



Trends and Disparities in TB among U.S.-born Black and White Chicago Residents,
1998-2008

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Trends and Disparities in TB among U.S.-born Black and White Chicago Residents, 1998-2008

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Trends and Disparities in TB among U.S.-born Black and White Chicago Residents, 1998-2008

Abstract

ABSTRACT

OBJECTIVE: To describe the decline of tuberculosis (TB) cases among U.S.-born non-Hispanic (NH) black and white Chicago residents.

METHODS: Data from the National TB Surveillance System was used to analyze trends and characteristics of reported TB cases among U.S.-born NH black and U.S.-born NH white Chicago residents from 1998-2008.

RESULTS: Chicago reported a total of 3,821 TB cases over the 11-year time period. Of these, 1,916 were U.S.-born NH black and 235 were U.S.-born NH white. The proportion of cases attributable to U.S.-born NH blacks was 63% (294/469) in 1998 and 34% in 2008 (72/213). Analysis for trends from 2000-2008 revealed a greater than predicted decrease in rates among U.S.-born NH blacks (p

CONCLUSION: Despite more TB risk factors in Chicago's U.S.-born black population, there was a narrowing of TB case disparity in Chicago from 1998-2008. Continued focused strategies aimed at controlling TB are needed.

Keywords

Tuberculosis; health equity; health disparity; African-American; Mycobacterium tuberculosis; urban tuberculosis; non-Hispanic black; non-Hispanic white; tuberculosis epidemiology

Cover Page Footnote

We would like to acknowledge Chicago TB patients and their families as well as the dedication of CDPH clinic and field staff. We also would like to recognize Drs. Bill Paul, William Clapp and Anna Lee in their leadership and efforts towards TB elimination in Chicago. We also would like to thank Drs. Dean Schraufnagal, Peter Sporn, James McCauley and Dan Johnson. Finally, we remember fondly the wonderful contributions and spirit of Martin Liss and Gennell Wilson.

Authors

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Trends and Disparities in TB among U.S. Born Black and White Chicago Residents, 1998 - 2008

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ABSTRACT

Objective: To describe the decline of tuberculosis (TB) cases among U.S.-born non-Hispanic (NH) black and white Chicago residents.

Methods: Data from the National TB Surveillance System was used to analyze trends and characteristics of reported TB cases among U.S.-born NH black and U.S.-born NH white Chicago residents from 1998-2008.

Results: Chicago reported a total of 3,821 TB cases over the 11-year time period. Of these, 1,916 were U.S.-born NH black and 235 were U.S.-born NH white. The proportion of cases attributable to U.S.-born NH blacks was 63% (294/469) in 1998 and 34% in 2008 (72/213). Regression analysis for trends from 2000-2008 revealed a greater than predicted decrease in rates among U.S.-born NH blacks ($p < 0.05$). U.S.-born NH blacks had greater odds than U.S.-born NH whites of HIV infection (OR 1.8), non-injecting drug use (OR 3.0), unemployment (OR 1.7), receiving care from the health department (OR 2.2) and receiving directly observed therapy (OR 3.0).

Conclusion: Despite more TB risk factors in Chicago's U.S.-born black population, there was a narrowing of TB case disparity in Chicago from 1998-2008. Continued focused strategies aimed at controlling TB are needed.

Keywords: TB, Epidemiology, Racial Difference, Health Disparities

INTRODUCTION

Tuberculosis (TB) is the 7th leading cause of death and infects one in three individuals worldwide (WHO, 2010). TB disproportionately affects the poor with the vast majority of disease occurring in the developing world. In the United States, TB is a serious public health concern with preventable death and illness. A review of urban tuberculosis in the United States from 2000-2007 revealed that, of the 100 most populous cities with at least 20 cases of TB each year, more than half did not show decreasing incidence rates (Oren et al., 2011).

Although TB cases in the United States have decreased since the resurgence in the early 1990s, ethnic and racial disparities persist (Schneider, 2005). National data from 2010 reported 3.6 new cases of TB per 100,000 population. The non-Hispanic (NH) black rate was 7.0/100,000 compared with the NH white rate of 0.9/100,000 – an almost 8-fold difference. Persistently, NH blacks have the third highest rate of TB among all racial/ethnic groups, less than Asians (22.4/100,000) and Native Hawaiians or other Pacific Islanders (20.8/100,000) and more than Hispanics (6.5/100,000) and American Indian or Alaska Natives (6.4/100,000) (CDC, 2011). TB disparity in blacks has been identified by Healthy People 2010, a national health initiative, as one of the ten largest health disparities in the U.S. (Keppel, 2007).

