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Epidemiology of Tuberculosis in Ohio

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Abstract

Background: Tuberculosis (TB) is a global infectious disease often associated with HIV. Study of the distribution and epidemiologic trends may help target prevention and control measures towards high risk areas and groups.

Objective: To determine TB trends in four counties in Ohio, i.e. Franklin, Cuyahoga, Hamilton and Montgomery counties, and to explore differences in distribution of cases across gender, age groups and races.

Methods: TB surveillance data was collected from the Ohio Department of Health website for 12 years (1999-2011). Mean TB rates across gender were compared using the two sample t-test. One way ANOVA was used to compare means across three age categories (< 15 years, 15-64 years,> 64 years) and races (Asians, Whites, and African Americans). To present trends in TB rates over 12 years, data were plotted by gender, age, and race across the four counties.

Results: TB case rates were significantly different across gender, with rates in males almost twice as high as compared to females (p-value < 0.009). TB rates were significantly higher in the 15-64 and > 65 age groups than in the < 15 years age group (p < 0.01). Asians had the highest number of TB case rates as compared to other races (p-value < 0.01). TB trends in Ohio over the past decade indicate that the incidence is declining over time.

Conclusion: TB rates differed significantly across gender, age, and race, decreasing over time. High risk target populations for TB control are males, people > 65 years, and Asians.

Keywords: Epidemiology, Tuberculosis, Ohio,

Epidemiology of Tuberculosis in Ohio

Tuberculosis (TB) is a common infectious disease caused by strains of bacteria belonging to the *Mycobacterium Tuberculosis (M.Tb)* complex, of which the most common organism infecting humans is *Mycobacterium Tuberculosis* (Tiruviluamala & Reichman, 2002). Humans are the prime reservoirs for this microbe. *M.Tb* infection is most commonly seen in the respiratory tract as pulmonary TB, and can spread through the lymphatic system to infect multiple organs systems in the body, causing cavitation and severe destruction of affected tissues. Patients with active pulmonary TB are infectious and could spread the bacilli through aerosolization of bacteria while coughing and sneezing. Transmission of *M.Tb* is affected by infectivity of the patient, concentration of organisms in the air and immunity level of the individual at risk (Tiruviluamala & Reichman, 2002). The main immune response to TB is cell mediated, involving CD4 T-lymphocyte cells, and can be detected by a positive tuberculin skin test which takes 2 to 12 weeks to elicit. There is no effective vaccine against this organism due to complexity of the immune response. Latent infection can persist for many years before the disease manifests in active form, during which period the infected individual remains asymptomatic and non-infectious (Tiruviluamala & Reichman, 2002). Humoral or antibody mediated immunity does not play a significant role. Screening for TB includes a chest x-ray followed by three consecutive Acid Fast Bacillus (AFB) sputum examinations if results are found to be abnormal. Culture of the organism is used to diagnose active TB. The standard treatment for TB involves chemotherapy with anti-TB drugs for 6 to 9 months. Directly Observed Therapy is an effective form of therapy where the patient receives treatment under direct supervision thereby ensuring compliance and reducing the chances of development of resistance.

Statement of Purpose

This study seeks to explore the distribution and demographic patterns of TB in four urban counties in Ohio comprising of Cuyahoga, Franklin, Hamilton, and Montgomery. The demographic variables included in this study in the study are age, race and gender. This exploratory analysis would help in understanding epidemiologic trends in TB in the region, thus helping in targeted prevention and control efforts.

Literature Review

Approximately a third of the world's population is infected with TB. There were 9 million cases of TB and nearly 1.4 million TB-related deaths worldwide in 2011(Centers for Disease Control and Prevention [CDC], 2012a). TB is an important cause of death in HIV infected people. Majority of the world's TB cases arise in Southeast Asia, Africa, and Western Pacific regions (World Health Organization, 2012).

Trends in the United States

Though there has been a continued decline in the overall number of TB cases in the United States (U.S.) since 1993, the 2010 goal of TB elimination has not yet been reached. TB elimination is defined as a case rate of less than 1/100,000 population (CDC, 2012b). In the U.S., the 2011 TB rate was 3.4 per 100,000 population (CDC, 2012b). There are a disproportionately higher number of cases in foreign-born persons and minorities in the U.S., with the rate of TB case incidence being almost twelve times greater in foreign-born individuals as compared to those born in the U.S. (CDC, 2012c). The proportion of multi-drug resistant TB (MDR-TB) cases occurring in foreign-born persons increased from 25.3% in 1993, to 82% in 2010 (CDC, 2012d).

Asians were the most prominent racial group among TB cases in 2011, as compared to the previous year relative to other groups (CDC, 2012b). This highlights the need for more effective TB prevention programs directed towards the Asian community. It was estimated that 78.8% of immigrants with TB were diagnosed with the disease after more than 2 years of being in the U.S. (CDC, 2012b). Screening of immigrants on entering the U.S. to control entry of patients with active disease, and treatment of latent tuberculosis infection (LTBI) are vital to control the rates of TB in foreign-born individuals.

In the U.S., the highest risk of developing active TB is found in people from sub-Saharan Africa and Southeast Asia, as well as those who are older at the time of entry into the country (Cain, Benoit, Winston, & MacKenzie, 2008). Since there are more than a million people with HIV infection in the U.S. (CDC, 2012e), and TB is the most common cause of death among HIV infected people worldwide, it is essential to direct prevention and control efforts towards TB in the U.S.

