	63%	37%
8 mm	97%	47%	53%
12 mm	67%	40%	60%
15 mm	40%	47%	53%
20 mm	25%	0	100%

6.4.3 Determinants of tuberculin reactivity: Country of Birth of Student

Prevalence of reactivity among adolescents was much higher among the foreign-born compared to the Canadian born. As seen in Table 6-14, 28% had significant reactions of 10mm or more, compared to only 4.3% of those born in Canada. Table 6-15 shows that among the immigrant students, prevalence of reactivity was 10% in those from countries where tuberculosis incidence rates are below 40/100,000 per year, compared to 22% in those from regions with intermediate tuberculosis rates, and 40% in those from regions with high rates of infection and disease. In addition, as was seen in Figure 5-3 (page 56), among students born in an endemic area, the prevalence of tuberculin reactivity was much higher among those who immigrated at a later age. Of those who immigrated before the age of 6, 15% were tuberculin positive compared to 62% of those who immigrated after their 12th birthday. The relationship between tuberculosis rates in the country of origin, number of years spent there, and prevalence of tuberculin reactivity found here in Canada, presumably reflects the greater cumulative risk of exposure and infection. The very high prevalence found among the foreign born meant that the overwhelming determinant was exposure in their country of birth, rather than any factors associated with increased risk of exposure here in Canada. For this reason the analysis of all subsequent determinants was restricted to the Canadian-born adolescents.

TABLE 6-14: TUBERCULIN REACTIVITY IN CHILDREN

GROUPED BY IMMIGRATION STATUS:

(Grade 10, All participants)

Size of Reaction to PPD-T	Immigration Status: Child-Can. Parents-Can.	Child-Can. Parents-Imm.	Child-Imm. Parents-Imm.
0-4	446 (92.7%)	275 (97.0%)	147 (67.4%)
5-9	10 (2.1%)	1 (0.3%)	10 (4.6%)
10-14	10 (2.1%)	6 (2.1%)	26 (11.9%)
15 +	15 (3.1%)	2 (0.7%)	35 (16.1%)
Total	481	284	218

TABLE 6-15: RELATIONSHIP OF TUBERCULIN REACTIVITY AMONG IMMIGRANT CHILDREN TO PREVALENCE OF TUBERCULOSIS IN COUNTRY OF BIRTH:

(Grade 10, Child immigrant)

Size of PPD-T (mm)	Prevalence of TB in country of birth of child * LOW	INTERMEDIATE	HIGH
0-4	29 (76.7%)	15 (79.0%)	104 (73.8%)
5-9	0	0	10 (6.0%)
10-14	2 (6.3%)	2 (10.5%)	21 (12.7%)
15 +	1 (3.1%)	2 (10.5%)	32 (19.3%)
TOTAL	32	19	167

* (Rates of tuberculosis taken from information published by IUAT see references # 79-88)

6.4.4 Determinants of tuberculin reactivity among Canadian born

6.4.4.1 Age:

After adjustment for both PPD-B, and BCG vaccination, the overall prevalence of infection was 3.56% among adolescents in this study. Given the average age of 16.1 years, the annual risk of infection was calculated to be 0.225%.

6.4.4.2 Tuberculosis rates in country of birth of parents:

Among the 284 Canadian born students whose parents were immigrants, information on the place of birth was available for 242. Of these, of the 70 students whose parents had immigrated from tuberculous endemic areas, 5.7% had significant reactions compared to only 0.6% among the 174 students whose parents had immigrated from non-endemic countries, ie. where tuberculosis incidence is less than 150/100,000.

TABLE 6-16: RELATIONSHIP OF TUBERCULIN REACTIVITY TO TUBERCULOSIS RATES IN COUNTRY OF BIRTH OF PARENTS:

(Grade 10, Child Canadian-born, Parents immigrant)

Reaction to PPD-T	Prevalence of TB in country of birth of parents * LOW	INTERMEDIATE	HIGH
0-4	100 (98.1%)	71 (98.6%)	66 (94.3%)
5-9	2 (2.0%)	0	0
10-14	0	0	3 (4.3%)
15+	0	1 (1.4%)	1 (1.4%)
TOTAL:	102	72	70

* (Countries classified based on information regarding tuberculosis rates from IUAT, see references # 79-88).

6.4.4.3 Effect of Socio-economic factors:

The responses to the questions regarding parental education and work status had little relationship to the tuberculin reactivity of the adolescents, as seen in Table 6-17. However as was seen among the Grade 6 students there was a striking gradient of tuberculin reactivity with worsening indices of socioeconomic status, particularly those of housing conditions. As seen in Tables 6-18A and 6-18B, half of all those with significant tuberculin reactions were resident in census areas in the lowest quartile for housing quality, or poverty index. These differences were highly significant, whether using Mantel-Hanszel chi squared for these tables ($p < .01$ for both indices), or using ANOVA with PPD-T as the continuous variable ($p < .001$), or using ANOVA with the SES indicators the continuous variables ($p < .01$) Of those with significant tuberculin reactions, 39% resided in the quartile of census areas with the greatest proportion of houses in need of major repairs, and 61% in the two lowest quartiles. The relative risk for tuberculin reactivity among those resident in neighbourhoods in the lowest quartile of socioeconomic indices, compared to the highest quartile was 2.5, 3.7, and 1.6 respectively for the indices of income level, houses without central heat, and houses in need of major repairs. In summary, from the present data, it appears that socioeconomic

status is an important determinant of tuberculous infection, but the effect is small as the prevalence in the most disadvantaged groups is still low.

TABLE 6-17: PARENTAL FACTORS AS DETERMINANTS OF TUBERCULIN REACTIVITY
(Grade 10, Canadian-born only)

Table 6-17A: Maternal Education

	None	Primary	High School	CEGEP	University
PPD-T Pos	2 (2.6%)*	4 (2.7%)	10 (3.5%)	1 (1.3%)	3 (3.8%)
PPD-T Neg	77	144	277	74	76

Table 6-17B: Paternal Education

	None	Primary	High School	CEGEP	University
PPD-T Pos	2 (2.4%)*	4 (2.8%)	9 (3.8%)	1 (1.5%)	3 (3.0%)
PPD-T Neg	81	141	226	67	97

Table 6-17C: Maternal Work-Status

	Absent	Housewife	Unemployed	Student	Working
PPD-T Pos	3 (3.6%)*	5 (2.0%)	0	1 (6.7%)	14 (2.8%)
PPD-T Neg	80	245	2	18	319

Table 6-17D: Paternal Work-status:

	Absent	Housekeeper	Unemployed	Student	Working
PPD-T Pos	4 (2.7%)*	0	2 (8.7%)	1 (6.7%)	14 (2.9%)
PPD-T Neg	147	7	21	14	477

* (Percent tuberculin positive for the category of parental education/work)

TABLE 6-18: NEIGHBOURHOOD SOCIOECONOMIC DETERMINANTS OF TUBERCULIN REACTIVITY

(Grade 10, Canadian-born only)

Table 6-18A: Relationship to Income levels:

PPD-T	Distribution by Quartiles RICHEST 1	2	3	POOREST 4
Negative	149	153	168	154
Doubtful	2	2	0	4
Positive	4	4	2	10
TOTAL	156	159	170	168

Table 6-18B: Relationship to Quality of Housing:

PPD-T	Distribution by Quartiles BEST 1	2	3	WORST 4
Negative	182	186	179	177
Doubtful	2	0	5	2
Positive	3	3	5	11
TOTAL	187	189	189	190

6.4.4.4 Effect of contact with immigrants:

To assess whether contact with immigrants in the community of residence was an important determinant of tuberculous infection, the percent of immigrants from all countries, and the percent from areas with persisting high tuberculosis rates, were both used as indices of exposure Students were grouped into quartiles on the basis of the proportion of foreign born, in these two categories, in their census area, and the number of reactors compared. This is seen in Tables 19A and 19B. The percent of foreign-born (all countries) ranged from 0-3% in the lowest quartile, to 30-80% in the highest quartile. The percent of foreign-born from tuberculous endemic areas ranged from 0-1% in the lowest quartile, to 6-14% (mean 9%) in the highest quartile. The proportion of immigrants from tuberculous endemic was highly

correlated with the proportion of immigrants from all countries. The majority of the other immigrants in these high immigrant areas had immigrated from Spain, Portugal, Italy and Greece (Wilkins, 1985). With the exception of Italy, the tuberculosis rates in these countries are considerably higher than in Canada (IUAT Ref # 79-88). Therefore, the prevalence of tuberculin reactors among the immigrants in these communities should have been considerably in excess of that in areas with few foreign-born. With either index of exposure, the number of tuberculin reactors was significantly less in the quartile of highest proportion of foreign-born, using the Mantel-Haenszel Chi Squared test ($p < .01$). The same was true using ANOVA with tuberculin reactivity as a categorical variable, and using percent immigrants as a continuous variable ($p < .001$).

The third measure of exposure was the proportion of immigrants from tuberculous endemic countries, in the same school class as the Canadian-born subjects. This was taken directly from the class lists. Values for the lowest quartile ranged from 0-5%, while for the highest quartile was 50%. This measure of exposure should have been more accurate as it was direct, and makes biologic sense because at this age, adolescents are at high risk to develop tuberculous disease (Comstock, 1974).

TABLE 6-19: RELATIONSHIP OF TUBERCULIN REACTIVITY

TO CONTACT WITH IMMIGRANTS:

(Grade 10, Canadian-born only)

Table 6-19A: Relationship to % Immigrants from all countries in the Neighbourhood

PPD-S	Distribution by Quartiles			
	LEAST 1	2	3	MOST 4
Negative	155	153	157	163
Doubtful	2	4	3	0
Positive	9	7	4	1
TOTAL	166	164	164	164

Table 6-19B: Relationship to % Immigrants from TB endemic areas in the Neighbourhood

PPD-T	Distribution by Quartiles LEAST 1	2	3	MOST 4
Negative	180	162	196	187
Doubtful	6	1	0	5
Positive	10	5	2	5
TOTAL	196	168	198	197

Table 6-19C: Relationship to % Immigrants from TB Endemic areas in the School

PPD-S	Distribution by Quartiles LEAST 1	2	3	MOST 4
Negative	208	141	146	234
Doubtful	6	1	0	5
Positive	11	5	2	5
TOTAL	224	147	148	244

6.5 SUMMARY

Overall participation was 60.9%. There was no information available for the majority of non-participants, but on the basis of the information available the non-participants did not differ significantly from the participants on the basis of characteristics that may be potential determinants of tuberculous infection. There were differences in the rates of participation of students attending schools of different school-boards, and language of instruction, but these differences appeared to be related to the support and enthusiasm provided by the staff of these schools. The low

participation rate did not appear likely to have created bias in the estimate of the determinants of tuberculous infection. The prevalence of tuberculin reactions of 10mm or more was 10.4%. Sensitivity to PPD-B was seen in 7% of the adolescents, and this accounted for over a third of reactions to PPD-T measuring 5-9mm, but only accounted for 10% of those measuring 10-14mm. Slightly over one-fourth of adolescents had received BCG vaccination in infancy, and of these over 90% had reactions to PPD-T less than 10mm. BCG was an important cause of false positive reactions, but principally for reactions measuring 5-11mm. The principal determinants of tuberculin reactivity were the tuberculosis rates in the country of birth of the student, and the age of immigration for the foreign-born. Among Canadian born the principal determinants were socioeconomic status as defined by indices taken from census data for the neighbourhoods where they were resident. Among students whose parents were immigrants, the tuberculosis rates in the country of birth of their parents played a minor role in determining tuberculous infection. Possible community exposure to tuberculosis, either through residence in communities or attendance at schools characterized by an increased proportion of immigrants from areas where tuberculosis rates are still considerably greater than in Canada, was not associated with an increased prevalence of tuberculin reactions.

CHAPTER 7: DISCUSSION

7.1 SOURCES OF ERROR IN THE ESTIMATE OF EFFECT:

7.1.1 Bias due to non-participation:

Reasons for non-participation may be broadly grouped into two major categories: individual decisions, and decisions on the part of school or health sector authorities. These latter decisions were responsible for the non-participation of 6 schools in one CLSC territory, (Centre Sud), because the CLSC personnel did not view this survey as a priority. If tuberculosis prevalence had indeed been lower in the one school in this area which participated, then this attitude could have been said to have been based on prior knowledge of low prevalence, so that the exclusion of schools in this area would have resulted in an overestimate of the prevalence in the study area. However the prevalence was one of the highest of all the primary schools tested (10% among Canadian born). Therefore the exclusion, due to certain preconceptions on the part of CLSC staff, was unfortunate but could not be construed as creating bias. The exclusion of one large high school, because of poor scolastic achievement by the students, was also unlikely to have created bias.

On the other hand, individuals' decisions to participate could create bias. For example an individual with prior exposure to someone with active tuberculosis, who is therefore more likely to be infected, may be more likely to volunteer to be tested. On the other hand those who refuse to participate in health surveys or trials may be more at risk. For this reason a detailed analysis was made of the characteristics of the non-participants to verify whether they differed from participants in terms of any of the potential determinants of tuberculous infection that were measured in this study.

A striking finding with regard to factors affecting participation were the differences in participation rates between schools of different Boards and language of instruction. Students attending schools of Catholic boards and in which French was the language of instruction were significantly more

likely to participate. This was seen consistently throughout the study period, and in both age groups. Even within the same schools there was significant variation in participation between classes. The study coordinators and the author felt that this was related to the approval, support and enthusiasm of the teachers responsible for each class. This was true for Grade 6 students and, somewhat surprisingly, for the Grade 10 students as well. These differences in participation were therefore unlikely to be due to factors related to tuberculosis, and more likely represented the strong influence of the school teachers and other authorities on students decisions to participate.

The overall rate of participation was 81% among Grade 6 students. Two previous tuberculin surveys conducted in Montreal among Grade 6 students had much lower participation rates; namely 57% (Cantin 1981), and 49% (Davignon 1979), and in neither of these surveys were the non-participants characterized in any way. In a number of other tuberculin screening surveys conducted in Canada, the participation rates were not mentioned (Jeanes 1969, Grzybowski 1969, Robakiewicz 1974), and non-participants were not characterized. Any differences between this survey's findings and those of other Canadian surveys may in part reflect greater opportunities for bias due to non-participation in these other surveys. Among the Grade 6 students, in this survey there was information on almost 80% of non-participants so that only 5% of the target population was uncharacterized. This enabled a detailed comparison of non-participants to participants overall, within each school-board, and by language of instruction. These comparisons revealed that non-participants did not differ significantly from participants on the basis of characteristics that were potential determinants of tuberculous infection. Therefore the results from those students who did participate should have been valid for the entire Grade 6 target population.