Health disparities are multifactorial and complex. Influenced by hereditary, socioeconomic and environmental conditions, TB infection and disease is no exception (Stead et al., 1990; Thye et al., 2010). In 2008, the World Health Organization highlighted social determinants because of their pervasive and direct impact on health. In the United States there are inequalities in mortality and life expectancy based on race as well as on poverty and education (CDC, 2005; Pappas et al., 1993; Williams, 1999). Furthermore, some of these disparities have worsened. A study published in 2001 by Levine, et al. stated: “There has been no sustained decrease in black-white inequalities in age-adjusted mortality or life expectancy at birth at the national level since 1945.” Between 1980 and 2000, there was increased inequality of life expectancy based on socioeconomic status (Singh, Siahpush, 2006).

Chicago, Illinois is the third most populous city in the United States with nearly 3 million people. Chicago has high unemployment and high poverty rates relative to the national average (Brookings Institute, 2003). Chicago’s TB rate exceeds the national average. Chicago is one of several northern U.S. cities that “cotton belt” blacks fled to in the early 1900s with the Great Migration (Lepore, 2010). The 2000 U.S. Census Bureau describes Chicago residents as having a median age of 31.5 years with 36% NH black, 31% NH white, 26% Hispanic and 4% Asian/Pacific Islander and 2% identified as two or more races. Of U.S. cities, Chicago has the highest segregation rate between blacks and Hispanics and the second highest segregation rate between blacks and whites (Lewis Mumford Center, 2002). A very large proportion of TB is seen in the U.S.-born NH black

population. A review of TB from 1974 to 1994 in the Chicago pediatric population, defined as age 0-14 years, showed an increasing proportion of TB in this age group that represented 4% of total cases (Reinhard et al., 1997). For the years when detailed data were available for this review, 6% of the children were foreign born and 72% were black. In Chicago, black children had a relative risk of TB disease of 13.8 ($9.3 < RR < 20.6$) compared to white children.

Tuberculosis case rates among different racial and ethnic groups has been chosen as a health status indicator for Healthy People 2000 and 2010 (Keppel et al., 2002; Healthy People, 2000). In a review of racial and ethnic-specific health status indicator rate trends for 1990-1998, years immediately preceding our study, Keppel et al. (2002) revealed that “the rate for white non-Hispanics, the group with the lowest rate in 1990, declined 45 percent. The rates for black non-Hispanics declined by 46 percent....” Authors from the Sinai Urban Health Institute evaluated Chicago’s success in reducing health disparities along the Healthy People 2000 goals. They reported that although black:white gaps improved nationally on 10 indicators, in Chicago they widened for 10 indicators, including TB (Margellos et al., 2004; Silva et al., 2001).

The objectives of our study in examining surveillance data from 1998-2008 for confirmed TB cases among Chicago residents are: 1) to describe black:white disparities, 2) to characterize risk factors for TB in these populations, and 3) to describe local TB control measures to address this disparity. Comparisons are also made to other large, high incidence TB U.S. cities. These objectives are important to elucidate domestic trends regarding racial health equity and to reflect on the historical improvement of decreasing TB in the U.S.-born urban NH black population.

METHODS

Surveillance data on confirmed TB cases reported from January 1, 1998 through December 31, 2008 by the city of Chicago, via the state TB program of Illinois, to the National TB Surveillance System (NTSS) were examined. Analysis was restricted to U.S.-born blacks and U.S.-born whites who were used as a comparison group. Population data stratified to race and country of birth do not exist prior to 2000 for the city of Chicago. Therefore, only case count and proportion of race by country of birth data will be presented for 1998 and 1999.

The NTSS collects data from the 50 states and the District of Columbia, with a standard report form, Report of Verified Case of Tuberculosis (RVCT) (CDC, 2009). The RVCT collects demographic, risk factor, and clinical information, including HIV status, initial TB treatment and mode (directly observed therapy (DOT) versus self-administered), treatment outcome, smear and culture results, *Mycobacterium tuberculosis* culture conversion, and drug susceptibility results on confirmed cultures of *M. tuberculosis* complex. Trends of incidence rate were determined by overall case count and by race/ethnicity.

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Overall city population data were obtained from the U.S. Census Bureau, Estimates Division, 1998–2008. Race/ethnicity population data by city were obtained from the U.S. Census Bureau, American Community Survey, 1998–2008. Race and ethnicity by foreign born or U.S.-born status was only available from 2000 onwards. Poisson regression analysis was used to determine rate trend over time. Stratified analyses compared demographic, risk factor, and clinical information for U.S.-born NH black TB cases and U.S.-born NH white TB cases using the Cochran Mantel Haenszel chi-square test for odds ratios. Program staff conducted active surveillance with visits to hospital laboratories in the city to look for missed reported cases of TB, making it highly likely that all cases were reported. Routine data checking was performed and incomplete or inaccurate data was corrected in the surveillance system. We examined U.S.-born NH black and NH white data for the three other largest and high TB incidence cities in the United States to evaluate changes in proportion of these cases over time. Data analyzed for this project were collected for routine disease surveillance, and CDC determined the project was not human subjects research requiring institutional review board approval.