Trends in Ohio

Trends in TB incidence in Ohio have followed national patterns over the past decade. The Ohio Department of Health statistics show that incidence of TB cases in Ohio has decreased from 2.8/100,000 population in 1999 to 1.3/100,000 population in 2011 (Ohio Department of Health [ODH], 2012). In 2006, Ohio had a TB case rate of 2.1/100,000, which was much lower than the national incidence rate of 4.6/100,000 population (Wang, Hunt, & Powell, 2009). However, the case incidence increased from 2.1/100,000 to 7.8/100,000 population in 2006 in Franklin County (Wang et al., 2009). This was attributed to a higher proportion of immigrants in this county as there is a considerable population of Somalis residing in Franklin County, constituting the largest immigrant population in Ohio, and second largest Somali population in the United States after Minnesota. There has been an increase in the proportion of cases of TB in immigrants in Ohio from 24% in 1999 to 56.5% in 2011 (ODH, 2012). At the same time the multiple drug resistant form of TB cases in Ohio has increased from 0.3% in 1999 to 1.3% in 2011, whereas Isoniazid (INH) resistant cases in Ohio have varied from 4.1% in 1999 to 3.4% in 2011(ODH, 2012).

Determinants of TB

Social determinants of TB.

TB is a social disease affected by conditions such as homelessness, dense population, lack of access to healthcare, and deteriorating public health infrastructure (Oren, Winston, Pratt, & Narita, 2011). Significant improvement in TB control in the lower socio-economic status group requires emphasis on the social determinants of TB in addition to the aspects of diagnosis, treatment, and enhancement of TB control programs. The most important social determinants of TB are food access and malnutrition, substandard housing and environmental situations, and economic, geographical, and cultural barriers to health care access (Hargreaves et al., 2011). These determinants influence the four stages of pathogenesis of the disease including exposure to infection, progress of infection to disease, delayed diagnosis and treatment, poor adherence to treatment and failure of treatment (Hargreaves et al., 2011). Overpopulation of homes, work environments and communities increase the risk of exposure to TB infection. Financial constraints and food insecurity increase vulnerability to infection, progression to active disease, and the final clinical outcome.

Social and economic barriers to seeking appropriate healthcare could include lack of transportation, concerns about social stigmatization, and inadequate social support for providing care. Due to the close association between HIV and TB, the main social determinants of HIV like gender inequality reflected through cultural norms and expectations also indirectly determine risk for TB. National TB incidence rates have a close correlation with social and economic status determinants like the Human Development Index, access to safe water, childhood mortality and effectiveness of the Directly Observed Therapy-Short Course strategy (Hargreaves et al., 2011). Interventions like urban planning and social protection which aid socioeconomic development are potential tools for strengthening TB control.

Socioeconomic Status

Poverty.

Low socio-economic status facilitates the transmission of *Mycobacterium tuberculosis* mainly through its effects on living conditions, such as people living in crowded homes with poor ventilation, delay in diagnosis, and increased susceptibility to infection due to malnourishment and/or HIV infection (Marais, Hesseling, & Cotton, 2009). An inverse linear association exists between TB incidence and *per capita* gross domestic product (GDP) (Janssens & Reider, 2008). The distribution of TB disease burden globally reveals the fact that extreme imbalance in socioeconomic status is an important factor for sustaining the TB epidemic (Marais et al., 2009).

Living conditions.

A significant burden of TB is located in urban areas, accounting for 36% of all TB cases in the U.S. (Oren et al., 2011). Social conditions like sub-optimal housing, over population, inadequate access to health care, deteriorating public health infrastructures, and the HIV epidemic are all closely linked with TB (Oren et al.,2011). Housing conditions are reflective of socio-economic status and can influence risk for TB infection and its’ outcomes through conditions like poor ventilation and air quality in the home (Murray, Oxlade, & Lin, 2011).

Concentration of TB in urban areas could be related to the increased numbers of foreign-born people and minorities of low socio-economic status in these areas who have a greater risk for LTBI and its' progression to active disease.

Education and awareness.

Lack of education and awareness could prove to be a significant barrier to seeking treatment for TB. Transportation problems as well as financial constraints are reasons for non-compliance. Enhanced education of the public and physicians regarding the gravity of the disease and the value of treatment is needed to aid effective and timely treatment (Hill et al., 2010). Adherence to treatment depends on disease related knowledge, attitudes and beliefs. Foreign born people are more likely to feel protected from developing TB if they have received Bacille Calmette-Guérin vaccination in the past though studies have shown that efficacy is not lifelong (Colson, Franks, Sondengam, Hirsch-Moverman, & El-Sadr, 2010). Health care providers also are prone to this misconception. Lack of knowledge concerning TB, especially with relation to its transmission, and differentiating latent infection from disease can lead to decreased willingness to accept treatment or even complete it. Providing materials tailored to the patient's education level can help support intentions leading to the desired outcome (Colson et al., 2010).

Foreign Born Cases of TB

In foreign-born persons, acquisition of TB infection is usually from their TB endemic countries of origin, followed by reactivation of latent TB at a later date after moving to the U.S. (Menzies, Winston, Holtz, Cain, & MacKenzie, 2010). The larger proportion of TB cases seen in this sub-population is reflective of the corresponding burden of disease in their respective countries, and could represent missed opportunities for identification and treatment of latent infection. Recent community transmission accounts for a smaller proportion of cases, which is why interruption of transmission would have little effect on elimination of TB in the U.S. TB case rates as well as resistance are higher in immigrants, especially those residing in the U.S. for more than 2 years (Cain et al., 2008). Many immigrants also do not have access to the healthcare facilities that U.S. born people do. Inadequate housing and nutrition could also contribute to the high TB rate in this group.