Participation among the Grade 10 students was much lower, and the possibility of bias therefore greater. Two previous surveys in Montreal among Grade 10 students, reported participation rates of 49% (Cantin 1981) and 34% (Davignon 1979), and again, the non-participants were not characterized. In the present survey, the 94 non-participants for whom some information was available, were not significantly different from the 983 participants. However 35% of the total eligible population was completely

uncharacterized, as so few returned questionnaires, and few schools provided detailed lists of all students. To characterize the non-participants, three approaches were taken. First, in the two English Protestant schools where a two-step survey was done, the initial participants were compared to those who participated only after extensive additional recruiting efforts. The students who participated in the second stage were similar to those who initially participated. These second stage participants could be considered equivalent to the non-participants in other schools where a two-stage survey was not done. If such a second stage survey had been conducted in all high schools, much higher participation rates might have been achieved. Secondly, in one English Catholic school a detailed school list was available enabling comparison of non-participants to participants within that school, and there were no significant differences. Thirdly, to gain further insight into the non-respondent, non-participants, those who did not complete questionnaires, or completed only part of the questionnaires (short), but participated, were compared to participants who returned completed questionnaires. As explained in Section 6.1.3, these individuals were those who decided on the day of testing to participate, and so represented students whose health behaviour was similar to that of the non-participants. As well the non-participants were compared on the basis of their completion of questionnaires, and again no differences were found. If there were no significant differences between participants who differed on the basis of questionnaire completing behaviour, then by inference non-participants who did not complete questionnaires (non-respondents), should have been no different from non-participants who did complete questionnaires. Based on this, the characteristics of those non-participants for whom some information was available should have been representative of all non-participants. Non-participants were not significantly different from participants, so therefore it seems unlikely that the non-participation rate of 39% created bias, and therefore the findings of the 983 participants should be valid for the entire target population.

7.1.2 Data Collection: Questionnaires:

A second source of bias was incomplete return, or inaccurate completion of questionnaires, by participants. As seen earlier very few of the

participants failed to return a questionnaire. There were no significant differences between the participants in either Grade 6 or 10, on the basis of questionnaire return. Questionnaire were labelled short when none of the questions relating to the parents were completed. In many instances questions relating to only one parent were completed. In this circumstance the other parent was assumed to be absent. Accuracy of response to questions regarding past history or exposure to tuberculosis was questionable, especially among the Grade 6 students, as there was little relationship to tuberculin status. Interestingly among the adolescents, who completed these questionnaires themselves, there was a stronger relationship between questionnaire response and tuberculin reactivity. Correlation of documented BCG vaccination to questionnaire response was poor, as most respondents could not distinguish this vaccination from the routine childhood immunizations. Despite the fact that over 95% of the BCG vaccinated adolescents had received this in infancy, the accuracy of their response for this question was better than for the parents who completed the questionnaire on behalf of their Grade 6 children.

7.1.3 Data collection: Tuberculin testing

The administration of the tuberculin tests was performed using the Mantoux technique, which is the currently accepted standard for skin testing (ATS 1981) because variability of results due to errors in administration are minimal with this technique (Rhoades 1980). As well alternative methods such as the Tine test, although simpler to administer than the Mantoux test, are associated with a much higher rate of false negative as well as false positive tests (BTS 1982). All tests were administered by nurses, after training by one of the study coordinators. All testing material was provided by Connaught laboratories, which has recently been recognized as the manufacturer of the best standardized tuberculin testing material in North America (Stead 1988). Therefore problems in administration of these tests should have been minimal and unlikely to have seriously affected the results.

Reading of tuberculin reactions is more difficult and problems with bias or errors in reading have been noted in previous studies. In one tuberculosis clinic, readings were noted to cluster just below the size at

which further action or evaluation was taken. Changes in the criteria for size of reaction for further action, did not eliminate the problem, but simply meant that the clustering occurred just below the new cutoff point (Hershfeld, personal communication). In one study of within reader variability the standard deviations for 4 different readers measured 1.5, 1.4, 1.3, and 1.9mm respectively (Bearman 1964), reflecting good consistency. However, variability between readers has been found to be a much more important problem in other studies. In the study by Bearman, there were major differences between the 4 readers for 5 of the 36 subjects (ie from 0 to 12 mm), but measurement method was not specified, nor standardized, so the 4 readers may have had very different criteria for induration, (Bearman 1964). Perez-Stable found that measurements within 2mm of the other were recorded by two independant readers 82% of the time, and that in less than 6% of all occasions did these paired readings differ by as much as 6 mm. As well diagnosis of significance or not differed in only 4.3% of all paired readings, with a kappa of 0.91 (Perez-Stable 1985). In this study, reading was performed by palpation, rather than the more consistent "ball-point" method of Sokal (Sokal, 1975), and despite the use of special calipers they found a significant 'digit preference' or a middling effect, in that readings ending in 0 or 5 were seen in excess.

In the present survey, steps were taken to minimize these potential problems. All readers used the same technique of reading, ie the ball-point method of Sokal to define induration. Initially, the two study coordinators were trained by the third reader, a nurse from the Montreal Childrens Hospital, with over 10 years of experience in tuberculin testing, and in the first schools tested, two readers were utilized. Consistency of technique was reinforced throughout the study. Terminal digit preference was not a major problem, as was seen in Figures 5-1 and 6-1, except for an excess at 15mm. Terminal digit preference is a source of random error in measurement, and as such may have reduced the likelihood of finding a significant effect even if one was present, but it should not have biased the estimate of effect.

Bias in reading is potentially a more serious problem since the readers were not blinded as to the identity of the antigens, nor to the criteria for referral for further evaluation. From Tables 5-8 and 6-8 there is no

evidence of a significant excess of readings in which PPD-B was one or two mm greater than PPD-T or vice versa. The criteria for referral were a reaction to PPD-T measuring: i) over 4mm; or, ii) over 9mm if BCG vaccination was documented in the vaccination booklets at the time of reading; or, iii) over 9mm if the accompanying PPD-B reaction was larger. There is no evidence of bias in reading to avoid referral in that, as seen in Tables 5-8 and 6-8 and in Figures 5-1 and 6-1, there is no evidence of clustering of readings just above or below these size criteria. As well the criteria used in the analysis were often different from that used for referral (eg 12mm for PPD-B, and BCG vaccination instead of 10mm), so any errors in reading of 1-2mm, due to bias regarding subsequent diagnosis and treatment, should not have influenced the estimate of effect of various determinants on tuberculin reactivity. Finally, the objectives of this study were not descriptive but rather to test several hypotheses. Therefore, while the overall prevalence found in the two age groups may have been over- or under-estimated because of some of these problems in reading, the estimate of effect of different determinants, from a comparison of tuberculin reactivity among subjects grouped on the basis of these different determinants, should not have been biased.

7.1.4 BCG Vaccination status and verification:

Questionnaire response was not very accurate in identifying those with prior BCG vaccination, among both Grade 6 and Grade 10 students. Therefore two sources of documentation of vaccination were used; namely vaccination booklets and the registry of the IAF. Of the 227 children for whom both sources of data were available, 136 were identified as vaccinated. The vaccination booklets identified 117 of these, but missed 17% of those who had received BCG according to the IAF. The accuracy of the central registry was lower, as 34% of those with BCG recorded in the booklet were not registered by the IAF. Of the 136 vaccinated children, the IAF identified 71%, which is similar to the findings of Cantin who noted that of children with BCG scars, only 75% were registered with the IAF (Cantin). This under-reporting of vaccination status, with attendant mis-classification may have resulted in an under-estimate of the effect of BCG. However the estimate of effect among those vaccinated was based on differences between

students in higher and lower SES strata, and between the two age groups. The under-reporting did not appear to be associated with one region or CLSC, but was equally frequent in the more, and less, disadvantaged areas, and so should not have created bias in the estimate of effect.

7.1.5 Data collection - Census data:

Postal codes were available on over 98% of participants, but in 120 participants census data information was not available. The census data from 1981 was used, but this should have been valid as 1981 represented the approximate mid-point of the lives of the students. A more serious potential problem is the use of current address and postal code to assign exposures for the students' entire lives. Surveys in two British cities found that in a 5 year interval, 28% of the population in one city had moved in, and 19% had moved out. The corresponding figures for the second city were 21% in-migration and 19% out-migration (Davies, 1980). In the present survey no information as to duration of time at current residence was obtained, and therefore the accuracy of current census data to reflect lifelong exposures is uncertain. However, the socioeconomic indices are likely to be applicable, even if there was significant migration within the city, because the disadvantaged are unlikely to be able to move to more affluent areas. Anecdotally, of the children who had vaccination booklets, over 80% were still resident in the same CLSC territory as they were at birth, when they were vaccinated.

One of the inaccuracies inherent in the use of census tract data is that the precision of the estimate of the exposure is reduced because the data represents the average for the entire neighbourhood which is usually comprised of 1000-2000 persons. The smaller the unit of population, the more homogeneous will be the characteristics of the residents, and the greater the variation between units. As an example, among the 7 DSC's of Montreal, each with average population of 250,000, the percentage of children living below the poverty line varies from 10-20%. On the other hand among the 51 CLSC's in Montreal, with average population of 40,000, the percent poor ranges from 6-54%, and among the census tracts included in this survey, from 0-90%. Socioeconomic status has been found to be particularly homogeneous within these small units (Wilkins 1980). Because of this homogeneity within

census tracts, census information for all residents of these areas has been used successfully in place of individual data, to explore the relationship between SES and such health events as respiratory illness, or cancer (Carstairs 1981, Davies 1980).

The major advantage of the use of this kind of information is that it has already been gathered, so that it is inexpensive and readily accessible. It is also a much less obtrusive method of gathering data about sensitive topics such as educational level, work-status, or income. Direct questioning such as was used in the present survey, may be less accurate if participants are unwilling to disclose this information, and in fact may have resulted in reduced participation, because the questions were considered offensive. It is of interest to note that in the present survey, data from the questionnaires regarding parental education and work, was not as strongly associated with tuberculin reactivity as neighbourhood socioeconomic indicators. It is important to emphasize again that this was an ecological study of the community factors affecting transmission of tuberculous infection. Therefore the use of neighbourhood data in place of individual data seems well justified.

7.2 CAUSES OF FALSE POSITIVE REACTIONS:

7.2.1 Sensitivity to PPD-B

The use of dual testing to distinguish tuberculin reactions due to tuberculous infection from cross-reactivity due to sensitization by atypical Mycobacteria, has been validated in two ways. Among patients with tuberculous disease, over 95% will have reactions to PPD-T greater than the simultaneous reaction to either PPD-B or PPD-G, and less than 2% will have larger reactions to either of these two antigens (Robakiewicz 1969). Among patients with Atypical Mycobacterial disease, sensitivity to the atypical antigen is greater than to PPD-T (Snider 1982). Dual testing has been validated in a more clinically relevant manner, in that among US Navy recruits with PPD-T measuring 5-11 mm, the risk of active tuberculosis over the subsequent 5 years was 10-15 times greater among those with larger reactions to tuberculin (PPD-T) compared to those with larger reactions to one of the atypical antigens (Edwards 1973).

Among Canadian born students in the present survey, only 0.8% of the primary school and 2.1% of the high school students had reactions to PPD-B of 10mm or more. Despite these low prevalences, sensitivity to PPD-B was still an important cause of false positive PPD-T reactions in the "doubtful" range of 5-9mm, accounting for 31% of these reactions, although it accounted for only 3% of PPD-T reactions of 10mm or more. Brickman et al performed tuberculin testing among 2152 first Grade students in the greater Montreal area in 1971, using standard tuberculin (PPD-T), and simultaneously one of four atypical antigens. Of those tested, 1.8% demonstrated sensitivity to PPD-B, and 4.0% to PPD-G (Gause for M. Scrofulaceum). Of 16 students with reactions to PPD-T measuring 5-9mm, 6 (38%) had larger simultaneous reactions to the accompanying atypical antigen. The authors did not specify whether any of the 26 students whose reaction to PPD-T exceeded 9mm, had a larger reaction to one of the atypical antigens (Brickman 1974). Jeanes et al surveyed nearly 30,000 high school students across Canada, in 1965-7 (Jeanes 1969). Simultaneous PPD-T and PPD-G were given to 24,000, of whom 7.2% had a reaction to PPD-G larger than the simultaneous PPD-T reaction and also measuring 5mm or more. Of the 246 with reactions to PPD-T measuring 5-9mm, 51% had larger simultaneous reactions to PPD-G, and of the 157 with reactions to PPD-T measuring 10-14mm, in 30% the PPD-G was greater. Among the 5,500 who received dual testing with PPD-B, 5.9% manifested a signficant reaction to this antigen. In this group, 19 of the 52 (37%) with reactions to PPD-T measuring 5-9mm, could be ascribed to sensitivity to PPD-B, and 6 of the 42 (14%) with reactions measuring 10-14mm (Jeanes 1989). Grzybowski found that 18.6% of high school students in British Columbia in 1967 were sensitive to PPD-G, compared to 10.8% sensitive to PPD-B (Grzybowski 1969). In a further study in 1972 by the same group, 18.4% of those aged 1-14 years were sensitive to either PPD-G or PPD-B, compared to 19.5% of those aged 15-34 and 24% of those aged 35-54 (Robakiewicz 1974). This prevalence of sensitivity is far higher than that seen in Montreal, perhaps because of the more temperate climate on the West Coast, similar to many parts of the USA where sensitivity to both PPD-B and PPD-G is known to be higher (Edwards 1969).

The findings of the present study with regard to sensitivity to PPD-B, are similar to those of Jeanes, although PPD-G was not used. The findings of

Jeanes et al suggest that this may have resulted in an underestimate of the false positive PPD-T reactions due to atypical sensitization, because sensitivity to PPD-G is more prevalent than is sensitivity to PPD-B here in Montreal (Brickman 1969). However in the studies regarding the prognosis associated with dual testing among Navy recruits, PPD-B was used from 1958-1965, and PPD-G only from 1965 until 1969. There does not appear to have been any evidence of a differences in prognosis associated with sensitivity to either antigen, so in view of the detailed information available regarding the prognosis with dual testing with PPD-B, use of this antigen seems justified.

Apart from regional variation (Edwards 1969), the individual factors associated with sensitivity to these atypical antigens have not been thoroughly investigated. In a survey of high school students in Washington County, Kuemmerer and Comstock analysed the relationship between various personal attributes and small tuberculin reactions measuring 2-10mm; reactions which they interpreted as evidence of atypical infection and sensitization. Prevalence of small reactions was higher in those who had moved into the county in their lifetime, had higher socioeconomic status and were resident in urban areas. There was no evidence of clustering of sensitive individuals within households, suggesting that factors within households were unlikely to have played a role (Kuemmerer 1967). In the present survey, prevalence of sensitivity to PPD-B was higher among the foreign born, particularly those from tropical countries, but among Canadian born, there was no relation to socioeconomic status, nor to travel to the SE USA, so the factors affecting the prevalence of this infection in native-born residents of this area remain unclarified. A recent survey in the Netherlands found that sensitivity to PPD-G among schoolchildren aged 7-14 years increased from 5.7% in 1966 to 21.1% in 1985. This apparent rise could have been explained by differences in the antigens used (Grzybowski 1969), but the authors could not find an explanation for this phenomenon, and emphasized that given our poor understanding of the epidemiology of non-tuberculous Mycobacteria, the prevalence may change unpredictably. However the results of the present survey are very similar to those of Brickman from 15 years ago and lower than the findings of Jeanes or the B.C. group. This suggests that despite socioeconomic changes, and increased

travel, the epidemiology of this atypical Mycobacterium has not changed significantly in Montreal over the last 15 years. However, as the prevalence of tuberculous infection declines among the native born population the relative importance of this sensitivity to atypical antigens becomes greater as a cause of false positive reactions.