RESULTS

Annual Chicago TB cases declined from 469 (16.7/100,000) in 1998 to 213 (7.5/100,000) in 2008. The pace of the decline of the TB rate for Chicago was greater than that of the national rate: from 2.5 times the national rate in 1998 (6.6/100,000) to 1.8 times in 2008 (4.2/100,000) (CDC, 2010). Over this 11-year time period, the percent decline in case counts for NH blacks in the United States was 44% and the percent decline in case counts for NH blacks in Chicago was 72%. Case rates in 2008 show a decline of 41% for U.S.-born NH blacks nationally and a decline of 58% for U.S.-born NH blacks in Chicago when compared to 2000, the first year for which population data are available by foreign born/U.S. born status.

From 1998 to 2008 there were a total of 3,821 TB cases in Chicago residents and 67% (n=2,555) were U.S.-born. Among the U.S.-born cases, 75% (n=1,916) were among NH blacks and 9% (n=235) were among NH whites with 16% among the other racial/ethnicity groups. These NH black and white cases represented 84% of the U.S.-born cases and 56% of total cases reported in Chicago. Over this 11-year time period, 50% of total TB cases were in U.S.-born NH blacks, 6% in U.S.-born NH whites, 3% in foreign-born blacks and 4% in foreign-born whites. Of the 3,821 total cases, race/ethnicity data were missing on 13 individuals (0.3%).

The first time U.S.-born NH blacks dropped to less than 50% of Chicago's total TB cases was in 2002. Figure 1 illustrates trends in the frequency of U.S.-born TB cases by race and ethnicity. Cases among U.S.-born blacks far exceed other groups throughout this time period. There is a four-fold decrease in this

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absolute number over time: 294 to 72 cases. This compares with a 2.5-fold decrease in U.S.-born whites: 34 to 14 cases. The proportion of U.S.-born NH blacks as a percentage of all Chicago TB cases was 63% (294/469) in 1998 and 34% (72/213) in 2008. The proportion of U.S.-born NH blacks as a percentage of all U.S.-born cases was 78% (294/376) in 1998 and 73% (72/98) in Chicago in 2008. Figure 2 illustrates the change in percentage of TB cases by race/ethnicity. The proportion of TB patients who are black and foreign born is very small: 8% (n=7) in 1998 and 11% (n=13) in 2008.

Figure 1. Trends in tuberculosis case counts by race/ethnicity among U.S.-born, Chicago, 1998–2008