Expansion of immigrant screening, improvement of screening techniques used abroad to increase sensitivity, investment in international TB control are approaches capable of decreasing TB in the foreign-born population (Cain et al., 2007). If current trends in TB in the U.S. persist, it would lead to near elimination of TB in the U.S. born populations and high level persistence in foreign-born people giving rise to a resurgence of TB. Complete elimination of TB in the U.S. would necessitate public health endeavors targeted at this high-risk population. Some of the strategies for TB control in the U.S. involve detection and treatment of TB cases, investigating contacts of cases for treating those with active disease or latent infection, conducting tuberculin skin tests on people likely to be infected and treating those who are infected.

TB in the Elderly

Though TB usually affects young adults, incidence rates are higher in the elderly population above 65 years of age. The TB rate in older adults in the U.S. is 30% higher than that in younger age groups (Pratt, Winston, Kammerer, & Armstrong, 2011). Elderly adults with TB are more likely to be U.S. born and non-Hispanic whites. Risk factors for TB like substance abuse, homelessness and HIV infection are less common in this age group. Presence of comorbid illnesses like diabetes mellitus, end stage renal disease and silicosis increases the risk of developing TB (Pratt et al., 2011). In older adults, concurrent use of medications like corticosteroids and immunosuppressant drugs increases the chances of progression of LTBI to active disease. Infection in the elderly could represent reactivation of latent infection or acquisition of new infection commonly seen in residents of nursing care facilities where spread of infection is facilitated due to congregation. Drug resistance (to INH and MDR-TB) rates are found to be lower with increasing age, which is suggestive of the fact that TB infections in this age group are more likely a result of reactivation of early life infection. Successful completion of treatment is found to be similar to that in younger adults. Presentation of TB in older individuals is often atypical, consisting of non-specific symptoms which can be mistaken for other lung disorders and treated accordingly. Immunity suppressing comorbid conditions can cause difficulty in diagnosis of TB due to reduced response to diagnostic tests. Radiologic appearances are also not characteristic of the disease in older adults.

Pediatric TB

Foreign-born children and adolescents have TB rates that are 10 to 20 times greater than U.S. born children and adolescents despite an overall reduction in rates of TB incidence in all age groups (Menzies et al., 2010). Among children born in the U.S., those born to foreign-born parents from TB endemic regions have a higher risk of TB exposure as compared to children of U.S. born patients (Menzies et al., 2010). Higher incidence rates in this age group could be reflective of a greater risk of progression from infection to disease. Only 5 to 10% of infected adults progress to the disease stage, whereas 43% of infants (children below 1 year) and 24% of children aged 1 to 5 years progress from infection to disease (Menzies et al., 2010). In adolescence, reactivation TB becomes more common.

Family immigration and travel patterns significantly increase risk for TB in U.S. born children, many of whom may have been exposed to risk factors associated with TB in the foreign-born, though they are U.S. born (Nelson, Schneider, Wells, & Moore, 2004). Drug resistance patterns in children are similar to those in adults, and have several risk factors like prior anti-TB treatment, contact with patients having drug resistant TB, being born in or emigrating from areas where drug resistance is endemic and poor response to treatment (Nelson et al., 2004). Diagnosis of TB in children is more difficult as sputum samples are difficult to obtain and gastric aspirates also provide low yield. Thorough investigation of all childhood contacts, interruption of transmission through identification and treatment of infectious patients, as well as identifying cases of LTBI are important strategies for elimination of childhood TB in the United States.

HIV-associated TB

TB poses a serious threat for the HIV-infected population in spite of an overall reduction in the number of TB cases. TB is one of the major causes of death among HIV infected people worldwide, killing one out of three people with TB/HIV co-infection (Arbune, Benea, & Scorpan, 2009).

People infected with HIV have increased vulnerability to other infections and diseases due to immunosuppression, and TB is the most frequent co-infection. Lack of TB treatment, as with other opportunistic infections, can shorten the lifespan of people with HIV and TB coinfection. Among people with LTBI, HIV infection is the biggest risk factor for progressing to TB disease (CDC, 2012f). An individual with untreated LTBI and HIV co-infection is 30 times more likely to develop active TB disease during his or her lifetime as compared to someone without HIV infection (Arbune et al., 2009).

Mycobacterium Tuberculosis enhances viral replication, thus accelerating the natural progress of HIV infection. An individual who has concurrent HIV and TB disease is categorized as having an AIDS-defining condition. HIV-infection with either latent TB infection or TB disease can be treated effectively if properly diagnosed. The risk factors for death in HIV/TB co-infection are low CD4 lymphocyte counts, extra-pulmonary involvement, and older age (Arbune et al., 2009). Since HIV infection is a major risk factor for progression from LTBI to TB disease, CDC recommends that TB clinics should screen their patients for HIV infection. Early diagnosis of HIV can facilitate implementation of interventions for improved outcomes like decreased progression of TB disease and mortality.

Drug Resistant Tuberculosis

TB bacteria are considered to have become drug resistant when the medications are no longer effective in killing them. Resistance to anti TB drugs can occur in cases of incomplete treatment, wrong treatment prescribed by health-care providers, improper dosage or wrong duration of treatment, unavailability of treatment, or poor quality drugs are of (CDC, 2012g).

Isoniazid Resistant TB (INH-R)

One in seven incident cases of TB all over the world has resistance to INH (Jenkins, Zignol, & Cohen, 2011). INH-R is an important parameter to quantify because it reduces the probability that treatment will be successful, facilitates spread of multi-drug resistant tuberculosis (MDR-TB), and even reduces the efficacy of INH prophylaxis. INH has extremely potent bactericidal effect and seldom leads to any adverse effects. If this drug loses effectiveness due to INH-R, both prophylaxis and treatment of the disease gets hampered. Since INH-R increases the chances of developing additional resistance to other TB drugs, monitoring the burden of INH-R may provide an early warning for areas susceptible to increase in MDR-TB (Jenkins et al., 2011). This could be achieved by financing of monitoring activities.

