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Disparities in Tuberculosis Rates in New England: 2011, 2014-2018

Etienne Bobe Leta

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Disparities in Tuberculosis Rates in New England: 2011, 2014-2018

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ABSTRACT

Purpose. The purpose of this study was to assess whether decreases in tuberculosis (TB) incidence have been followed by reductions in TB disparities in New England during 2011 and from 2014 to 2018.

Background. Tuberculosis is a potentially serious infectious disease which, without treatment, can be fatal. In the United States, 8,920 new cases were temporarily reported in 2019, showing a decrease of 1.1% from 2018. Similarly, TB incidence declined to 2.7 cases per 100,000 persons, accounting for 1.6% decrease from 2018 (CDC, 2020). Although this improvement, disparities in rates of tuberculosis disease between Whites and minority groups continue to grow (Noppert, Wilson, Clarke, Ye, Davidson & Yang, 2017). Among non-U.S.-born persons residing in the United States in 2019, the highest TB rate was observed among Asians (25.7 per 100,00), compared with 25.1 per 100,000 for Native Hawaiians/Pacific Islanders, 19.5 per 100,000 for blacks/African Americans, 10.2 per 100,000 for Hispanics/Latinos, 5.3 per 100,000 for American Indians/Alaska Natives, and 3.1 per 100,000 for whites (CDC, 2020).

Methods. To calculate TB rates, TB rates by race/ethnicity and TB rates by country of origin, we used TB case data from Centers for Disease Control and Prevention (CDC), Connecticut Department of Public Health (CDPH), Connecticut Health I-Team, Rhode Island Department of Public Health (RIDPH), and Vermont Department of Public Health (VDPH). We used rate ratios (RRs) to evaluate tuberculosis rate disparities.

Results. Although minority groups experienced decreases in TB rates, the study showed that RRs for minorities increased, compared with Whites. Similarly, RR for non-U.S.-born people increased, compared with U.S.-born individuals.

Conclusion. Overall Tuberculosis rates in New England declined during 2011 and from 2014 to 2018 while tuberculosis disparities increased at the same period. Asians experienced the greatest disparity followed by Blacks and Hispanics, compared with Whites. Non-U.S.-born people had a greater TB disparity, compared with U.S.-born people.

Introduction

Background

Tuberculosis (TB) is one of the leading infectious diseases worldwide. According to the World Health Organization [WHO] (2020), in 2019, about 10 million persons were devastated by tuberculosis in the world. Overall, incidence in tuberculosis is decreasing at about 2% annually, and during 2015 to 2019, the cumulative TB incidence reached a reduction of 9% (World Health Organization, 2020). Similarly, in 2019, 8,900 new TB cases were provisionally reported in the United States (Centers for Disease Control and Prevention [CDC], 2020), compared with 9272 TB cases reported in 2016 (CDC, 2017). The incidence of tuberculosis in the United States remained relatively flat from 2013 to 2015 after steadily declining since the 1990s (Salinas et al., 2016).

Although this improvement, TB in the United States disproportionately affects the population as minority groups are the most stricken by this infection (Schneider, 2005; Lippold, Carter, Armstrong, & Hardison, 2014). In the United States, inequalities in income and education, environmental and socioeconomic conditions, specific health behaviors and lifestyle patterns, access to care, quality of services, culture and acculturation, racism and racial discrimination, and ethnicity are some factors that contribute to the disproportionate burden of TB among minorities, referred to as health disparity (Atrash, 2018).

Definition of health disparities

Health disparities have been defined as “particular types of health difference closely linked with social, economic, and/or environmental disadvantage”. Hence, health disparities adversely affect groups of people who have systematically experienced greater obstacles to health based on their ethnicity or race, gender or sex, age, religion, socioeconomic status, mental health, physical disability, or other relevant characteristics (Department of Health and Human Services [DHHS], 2015). As Braveman reported in 2006, only differences that methodically and adversely affect less advantaged groups are considered to be disparities.

Although disparities exist across these different dimensions mentioned above, the term is often used or interpreted to reflect primarily differences between racial or ethnic groups (Dehlendorf, Bryant, Huddleston, Jacoby, & Fujimoto, 2010). Health disparities may stem from health inequities that are “systematic differences in the health of groups and communities occupying unequal, avoidable, and unjust positions in society” (Graham, 2004). In the United States, although a lot of progress have been made to ameliorate health, racial and ethnic disparities remain the most persistent inequities in health over time (Bell & Lee, 2011; Williams, Mohammed, Leavell, & Collins 2010),

Racial and ethnic health disparities for minorities in the United States have many shapes, such as higher rates of chronic disease and premature death, compared with the rates among whites. This observation cannot be generalized as some minority groups, such as Hispanic immigrants have better health outcomes than whites (Lara, Health, & Rand, 2005). However, this “immigrant

paradox” is susceptible to decrease with the years lived in the United States (Lara, Health, & Rand, 2005).