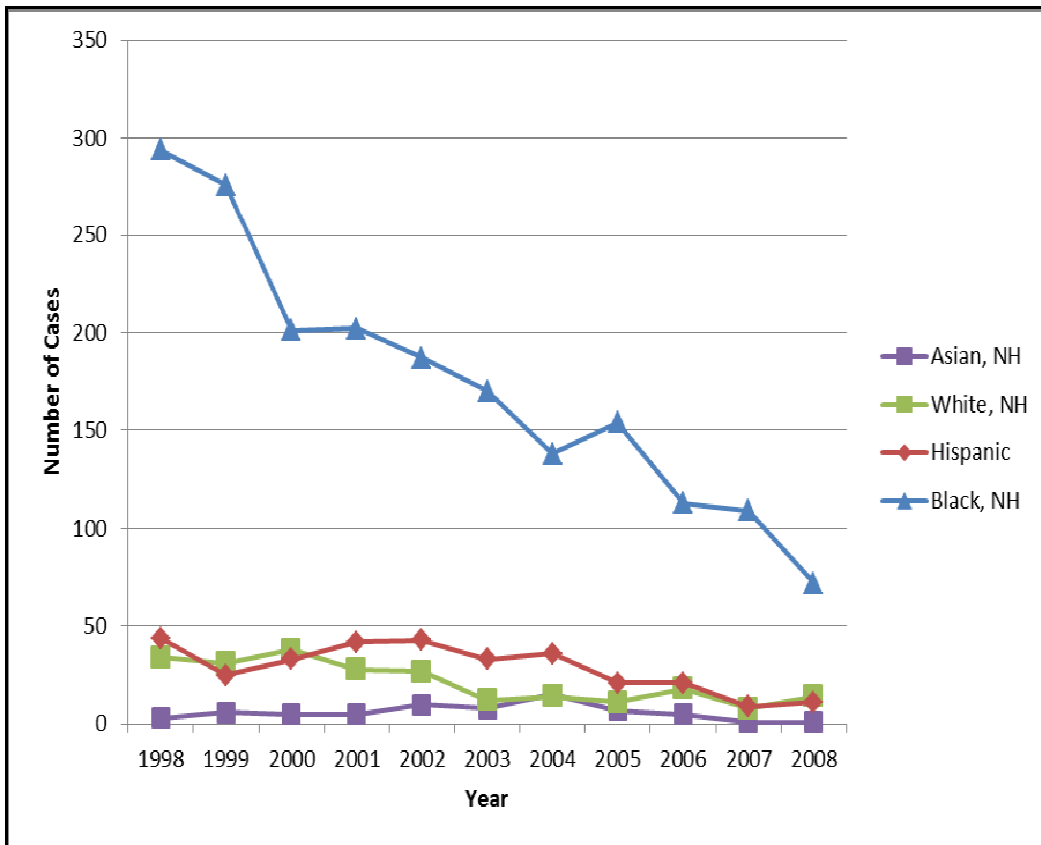
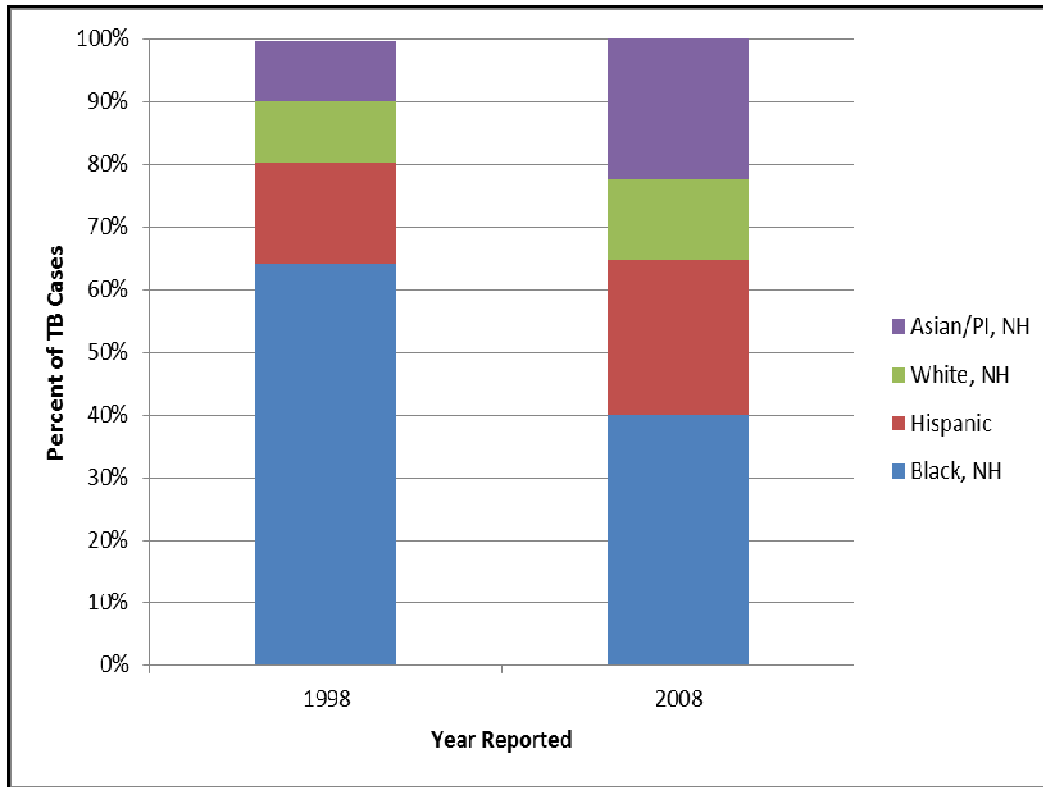
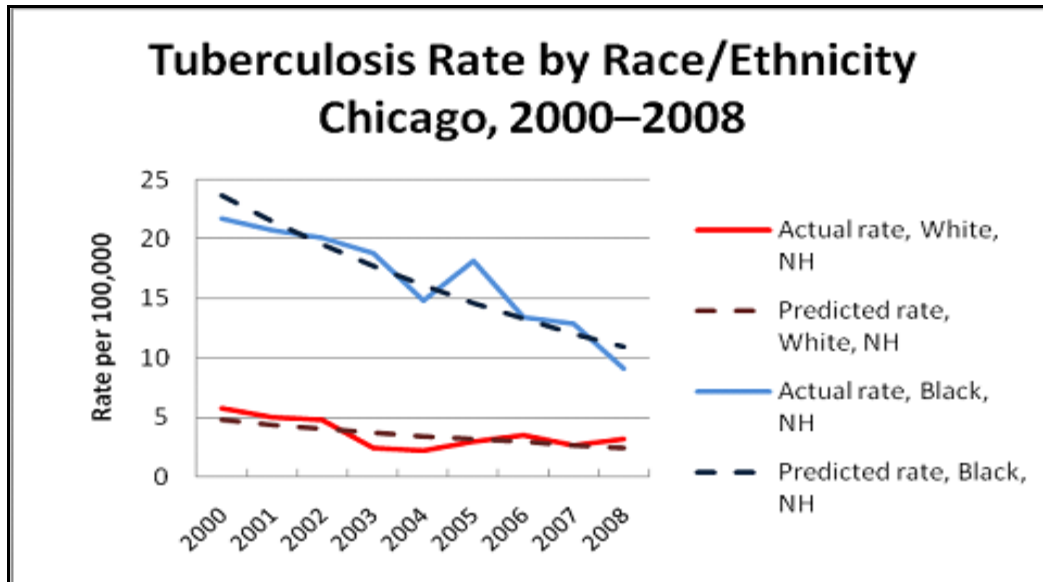