Multi-drug Resistant TB (MDR-TB)

MDR-TB is TB resistant to at least two of the major first-line drugs used to treat all cases of TB, i.e. Isoniazid and Rifampicin. Globally, approximately 3.6% of incident TB cases are resistant to these two most important first line drugs (Jenkins et al., 2011). MDR-TB can take up to two or more years to treat using drugs that are less efficacious, more expensive and lead to greater adverse effects. Increase in MDR-TB cases can dampen efforts made to control TB. Extensively drug-resistant TB (XDR TB) is a rare type of MDR-TB defined as TB that is resistant to Isoniazid and Rifampicin, plus any fluoroquinolone, and at least one of three injectable second-line drugs - Amikacin, Kanamycin, Capreomycin (CDC, 2012g). Patients with this type of TB have less effective treatment options.

Importance of TB in Ohio

Though there is an overall decrease in TB cases in Ohio, an increase in the number of foreign born cases of TB and MDR-TB cases in Ohio over the past decade makes it necessary to conduct a detailed study of the demographics. A small percentage of Ohio's population is constituted of refugees. Refugees often have sub-optimal access to health care and live in conditions with poor sanitation. Communicable diseases like TB spread easily in crowded living conditions. Monitoring illnesses in this group can have a significant impact on the health status of the state's overall population.

Methods

Data Source

Data was obtained from existing TB surveillance cases from the Ohio Department of Health website. Data comprised of TB rates for the entire State of Ohio as well as the four major counties of Cuyahoga, Franklin, Hamilton, and Montgomery for the years 1999 to 2011. These four counties were chosen because they have the maximum prevalence of cases as compared to other counties in the state. The variables included in the data were age (continuous), gender (categorical), race (categorical) and county (categorical). The age grouping comprised of three categories, below 15 years group, 15-64 years, and above 65 years. The three major racial groups constituted of Whites, African Americans and Asians, as these are the groups with the highest number of cases.

Data Analysis

Frequencies of cases for the categories of age, gender, and race were calculated for the period of 1999 through 2011. Statistical differences in the variables were measured between the four counties. Mean TB rates across genders were compared using the two sample t-test. One way ANOVA was used to compare means across the categories related to age and race. Scheffe's post-hoc comparisons were made to assess differences between groups. For both t-test and ANOVA, p-values of <0.05 were considered statistically significant. Means plots were graphed for displaying the differences in mean TB rates across various categories.

Statistical analysis was carried out using the IBM SPSS (Statistical Package for Social Sciences) for Windows, Version 19. Microsoft Excel plots were graphed to show trends of TB case rates across the 12 years by gender, age groups, and race categories for the four counties.

Results

Gender Differences

Descriptive characteristics of the study population categorized by gender, age, and race are presented in the following tables and graphs. TB rates in men was almost twice as high (5.03 cases per 100,000 population) as compared to women (2.43 cases per 100,000 population). This difference was statistically significant at $p < 0.009$ (Table 1 and Figure 1).

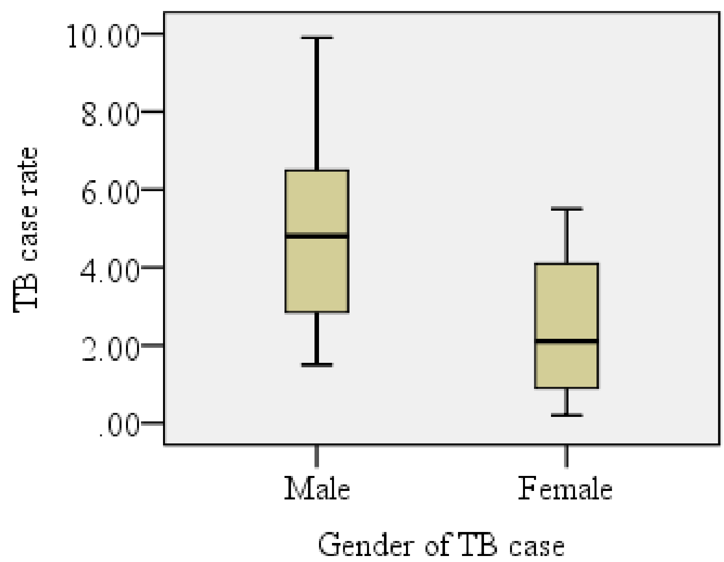

Figure 1. Distribution of TB case rate/100,000 population in four Ohio Counties across gender

Table 1

Distribution of TB Case Rate/100, 000 in Four Ohio Counties across Gender

Characteristic	Mean ± sd		
	Males N=12	Females N=12	p-value
TB case rate per 100,000 population	5.03 ± 2.60	2.43 ± 1.76	< 0.009

Age Differences

The mean TB rates across the three age groups shows a higher mean TB case rate in the >65 years category (M=6.23 cases per 100,000), as compared to rates in the 15-64 years (M=3.97 cases per 100,000 population) and <15 years (M=0.93 cases per 100,000 population), at p < 0.01(Table 2). Scheffe's post-hoc comparison for differences between groups showed that the mean TB case rate in the >65 years age group and 15-64 years age group was significantly higher than that in the <15 years group, at p < 0.01 and p=0.041, respectively (Table 3). A means plot reflects the same variation in TB case rates across the three age categories (Figure 3).