Status of health disparities

Despite the significant progress made in reducing inequality in health outcomes (DHSS, 2016), the elimination of disparities in health has still to be accomplished. Furthermore, for many illnesses, the reduction of health inequity does not represent the authenticity of fact as many are concerned by the fact that minorities continue to face poorer quality of the care and have less probability to undergo even ordinary medical care than Whites, even at the same health insurance coverage (Smedley, Stith, & Nelson, 2003). As a result, some disparities, such as TB disparity between white people and racial/ethnic minority groups, and between U.S.-born and foreign-born people persist and grow substantially over time and continue to defy progression to the TB suppression in the U.S (Jung, Bennion, Sorvillo, & Bellomy, 2010).

As many factors that contribute to health disparities fall outside the influence of the health system, the elimination of inequalities in health status ultimately may require changes not only of psychosocial factors, such as lifestyle characteristics and living conditions or health care delivery, but also changing of socioeconomic conditions. In addition, health service interventions, whether used alone or in collaboration with social and economic interventions, are likely to play a significant role in reducing racial and ethnic disparities (Companelli, 2003).

Significance of study

The study describes and evaluates variations in tuberculosis rates and tuberculosis disparities in New England during 2011 and from 2014 to 2018. It focuses on minority groups who

carry an unequal weight of tuberculosis as the risk factors and TB incidence are greater among this fringe of the population (Schneider, 2005). In fact, in 2019, among non-U.S.-born persons residing in the United States, Asians had the highest TB rate of 25.7 per 100,000, followed by Native Hawaiians/Pacific Islanders with 25.1 per 100,000, blacks/African Americans with 19.5 per 100,000, Hispanics/Latinos with 10.2 per 100,000, American Indians/Alaska Natives with 5.3 per 100,000 and whites with 3.1 per 100,000 (CDC, 2020).

According to Nelson, Schneider, Wells, & Moore (2004), in the United States, TB cases were also reported among children younger than age 15 years who frequently and closely lived with TB infected people in an environment where tuberculosis was endemic (Marais et al., 2005). The study showed that children of all ages had higher TB rates. However, infants younger than 1 year and children aged 1 to 5 years presented higher TB rates, compared with adult TB rates in progression from infection to disease (Nelson & Wells, 2004).

In addition, contaminated children whose tuberculosis does not progress to illness constitute a likely reservoir for tuberculosis in adulthood (Nelson & Wells, 2004). Moreover, adolescents represent a major group that is likely affected with adult-type pulmonary TB and in which tuberculosis rates continue to increase. As a result, adolescents are more likely than younger children to transmit TB to others (Donald, Maher, & Qazi, 2007)

Purpose of the study

The purpose of this study was to assess whether declines in TB incidence have been followed by decreases in TB disparities in New England during 2011, and from 2014 to 2018. The study was consisted of two questions that were formulated using the variables race/ethnicity, country of

origin, and TB incident cases. The first question we looked further was to investigate whether gaps in TB rates narrowed when TB incidence globally decreased. Calculation of TB rates was based on person-time that is an estimate time-at-risk participants contributed to the study (CDC, 2020 a). The second question to be studied was to evaluate whether decreases in TB incidence have been followed by reductions in TB disparities among racial/ethnic minority groups and non-U.S.-born people. Reducing TB disparities in New England could play a substantial role in not only for an equity point of view, but also for improving access of minorities to a health coverage and care of quality (DHHS, 2015), and ensuring they receive care in a culturally and linguistically suitable way (Malcolm, Laurie, Lois, Linnea, & Alice (n.d.)).