Figure 2. Percent of Reported Tuberculosis Cases by Race/Ethnicity, Chicago, 1998 vs 2008



A regression analysis for years 2000-2008, ([Figure 3](#)) shows that U.S.-born NH blacks significantly declined at a rate of about 10% per year (parameter estimate=-0.096, p value 0.0005) with a predicted 54% overall decline in the rate. The decline for U.S.-born NH whites of 8% per year is not significant (parameter estimate = -0.08, p value 0.06) with a predicted 48% overall decline in the rate. The U.S.-born NH black rate declined from 21.7/100,000 to 9.1/100,000 while the U.S.-born NH white rate declined from 5.8/100,000 to 3.1/100,000.

Figure 3. Regression Analysis. Actual vs. Predicted rates for U.S.-born Tuberculosis Rate by Race/Ethnicity, Chicago, 2000-2008



The U.S.-born NH black:white TB case rate ratio was 3.7 in 2000 and 2.9 in 2008. This is considered a narrowing gap. Another method to evaluate disparities is to measure percent change in proportion over time. We compared the proportion of TB in U.S.-born NH blacks of all U.S.-born cases to the proportion of U.S.-born NH whites of all U.S.-born cases for the years 1998 and 2008. The percent change in this ratio is -41%. For the same time period, this exceeded the change seen for U.S.-born NH blacks to U.S.-born Hispanics (-2%) and for U.S.-born NH blacks to U.S.-born NH Asians (-27%).

Descriptors of patient demographics and risk factors are evaluated as a bivariate analysis in Table 1. U.S.-born NH blacks with TB have greater odds of being HIV-infected than U.S.-born NH whites (OR 1.8), using non-injecting drugs (OR 3.0), and being unemployed (OR 1.7). They have greater odds of receiving care from the health department (OR 2.2) or combination health department and private sector (OR 2.1), and receiving either DOT (OR 3.0) or DOT with some component of self-administered therapy (OR 2.2).

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Table 1. Demographics, Residential status, and Occupation for reported TB cases among U.S.-Born Non-Hispanic Blacks and U.S.-Born Non-Hispanic Whites, Chicago, 1998-2008

	Black (n=1916)		White (n=235)		*Odds Ratio Unadjusted	95% Confidence Interval
	N	% Among Black	N	% Among White		
Age Group						
0-4 years	79	4%	1	0%	ref.	
5-14 years	83	4%	2	1%	0.5	0.1-5.9
15-24 years	141	7%	8	3%	0.2	0.0-1.8
25-44 years	660	34%	61	26%	0.1	0.0-1.0
45-64 years	668	35%	84	36%	0.1	0.0-0.7
65+ years	285	15%	79	34%	0.1	0.0-0.3
Gender						
Female	765	40%	75	32%	ref.	
Male	1151	60%	160	68%	0.7	0.5-0.9
Residential Status						
Not homeless w/in past year	1713	89%	206	88%	ref.	
Homeless w/in past year	167	9%	24	10%	0.8	0.5-1.3
Missing/Unknown	36	2%	5	2%		
Residential Status						
Not a resident of Correctional Institution	1821	95%	224	95%	ref.	
Correctional Institution residence	85	4%	10	4%	1.1	0.6-2.0
Missing/Unknown	10	1%	1	0%		
Residential Status						
Not resident of Long-term Care Institution	1846	96%	218	93%	ref.	

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Resident of Long-term Care Institution	59	3%	17	7%	0.4	0.2-0.7
Missing/Unknown	11	1%	0	0%		
Occupation						
Health Care Worker	34	2%	5	2%	1.1	0.4-3.0
Correctional Employee	3	0%	0	0%	1.2*	0.1-23.0
Migratory Agricultural Worker	1	0%	0	0%	0.5*	0.0-12.5
Other Occupation	378	20%	63	27%	ref.	
Multiple Occupations	2	0%	0	0%	1.2*	0.1-25.1
Not Employed	117 6	61%	119	51%	1.7	1.2-2.3
Missing/Unknown	322	17%	48	20%	1.1	0.7-1.7
*Odds ratio estimations use a correction of 0.5 in every cell that contain a zero.						
All analyses were performed in SAS version 9.2 (SAS Institute, Inc., Cary, NC).						