Table 2

Distribution of TB Case Rates/100,000 Population in the Age Categories in Four Ohio Counties

	Mean± sd				
Characteristic	Overall N=36	Age <15yrs N=12	Age 15-64yrs N=12	Age >65yrs N=12	p-value*
TB Case Rate Per 100,000 Population	3.71±3.49	0.93± 1.30	3.97± 2.36	6.23± 4.01	< 0.01

*-ANOVA test

Table 3

Comparison of Mean TB Case Rates within the Age Categories

(I) Age Groups	(J) Age Groups	Mean Difference (I-J) in TB Case Rate Per 100,000 Population	p-value
Age <15yrs	Age 15-64yrs	-3.03*	0.041
	Age >65yrs	-5.30*	< 0.01
Age 15-64yrs	Age <15yrs	3.03*	0.041
	Age >65yrs	-2.27	0.155
Age >65yrs	Age <15yrs	5.30*	< 0.01
	Age 15-64yrs	2.27	0.155

* The mean difference is significant at the 0.05 level

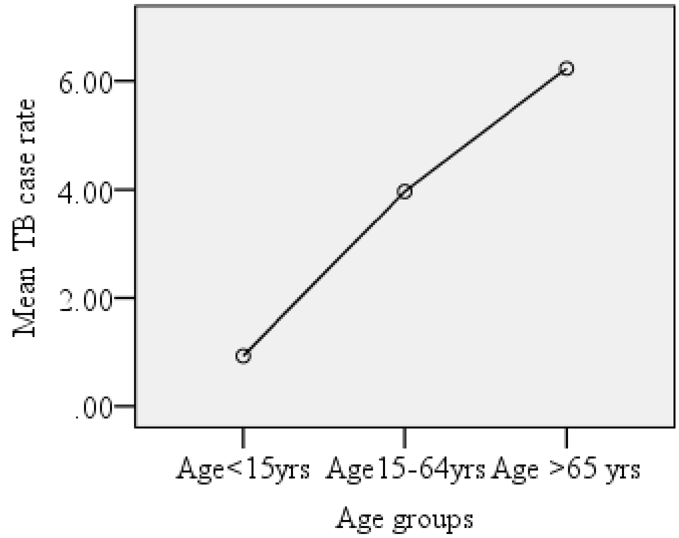

Figure 2. Means plot of mean TB case rates in the three age categories

Racial Differences in TB

A one-way ANOVA showed a significant difference in TB rates between the three racial categories, $p < 0.01$. Asians were found to have the highest mean TB case rates at 25.56 cases per 100,000 population, as compared to 8.29 cases per 100,000 population in African Americans and 1.57 cases per 100,000 population in Whites (Table 4). Scheffe's post-hoc comparisons of the groups indicate that Whites (M=1.60, 95% CI= [1.08, 2.05], had significantly lower TB rates than Asians (M=25.6, 95% CI= [16.9, 34.2], $p < 0.01$. Comparisons between the African Americans (M=8.3, 95%, CI= [4.33, 12.25]) and Whites were not statistically significant at $p < 0.181$. TB rates in African Americans were significantly lower as compared to Asians at $p < 0.01$ (Table 5). The means plot shows highest mean TB rates in the Asian population as compared to the Whites and African American (Figure 3).

Table 4

Distribution of Mean TB Case Rates in Whites, African Americans and Asians

Mean±sd					
Characteristic	Overall N=36	Whites N=12	African-American N=12	Asian N=12	p-value*
TB Case Rate Per 100,000 Population	11.80±13.27	1.57± 0.76	8.29 ± 6.23	25.56 ± 13.66	< 0.01

*-ANOVA test

Table 5

Comparison of Mean TB Case Rates in Whites, African Americans and Asians

(I) Name of Race	(J) Name of Race	Mean Difference (I-J) in TB Case Rate Per 100,000 Population	p-value
Whites	African- American Asian	-6.72 -23.99*	0.181 < 0.01
African-American	Whites Asian	6.72 -17.27*	0.181 < 0.01
Asian	Whites African- American	23.99* 17.27*	< 0.01 < 0.01

*. The mean difference is significant at the 0.05 level

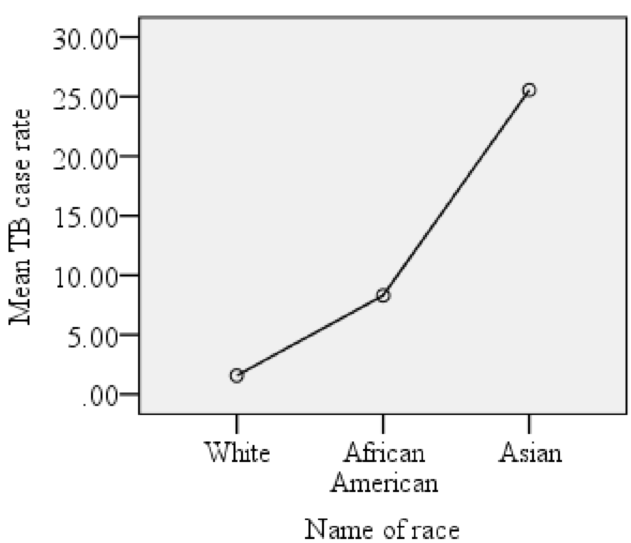

Figure 3. Means plot of TB case rates across races in the four counties

Distribution of TB Case Rates across Counties

Distribution of the total number of TB cases over the past decade in the four major counties in Ohio shows a higher number of cases in Franklin and Cuyahoga counties (Figure 4).