Literature Review

Tuberculosis incidence rates and disparities

In 1989, after greatly reducing tuberculosis incidence rates in the United State, the Center for Disease Control and Prevention (CDC) formulated a national strategic plan for TB elimination, stipulated as “less than 1 case per million population” (CDC, 1989). In 2019, the CDC’ National TB Surveillance System (NTSS) reported 8900 TB cases, the lowest annual number ever recorded before (CDC, 2020). In the same year, due to the CDC organized TB control, an incidence rate of 29 per million, the lowest in the surveillance history (Khan et al., 2018), was recorded (Katrak & Flood, 2018),

Despite the considerable efforts mentioned above, tuberculosis disparities related to race/ethnicity continue to be reported in the United States (Noppert et al., 2017) as the disease is differentially distributed among the U.S. population, striking largely minorities groups (Schneider,

2005; Lippold, Carter, Armstrong & Hardison, 2014). The persistence of TB disparities between whites and racial/ethnic minority groups, and between U.S.-born and foreign-born people constitute a defiance to overcome to eliminate tuberculosis in the United States (Jung, Bennion, Sorvillo & Bellomy, 2010).

Causes of persistence of TB disparity.

The higher prevalence of latent TB infection (LTBI) observed in minority groups, mainly in non-U.S.-born people is one of the causes leading to the persistence of TB disparities in the United States (Miramontes et al., 2012). The reactivation of LTBI, mostly that contracted in the countries of origin, is considered as the reason for justifying the presence of TB cases among more than 90% of non-U.S.-born persons (CDC, 2017). In fact, the United States accounts for 6.3 million of the LTBI among about 40 million non-U.S.-born persons (Miramontes et al., 2012).

In addition, TB disparity persistence may derive from the roots of TB disparities that include differential exposure to TB, historical discrimination, lack of health care access or quality of care, lifestyles, and cultural practices (Thomas, Fine & Ibrahim, 2004). Moreover, many people who are infected by tuberculosis present more than 1 social or medical condition that increases their risk of infection with *Mycobacterium tuberculosis* or progression of TB disease, once infected (Oeltmann, Kammerer, Pevzner & Moonan, 2009).

Determinants of tuberculosis disparities

Disparities in TB incidence may be related to nativity, the country where a person is born (Noppert et al., 2017). This type of disparities can be differentiated into TB cases whose transmission occurred recently and those occurring from reactivation of LTBI. Immigrants, for

example, can be found in the second case as they may be infected in their country of origin and reactivate sometime later when in the United States (Nuzzo, Golub, Chaulk & Shah, 2015).

Depending on race or ethnicity, TB adversely affects minority groups that have historically experienced greater obstacles to health care. In fact, the percentage of TB cases that occurs in Hispanics, Blacks, and Asians is constantly higher, compared to the one observed in White Americans who represent the majority group. In 2016, for example, about 85.9% of the TB cases reported in the United States were found among racial and ethnic minority groups. The percentage of TB cases occurring in foreign-born was 68.5% of the total of the national cases (CDC, 2016).

The socio-economic status constitutes an important determinant of tuberculosis disparities. It is a complex concept that includes a combination of factors, such as lack of education, low income, overcrowding, unemployment, and some medical conditions that are responsible for an important part of health inequities or increasing the risk of contracting tuberculosis (Sarkar, 2014). To illustrate, HIV-infected patients are 18 times more likely to have active TB disease than persons without HIV as HIV infection alters the immune system's ability to fight TB germs (WHO, 2020; Narasimhan, Wood, Macintyre & Mathai, 2013). As a result, people with this condition are likely to develop TB disease if they are infected with TB germs (CDC, n.d.). Other TB risk factors, such as diabetes, alcohol, malnutrition, homelessness, hepatitis C, and tobacco use may as well play an important role in TB disparity determinants (Narasimhan, Wood, Macintyre & Mathai, 2013).

Methods

Data collection

The data of TB cases, TB cases by race/ethnicity and TB cases by country of origin of the years 2011, 2014, 2015, 2016, 2017, and 2018 from the States of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont were collected and combined to estimate TB case rate (TB incidence rate), TB rate by race/ethnicity, TB rates by countries of origin, and rate ratios (RRs) to assess TB disparities between minority groups and Whites, and between U.S.-born and non-U.S.-born population.

Measures of TB rates

To calculate the annual TB case rates, the total number of new TB cases collected in given year across all New England region was divided by the total number of populations observed in the same year, using a multiplier of 100,000 to express the TB rate as the number of cases per 100,000 persons (Passannante, Sevilla, & Ahamed, 2005). The annual TB rates by race/ethnicity was obtained dividing the total number of new TB cases observed in given race/ethnicity in given year by the total number of the population inventoried in that race/ethnic group in the same year, using a multiplier of 100,000. The annual TB rates for U.S.-born or non-U.S.-born persons were obtained dividing the total number of new TB cases in U.S.-born or non-U.S.-born observed in given year by the total number of the U.S.-born or non-U.S.-born population identified during the same year, using a multiplier of 100,000.