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Table 2. Risk factors of reported TB cases among US-Born Non-Hispanic Blacks and U.S.-Born Non-Hispanic Whites, Chicago, 1998-2008

	Black (n=1916)		White (n=235)		*Odds Ratio Unadjusted	95% Confidence Interval
	N	% Among Black	N	% Among White		
TB History						
No History of Previous TB	1735	91%	221	94%	ref.	
History of Previous TB	172	9%	14	6%	1.6	0.9-2.8
Missing/Unknown	9	0%	0	0%		
HIV Status						
HIV-Negative	890	46%	101	43%	ref.	
HIV-Positive	272	14%	17	7%	1.8	1.1-3.1
Unknown**	754	39%	117	50%	0.7	0.6-1.0
Substance/Alcohol Abuse						
No Injecting Drug Use	1623	85%	201	86%	ref.	
Injecting Drug Use	97	5%	6	3%	2.0	0.9-4.6
Missing/Unknown IDU	196	10%	28	12%	0.9	0.6-1.3
Non-Injecting Drug Use						
No Non-injecting Drug Use	1317	69%	185	79%	ref.	
Non-Injecting Drug Use	387	20%	18	8%	3.0	1.8-5.0
Missing/Unknown Non-IDU	212	11%	32	14%	0.9	0.6-1.4
Alcohol Abuse						
No Alcohol Abuse	1290	67%	150	64%	ref.	
Alcohol Abuse	417	22%	54	23%	0.9	0.7-1.3
Missing/Unknown	209	11%	31	13%	0.8	0.5-1.2

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*Odds ratio estimations use a correction of 0.5 in every cell that contain a zero.
 **For the purpose of national analysis, *unknown* HIV status is defined as those patients with results that were missing, “unknown,” “indeterminate,” “refused,” “not offered,” and “test done, results unknown.”

All analyses were performed in SAS version 9.2 (SAS Institute, Inc., Cary, NC).

Table 3. Treatment characteristics of reported TB cases among US-Born Non-Hispanic Blacks and U.S.-Born Non-Hispanic Whites, Chicago, 1998-2008

	Black (n=1916)		White (n=235)		*Odds Ratio Unadjusted	95% Confidence Interval
	N	% Among Black	N	% Among White		
Type of Health Care Provider						
Health Department	617	32%	51	22%	2.2	1.6-3.1
Private/Other	714	37%	130	55%	ref.	
Both Health Department and Private/Other	570	30%	50	21%	2.1	1.5-2.9
Missing/Unknown	15	1%	4	2%		
Reason Therapy Stopped						
Completed Therapy	1421	74%	154	66%	ref.	
Moved	22	1%	9	4%	0.3	0.1-0.6
Lost	102	5%	13	6%	0.9	0.5-1.6
Uncooperative or Refused	16	1%	2	1%	0.9	0.2-3.8
Not TB	0	0%	0	0%		
Died	195	10%	33	14%	0.6	0.4-1.0
Other	6	0%	0	0%	0.7*	0.0-12.6
Missing/Unknown	154	8%	24	10%	0.7	0.4-1.1
DOT/Self-Administered Therapy						
Total Direct	1107	58%	81	34%	3.0	2.2-4.1
Direct and Self-Administered	208	11%	21	9%	2.2	1.3-3.6
Self-Administered	543	28%	119	51%	ref.	

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Missing/Unknown	58	3%	14	6%		
*Odds ratio estimations use a correction of 0.5 in every cell that contain a zero.						
All analyses were performed in SAS version 9.2 (SAS Institute, Inc., Cary, NC).						

U.S.-born NH blacks have lower odds than U.S.-born NH whites of being older than 45 years of age (OR 0.1), older than 65 years of age (OR 0.1), male (OR 0.7), a resident of a long-term care institution at the time of diagnosis (OR 0.4), and moving (OR 0.3) or dying before therapy is completed (OR 0.6).

Over the 11-year study period, 14% (n=272) of U.S.-born NH blacks and 7% (n=17) of U.S.-born NH whites with TB were HIV infected. Reviewing all cases in Chicago in this time period, 49% (n=1,857) were HIV-negative, 10% (n=389) HIV infected, 0.2% (n=7) indeterminate, 5% (n=201) refused testing, 22% (n=826) not offered testing, 7% (n=251) tested but results unknown, and 8% (n=290) unknown. In Table 2, responses of missing data, indeterminate, refused, unknown, and not offered, were grouped into “unknown” HIV status. The total proportion of “unknown” HIV status was 39% (n=754) for U.S.-born NH blacks and 50% (n=117) for whites. However, for local program performance and reporting purposes, CDPH considered positive, negative and refused as “tested.” In 1998, CDPH locally reported 59% (180/301) of U.S.-born NH blacks as “tested” for HIV with 5% (16/301) having refused and 43% (20/46) of U.S.-born NH whites as “tested” with 4% (2/46) refused. In 2008, the “tested” numbers for U.S.-born NH blacks, as defined by CDPH, were 91% (77/85) including the 2% (2/85) that refused testing and for U.S.-born NH whites was 89% (24/27) including the 26% (7/27) that refused testing.