7.2.2 BCG Vaccination:

One of the major disadvantages of BCG vaccination is that those who have been vaccinated will become tuberculin sensitive as a result of vaccination (Snider 1982), and if exposed, vaccinated persons may still become infected with the tubercle bacillus (Sutherland 1979). This would not matter if progression to tuberculous disease was prevented with complete efficacy, but unfortunately efficacy of this vaccine has varied from nil to 80% in different well-conducted trials (Comstock 1988). Because of these problems, BCG has never been given widely in the USA (Snider, 1982), so that tuberculin testing can still be used to identify those with tuberculous infection, who can be given preventive treatment (ATS 1986). However mass BCG vaccination was given in Quebec from 1949 until the mid- to late 1970's (Frappier 1971). Over 100,000 vaccinations were given annually throughout that period, with coverage at birth of 40-47%. Re-vaccination was given in primary school with 53% coverage (Frappier 1971). During the 1970's mass vaccination was slowly phased out in one health district after another (MSSS,PQ 1987). In Montreal, two of the last areas to abandon BCG vaccination were Verdun and Cote St. Paul. In these two areas over 40% of the Grade 6 students and 60% of the Grade 10 students who participated in the study, had received BCG vaccination.

A significant proportion of participants in this survey had received BCG, so that the effect of BCG on tuberculin reactivity was an important aspect of the analysis. Virtually all of the students in both age groups had received this vaccine in the first year of life, and none had received it more than once. Because the two areas with the highest vaccination rates were also among the most disadvantaged, BCG was confounded with socioeconomic status. To establish the effect of BCG on reactivity, the higher SES, vaccinated group in Grade 6 was used as the reference vaccinated group. Prevalence of reactions was compared to the non-vaccinated, higher

SES, Grade 6 students. This excess prevalence, attributed to the effect of BCG, was 3.0% for 5-7mm, 1.8% for 8-9mm, and 2% for 10-15mm. Among the vaccinated Grade 6 students from the lower SES stratum, and among all the Grade 10 vaccinated students, any differences in prevalences compared to the reference vaccinated group were assumed to represent tuberculous infection. Using this, the prevalence of tuberculous infection could be calculated, and from this the sensitivity and specificity of different size criteria could be calculated. The extremely low prevalence of tuberculous infection among the Grade 6 students meant that at all sizes of reactions under 20mm, specificity was disappointingly low. A cutoff point of 12mm gave a relatively low sensitivity, and also low specificity among the Grade 6 students, but among the Grade 10 students, who had higher prevalence, this criterion was associated with more acceptable sensitivity and specificity.

These calculations are based on two assumptions. First, that the tuberculin reaction of those with tuberculous infection is not different among those who have been BCG vaccinated, compared to the non-vaccinated. Among 84 previously BCG-vaccinated young adults with active tuberculosis (Groth-Peterson 1976), the mean and distribution of tuberculin reactions was not different from that reported for patients with tuberculosis (Snider 1982, Grzybowski 1980). Secondly, the underlying distributions of reaction sizes among the BCG vaccinated and those infected with tubercle bacillus are different. The distribution of tuberculin reactions of those infected with tuberculosis is a unimodal normal distribution, centered at a mean/mode of 15-18mm (Snider 1980). The frequency distribution of all BCG-vaccinated Canadian-born participants in this survey, shown in Figure 5-5, is very different in that it is a Poisson distribution with the mode at zero, and skewed to the right. This distribution is very similar to the tuberculin reactions associated with atypical sensitization (Edwards 1973). It is interesting to note that the frequency distributions of tuberculin reactions among Danish schoolchildren who had been vaccinated at the age of 6-8 years, were almost indistinguishable from those associated with tuberculous infection (Guld 1968, Horwitz 1972). On the other hand in tuberculin surveys among S. African blacks, (Fourie 1986), Navajho Indians (Lifschitz 1965), Quebec infants (Joncas 1975), and Israeli infants (Margus 1965), all of whom were vaccinated shortly after birth, the frequency distributions were

similar to that found in this study.

Differences in tuberculin reactivity following BCG vaccination have been found as a result of different manufacturers of vaccines (Horwitz 1972), viability counts (Ashley 1967), and different techniques (Landi 1967). The very low prevalence of tuberculin reactions found in this study among those with documented vaccinations, can not be ascribed to low sensitization by the vaccine or because of the technique. Tuberculin conversion was demonstrated in 97% of recipients following BCG vaccination here in Quebec (Frappier 1971). Of those vaccinated, 87% and 70% were still tuberculin positive one and 5 years later respectively (Frappier 1971). Waning of tuberculin sensitivity in the years following vaccination has been reported, and is particularly evident in studies of infants or children vaccinated at birth. Margus et al found that among 600 Israeli infants who had received BCG at birth, almost 70% had no reaction, and the maximal reaction was 12-13 mm (Margus 1965). Lifschitz tested 250 Navajho children aged 6 months to 6 years, all of whom had been vaccinated at birth. Maximal reaction in those tested after 1 year of age was 9mm (Lifschitz 1965) Joncas tested 68 Monteal children who had been vaccinated at birth. Of the 31 who were older than one year when tuberculin tested, 59% had no reaction, and maximal reaction was 11 mm. In the same study, of 84 children vaccinated at the age of 6 years, and tested one year later, 71% had significant reactions, with a maximal size of 20mm Joncas 1975). The evidence is relatively consistent that waning of tuberculin reactivity after BCG vaccination is more frequent among those vaccinated at birth, or in infancy, compared to those vaccinated at an older age. What has perhaps not been recognized is that the distribution of reaction sizes is also affected by the age when vaccinated; older children will demonstrate a distribution similar to that of tuberculous infected (Guld 1968, Horwitz 1972), making differentiation of infection from vaccination almost impossible. This differentiation should be possible among those vaccinated in infancy because they will demonstrate a distribution of reactions similar to that found for atypical Mycobacterial sensitization.

The longest interval from vaccination to testing reported to date has been 5 years (Horwitz 1972), except for a short report by Comstock, based on 141 recruits tested on induction into the Navy, who had participated in the

Muscogee BCG trial (Comstock 1966). In this report, 63 had received BCG between the ages of 6-16, and were tuberculin tested on average 11 years later. Nine had reactions measuring 5-9mm, and nine had reactions of 10-17mm, compared to one in each size category among the 66 (Comstock 1971) controls. Unfortunately most of these subjects had been tuberculin tested at least once since vaccination, which has been shown to result in maintenance of tuberculin reactivity because of the booster effect (Maqnus 1955).

The present survey represents the largest series of BCG-vaccinated subjects tuberculin tested after a prolonged interval. The problem of verification of BCG status is a weakness, but this should have resulted in an increase in false positive reactions among those labelled not vaccinated, and not a decrease in reactivity in those labelled vaccinated. The strength of the present study is that it is community based, and therefore avoids the bias of the hospital or clinic based studies of others (Joncas 1975, Lifschitz 1965). The comparison of frequency distributions between vaccinated and non-vaccinated is likely to be valid because the factors in selecting the two groups of children for study were the same, and all community factors should have been similar. One cannot exclude the possibility that some children were vaccinated because they were at greater risk of tuberculous infection, because of an active case in the family for example, but otherwise the estimate of BCG effect on tuberculin reactivity should have been free from major error or bias.

This suggests that for persons who have received BCG vaccination in infancy, reactions to PPD-T above 11mm may be considered to represent tuberculous infection, while smaller reactions are increasingly likely to represent false positive reactions due to vaccination alone. For the present analysis, 12mm or more was adopted so that as few false positive reactions as possible were included, to improve the precision of the estimate of the effect of various determinants of infection. It should be emphasized that in a clinical setting the use of this or a lower cut-off point would depend on the likelihood of true infection (the expected prevalence), and the consequences of mis-diagnosis.

7.3 DETERMINANTS OF TUBERCULOUS INFECTION: IMMIGRATION STATUS OF THE STUDENT

Of those with significant reactions to PPD-T (10mm or more) 60% were recorded among immigrant students, as seen in Table 7-1. Among the immigrants, the major determinants were the prevalence and incidence of tuberculosis in their country of birth, as seen in Table 7-2, and the age at which they had immigrated to Canada. The rising prevalence seen in Figure 5-3, among those who were older when they immigrated from tuberculous endemic areas, parallels the findings of prevalence surveys in many of these countries (IUAT ref. # 79-88). Incidence of active tuberculosis among immigrants from tuberculous endemic areas is 20-40 times more frequent than the incidence among the native population in the USA (Powell 1984), or Britain (MRC 1983). In the present study, the prevalence of infection among those from tuberculous endemic areas compared to that among the Canadian born showed similar differences; 23.6% vs 1.4% in Grade 6, and 28% vs 3% in Grade 10 (Tables 7-1 and 7-2). The probability of being infected among the foreign born appeared to be related to the number of years spent in these high prevalence areas, and to the annual incidence of pulmonary disease in their country of origin, a finding which has been corroborated by others (Mihalescu 1989). Because country of origin appeared to be such an overwhelming determinant, it seemed unlikely that the factors affecting tuberculous transmission and infection in Canada, would be detectable. Therefore in all subsequent analysis all foreign born were excluded.

TABLE 7-1: TUBERCULIN REACTIVITY IN STUDENTS GROUPED BY IMMIGRATION STATUS
(Students of Grades 6 and 10 combined)

PPD-T size	Immigration sub-group			
	Canadian-born		Foreign-born	
0-4	2727	(95.5%)	364	(71.1%)
5-9	70	(2.4%)	18	(3.5%)
10-14	46	(1.6%)	58	(11.3%)
15 +	37	(1.3%)	72	(14.1%)
TOTALS	2880		512	

TABLE 7-2: RELATIONSHIP OF TUBERCULIN REACTIVITY AMONG IMMIGRANT STUDENTS

TO TUBERCULOSIS RATES IN COUNTRY OF BIRTH:

(Students of Grades 6 and 10 combined)

PPD-T size	Prevalence of TB in country of birth of student *		
	LOW	INTERMEDIATE	HIGH
0-4	52 (83.9%)	43 (74.1%)	269 (68.8%)
5-9	2 (3.6%)	0	16 (4.1%)
10-14	7 (12.0%)	5 (8.6%)	45 (11.5%)
15 +	1 (1.9%)	10 (17.2%)	61 (15.6%)
TOTALS	62	58	391

* (Tuberculosis rates taken from information published by the I.U.A.T. see references # 79-88)

It was impossible to verify BCG vaccination status for the foreign-born, and it is possible this may have accounted for some of the tuberculin reactions seen among those students from countries where tuberculosis rates were low. Among those from tuberculous endemic countries two findings suggested that BCG vaccination was not responsible for the high prevalence of tuberculin reactivity seen. The frequency distribution of reactions among these students is clearly bimodal as was shown in Figure 5-5. There were very few with reactions in the 5-9mm range, after correction for PPD-B, and there were a significant number with reactions in the 15-20mm range. This is very different from the unimodal Poisson distribution of reactions, shown in Figure 5-2, seen among the Canadian participants who had received BCG vaccination. As discussed earlier this bimodal distribution has been described among children who were vaccinated at school entry, but is also typical of those with tuberculosis. The prevalence of tuberculin reactivity among those from tuberculous endemic countries was proportional to the age at which the student had immigrated to Canada, as was seen in Figure 5-4. BCG vaccination is given in infancy in most developing countries, and may also be given at school entry in some. The tuberculin

sensitivity resulting from such a practice of BCG vaccination should not show any relationship to age when the child left their country of birth. The age related increase in tuberculin reactivity shown in the present survey closely parallels findings of prevalence surveys in developing countries, among non-BCG vaccinated populations (IUAT ref # 79-88), and this can therefore be interpreted as an effect of cumulative exposure resulting in progressively increasing prevalence in these endemic areas.

7.4 THE DETERMINANTS OF TUBERCULIN REACTIVITY AMONG CANADIAN BORN:

7.4.1 Age

The overall average prevalence of tuberculous infection was calculated using the following criteria for size of PPD-T to be considered significant: i) Among the 630 students with documented BCG vaccination, all those with reactions of 12mm or more; ii) Among the 1937 known not to have received BCG, a reaction of 5mm or more; and, iii) Among the 305 without documented BCG vaccination status, a reaction of 10mm or more. As well if the reaction to PPD-T was less than 12mm and the corresponding PPD-B then the PPD-T was considered negative, regardless of the BCG status.

Based on these criteria the results of the present survey can be summarized as follows:

The overall prevalence among the Grade 6 students:	2.04%
The overall proportion of uninfected at the time of testing:	.9796
The students average age was (in years):	11.5
The proportion uninfected each year is: the (11.5)th root of (.9796)	
This is equal to:	.9982
The proportion infected each year:	.0018
The annual risk of infection:	0.18%

The overall prevalence among the Grade 10 students:	3.56%
The overall proportion of uninfected at the time of testing:	.9644
The students average age was (in years):	16.1
The proportion uninfected each year is: the (16.1)th root of (.9644)	
This is equal to:	.99775
The proportion infected each year:	.00225
The annual risk of infection:	0.225%

These results suggest that the annual risk of infection has declined by 20% over the 4.6 year average interval between the births of the members of the two groups. This is equivalent to a decline in the risk of infection of approximately 4.5% annually, which is consistent with the findings of Styblo who reported that the annual risk of infection is declining by 10% per year in the Netherlands, or almost 50% every 5 years (Styblo 1978). There are two possible reasons why the decline in risk of infection may have been under-estimated from the present survey. The first is that the population surveyed in the high schools included all high schools in the poorest sectors, but because of problems in obtaining approval from school authorities not all high schools in the more well to do areas were included. This would tend to inflate the prevalence in the high schools relative to the primary schools. The second reason why the decline in risk of annual infection may have been under-estimated is that the risk of being infected does not appear to be equal at all ages (Styblo 1978). In the Netherlands, risk of infection declined with increasing age, so that prevalence rose rapidly in childhood and early adolecence but then appeared to plateau in early adult life. For instance, in 1940 prevalence of infection was 25% at the age of 20, and was 10% greater, or 27.5% by the age of 25. The annual risk of infection in the first 20 years was 1.43%, but was only 0.51% in the last 5 years. This remained true even as the risk of infection declined. In 1956 prevalence of infection among 20 year-olds was only 6%, (annual risk of infection = 0.31% from birth to age of 20) while prevalence among 25 year olds was only 6.6% or 10% more (annual risk of infection of 0.12% from age of 20 until 25). This suggests that risk of tuberculous infection is higher among those who are younger, either because of greater exposure to an older cohort (parents) who are more likely to have tuberculous infection and thus disease, or reduced host defenses. In the present survey, this would have resulted in an underestimate of the change in annual risk of infection. To resolve these problems, the survey could be repeated in several years time in the two age groups, and comparison made between groups of similar age, as was done by Styblo, but the problem with such longitudinal data is that the test material, the personnel involved in administration, and more importantly the reading, would be different which may introduce more errors in measurement.