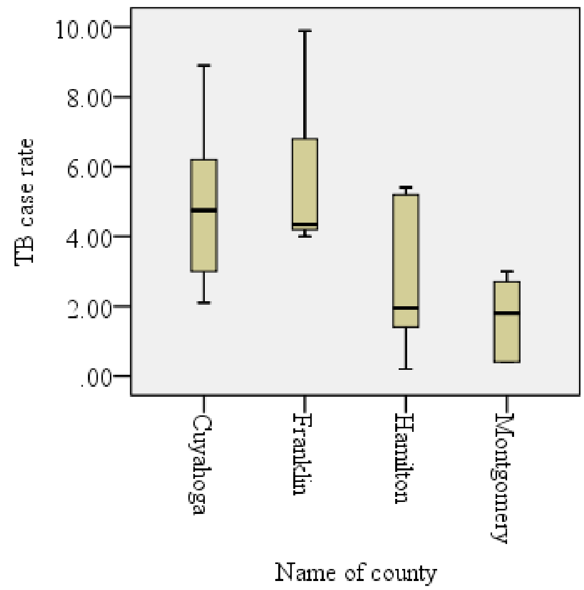

Figure 4. Box plot of distribution of TB case rates/100,000 population in the four counties

Trend Graphs for TB Cases in Ohio

Trends of TB cases over the past decade in Ohio and the four major counties shows a higher number of cases in Franklin and Cuyahoga counties (Figure 5). In 2006, there was a spike in number of TB cases in Franklin County which had a case rate of 7.8 per 100,000. In 2011 Franklin County, with 50 TB cases and two transfer-in TB cases, had the highest incidence of active TB in the state of Ohio (case rate, 4.3/100,000), accounting for 34.4% of all Ohio's TB cases (Columbus Public Health, 2012). There were 38 TB cases in Cuyahoga County with a case rate of 3.0 per 100,000. In Hamilton County there were 10 cases with a case rate of 1.2 per 100,000 population, Montgomery County had a case rate of 1.5 per 100,000. This could be attributed to the higher immigrant population in Franklin and Cuyahoga counties.

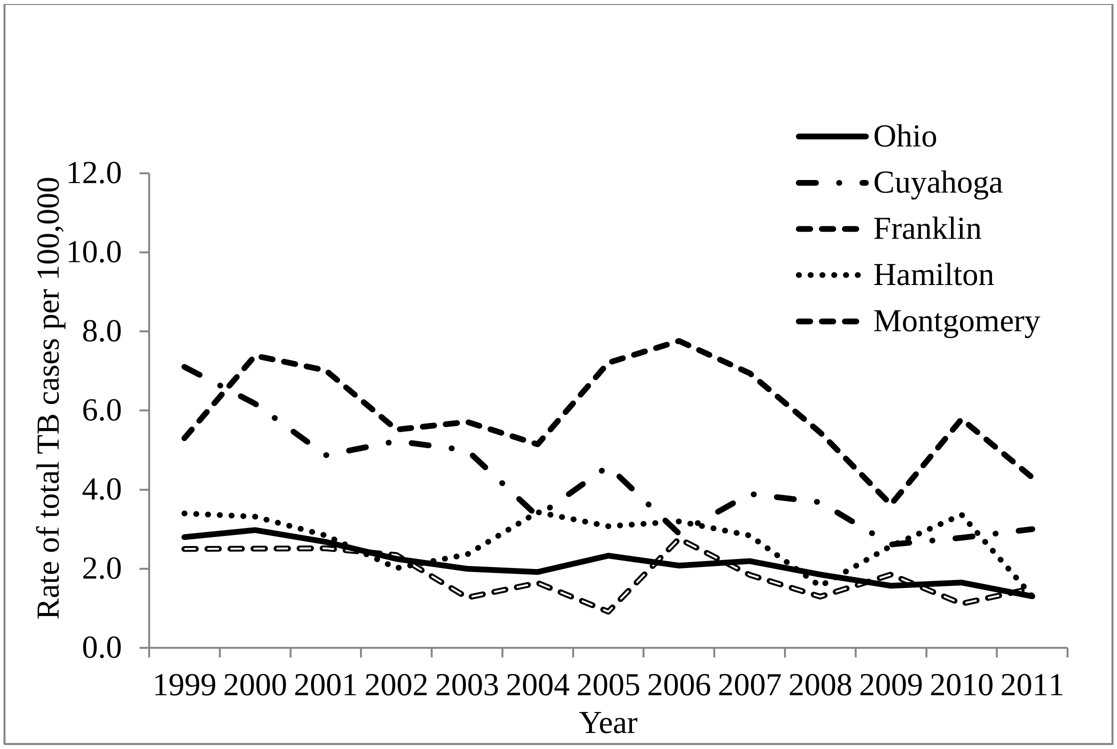

Figure 5. Rates of total number of TB cases in Ohio and the four major counties

Trend Graph for TB in Males

Rates of TB cases in males over the past decade were compared and it was found that the highest rates of TB cases in males are in Franklin and Cuyahoga counties, as compared to the other counties (Figure 6). In 2011, Franklin County had a case rate of 4.5 per 100,000 population, whereas Cuyahoga County had a case rate of 3.9 per 100,000 population. Montgomery County had a case rate of 2.7 per 100,000 population and Hamilton County had a case rate of 2.4 per 100,000 population.