There were no reported differences between U.S.-born NH blacks and U.S.-born NH whites regarding history of previous TB, homelessness within the past year, and residence of a correctional institution at the time of diagnosis (Tables 1 and 2). Overall, 74% of U.S.-born NH blacks and 66% of U.S.-born NH whites completed therapy within one year and NH blacks had 3 times greater odds of having directly observed treatment (DOT) and over 2 times greater odds of having combined DOT and self-administered therapy than NH whites.

Combining all cases regardless of place of birth, fewer children with TB were reported in later years. In 1998, there were 20 black children with TB aged 0–4 years and 17 aged 5–14, whereas, there was only one white child aged 5–14 reported. In 2008, there were three black children aged 0–4, one aged 5–14 years and no white children were reported.

We compared the proportion of U.S.-born NH blacks out of all TB cases in four U.S. cities with the highest TB morbidity. These cities: New York, New York, Los Angeles, California and Houston, Texas, had similar or higher population size as Chicago. In 1998, the proportion of U.S.-born NH black cases

out of all cases in Chicago was near 63%. In comparison, this proportion in the other three cities ranged from 17% to 35%. By 2008, Chicago's proportion of U.S.-born NH blacks among total TB cases dropped to 34% while the other cities decreased to 12% to 27%. Compared to this 3% to 16% proportion decrease in the three other large cities, Chicago experienced the greatest decline of 29% for U.S.-born NH black to total TB cases from 1998 to 2008.

DISCUSSION

Improved Black:White TB Disparity in Chicago

Chicago is a large city with a high-incidence of TB and with a particularly high proportion of U.S.-born NH black TB cases. Our analysis showed that case counts and proportion of TB in U.S.-born blacks decreased from 1998 to 2008. Using rates by U.S.-born status, available from 2000 onward, TB in the U.S.-born NH black population decreased significantly from 2000 to 2008. These decreases exceeded those seen in the U.S.-born NH white population. To our knowledge, this epidemiologic trend of decreased TB black:white disparity in a large urban U.S. population is not described elsewhere in the literature.

TB in urban areas often results from ongoing transmission or imported disease, whereas in rural areas, where immigration may not be as common, reactivation of remote infections is found (Oren et al., 2011; De Vries et al., 2010; Braden et al., 1997). In the 2000-2007 Oren et al. review of U.S. urban TB, the cities that showed decreasing rates had more NH black and more foreign-born cases than those cities that did not have decreasing rates. When comparing Chicago to the three other large U.S. cities with the highest number of TB cases, the decrease in proportion of U.S.-born NH black cases out of total cases was greatest in Chicago. Nonetheless, the burden of disease amongst U.S.-born blacks was still more in Chicago in both 1998 and in 2008.

Other Literature Concerning TB in the U.S. Black Population

In a review of seven southeastern states from 1991-2002, a time period overlapping our review, TB in NH blacks was compared with NH whites (CDC, 2004). For NH blacks during this time period, the percentage of TB among foreign born persons grew 0.2% to 7%. TB rates declined 54% for NH blacks and 64% for NH whites and the ratio of TB rates in NH blacks to rates in NH whites increased from an average of 4.0 (1991-1996) to 4.6 (1997-2002). This showed a worsening trend of black:white disparity. Aware of historic high case rates of TB among blacks and this health inequity, the National Advisory Council for the Elimination of TB held a consultation meeting in 2003. Demonstration project funding became available to develop innovative strategies to improve this situation. Multiple actions needed to occur to reduce this disparity: reduce stigma, address the health care delivery system, improve the educational process of patients and ensure culturally sensitive program efforts (DeLuca, Royce, 2005).

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In our review, U.S.-born NH black TB cases had higher associations with the typical TB risk factors: using non-injecting drugs, being unemployed, and being HIV infected. The U.S.-born NH black Chicago residents with TB were also more likely to be of younger age, receive care from the health department, and receive DOT when compared to U.S.-born NH whites. The risk factors of lower socioeconomic status and co-infection with HIV were also seen in NH blacks in the seven southeastern states review. Unlike our study, this study showed additional associations of excess alcohol and drug use and residence of a correctional facility at time of diagnosis in NH blacks. Percentage of TB cases who received all or part of treatment as DOT, as with our study, was greater in NH blacks.

In a 1995-2004 analysis of TB among U.S.-born blacks and U.S.-born NH whites living in Houston, Texas, Serpa et al. (2009) reported TB in the black population was associated with younger age and HIV infection – both seen in our study. In addition, they reported higher associations in blacks with inner-city residence and *Mycobacterium tuberculosis* drug resistance. In another review of TB in the southeastern U.S., but looking at a rural community from 1997 to 2001, O'Donnell et al. (2010) reported that both reactivation of latent infection and recent TB transmission were increased among blacks. Our analysis did not find a difference between U.S.-born NH blacks and U.S.-born NH whites with regard to history of previous TB diagnosis.