Our findings can be compared to two of the earlier surveys in Montreal,

albeit with certain reservations due to differences in study design. In Brickman's survey of 1971/2, the study population was comprised of children resident in the suburbs, who were younger, ie, in first Grade only, the foreign-born may have been included, and participation was only 50%. However the technique of testing (Mantoux) was the same and dual testing with atypical antigens was also conducted. Overall prevalence of significant tuberculin reactions was 1.45%. Assuming a mean age of 6 years, the annual risk of infection was 0.24% for the cohort born in 1965/6 (Brickman 1974). This is 7.5% higher than the annual risk of infection calculated for the Grade 10 students of the present study, who were born in 1971/2, or 6 years later. This is equivalent to an average annual decline of only 1.2%, but given the differences in population studied, and other methodological differences noted above, even a small downward trend is encouraging!

In the survey by Cantin, some of the population was suburban, dual testing was not done, all those with BCG were excluded, and participation was only 40-50%. However, overall the study population was more comparable in that students in Grades 1, 6, and 10 were studied, and those who were foreign-born were excluded. Overall prevalence of the Grade 1 students, (birth cohort of 1972/3) was 0.87%, meaning that calculated annual risk of infection was 0.145%. This is much lower than risk calculated for the Grade 10 students in this survey who were born on average 1 year earlier. Among the Grade 6 students (born in 1968/9) overall prevalence was 2.12%, giving an annual risk of infection of 0.19% (Cantin 1981). This is very similar to the annual risk of infection calculated for the Grade 6 students tested in the present survey, born on average 10 years later. As discussed earlier, differences in study population and design, and techniques of testing and reading make direct comparison of prevalence between the present survey and that of Cantin difficult. However, from Cantin's findings the decline in risk of infection between the Grade 1 and Grade 6 students can be calculated, and was 23% or approximately 4.6% annually, very similar to the findings in the present survey.

A significant proportion of the study population had received BCG vaccination. It has been claimed that tuberculin surveys to provide estimates of prevalence and incidence of infection will be grossly inaccurate in such a vaccinated population (Snider 1982, ATS 1981). While it

is certainly true that the estimates of overall prevalence and the annual incidence of infection calculated from this prevalence may be inaccurate, the estimate of change in annual risk of infection should not be influenced by BCG vaccination. This is because the number of false positive and negative tuberculin tests among the vaccinated, is determined by the criteria for distinguishing effect of vaccination from tuberculous infection. These rates should be identical as long as the technique and age of administration among the groups being compared are the same. The present survey is relatively small, yet the calculated risk of infection is close to that found in many other Western countries with similar rates of active disease (Styblo 1980, Pio 1984, Grzybowski 1986, Horwitz 1964, 1969). This supports the validity of our methods, and the criteria for assessing infection prevalence in a population in whom a substantial proportion were BCG vaccinated. From this it would seem reasonable to conclude that the annual risk of infection is low, and appears to be decreasing.

7.4.2 Country of birth of parents:

Among the Canadian born students, prevalence of infection among the 1027 whose parents were foreign-born was slightly lower. This may have been because, in this survey population these children were of higher average socioeconomic status than the 1844 whose parents were Canadian-born. This was largely a result of the selection of the study population which included five of the six poorest CLSC's, in greater Montreal, three of whom had very low proportions of immigrants.

Among students whose parents were foreign-born, those from tuberculous endemic areas were somewhat more likely to be infected than those whose parents came from non- or intermediate endemic areas. Among children born in Britain, the incidence of tuberculous disease was three times higher among those with Asian born parents compared to children of British born parents (MRC 1980). This was also seen in San Francisco, where the prevalence of tuberculin reactivity among USA-born schoolchildren was significantly higher among those of Mexican-born parents compared to those of American born parents (P Hopewell, personal communication). The present findings, summarized in Table 7-3, may be due to increased risk of household exposure from reactivation of latent or dormant infection among the foreign-born

members of the family or close relatives who themselves acquired infection in their country of birth before immigration. An example of this phenomenon was an outbreak with extensive transmission of infection within a large extended family from a parent who was born in Asia, to several children born in Britain (Festenstein 1981). On the other this could be due to exposure because of travel to their parents homeland. This would explain the higher rate of infection seen among the Grade 10 students compared to the Grade 6 students, who might be expected to have travelled less often. Comstock found that among American born Navy recruits, 4.3% of those who had ever lived abroad were tuberculin reactive compared to 3.5% of those who had never lived outside of the continental USA (Comstock 1975).

TABLE 7-3: TUBERCULIN REACTIVITY AMONG CANADIAN-BORN STUDENTS:

BY COUNTRY OF BIRTH OF PARENTS

(Grades 6 and 10 combined, whose parents immigrated)

PPD-T	Prevalence of tuberculosis in country of birth of parent *		
	LOW	INTERMEDIATE	HIGH
0-4	399 (96.8%)	268 (98.1%)	244 (95.8%)
5-9	11 (2.7%)	4 (1.5%)	4 (1.6%)
10-14	0	0	4 (1.6%)
15+	2 (0.5%)	1 (0.4%)	3 (1.2%)
TOTAL	412	273	255

* (Tuberculosis rates taken from information published by the I.U.A.T. see references # 79-88)

7.4.3 Socio-economic factors:

Socio-economic status appeared to be the major determinant of tuberculous infection among Canadian-born students in the present study. As seen in Table 7-4, the information from questionnaire responses regarding parental education and work status was not significantly associated with tuberculin reactivity, except if the family was mono-parental, a significant indicator of lower socioeconomic status (Wilkins 1985). Students of mono-

-parental families were more likely to have tuberculous infection; the relative risk if the mother was absent was 1.4 (95% Confidence interval of 0.97 to 2.06), and if the father was absent the risk was 1.26 (95% C.I: 0.95, 1.68). On the other hand, Kuemmerer and Comstock found a number of significant associations of large tuberculin reactions (over 11 mm) with parental or familial sociological attributes, such as less parental education, and poor housing reflected by no indoor bathroom. Prevalence of tuberculin reactivity was most strongly associated with a mono-parental family, in that prevalence among students of mono-parental families was 2.5 times higher compared to those where both parents were present (Kuemmerer 1967). In this survey, the sociological information was gathered separately by matching students to household census data, rather than direct questionnaire. These questions relate to sensitive topics, and therefore responses may be less accurate to a questionnaire than from a census.

TABLE 7-4: SOCIOECONOMIC DETERMINANTS OF TUBERCULIN REACTIVITY
(Grades 6 & 10, Canadian-born only)

Maternal Work-Status

	Absent	House-wife	Unemployed	Student	Working
PPDT Pos	8 (4.2%)*+	23 (2.0%)	0	1 (1.2%)	32 (2.3%)+
PPDT Neg	183	1119	6	85	1340

+ (Chi Sq. of Absent vs Working = 1.59, p > .10)

Paternal Work-Status

	Absent	House-wife	Unemployed	Student	Working
PPDT Pos	16 (3.3%)#	1 (1.2%)	2 (4.4%)	3 (2.6%)	43 (2.1%)#
PPDT Neg	464	82	43	114	2032

* (Percent with significant reaction to PPD-T in that work category)
# (Chi Sq. of Absent vs Working = 2.21, p > .10)

The information characterizing socioeconomic status from census data, although indirect because it was not matched to the individuals' households, was nevertheless strongly associated with tuberculin reactivity in the present study. For indicators of housing quality, such as houses without central heat, or in need of major repairs, there was a consistent association among Grade 6 and 10 students between indices of worse housing and tuberculin reactivity (see Tables 5-18 and 6-18). There was no such clear relationship to indices of annual income such as the poverty index. When the data from both Grades were combined in a logistic regression analysis, the most important predictors were parental absence and housing quality, defined by the indices of housing without central heat, or in need of repairs. Only the index of lack of central heating reached the conventional levels of statistical significance.

The present findings are also supported by the findings of Chapman and Dyerly. These authors examined factors involved in intra-familial transmission of infection in 187 investigations of household contacts of active cases of tuberculosis in Dallas, Texas (Chapman 1964). As has been found by others (BTS 1978, Rose 1979), the most important determinants of transmission were the severity of disease in the source case, and the closeness of contact within the household. By using multivariate analysis to control for these effects the authors also found that the degree of crowding (expressed as cubic feet per person), and housing quality (a complex score of water source, plumbing and heating facilities) were significantly associated with transmission. As with the present findings, family income was not directly related to the likelihood of transmission (Chapman 1964). In this study as well as that of Kuemmerer and Comstock, accessibility to medical care was not assessed, and, given the US health care system, this may be an important factor in causing delays in seeking medical attention, resulting in more prolonged exposure among the poor. Virtually all the participants in the present study were born since the introduction of universal health care, so that this confounding effect should have been less important.

TABLE 7-5: SOCIOECONOMIC DETERMINANTS OF TUBERCULIN REACTIVITY

(Canadian-born only, Grades 6 & 10 combined)

Factor	Rel. risk *	(95% C.I.)	p value
Neighbourhood factors:			
Housing-Heat	2.03 *	(1.09, 3.78)	.025
Housing-Repairs	1.64 *	(.98, 2.92)	.06
Poverty-Index	0.9 *	(.52, 1.56)	.71
Parental factors:			
Maternal Absence	1.41	(.97, 2.06)	.07
Paternal Absence	1.26	(.95, 1.68)	.11
Maternal Education	1.19	(.78, 1.83)	.41
Paternal Education	1.35	(.98, 1.86)	.07

* (For these 3 continuous variables the relative risk is calculated for the mid-points of the highest and lowest quartiles (87.5% vs 12.5%)

In a further analysis of the present data, multivariate models were developed using both indicators of housing quality, and whether or not the family was mono-parental. These are shown in Table 7-6, from which it can be seen that student having all three unfavourable factors were 2.5 times more likely to be tuberculin reactive than those with with none of these factors. After adjustment for these three factors, the average income expressed as the poverty index, was not associated with tuberculin reactivity.

TABLE 7-6: MULTIVARIABLE MODELS OF THE DETERMINANTS OF TUBERCULIN REACTIVITY
(Grades 6 & 10 combined)

Factor	Estimate	Rel. risk *	(95% C.I.)	p value
Housing-Heat	+ .0109	1.65	(.86, 3.16)	.13
Mother absent	+ .2938	1.34	(.9 , 2.0)	.15
Both factors		**2.21**		
Housing-Heat	+ .00861	1.48	(.65, 3.37)	.25
Housing-Repairs	+ .0142	1.18	(.53, 2.6)	.62
Mother Absent	+ .289	1.34	(.89, 2.0)	.16
All three factors		**2.34**		
Housing-Heat	+ .0099	1.57	(1.30, 1.89)	.27
Housing-Repairs	+ .0170	1.21	(.84, 1.74)	.62
Father Absent	+ .2680	1.31	(.57, 2.98)	.13
All three factors		**2.49**		

* (For all continuous variables the relative risk is calculated for the mid-points of the highest and lowest quartiles (87.5% vs 12.5%)

Despite the belief widespread even among the lay public, that tuberculosis is related to SES, there have been surprisingly few studies demonstrating that association. Among white Britons in 1983, there was a significant association between incidence of tuberculosis, and residence in boroughs characterized by indices of lower social class (MRC 1986). Very recently Cauthen presented data that incidence of tuberculosis was significantly associated with several indices of socioeconomic status obtained from census data, including income, housing quality, and plumbing facilities (Cauthen 1989). Reichmann correlated SES with tuberculin reactivity in New York City and found a significantly greater prevalence among those of lower socioeconomic status (Reichmann 1975). The factors associated with greater incidence of disease may not be the same as those associated with greater prevalence of infection. For instance Edwards et al found that among Navy recruits with significant tuberculin reactions on

induction, the risk of subsequent disease on follow-up for an average of four years, was four-fold greater among those who were 10% under ideal body weight compared to those who were 10% over (Edwards 1971). In this study there was no difference between these two groups in terms of initial prevalence or subsequent incidence of tuberculous infection. Tverdal also found a relationship between body mass index and risk of subsequent disease in a Norwegian population (Tverdal 1986), while Comstock found a significant relationship between risk of disease and fatness (Comstock 1975). In summary risk of infection is greater among those of lower socioeconomic status, which is best explained on the basis of poor housing quality, as was found in the present study. Risk of disease also appears to be greater among the disadvantaged, but the only factor consistently associated has been thin body habitus, presumably related to chronic under nutrition. Whether the increased risk of disease is totally explained by increased prevalence of infection, or whether the risk of disease among those infected is greater for the poor, compared to those who are more affluent, remains unclear. In any event, poverty remains a major risk factor for tuberculous infection.

7.4.4 Contact with immigrants:

The percentage of immigrants in the communities was used as an index of exposure, and as seen in Table 7-7A, there was no association between proportion of immigrants in the neighbourhood, and prevalence of tuberculous infection among Canadians resident in these communities. This measure of exposure has some limitations; namely that in the areas with the highest percentage of immigrants, the majority had immigrated from Southern Europe, especially Portugal, Spain and Greece. Tuberculosis rates in these areas are still considerably in excess of those of Canada (IUAT, Ref No. 79-88), and the prevalence of infection among those who immigrated as adults is high, but it is less than among adults who have immigrated more recently from Asia, Africa or South/Central America. Therefore the potential exposure in these communities may be lower than if all foreign born residents had come from tuberculous endemic areas. Analysis of the findings in relation to the percent of immigrants from tuberculous endemic areas only, was limited because 75% of the Canadian born students lived in communities where fewer than 6% of the population were immigrants from tuberculous endemic

areas. Even in the highest quartile the proportion ranged from only 6 to 14 percent.

TABLE 7-7: RELATIONSHIP OF TUBERCULIN REACTIVITY TO CONTACT WITH IMMIGRANTS
(Grades 6 and 10 combined, Canadian-born only)

Table 7-7A: Relationship to Immigrants from all Countries

in the Neighbourhood:

Reaction to PPD-T	Distribution by quartiles			
	LEAST			MOST
	1	2	3	4
Negative	636	670	645	684
Doubtful	17	14	14	8
Positive	21	16	11	4
TOTALS	674	700	670	696

A more direct measure of exposure was the proportion of immigrants from tuberculous endemic areas in the schools. This was measured from school lists, and ranged from 0-5% for the lowest quartile to 50% or over for the highest quartile. The likelihood of actual exposure among students in primary school is low, because reactivation rates are low before adolescence, and children are rarely contagious. But for the Grade 10 students this is a biologically valid measure of exposure, because adolescents with latent tuberculous infection are at signficant risk of developing active disease from the age of 13 until 25 (Comstock 1974), and this will most likely take the form of contagious pulmonary disease (Pio 1984, Grzybowski 1980).