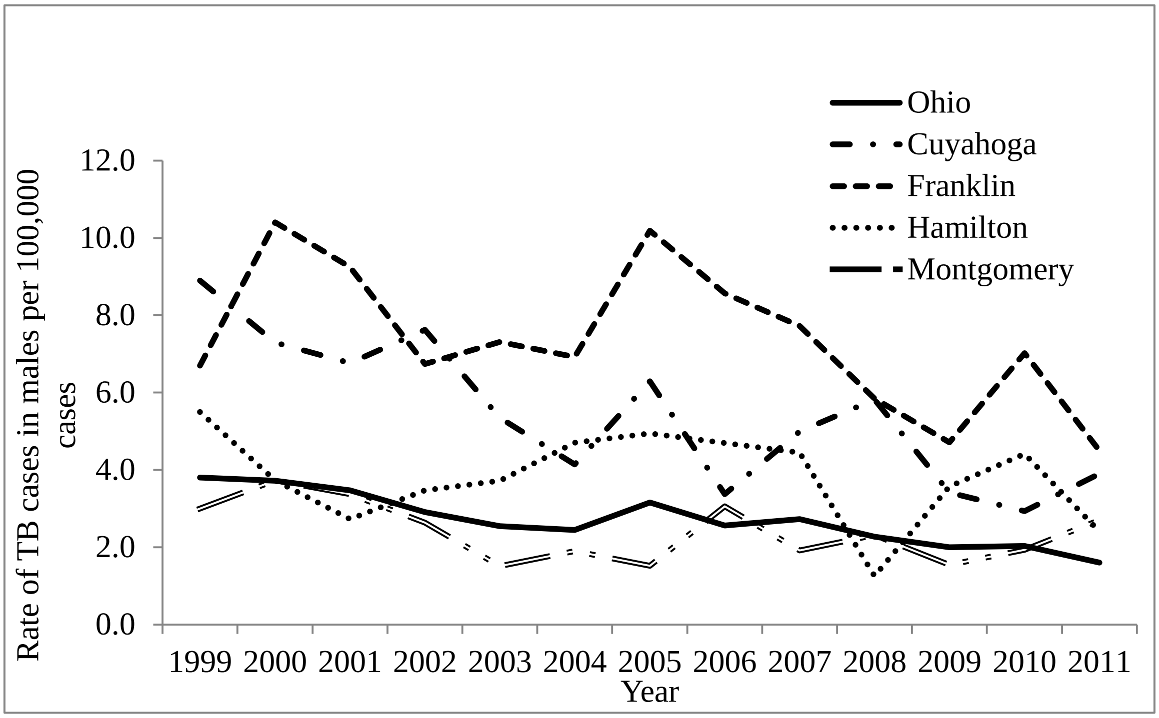

Figure 6. Rate of TB cases in males from 1999-2011 in Ohio and the four major counties

Trend Graph for TB Cases in Females

Rates of TB cases in females over the past decade were compared and it was found that the highest rates of TB cases in females are in Franklin and Cuyahoga counties, as compared to other counties (Figure 7). Franklin County had a case rate of 4.2 per 100,000 population in 2011, and Cuyahoga County has a case rate of 2.1 per 100,000 population. Montgomery County had a case rate of 0.4 cases per 100,000 population in 2011, whereas Hamilton County had a case rate of 0.2 per 100,000 population.

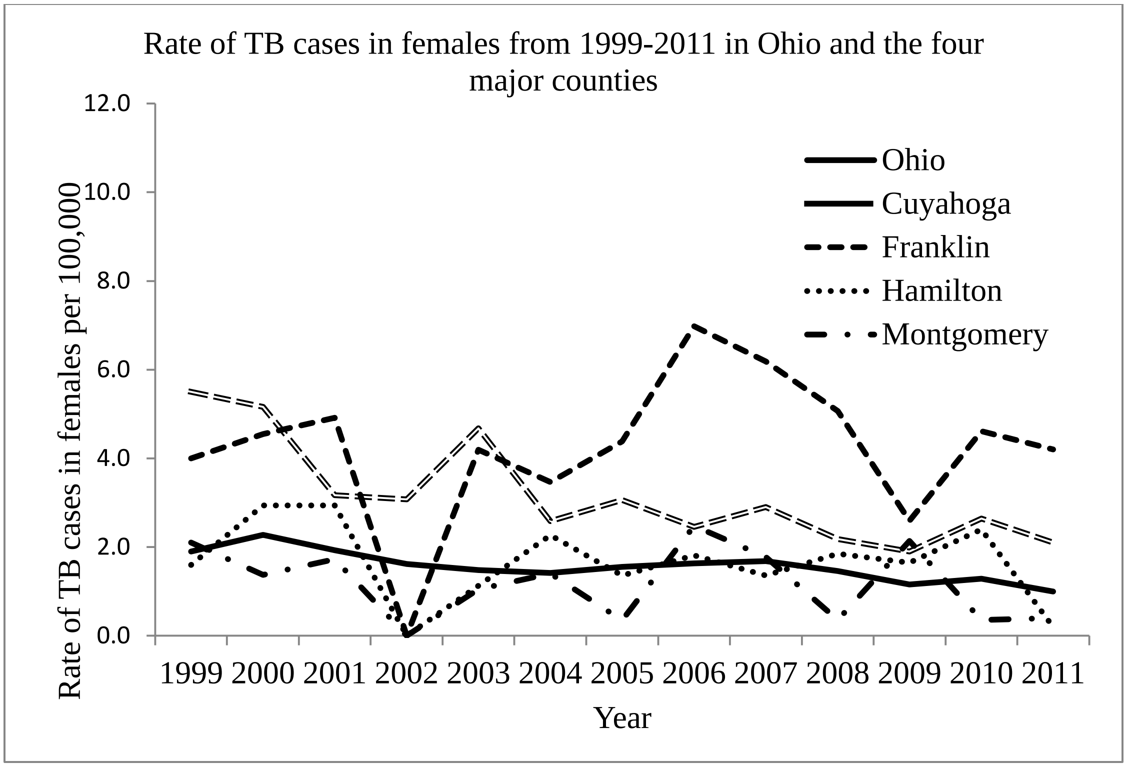

Figure 7. Rate of TB cases in females from 1999-2011 in Ohio and the four major counties

Discussion

Statistical analysis of TB rates in the four major counties of Ohio shows that there is a significantly higher number of cases amongst males, greatest number of TB cases were in the age group above 65 years, and in the Asian community. Majority of the TB cases are concentrated in Franklin and Cuyahoga counties of Ohio.