Chicago Department of Public Health TB Control Efforts

As with the rest of the United States, Chicago experienced a TB resurgence in the early 1990s with a case rate high of 28.7/100,000 persons. The CDPH TB Control Program established regionalized nurse case management that included public health nursing supervision of DOT and communicable disease investigation. DOT was established as the standard of care. By 1996, over 500 cases were averted, with a cost saving of \$7.5 million dollars in hospital costs alone (Grigonis et al., 1997). Thus began the decrease in TB case counts. Today DOT remains crucial to Chicago's TB control; nurse case management is conducted in 100% of active TB cases.

In 2000, Public Health Nurse supervisor Ms. Dorothy Nisbeth was quoted in the "Chicago Tribune" as saying, "A lot of the times they [Southside blacks] don't have the money to go to doctors or they are too worried to take time off from work - and supporting their families - to go. But the change has got to come." She remarked that there is little prevention among the poor who may not have access to doctors who can help them understand and combat the infectious disease (Igoe, 2000). In 2001, with 62% of cases occurring in blacks and 30% of cases occurring within 13 contiguous community areas, the Chicago City Council passed a resolution to look further into this marked health disparity.

From 1998 to 2008, both federal and city funding decreased; CDPH staffing levels were halved. It was an opportune time for CDPH to receive one of

three CDC grants to address black communities with disproportionately high burden of TB. From 2003–2006, the Southside Project (also known as the High Risk Project) developed several interventions to eliminate TB in thirteen black communities on Chicago's south side. First, a taskforce of community and business leaders and former TB patients was created. Second, focus groups of patients and TB control staff were held. As a result of the focus group findings, CDPH reorganized the TB Control Program in 2004. Dedicated TB nurses and supervisory nurses became responsible for both clinic and field operations. Mid-management positions to oversee contact investigations were created. Social marketing and community awareness activities were developed, including an educational video, community awareness slogans, an informational telephone line, a rap song, a TB video and an art contest for school-aged children with subsequent distribution of T-shirts using the designs created (Lampthey et al., 2006).

CDC's Tuberculosis Genotyping Program was started in 2004 and had great utility in identifying real-time transmission in two outbreaks affecting the U.S.-born black population: one in a family with three generations of TB disease, including two deaths, and another of an outbreak in a homeless shelter serving mostly black clients. In 2005, CDPH determined that TB case completion of therapy (COT), a major indicator of programmatic performance, should be a focus for improvement. This led to staff education on program evaluation, initiation of quarterly cohort reviews including those of contracted sites, and pursuing legal means to promote adherence to medical therapy (Handelman et al., 2006).

In 2006, the CDPH TB Control Program conducted a 9-year retrospective analysis to determine whether statistical differences in demographic and social factors existed between persons residing within and outside the High Risk Project area. According to the results, injecting drug use, excessive alcohol use and unemployment were more prevalent among persons with TB from this area as compared to those who resided outside the project area. The program also demonstrated that there was no difference in the TB treatment completion rates between the two areas (Eaglin et al., 2006).

During the years of our study, low income housing units in Chicago decreased and blacks migrated from the city. From 2000 to 2010, Chicago's black population declined by 17% (about 18,100 people) (Little, Mihalopoulos, 2011). Although this migration away from the city included blacks from different socioeconomic levels, this is a potential factor in influencing the change in Chicago's TB incidence. Despite this, the rate of TB among U.S.-born NH blacks still declined significantly; 54% far exceeds the decline in the black NH population.

Tuberculosis has and continues to disproportionately affect blacks. The reasons behind discrepancies in health care are many and varied and may either be poorly understood or not acted upon, or both. In order to address or even

discuss race-associated health outcomes or health equity, different frameworks can be employed. One theoretical model, posed by Dr. Camara Jones in an article entitled “Levels of Racism: A Theoretic Framework and a Gardener’s Tale” outlines three levels of racism: institutionalized, personally mediated and internalized. Another, articulated by the WHO Commission on Social Determinants of Health, describes the micro level with individual interaction to the macro and global level (WHO, 2008). WHO’s “framework for action on tackling social determinants of health inequalities” is to 1. Improve daily conditions 2. Tackle the inequitable distribution of power, money and resources and 3. Measure and understand the problem and assess the impact of action. It is hoped that by understanding these disparities, services and systems can be built to address them.

Study Limitations

There are several limitations to our study. Risk factor data are self-reported and may be under reported. Data from NTSS does not directly collect information that allows analysis of health equity data, such as access to healthcare, crowded living conditions and income. Data from NTSS are gathered from local health departments. Because the focus was one health department, inter-public health department variability is not a factor. Data were generated at different field/clinic sites and data entry was often entered at these sites. There may be unforeseen intra-departmental (site) variability even though quality assurance measures were conducted centrally. Another important limitation to the study is missing HIV status data in up to 50% of cases over the 11-year time period. In addition, this is an ecological project design; characteristics of TB cases can be described but interventions cannot be causally linked to decreasing case counts.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention/the Agency for Toxic Substances and Disease Registry.

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