Table 7-7B: Relationship to Immigrants from TB Endemic Countries in the Schools:

Reaction to PPD-T	Distribution by quartiles			
	LEAST			MOST
	1	2	3	4
Negative	735	677	607	744
Doubtful	24	15	5	14
Positive	21	13	6	14
TOTALS	781	705	618	772

The relationship between the three indices of exposure and tuberculin reactivity was anlyzed using logistic regression analysis. These findings are summarized below in Table 7-7C. The findings are so consistently negative that they cannot be dismissed as simply poor measures of exposure. The negative association probably reflects the negative correlation between percent immigrants in the community and indices of SES, such as housing quality, seen in Tables 5-5 and 6-5. It is difficult to postulate a true negative or protective effect of attending such schools or living in such neighbourhoods, and it seems more likely that other characteristics of these neighbourhoods accounted for these differences. When the three indices of percent immigrants were used in multivariate analysis together with the indices of socioeconomic status shown in Table 7-6, much of the apparent protective effect of living in communities or attending schools with a high proportion of immigrants was explained by the differences in SES.

Table 7-7C: Relative Risks associated with Indices of Contact with Immigrants:

Factor	Relative risk *	(95% C.I.)	p value
% Immigrants in School	1.04 *	(.69, 1.57)	.7
% Immigrants in Neighbourhood	.46 *	(.23, .9)	.02
% Immigrants from TB Endemic in N'hood	.64 *	(.34, 1.17)	.15

* (For the continuous variables the relative risk is calculated for the mid-points of the highest vs lowest quartiles (87.5% vs 12.5%)

In summary, despite some weaknesses of the indices of exposure, as discussed above, there is no evidence that contact with immigrants from tuberculous endemic areas increases the risk of infection among Canadian born students. This was the case even though prevalence of infection among the Canadian born students was low, so that most of the population is susceptible, and despite a high prevalence of infection among the foreign-born students attending the same schools. The prevalence of tuberculous infection among foreign-born adults in the communities was not measured but can be estimated using prevalence figures from their country of origin. In the areas with a high proportion of immigrants surveyed in the present study, the majority of these immigrants came from areas considered intermediate as regards tuberculosis rates, so that the prevalence of tuberculin reactivity should be much higher among the adults in these communities compared to communities with few immigrants. However Canadian born students who were resident in these communities, and attended schools where a significant proportion of the population were infected with tuberculosis, had no evidence of increased risk of infection.

There have been no similar studies attempting to answer this question. However there is some evidence from Edwards et al who found that

prevalence of tuberculin reactivity was increased among American born Navy recruits who were lifetime residents of counties in the Southwestern USA, adjacent to the Mexican border. In the same survey, prevalence was higher in the Appalachia, large metropolitan cities, and Northwestern Colorado. The findings in the Appalachia and cities were ascribed to the impact of lower socioeconomic status (Edwards 1969). The increased prevalence in Colorado was traced to a single source of Mycobacterium Balnei in a popular swimming spot (Judson 1974). The higher prevalence in the southwestern USA has been ascribed to greater contact with immigrants from Mexico, but the possibility that this was due to another, unidentified environmental Mycobacteria was not excluded. In Britain there was no relationship between incidence of active tuberculosis among Asian born immigrants, and rates of disease among British born persons resident in the same boroughs, including rates of those under 25 years of age (MRC 1986).

Tuberculosis is not a highly contagious disease. Often less than half of those exposed to an active case become infected, even among household contacts (Snider 1985, Rose 1979, Capewell 1984). In one Dutch study, 10% of non-household contacts of smear positive cases became infected (Styblo 1980). Most Canadian born persons have only incidental contact with foreign born persons, such as in shops, restaurants, or other public places. The likelihood of exposure is small. An important determinant of transmission is duration of exposure which is determined by the delay between onset of symptoms, especially cough, and diagnosis and treament. The advent of effective therapy more than doubled the rate of decline of the annual risk of infection (Styblo 1978), and has probably contributed to the failure to demonstrate a relationship between exposure to immigrants and prevalence of infection in the present study. This is not to say that outbreaks can not occur in the future. However it would appear from the present findings that the most important determinant of whether a child born in Canada will become infected with tuberculosis in his or her lifetime is the socioeconomic status of the childs family. Residence in communities or attendance at schools characterized by an increased proportion of immigrants with latent tuberculous infection is not an important factor.

CHAPTER 8: CONCLUSIONS

1. Overall prevalence of tuberculin reactivity among Canadian born students resident in Montreal was low, and based on the prevalence figures, the calculated annual risk of tuberculous infection appears to be declining by 4.5% annually.

The prevalence found in the present survey is comparable to that found by two earlier surveys, despite differences in populations studied, and methodology used. The prevalence, and annual risk of infection may have been either over or under estimated, but probably only slightly, because of problems in identifying tuberculous infected students among those who had been BCG vaccinated. However, these considerations are less important in calculating the change in annual risk of infection, based on the prevalence in two age groups.

2. Sensitivity to PPD-B was a common cause of false positive tuberculin reactions in the range of 5-9mm, that is traditionally regarded as doubtful. However, this sensitivity was rarely associated with false positive reactions over 9 mm.

The findings of the present survey were similar to those of an earlier survey in Montreal, and suggest that in the last 15 years the prevalence of sensitivity to PPD-B has not changed. Sensitivity to PPD-G was not measured, and this may have resulted in an underestimate of the number of false positive reactions in the 5-9mm range, but is unlikely to have altered the findings. Sensitivity to PPD-B was not associated with socioeconomic status as indicated by annual income, or housing quality, nor with travel to the Southeastern USA among the Canadian born students. Sensitivity to PPD-B was more common among the foreign born, in whom it was associated with more false positive tuberculin reactions as well.

3. Prior BCG vaccination was an important cause of false positive reactions in the 5-11 mm range. However almost 95% of students vaccinated in infancy had reactions under 10 mm. Among persons who were BCG vaccinated at birth, tuberculin reactions of 12 mm or more should be considered to represent tuberculous infection.

The effect of BCG on tuberculin reactivity could be accurately evaluated in the present study, because of the presence of documented vaccination records, and the fact that the present study was a community based survey which included vaccinated and un-vaccinated students in all schools, and in all strata of socioeconomic status. This allowed frequency distributions to be compared within each age group, and within strata of SES, so that the underlying prevalence of tuberculous infection could be established. The findings of the present survey among the vaccinated students, are similar to those of four other studies of subjects who were vaccinated in infancy, despite differences in technique and vaccines used. This suggests that the most important determinant of post-vaccinal reactivity is the age at which BCG is given. Very few of the students had been tuberculin tested in the past. Therefore the findings of the present study apply only to those who are tested for the first time after a long interval since BCG vaccination. A booster effect is theoretically possible, and has been described in other populations.

4. Prevalence of tuberculin reactivity among foreign born students was high. The likelihood of a positive reaction was greater if the student had immigrated from an area where tuberculosis is still endemic, particularly if immigration occurred at a later age.

The prevalence of tuberculin reactivity among the foreign born at the time when they leave their country of birth, is similar to those of the same age who remain. The prevalence on emigration is equal to the product of the numbers of years lived in that country and the annual risk of infection, and this, in turn, is related to the annual incidence of active pulmonary tuberculosis.

5. Despite this high prevalence of infection among the foreign born students, there was no evidence of increased prevalence, or risk of infection among the Canadian born students who are resident in communities or attend schools characterized by an increased proportion of immigrants.

6. The indices of socioeconomic status that were most associated with tuberculin reactivity were poor quality of housing, as defined by housing in need of repairs or lacking central heating, and mono-parental families. Children with all three adverse factors had prevalence of tuberculous infection that was 2.4 times greater than those with none of these factors. Among the Canadian born, the major determinant of tuberculous infection was the socioeconomic status of the students and their families.

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GLOSSARY OF TERMS

BCG Vaccination: A live attenuated vaccine first developed by Calmette and Guerin (hence Bacille Calmette-Guerin or BCG), given as protection against tuberculosis disease.

CLSC (Centre Locale des Services Communautaires): Community clinic responsible for preventive health measures, including school health programs, for the population resident in a geographically defined area, usually 40-50,000 persons

DSC (Département de Santé Communautaire): Planning and control body responsible for public health in a geographically defined area, usually comprising 4-5 CLSC territories, or roughly 200-250,000 persons.

IAF: Institut Armand Frappier: This was originally established by Dr. Armand Frappier to produce the BCG vaccine, and to promote and coordinate the mass vaccination campaigns from the 1940's until the 1970's. It is now a pharmaceutical manufacturing firm, but still maintains the records of all those vaccinated in Quebec.

Mantoux test: Technique of tuberculin testing in which 0.1 ml of liquid test material is injected intra-dermally into the volar aspect of the forearm.

M. Avium Intracellulare: Species of Mycobacteria that is present in environment in geographically defined areas (such as the South-Eastern USA), and is felt to be responsible for tuberculin reactivity on the basis of cross-reacting antigens, but rarely causes disease in humans with normal host defenses.

M. Tuberculosis: Species of mycobacteria that is responsible for the human disease of tuberculosis.

PPD-B: (Purified Protein Derivative-Battey) Antigenic testing material derived from culture of M. Avium, supposed to be more specific for diagnosis of infection with M.Avium.

PPD-T: (Purified Protein Derivative-Tuberculin) Antigenic testing material derived from culture of M. TB, supposed to be more specific for diagnosis of infection with M.TB

Significant reaction: Reaction to tuberculin material resulting in induration of of 5 or more mm usually. Interpretation of significance varies according to clinical situation. Definition(s) stated in text.

SES: Socioeconomic status: A number of attributes such as annual income, education, job-status, mono-parental families, housing characteristics are taken to represent SES at various points in the text.

Tine test: A multiple puncture technique of tuberculin testing utilizing an intrument with 4 prongs which have been coated with tuberculin protein, which is pushed into the skin.

Tuberculous disease: Active disease which may be diagnosed radiographically, histologically, or bacteriologically.

Tuberculous infection: Inactive or dormant tuberculin status, diagnosed by skin test only.

Tuberculous endemic country: country in which tuberculosis is considered by the W.H.O. to be still highly prevalent, and is declining only slightly or not at all, with annual incidence of disease of over 150/100,000 (all forms). This includes all countries of Central and South America, Caribbean states, Africa, and Asia except Japan.

Tuberculous intermediate country: TB is not highly prevalent (40-150/100,000) and is declining. This includes all countries of Eastern Europe, Japan and Southern Europe, except Italy.

Tuberculous non-endemic country: Incidence of TB is very low, less then 40/100,000 annually and is declining rapidly. This includes all countries of North and Western Europe, and Italy, the USA, and Canada.

APPENDIX TABLE i: CHARACTERISTICS OF GRADE 6 STUDENTS PARTICIPANTS COMPARED TO NON-PARTICIPANTS: AMONG ENGLISH LANGUAGE SCHOOLS

Characteristic	Non-Participants	Participants
NUMBER	245	830
CHILD		
Age	11.5	11.5
Immigration status:		
Child-Can. Parents-Can.	33	256
Child-Can. Parents-Imm.	81	474
Child-Immigrant	11	81
Country of birth:		
Non-endemic for TB	1	19
Intermediate for TB	1	6
Endemic for TB	7	50
Year of immigration:	19-82	19-80
MOTHER		
Age	40	39
Country of birth:		
Non-endemic for TB	21	19
Intermediate for TB	30	127
Endemic for TB	7	147
Year of immigration	19-66	19-60
FATHER		
Age	43.1	42.5
Country of birth:		
Non-endemic for TB	31	154
Intermediate for TB	34	127
Endemic for TB	13	166
Year of immigration	19-65	19-68
NEIGHBOURHOOD DATA:		
Poverty Index (child)	31.9	31.4
% Immigrants (all countries)	27.3	24.5

APPENDIX TABLE ii: CHARACTERISTICS OF GRADE 6 STUDENTS

PARTICIPANTS COMPARED TO NON-PARTICIPANTS:

AMONG FRENCH LANGUAGE SCHOOLS

Characteristic	Non-Participants	Participants
NUMBER	283	1588
CHILD		
Age	11.7	11.6
Immigration status:		
Child-Can. Parents-Can.	121	978
Child-Can. Parents-Imm.	53	371
Child-Immigrant	81	20
Country of birth:		
Non-endemic for TB	1	11
Intermediate for TB	1	33
Endemic for TB	18	169
Year of immigration:	19-83	19-82
MOTHER		
Age	38.8	38.0
Country of birth:		
Non-endemic for TB	7	57
Intermediate for TB	18	117
Endemic for TB	20	219
Year of immigration	19-74	19-75
FATHER		
Age	40.6	50
Country of birth:		
Non-endemic for TB	9	78
Intermediate for TB	18	126
Endemic for TB	24	249
Year of immigration	19-73	19-73
NEIGHBOURHOOD DATA:		
Poverty Index (child)	38.5	38.4
% Immigrants (all countries)	16.7	16.2

APPENDIX TABLE iii: CHARACTERISTICS OF GRADE 6 STUDENTS

PARTICIPANTS COMPARED TO NON-PARTICIPANTS:

AMONG SCHOOLS OF THE PROTESTANT SCHOOL BOARD

Characteristic	Non-Participants	Participants
NUMBER	194	522
CHILD		
Age	11.5	11.4
Immigration status:		
Child-Can. Parents-Can.	27	175
Child-Can. Parents-Imm.	61	273
Child-Immigrant	9	63
Country of birth:		
Non-endemic for TB	1	15
Intermediate for TB	1	4
Endemic for TB	5	41
Year of immigration:	19-83	19-80
MOTHER		
Age	40	39
Country of birth:		
Non-endemic for TB	10	64
Intermediate for TB	25	75
Endemic for TB	6	101
Year of immigration	19-68	19-68
FATHER		
Age	42	42
Country of birth:		
Non-endemic for TB	19	66
Intermediate for TB	29	74
Endemic for TB	12	112
Year of immigration	19-66	19-69
NEIGHBOURHOOD DATA:		
Poverty Index (child)	31.1	29.1
% Immigrants (all countries)	30.3	23.3

APPENDIX TABLE iv: CHARACTERISTICS OF GRADE 6 STUDENTS PARTICIPANTS COMPARED TO NON-PARTICIPANTS: AMONG SCHOOLS OF THE MONTREAL CATHOLIC BOARD