A much higher rate of TB in males as compared to females in Ohio is reflective of global trends in gender affiliation of TB and could probably be attributed to the higher presence of risk factors like drug abuse, smoking, and HIV infection in males as compared to females. Increased number of cases in men could also be due to biological differences in susceptibility to the infection, as well as progression from infection to disease (Neyrolles & Quintana-Murci, 2009). This could be a result of gender-specific hormonal and genetic factors (Neyrolles & Quintana-Murci, 2009).

Social and economic barriers to seeking healthcare including lack of transportation, concerns about social stigmatization, and inadequate social support could be contributing factors in females. As TB is an opportunistic infection closely associated with HIV, social determinants of HIV like gender inequality reflected through cultural norms and expectations could also indirectly determine risk for TB. Only 5 to 10% of individuals exposed to *M.Tb* develop TB, and up to70% of those who do develop the disease are male (Neyrolles & Quintana- Murci, 2009). The reasons as to why women are less likely to develop TB than men necessitate research to decipher the mechanisms involved in gender-associated resistance to TB. Such research would facilitate in designing interventions in future.

There are a greater number of TB cases in the age group above 65 years in Ohio. This is reflective of the fact that though TB usually affects young adults, incidence rates are higher in the elderly population above 65 years of age. Higher TB case rates in the elderly are due to a greater likelihood of presence of concomitant co-morbidities causing immunosuppression which can lead to activation of latent disease as well as delay in diagnosis, atypical clinical features and radiologic appearances (Pratt et al., 2011). Occurrence of a higher number of cases in the elderly is also consistent with the fact that that TB is more common in foreign-born people in the U.S. who have a latent infection that gets re-activated several years after living in the U.S. This is the birth cohort effect evident in older age groups-higher disease rates due to increased incidence of cases and high transmission during earlier years, which results in latent TB.

Majority of the TB cases are concentrated in Franklin and Cuyahoga counties of Ohio with a decreasing trend in number of cases over the past decade. Detection of a higher number of cases in the Franklin and Cuyahoga counties is consistent with the higher number of immigrants in these areas. The Franklin county area is home to the second largest population of

Somali refugees in the United States. Greater incidence of cases among Asians in Ohio as compared to other races is reflective of greater number of cases in foreign born people as compared to the local population, and is proportional to disease burden in the country of origin.

Limitations of the Study

Some of the limitations of this study include lack of information available regarding other factors like socio-economic status, availability of health care, education or immigrant status of the cases. So the data can only be used to study trends in TB, but not to evaluate the multiple risk factors associated with the etiology of disease. It is also necessary to interpret the TB case rates with caution as the small numbers of absolute TB cases can lead to large changes in case rates from one year to the subsequent year that may not truly reflect changes in the burden of infection in the community at large. Examining the trends over several years provides a more accurate picture.

Public Health Implications and Recommendations

Priority should be given to TB control activities directed towards high risk populations in the four major counties of Ohio. Initiatives must be taken to improve awareness about the disease using informative materials tailored to the education levels and understanding of the populations. Detecting and treating cases of latent TB infection among people who are foreign-born, surveillance for cases of active infection with prompt treatment, investing in global TB control are the important strategies for controlling this disease. The CDC has come up with new guidelines for treatment of latent TB, as an alternative to the traditional nine month course of INH which has low compliance rates. This new strategy involves a once weekly dose of INH and Rifapentin under direct observation, and has a greater chance of compliance as treatment is given under supervision. Monitoring medications is necessary to cure those infected and to prevent the spread of resistant strains of the organism. Screening of immigrants entering the United States would also help in limitation of entry of active infectious cases of TB and spread of infection. This would facilitate the elimination of TB in the United States. As long as TB is a major global problem, initiatives will need to be taken to improve TB control in the United States.

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Appendix 1 – List of Tier 1 Core Public Health Competencies Met

Domain #1: Analytic/Assessment
Identify the health status of populations and their related determinants of health and illness (e.g., factors contributing to health promotion and disease prevention, the quality, availability and use of health services)
Describe the characteristics of a population-based health problem (e.g., equity, social determinants, environment)
Use variables that measure public health conditions
Use methods and instruments for collecting valid and reliable quantitative and qualitative data
Identify sources of public health data and information
Recognize the integrity and comparability of data
Identify gaps in data sources
Adhere to ethical principles in the collection, maintenance, use, and dissemination of data and information
Describe the public health applications of quantitative and qualitative data
Collect quantitative and qualitative community data (e.g., risks and benefits to the community, health and resource needs)
Use information technology to collect, store, and retrieve data
Describe how data are used to address scientific, political, ethical, and social public health issues
Domain #2: Policy Development and Program Planning
Gather information relevant to specific public health policy issues
Gather information that will inform policy decisions (e.g., health, fiscal, administrative, legal, ethical, social, political)
Domain #3: Communication
Communicate in writing and orally, in person, and through electronic means, with linguistic and cultural proficiency
Participate in the development of demographic, statistical, programmatic and scientific presentations
Domain #4: Cultural Competency
Incorporate strategies for interacting with persons from diverse backgrounds (e.g., cultural, socioeconomic, educational, racial, gender, age, ethnic, sexual orientation, professional, religious affiliation, mental and physical capabilities)
Respond to diverse needs that are the result of cultural differences
Describe the dynamic forces that contribute to cultural diversity
Domain #5: Community Dimensions of Practice – N/A
Domain #6:Public Health Sciences
Describe the scientific evidence related to a public health issue, concern, or, intervention
Retrieve scientific evidence from a variety of text and electronic sources
Discuss the limitations of research findings (e.g., limitations of data sources, importance of observations and interrelationships)
Domain #7: Financial Planning and Management – N/A
Domain #8: Leadership and Systems Thinking – N/A