Characteristic	Non-Participants	Participants
NUMBER	267	1369
CHILD		
Age	11.7	11.7
Immigration status:		
Child-Can. Parents-Can.	82	627
Child-Can. Parents-Imm.	62	498
Child-Immigrant	20	224
Country of birth:		
Non-endemic for TB	1	14
Intermediate for TB	1	31
Endemic for TB	18	167
Year of immigration:	19-82	19-81
MOTHER		
Age	39	38
Country of birth:		
Non-endemic for TB	18	118
Intermediate for TB	22	159
Endemic for TB	19	250
Year of immigration	19-71	19-73
FATHER		
Age	41	41
Country of birth:		
Non-endemic for TB	21	139
Intermediate for TB	22	167
Endemic for TB	23	279
Year of immigration	19-70	19-72
NEIGHBOURHOOD DATA:		
Poverty Index (child)	40.9	39.3
% Immigrants (all countries)	20.4	21.7

APPENDIX TABLE v: CHARACTERISTICS OF GRADE 6 STUDENTS PARTICIPANTS COMPARED TO NON-PARTICIPANTS: AMONG SCHOOLS OF THE VERDUN CATHOLIC BOARD

Characteristic	Non-Participants	Participants
NUMBER	58	315
CHILD		
Age	11.8	11.8
Immigration status:		
Child-Can. Parents-Can.	36	271
Child-Can. Parents-Imm.	7	34
Child-Immigrant	2	8
Country of birth:		
Non-endemic for TB	0	1
Intermediate for TB	0	0
Endemic for TB	2	7
Year of immigration:	19-81	19-82
MOTHER		
Age	37	38
Country of birth:		
Non-endemic for TB	0	4
Intermediate for TB	1	2
Endemic for TB	1	7
Year of immigration	19-78	19-72
FATHER		
Age	40	41
Country of birth:		
Non-endemic for TB	0	5
Intermediate for TB	1	4
Endemic for TB	1	9
Year of immigration	19-75	19-68
NEIGHBOURHOOD DATA:		
Poverty Index (child)	31.1	35.4
% Immigrants (all countries)	4.6	3.8

APPENDIX TABLE vi: CHARACTERISTICS OF GRADE 6 STUDENTS

PARTICIPANTS COMPARED TO NON-PARTICIPANTS:

AMONG SCHOOLS OF THE LASALLE CATHOLIC BOARD

Characteristic	Non-Participants	Participants
NUMBER	15	212
CHILD		
Age	11.9	11.7
Immigration status:		
Child-Can. Parents-Can.	9	161
Child-Can. Parents-Imm.	4	40
Child-Immigrant	0	8
Country of birth:		
Non-endemic for TB	0	0
Intermediate for TB	0	4
Endemic for TB	0	4
Year of immigration:	-	19-83
MOTHER		
Age	37	38
Country of birth:		
Non-endemic for TB	0	14
Intermediate for TB	0	8
Endemic for TB	1	8
Year of immigration	19-75	19-72
FATHER		
Age	43	42
Country of birth:		
Non-endemic for TB	0	22
Intermediate for TB	0	8
Endemic for TB	1	15
Year of immigration	19-69	19-67
NEIGHBOURHOOD DATA:		
Poverty Index (child)	26.7	24.6
% Immigrants (all countries)	9	12

APPENDIX TABLE vii: CHARACTERISTICS OF PARTICIPATING GRADE 10 STUDENTS BY SCHOOL BOARD

Characteristic of Participant	BOARD Protestant Montreal	Catholic Montreal	Catholic Verdun
NUMBER	290*	440	195
CHILD			
Age in years	15.9	16.3	15.9
Immigration status:			
Child-Can/Parents-Can	114 = 39%	123 = 28%	160 = 82%
Child-Can/Parents-Imm	116 = 40%	175 = 40%	29 = 15%
Child-Imm/Parents-Imm	60 = 21%	142 = 32%	6 = 3%
Year of immigration	19-79	19-80.5	19-77
PARENTS			
Age of Mother	42.5	44.5	42.2
Age of Father	46	48	45
NEIGHBOURHOOD FACTORS			
Poverty Index	25.1	37.5	33.1
Percent Immigrants	17.1	23.5	4.6

* (Number of students for whom this information was available)

APPENDIX TABLE viii: CHARACTERISTICS OF PARTICIPATING GRADE 10 STUDENTS BY LANGUAGE OF INSTRUCTION OF THE SCHOOL

Characteristic of Participant	LANGUAGE OF INSTRUCTION ENGLISH	FRENCH
Age of Child	16.1	16.1
Immigration status:		
Child-Can & Parents-Can	161 = 32%	236 = 56%
Child-Can & Parents-Imm	258 = 51%	62 = 15%
Child-Immigrant	85 = 17%	123 = 29%
Year Child immigrated	19-77.7	19-81.6
Age of Mother	44.1	42.6
Age of Father	47.7	45.7
Neighbourhood Factors:		
Poverty Index (child)	29.9	36.8
Percent of Immigrants	22.0	12.9

APPENDIX TABLE ix: RELATIONSHIP OF SENSITIVITY TO PPD-B TO DOCUMENTED BCG VACCINATION GRADE 6, CANADIAN BORN STUDENTS ONLY

PPD-B	BCG Given	BCG Not Given
S>B	399 (87.1%)	1248 (91.8%)
2-4	43 (9.4%)	78 (5.7%)
5-9	13 (2.8%)	25 (1.8%)
10+	3 (0.7%)	9 (0.7%)
TOTALS: (22 missing)	458	1360

APPENDIX TABLE x: RELATIONSHIP OF SENSITIVITY TO PPD-B TO DOCUMENTED BCG VACCINATION GRADE 10, CANADIAN BORN STUDENTS ONLY

PPD-B	BCG Given	BCG Not Given
S>B	151 (92.7%)	331 (93.1%)
2-4	7 (4.3%)	32 (8.4%)
5-9	2 (1.2%)	7 (1.9%)
10+	3 (1.8%)	9 (2.3%)
TOTALS:	163	379

APPENDIX TABLE xi: RELATIONSHIP OF SENSITIVITY TO PPD-B

TO TRAVEL TO THE SOUTHEAST USA

GRADE 6, CANADIAN BORN STUDENTS ONLY

PPD-B	Visited SE USA	Never visited
S>B	352 (91.4%)	1522 (90.9%)
2-4	27 (7.0%)	103 (6.1%)
5-9	3 (0.8%)	39 (2.3%)
10+	3 (0.8%)	11 (0.7%)
TOTALS: (54 missing)	385	1675

APPENDIX TABLE xii: RELATIONSHIP OF SENSITIVITY TO PPD-B

TO TRAVEL TO THE SOUTHEAST USA

GRADE 10, CANADIAN BORN STUDENTS ONLY

PPD-B	Visited SE USA	Never visited
S>B	150 (87.7%)	527 (89.4%)
2-4	11 (6.4%)	30 (5.1%)
5-9	5 (2.9%)	8 (1.4%)
10+	5 (2.9%)	24 (4.1%)
TOTALS:	171	589

APPENDIX - INSTRUMENTS

On the following 23 pages are shown the questionnaires and consent forms used for the Grade 6 and Grade 10 students. Both English and French versions are shown, for both levels. As well, the modified questionnaire, together with the reminder note, used in the two-stage survey in two English language schools are shown. Finally the feedback forms given to the students at the time of testing and reading are shown at the end. Not shown are the questionnaires and consents translated into 7 other languages that were used, primarily for the Grade 6 students. All forms have been reduced by approximately 12% in order to adhere to the margin specifications of the University. In some instances these forms could not be reduced sufficiently to meet these guidelines, and yet remain legible. In these circumstances, the margins were exceeded.

Centre Hospitalier Thoracique de Montréal
Montreal Chest Hospital Centre
3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL. 849 5201

TUBERCULIN SURVEY IN MONTREAL

A joint project of the Department of Medicine of the Montreal Chest Hospital, and the Department of Epidemiology and Biostatistics of McGill University, in cooperation with the Montreal Children's Hospital, and the Departement de Sante Communautaire of Verdun Hospital.

PEDIATRIC QUESTIONNAIRE

(for those under 14)

Your cooperation in completing this questionnaire about your child and yourselves is appreciated very much. Please answer these questions as frankly and accurately as possible. All information from this survey will remain **STRICTLY CONFIDENTIAL.**

You will answer the questions by circling the correct response, or by writing a number or a word in the space provided. The questions on page 1 are about your child, while those on page 2 are about yourselves - the child's mother and father.

Dear parent or guardian,

The Montreal Chest Hospital, in collaboration with the department of Epidemiology of McGill University, the Montreal Children's Hospital and the school health programme of your neighbourhood CLSC, is conducting a tuberculosis survey in Montreal this winter. Our aim is to identify among Grade 6 students children who have been infected with TB and to determine WHY this happened to prevent it happening again.

Why a TUBERCULOSIS survey? Hasn't it almost disappeared?
- Each year hundreds of Montrealers become ill with Tuberculosis. Because it is a contagious disease many others may be infected from them.

Could a child become infected even if there was no known contact?
- People may be exposed to TB and become infected, without recognizing it.

But if children are healthy do they still need a test?
- Yes, because children can be infected, and yet still appear healthy.

How can you tell if they are infected with Tuberculosis?
- By means of 2 simple skin tests, which are painless and harmless.

If infection is found can anything be done about it?
- YES, this infection is easily treated. The Montreal Children's Hospital or your child's pediatrician will recommend treatment.

We appeal to all parents to enrol their children in this survey to help to eliminate tuberculosis once and for all. In order for your child to participate, please sign the consent below and complete the questionnaire which is attached. Have your child bring both back to school tomorrow. If the test is positive the school health nurse will contact you directly.

If you have any questions about this survey or about tuberculosis in general you can call the school health nurse who can be reached through the school. Or you can call one of the survey coordinators listed below.

Richard Menzies MD 849-5201 local 222 or 398-6976
or Billie Visanjee RN and Donna Amyot RN - 849-5201 local 222

---------- CONSENT ----------

I give my permission for my child _____

to receive the tuberculin skin test as part of the tuberculosis survey at school.

Signature of parent or guardian _____ Date _____

(Office use only)

SCHOOL _____ 1-2
ID _____ 3-5
PPD-S _____ 6-7
PPD-B _____ 8-9
BCG Y N 10

FIRST, A FEW QUESTIONS ABOUT YOUR CHILD:

NAME: Last _____ First _____

ADDRESS: No._____ Street_____ Apt_____

CITY _____ POSTAL CODE _____ 11-15

TELEPHONE NO. _____

1 How old is your child? (Please mark age in years) _____ 16 17

2 In what country was the child born? _____ 18-20

If not born in Canada,

3 In what calendar year did the child immigrate to Canada?
(Mark year of arrival) 19_____ 21-22

4 Has your child ever been diagnosed that he/she is suffering from tuberculosis? (Circle one) Yes No 23

5 Has he/she ever received treatment for tuberculosis? Yes No 24

6 Has the child ever lived in the same house-hold as someone with active tuberculosis? (Someone who was diagnosed or treated at that time). Yes No 25

7 Did your child ever receive the BCG vaccination, which is not routine but instead is the vaccination against tuberculosis? Yes No 26

If Yes to Question 7,

8 At what age did he/she receive this vaccination?
(Mark age in years) _____ 27-28

9 Has your child ever visited the South-Eastern USA?
(The area marked in black on the map below - the states of: Florida, Alabama, Georgia, Texas, Louisianna & the Carolinas) Yes No 29

If Yes to Question 9,

10 If you add together all the time he/she has there there in all visits, how much time would that be? (Circle one) 30

less than 2 weeks 1
2-5 weeks 2
6-12 weeks 3
2-5 months 4
more than 6 months 5

NOW, A FEW QUESTIONS ABOUT YOURSELVES - THE CHILD'S PARENTS OR GUARDIANS:

THE CHILD'S MOTHER:

10 What is her present age? (Please mark age in years) _____ 31-3

11 In what country was she born? _____ 33-3

12 If not born in Canada, in what year did she immigrate?
(Mark calendar year of arrival) 19____ 36-3

13 What is the highest level of education she completed? (Circle one)

No schooling	1
Elementary	2
Secondary (High school)	3
Technical, trade or vocational school, Community college or CEGEP	4
University	5

3

14 In the past 12 months what has been the mother's major activity or occupation? (Circle one)

Working	1
Unepmployed/looking for work	2
Going to school	3
Retired	4
Keeping house	5
Unknown/not at home/deceased	6

3

THE CHILD'S FATHER:

15 What is his present age? (Please mark age in years) _____ 40-4

16 In what country was he born? _____ 42-4

17 If not born in Canada, in what year did he immigrate?
(Mark calendar year of arrival) 19____ 45-4

18 What is the highest level of education he completed? (Circle one)

No schooling	1
Elementary	2
Secondary (High school)	3
Technical, trade or vocational school, or Community college or CEGEP	4
University	5

4

19 In the past 12 months what has been his major activity or occupation? (Circle one)

Working	1
Unemployed/looking for work	2
Going to school	3
Retired	4
Keeping house	5
Unknown/not at home/deceased	6

4

Centre Hospitalier Thoracique de Montréal
Montreal Chest Hospital Centre
3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL. 849 5201

DEPISTAGE TUBERCULINIQUE A MONTREAL

Un projet conjoint du département de Médecine du Centre Hospitalier Thoracique de Montréal et du département d'Epidémiologie et Biostatistiques de l'Université McGill, avec la collaboration de l'hôpital de Montréal pour Enfants et du département de Santé Communautaire de l'Hôpital de Verdun.

QUESTIONNAIRE S'ADRESSANT AUX ENFANTS

moins de 14 ans

Votre collaboration à ce questionnaire concernant votre enfant et vous-mêmes est grandement appreciée. Veuillez répondre aux questions de la manière la plus franche et précise possible. Toute information recueillie au cours de ce dépistage est **STRICTEMENT CONFIDENTIELLE.**

Vous répondrez aux questions soit en encerclant la bonne réponse ou en inscrivant un nombre ou un mot dans l'espace prévu. Les questions de la page 1 concernent votre enfant, tandis que celles de la page 2 concernent la mère et le père de l'enfant.

Cher parent ou tuteur,

Le centre hospitalier Thoracique de Montréal, en collaboration avec le départemen d'Epidemiologie de l'Université McGill, l'hôpital de Montréal pour Enfants et le personne du programme scolaire de santé du CLSC de votre quartier, procèdera à un dépistage de tuberculose à Montréal cet hiver. Notre but est d'identifier, parmi les enfants de la 6e annee ceux qui auraient contracté la tuberculose et de déterminer POURQUOI ils ont été infectes, afin d'empêcher que cela ne se reproduise.

Pourquoi un dépistage de TUBERCULOSE? Est-ce que celle-ci n'a pas disparu?
- Chaque annee des centaines de Montréalais contractent la tuberculose. Puisqu'il s'agit d'une maladie contagieuse, plusieurs autres peuvent être infectés.

Est-ce qu'un enfant pourrait être atteint de cette maladie sans avoir été en contact?
- Oui, les gens peuvent être atteints de la tuberculose sans même le savoir.

Mais si les enfants sont en santé, est-ce qu'ils ont quand même besoin de passer un test?
- Oui, puisque des enfants atteints de tuberculose peuvent quand même sembler en bonne santé

Comment pouvez-vous reconnaître une personne atteinte de la tuberculose?
- En effectuant deux (2) tests très simples, qui ne sont ni douloureux ni dangereux.

S'il s'avérait qu'une infection soit dépistée, peut-on faire quelque chose?
- Oui, la tuberculose est facilement traitable. L'hôpital de Montréal pour les Enfants, va vous recommander un traitement si nécessaire.

Nous demandons à tous les parents de bien vouloir faire participer leurs enfants à cette etude, afin d'aider à faire éliminer la tuberculose une fois pour toute. Afin que votre enfant participe à ce depistage, nous vous demandons de signer la formule de consentement et de completer le questionnaire ci-joint. Le questionnaire et la formule de consentement doivent être retournes à l'école des demain si possible. Si votre enfant s'averait positif au test, l'infirmiere de l'école vous contactera personellement.

Si vous desirez de plus amples informations concernant ce dépistage ou concernant la tuberculose en general, vous pouvez communiquer avec l'infirmière de l'école ou l'un des coordinateurs du depistage mentionnés ci-bas.

Richard Menzies MD - 849-5201 poste 222, ou 398-6976
Billie Visanjée RN ou Donna Amyot RN - 849-5201 poste 222

---------- CONSENTEMENT ----------

Je consens que mon enfant _____ recoive le test de depistage de tuberculose à l'école.

Signature de parent ou tuteur _____ Date _____

Usage de bureau seulement	
ECOLE	1 2
ID	3 5
PPD-S	6 7
PPD-B	8 9
BCG Y N	10

QUELQUES INFORMATIONS CONCERNANT VOTRE ENFANT:

NOM_____ PRENOM_____

ADRESSE: No._____ Rue_____ App._____

VILLE: _____ CODE POSTAL _____ 10 15

NUMERO de TEL._____

1 Votre enfant, quel âge a-t-il(elle)? (Veuillez l'inscrire en annees) _____ 16-17

2 Dans quel pays est il/elle né(e)? _____ 18 20

3 Si il(elle) n'est pas né(e) au Canada, en quelle année a-t-il(elle) immigré? (SVP, marquez l'année de l'arrivee) 19____ 21 22

(Encerclez)

4 Est-ce que votre enfant a déjà été diagnostiqué ayant la tuberculose? Oui Non 23

5 A-t-il(elle) jamais été traité(e) pour la tuberculose? Oui Non 24

6 Est-ce que votre enfant a déjà demeuré avec une personne souffrant de tuberculose active? (Quelqu'un qui aurait recu récemment un diagnostic de tuberculose ou serait traité pour cette maladie) Oui Non 25

7 Votre enfant, a-t-il(elle) déjà reçu le vaccin BCG comme protection contre la tuberculose? Oui Non 26

Si Oui à la question 7,

8 A quel âge votre enfant a-t-il(elle) été vacciné? (SVP, inscrire l'âge en nombre d'annees) _____ 27-28

9 Votre enfant a-t-il(elle) déjà visité le sud-est des Etats-Unis? (le region en noir sur la carte ci-dessous - Floride, Alabama, Georgie, Louisiane, Texas, ou les Carolines.) Oui Non 29

Si Oui à la question 9,

10 Combien de temps en tout a-t-il(elle) passé dans cette région? (Si vous additionez tous les séjours)

(Encerclez) 30

moins de 2 semaines 1
2-5 semaines 2
6-11 semaines 3
3-6 mois 4
plus de 6 mois 5

QUELQUES QUESTIONS VOUS CONCERNANT, EN TANT QUE PARENTS DE L'ENFANT

LA MERE DE L'ENFANT:

11 La mere de l'enfant, quel âge a-t-elle? (Veillez l'inscrire en années) _____ 31-32

12 Dans quel pays est-elle née? _____ 33-35

13 Si elle n'est pas née au Canada, en quelle année a-t-elle immigre au Canada? (SVP inscrivez l'année de son arrivée) 19_____ 36-37

14 Quel est son plus haut degré de scolarite complété? (Encerclez)

aucun	1
Ecole élémentaire	2
Ecole secondaire	3
Ecole technique ou professionelle ou CEGEP	4
Université	5

38

15 Au cours des 12 derniers mois, quelle était son occupation principale? Etait-elle: (Encerclez)

au travail	1
à l'ecole	2
en chômage/ cherchant du travail	3
à la retraite	4
ménagère	5
inconnu/ pas à la maison/ décédée	6
autre, spécifier _____	

39

LE PERE DE L'ENFANT:

16 Le pere, quel âge a-t-il? (Veuillez l'inscrire en années) _____ 40-41

17 Dans quel pays est-il né? _____ 42-44

18 Si il n'est pas né au Canada, en quelle année a-t-il immigre? (Indiquez l'année de son arrivée) 19_____ 45-46

19 Quel est son plus haut degré de scolarité complété? (Encerclez)

aucun	1
école élementaire	2
école secondaire	3
école technique ou professionnel ou CEGEP	4
Université	5

47

19 Au cours des derniers 12 mois, quelle était son occupation principale? Etait-il: (Encerclez)

au travail	1
à l'école	2
en chômage/ cherchant du travail	3
à la retraite	4
travaux ménagers	5
inconnu/ pas à la maison/ décédé	6
autre, spécifier _____	

48

Centre Hospitalier Thoracique de Montréal
Montreal Chest Hospital Centre
3650 ST URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL 849 5201

TUBERCULIN SURVEY IN MONTREAL

A joint project of the Department of Medicine of the Montreal Chest Hospital, and the Department of Epidemiology and Biostatistics of McGill University, in cooperation with the Montreal Children's Hospital, and the Department of Community Health of the Verdun General Hospital.

ADOLESCENT QUESTIONNAIRE

(for those 14 - 18)

Your cooperation in completing this questionnaire is appreciated very much. Please answer these questions as frankly and accurately as possible. It is NOT compulsory to answer any or all of the questions. All information from this survey will remain STRICTLY CONFIDENTIAL.

You will answer the questions by circling the correct response, or by writing a number or a word in the space provided. Please complete the questions in the first section which are about yourselves. Ask your parents to complete the questions about themselves which are on the last page.

Dear student,

The Montreal Chest Hospital, in collaboration with the department of Epidemiology of McGill University, the Montreal Children's Hospital and the school health programme of your neighbourhood CLSC, is conducting a tuberculosis survey in Montreal this winter. Our aim is among Grade 10 students to identify adolescents who have been infected with TB and to determine WHY this happened to prevent it happening again.

"Why a TUBERCULOSIS survey? Hasn't it almost disappeared?"
- Each year hundreds of Montrealers become ill with Tuberculosis. Because it is a contagious disease many others may be infected from them.

"Could I become infected even if there was no known contact?"
- People may be exposed to TB and become infected, without recognizing it.

"But I feel perfectly healthy! Do I still need a test?"
- Yes, because adolescents can be infected, and yet still appear healthy.

"How can you tell if I am infected with Tuberculosis?"
- By means of 2 simple skin tests, which are painless and harmless.

"If this infection is found can anything be done about it?"
- YES, this infection is easily treated. The Montreal Children's Hospital or your family doctor will recommend treatment.

We appeal to all students to enrol in this survey to help to eliminate tuberculosis once and for all. In order for you to participate, please sign the consent below, and ask your parents to sign that they agree with your decision to have this done. Then complete the first page of the questionnaire which is attached, and ask one of your parents to complete their section.

If you have any questions about this survey or about tuberculosis in general you can call the school health nurse who can be reached through the school. Or you can call one of the survey coordinators listed below.

Richard Menzies MD 849-5201 local 222 or 398-6976
Billie Visanjee RN and Donna Amyot RN - 849-5201 local 222

---------- CONSENT ----------

I agree to receive the tuberculin skin tests as part of the tuberculosis survey at school.

Signature of student _____ Date _____

I agree with the decision of my son/daughter _____
to participate in the tuberculosis survey at school.

Signature of parent or guardian _____ Date _____

Office use only

SCHOOL _____ 1 2
ID _____ 3 5
PPD-S _____ 6 7
PPD-B _____ 8 9
BCG Y N N/A 40

FIRST, A FEW QUESTIONS ABOUT YOURSELF:

NAME: Last _____ First _____

ADDRESS: No._____ Street_____ Apt_____

CITY _____ POSTAL CODE _____ 11 15

TELEPHONE NO. _____

1 How old are you? (Please mark age in years) _____ 16 17

2 In what country were you born? _____ 18 20

If not born in Canada,
3 In what calendar year did you immigrate to Canada?
(Mark year of arrival) 19_____ 21 22

(Circle one)

4a. Have you ever received the skin test for tuberculosis? Yes No 50

4b Have you ever been diagnosed that you were suffering from tuberculosis? Yes No 23

5 Have you ever received treatment for tuberculosis? Yes No 24

6 Have you ever lived in the same house-hold as someone with active tuberculosis? (Someone who was diagnosed or treated at that time). Yes No 25

7 Did you ever receive the BCG vaccination, which is not routine but instead is the vaccination against tuberculosis? Yes No 26

If Yes to Question 7,
8 At what age did you receive this vaccination?
(Mark age in years) _____ 27-28

9 Has you ever visited the South-Eastern USA?
(The area marked in black on the map below - the states of: Florida, Alabama, Georgia, Texas, Louisianna & the Carolinas) Yes No 29

If Yes to Question 9,
10 If you add together all the time you have spent there in all visits, how much time would that be?

(Circle one)
less than 2 weeks 1
2-5 weeks 2
6-12 weeks 3
2-5 months 4
more than 6 months 5 30

NOW, A FEW QUESTIONS FOR YOUR PARENTS TO ANSWER ABOUT THEMSELVES:

About your Mother:

11 What is her present age? **(Please mark age in years)** _____ 31-32

12 In what country was she born? _____ 33-35

If not born in Canada,
13 In what year did she immigrate? **(Mark calendar year of arrival)** 19_____ 36-37

14 What is the highest level of education she completed? **(Circle one)**

No schooling	1
Elementary	2
Secondary (High school)	3
Technical, trade or vocational school, Community college or CEGEP	4
University	5

38

15 In the past 12 months what has been the mother's major activity or occupation? **(Circle one)**

Working	1
Unemployed/looking for work	2
Going to school	3
Retired	4
Keeping house	5
Deceased/not at home/unknown	6

39

About your Father:

16 What is his present age? **(please mark age in years)** _____ 40-41

17 In what country was he born? _____ 42-44

If not born in Canada,
18 In what year did he immigrate to Canada? **(Mark year of arrival)** 19_____ 45-46

19 What is the highest level of education he completed? **(Circle one)**

No schooling	1
Elementary	2
Secondary (High school)	3
Technical, trade or vocational school, Community college or CEGEP	4
University	5

47

20 In the past 12 months what has been the father's major activity or occupation? **(Circle one)**

Working	1
Unemployed/looking for work	2
Going to school	3
Retired	4
Keeping house	5
Deceased/not at home/unknown	6

48

Centre Hospitalier Thoracique de Montréal
Montreal Chest Hospital Centre
3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL 849 5201

DEPISTAGE TUBERCULINIQUE A MONTREAL

Un projet conjoint du département de Médecine du Centre Hospitalier Thoracique de Montréal et du département d'Epidémiologie et Biostatistiques de l'Université McGill, avec la collaboration de l'hôpital de Montréal pour Enfants et du département de Santé Communautaire de l'Hôpital Général de Montréal.

QUESTIONNAIRE S'ADRESSANT AUX ADOLESCENTS

14 à 18 ans

Votre collaboration à ce questionnaire est grandement appreciée. Veuillez répondre aux questions de la manière la plus franche et precise possible.- Toute information recueillie au cours de ce dépistage est **STRICTEMENT CONFIDENTIELLE.**

Vous répondrez aux questions soit en encerclant la bonne réponse ou en inscrivant un nombre ou un mot dans l'espace prévu. Les questions de la prémiere section vous concernent, mais veuillez demander à un de vos parents de compléter la derniére section.

Chèr(e) etudiant(e)

Le centre hospitalier Thoracique de Montréal, en collaboration avec le département d'Epidémiologie de l'Université McGill, l'hôpital de Montréal pour Enfants et le personnel du programme scolaire de santé du CLSC de votre quartier, procèdera à un depistage de tuberculose à Montréal cet hiver. Notre but est d'identifier, parmi les enfants de 10ème annee ceux qui auraient contracté la tuberculose et de déterminer POURQUOI ils ont été infectés, afin d'empêcher que cela ne se reproduise.

Pourquoi un dépistage de TUBERCULOSE? Est-ce que celle-ci n'a pas disparu?
- Chaque année des centaines de Montréalais contractent la tuberculose. Puisqu'il s'agit d'une maladie contagieuse, plusieurs autres peuvent être infectés.

Est-ce qu'un étudiant pourrait être atteint de cette maladie sans avoir été en contact?
- Oui, les gens peuvent être atteints de tuberculose sans même le savoir.

Mais si les étudiants sont en santé, est-ce qu'ils ont quand même besoin de passer un test?
- Oui, puisque des personnes atteintes de tuberculose peuvent quand même paraître en bonne sante

Comment pouvez-vous reconnaitre une personne atteinte de la tuberculose?
- En effectuant deux (2) tests très simples, qui ne sont ni douloureux, ni dangereux.

S'il s'avérait qu'une infection soit dépistée, peut-on faire quelque chose?
- Oui, la tuberculose est facilement traitable. L'hôpital de Montréal pour les Enfants, va vous recommander un traitement si nécessaire.

Nous demandons a tous les étudiantes de bien vouloir participer à cette étude, afin d'aider à eliminer la tuberculose. Ainsi pour que vous puissiez prendre part à ce depistage, nous vous demandons de signer la formule de consentement et de compléter la première page du questionnaire ci-joint. Un de vos parents doit aussi signer le consentement, et completer la deuxieme page du questionnaire. Le questionnaire et la formule de consentement doivent etre retournes à l'école dès demain si possible. S'il s'averait que vous étiez positif au test un suivi sera assuré par l'infirmière de l'école, ou bien par l'infirmière de l'hôpital de Montréal pour enfants.

Si vous desirez de plus amples informations concernant cet depistage ou concernant la tuberculose en general, vous pouvez communiquer avec l'infirmière de l'école ou l'un des coordinateurs du depistage mentionnes ci-dessous.

Richard Menzies MD - 849-5201 poste 222, ou 398-6976
Billie Visanjee RN ou Donna Amyot RN - 849-5201 poste 222

---------- CONSENTEMENT ----------

Je consens a participer au test de dépistage de tuberculose qui aura lieu à l'école.
Signature de l'étudiant(e) _____

J'accepte la decision de mon enfant _____ à participer au dépistage.
Signature du parent ou tuteur _____ Date _____

Usage de bureau seulement		
ECOLE	_____	1 2
ID	_____	3-5
PPD-S	_____	6 7
PPD-B	_____	8 9
BCG	Y N N/A	49

QUELQUES INFORMATIONS VOUS CONCERNANT

NOM_____ PRENOM_____

ADRESSE: No._____ Rue_____ App._____

VILLE: _____ CODE POSTAL _____ 10 15

NUMERO de TEL._____

1 Quel âge avez-vous? (Veuillez l'inscrire en années) _____ 16 17

2 Dans quel pays êtes-vous né? _____ 18 20

3 Si vous n'êtes pas né(e) au Canada, en quelle année avez-vous immigré? (SVP, marquez l'année de l'arrivée) 19_____ 21 22

	(Encerclez)		
4a Est-ce que vous avez déjà reçu un test pour la tuberculose? (le Mantoux ou le Tine test)	Oui	Non	50
4b Avez-vous déjà été diagnostiqué que vous souffriez de la tuberculose? (la maladie proprement dite).	Oui	Non	23
5 Avez-vous jamais été traite(e) pour la tuberculose?	Oui	Non	24
6 Avez-vous déjà demeuré avec une personne souffrant de tuberculose active? (Quelqu'un qui aurait recu récemment un diagnostic de tuberculose ou serait traité pour cette maladie)	Oui	Non	25
7 Avez-vous déjà reçu le vaccin BCG qui n'est pas un vaccin de routine (c'est le vaccin contre la tuberculose)?	Oui	Non	26

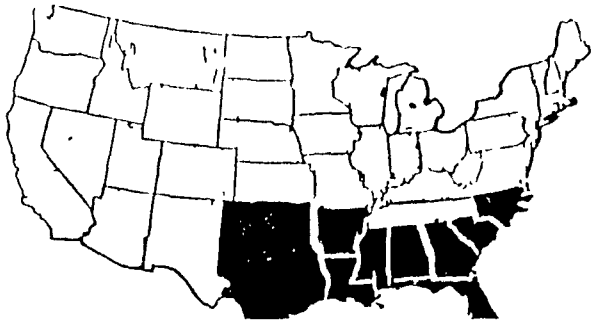
Si Oui à la question 7,

8 A quel âge avez-vous été vacciné(e)? (SVP, inscrire l'âge en nombre d'annees) _____ 27-28

9 Avez-vous déjà visité le sud-est des Etats-Unis? (le region en noir sur la carte ci-dessous - Floride, Alabama, Georgie, Louisianne, Texas, ou les Carolines.) Oui Non 29

Si Oui à la question 9,

10 Combien de temps en tout avez-vous passé dans cette région? (Si vous additionez tous les séjours?)



(Encerclez)

moins de 2 semaines	1	30
2-5 semaines	2	
6-11 semaines	3	
1-6 mois	4	
plus de 6 mois	5	

QUELQUES QUESTIONS CONCERNANT LES PARENTS DE L'ETUDIANT(E)
(SVP Demandez un de vos parents)

LA MERE DE L'ETUDIANT:

11 La mere, quel âge a-t-elle? **(Veillez l'inscrire en années)** _____ 31-32

12 Dans quel pays est-elle née? _____ 33-35

13 Si elle n'est pas née au Canada, en quelle année a-t-elle immigré au Canada? (SVP inscrivez l'année de son arrivée) 19_____ 36-37

14 Quel est son plus haut degré de scolarite complété? **(Encerclez)**

aucun	1	38
Ecole élémentaire	2	
Ecole secondaire	3	
Ecole technique ou professionelle ou CEGEP	4	
Université	5	

15 Au cours des 12 derniers mois, quelle était son occupation principale? **(Encerclez)**

Etait-elle:		
au travail	1	39
à l'école	2	
en chômage/ cherchant du travail	3	
à la retraite	4	
ménagère	5	
inconnu/ pas à la maison/ décédée	6	

LE PERE DE L'ETUDIANT:

16 Le père, quel âge a-t-il? **(Veuillez l'inscrire en années)** _____ 40-41

17 Dans quel pays est-il ne? _____ 42-44

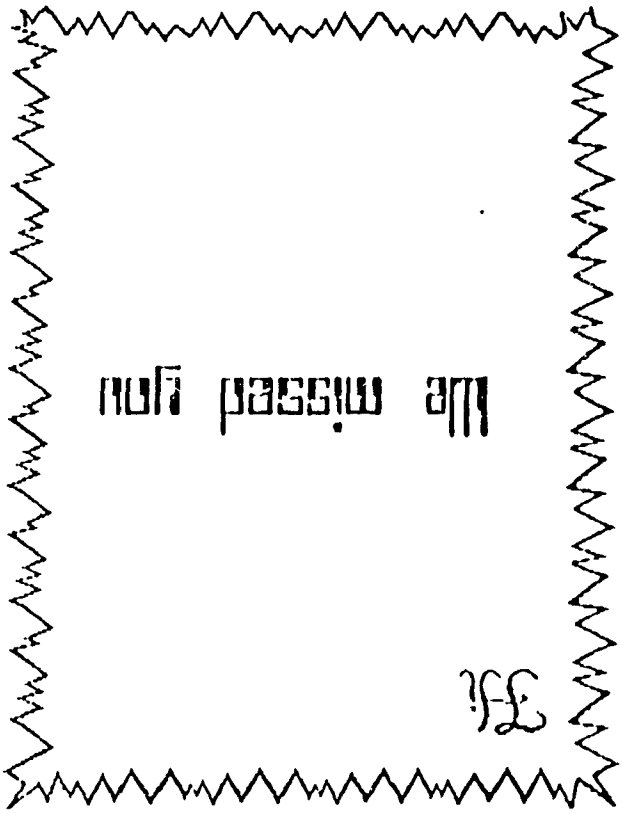
18 S'il n'est pas né au Canada, en quelle année a-t-il immigré? (Indiquez l'année de son arrivée) 19_____ 45-46

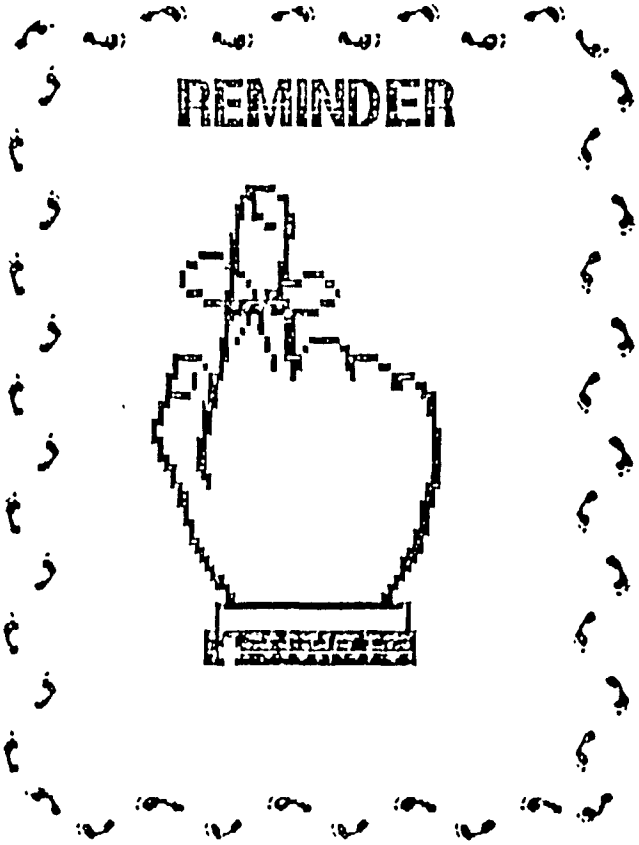
19 Quel est son plus haut degré de scolarite complété? **(Encerclez)**

aucun	1	47
école élementaire	2	
école secondaire	3	
école technique ou professionnel ou CEGEP	4	
Université	5	

19 Au cours des derniers 12 mois, quel était son occupation principale? **(Encerclez)**

Etait-il:		
au travail	1	48
à l'école	2	
en chômage/ cherchant du travail	3	
à la retraite	4	
travaux ménagers	5	
inconnu/ pas à la maison/ décédé	6	





THE TUBERCULOSIS SURVEY HAS JUST BEEN COMPLETED, BUT YOU WERE NOT INCLUDED.

DID YOU FORGET? WERE YOU SCARED??
OR MAYBE YOU THOUGHT IT WASN'T IMPORTANT

THIS SURVEY IS IMPORTANT TO YOUR HEALTH

SO NEXT TIME WHEN WE COME BACK....

<u>GET INVOLVED!!</u>

Centre Hospitalier Thoracique de Montréal
Montreal Chest Hospital Centre
3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL: 849 5201

TUBERCULIN SURVEY IN MONTREAL

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(for those 14 - 18)

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"Could I become infected even if there was no known contact?"
- People may be exposed to TB and become infected, without recognizing it.

"But I feel perfectly healthy! Do I still need a test?"
- Yes, because adolescents can be infected, and yet still appear healthy.

"How can you tell if I am infected with Tuberculosis?"
- By means of 2 simple skin tests, which are painless and harmless.

"If this infection is found can anything be done about it?"
- YES, this infection is easily treated. The Montreal Children's Hospital or your family doctor will recommend treatment.

We appeal to all students to enrol in this survey to help to eliminate tuberculosis once and for all. In order for you to participate, please sign the consent below, and ask your parents to sign that they agree with your decision to have this done. Then complete the first page of the questionnaire which is attached, and ask one of your parents to complete their section.

If you have any questions about this survey or about tuberculosis in general you can call the school health nurse who can be reached through the school. Or you can call one of the survey coordinators listed below.

Richard Menzies MD 849-5201 local 272 or 398-6976
Billie Visanjee RN and Donna Amyot RN - 849-5201 local 222

---------- CONSENT ----------

I agree to receive the tuberculin skin tests as part of the tuberculosis survey at school.

Signature of student _____ Date _____

I agree with the decision of my son/daughter _____
to participate in the tuberculosis survey at school.

Signature of parent or guardian _____ Date _____

Office use only

SCHOOL _____ 1-2
ID _____ 3-5
PPD-S _____ 6-7
PPD-B _____ 8-9
BCG Y N N/A 49

FIRST, A FEW QUESTIONS ABOUT YOURSELF:

NAME: Last _____ First _____

ADDRESS: No._____ Street_____ Apt_____

CITY _____ POSTAL CODE _____ 11-15

TELEPHONE NO. _____ _____

1 How old are you? (Please mark age in years) _____ 16-17

2 In what country were you born? _____ 18-20

If not born in Canada,
3 In what calendar year did you immigrate to Canada?
(Mark year of arrival) 19_____ 21-22

(Circle one)

4a. Have you ever received the skin test for tuberculosis? Yes No 50

4b Have you ever been diagnosed that you were suffering from tuberculosis? Yes No 2

5 Have you ever received treatment for tuberculosis? Yes No 2

6 Have you ever lived in the same house-hold as someone with active tuberculosis? (Someone who was diagnosed or treated at that time). Yes No 2

7 Did you ever receive the BCG vaccination, which is not routine but instead is the vaccination against tuberculosis? Yes No 2

If Yes to Question 7,
8 At what age did you receive this vaccination?
(Mark age in years) _____ 27-2

9 Has you ever visited the South-Eastern USA?
(The area marked in black on the map below - the states of: Florida, Alabama, Georgia, Texas, Louisianna & the Carolinas) Yes No 2

If Yes to Question 9,
10 If you add together all the time you have spent there in all visits, how much time would that be?

(Circle one)
less than 2 weeks 1 3
2-5 weeks 2
6-12 weeks 3
2-5 months 4
more than 6 months 5

Centre Hospitalier Thoracique de Montréal
Montreal Chest Hospital Centre
3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL: 849-5201

Date: _____

Vous avez reçu le test tuberculinique aujourd'hui. Vous pouvez prendre un bain ou une douche comme d'habitude. Veuillez ne pas gratter le site de l'injection. La lecture de la réaction sera faite à l'école dans deux jours (48 heures).

Infirmiére _____

Centre Hospitalier Thoracique de Montréal
Montreal Chest Hospital Centre
3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL: 849 5201

Date: _____

You have received your tuberculosis test today. You may have a bath or shower as usual. You should not scratch the area of injection. The reading of the reaction will be done in the school in 2 days (48 hours).

Nurse _____

Centre Hospitalier Thoracique de Montréal

3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL: 849 5201

Nom _____ Date _____

Vous avez une reaction qui measure _____mm. Nous considerons que cela represente un test negatif. Vous n'avez pas d'evidence de tuberculose maintenant.

Signature: _____

Si vous avez des questions relative a cette etude, ou relative a la tuberculose en general vous pouvez contacter un des coordinateurs mentionne ci-bas.

Richard Menzies MD, ou D. Amyot RN - 849 5201 poste 222

Montreal Chest Hospital Centre

3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL: 849 5201

Name _____ Date _____

Your tuberculosis test measures _____ mm. This is **negative** meaning that you have no evidence of tuberculosis infection at this time. We thank you for your cooperation in taking part in this survey. If you have any questions about this test or about tuberculosis in general you can call one of the study coordinators listed below.

Signature _____

Coordinators: Richard Menzies MD, Denis Amyot RN
Tel. No. - 849-5201/222.

Montreal Chest Hospital Centre

3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL: 849-5201

Name _____ Date _____

Your tuberculosis test measures _____mm. This is considered **positive**, and means that you may have been exposed and infected with tuberculosis. It does **not** mean that you are contagious, but you should have a check-up by a doctor for this. We have made an appointment for you at the Montreal Children's Hospital, as follows:

Date of appointment: _____ Hour: _____

Place: Chest Clinic - Room D380, Montreal Children's Hospital

Address: 2300 Tupper St., Montreal. Phone: 934-4400

If you have any questions, you can call: Louise Cadieux -934-4444 or the school health nurse, who can be reached through the school

Or you can call one of the study coordinators listed below:
Richard Menzies MD, B Vissanjee RN, or D. Amyot RN - 849-5201/222

Centre Hospitalier Thoracique de Montréal

3650 ST. URBAIN, MONTREAL, QUEBEC H2X 2P4 TEL: 849 5201

Nom _____ Date _____

Votre test tuberculinique mesure _____mm. Nous considérons que cet reaction est positif et que peut-être ca represente une exposition et quand-même une infection avec la tuberculose. Ce test n'indique pas que vous êtes contagieux, mais il est important de voir un medecin. Nous avons fait un rendez-vous pour vous à l'hôpital de Montréal pour enfants:

Date de rendez-vous: _____ Heure: _____

Endroit: Clinique thoracique, Chambre D380

Addresse: L'hôpital de Montreal pour Enfants, 2300 rue Tupper

Si vous avez des questions vous pouvez contacter:
- Louise Cadieux RN - 934-4444 ou l'infirmière de l'ecole.

- Ou bien un des coordinateurs de ce dépistage:
R. Menzies MD, B. Vissanjee RN, ou D. Amyot RN - 849-5201 poste 222.