To calculate different TB cases per 100,000 persons, we used as numerators the numbers of TB cases, TB cases by race/ethnicity and TB cases by country of origin collected from different

tuberculosis reports (CDC, n.d.; CDC, 1989; CDC, 2009; CDC, 2013; CDC, 2014; CDC, 2015; CDC, 2016; CDC, 2017; CDC, 2018, CDC, 2018a; CDC, 2019a; CDC, 2019b; CDC, 2019c; CDC, 2020; Connecticut Department of Public Health [CDPH], 2017; CDPH, 2020; Connecticut Health I-Team, 2016; Rhode Island Department of Public Health [RIDPH], 2016; ; RIDPH, 2018; and Vermont Department of Public Health [VDPH], 2017).

To obtain the number of population at risk for different racial/ethnic groups, U.S.-born persons, and non-U.S.-born people, the data of annual estimates of the population of the years 2011, 2014, 2016, 2017, and 2018 from the States of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont were collected from different sources (U.S. Census Bureau, n.d. a, b, c, d, e, f; CDC, 2013, 2016, 2017, 2018, 2018 a; Governing the Future of States & Localities [GFSL], n. d.; Index Mundi, n. d.; Lattice Publishing, n. d.; Mass.gov., n. d.; Migration Policy Institute [MPI], n. d. a, b; Pew Research Center [PRC], n. d. a, b). Annually, the data of population of different racial/ethnic groups, and U.S.-born and non-U.S.-born populations was collected from all States forming the New England region. The annual results of population of each demographic characteristic obtained in different States was combined to obtain the total annual number of the population. For each demographic group, we added the different total annual numbers of the population obtained during the study period to obtain the number of the population at risk for that demographic group. The addition of all numbers of the population at risk of all demographic groups constituted the global number of the population at risk for this study.

Measures of TB disparities

To measure TB disparity between racial/ethnic groups and Whites, and between U.S.-born persons and non-U.S.-born persons, we annually calculated TB rate ratios (RRs) dividing TB rate in given minority group in given year by TB rate in Whites (majority group) in the same year. Whites were considered as reference group because of their historical lowest reported rates of TB (Khan et al., 2018).

Using TB data published by CDC and other Agencies was ease of access online and cost effectiveness as we did not invest any money, time, or effort into the data collection stages. The data were cleaned and ready to be analyzed.

To evaluate the risk of tuberculosis for minorities, we calculated the Incidence Rate Ratio (IRR) for each racial/ethnic minority groups during the study period comparing the average of incidence rate in the more exposed group (a minority group) to the less exposed (Whites) (Boston University School of Public Health, n. d.).

Measure of the average annual percentage change

To understand variations in TB rates, the average annual percentage decline and increase rates were successively calculated for two years apart from 2011, 2014 to 2018. For each two years, the final rate value was divided into the start rate, raised the power of two divided into one. From this exponent, we subtracted one and then multiplied by 100 to obtain annual percentage change for that period of time. Once the change rate percentage was calculated for all periods of the study, we added them and divided the obtained number by six which is the number of years of

the study period. The average annual percentage decreased if the obtained number was negative or increased if the number was positive (Michael, 2019).

Data analysis

Overall, we examined variations of TB cases and TB incidence in New England during 2011, and from 2014-2018. We described trends in RRs for tuberculosis among racial/ethnic minority groups compared with Whites and compared tuberculosis rates in U.S.-born with non-U.S.-born people. The variables used in the analysis included TB incidence and race/ethnicity categorized into Hispanic Americans, Asian Americans, Blacks or African Americans, and Whites Americans. The country of origin variable was classified into U.S.-born and non-U.S.-born individuals.

Results

Characteristics of the study population

A total of 1,891 TB cases were found in New England during 2011, and from 2014 to 2018. Racial/ethnic minorities accounted for 82.3% (n = 1,557) of all reported cases, compared with 15.9% (n = 302) for Whites. Hispanics accounted for 18,8% (n = 356) of TB cases, Asian 38,5% (n = 728), Blacks 25% (n = 473), and White 16% (n = 302). U.S.-born persons accounted for 16.9% (n = 320) and non-U.S.-born persons accounted for 82.5% (n = 1,560) (Table 1). Overall, TB cases decreased 9.5%, from 334 cases to 302 cases during the study period.

We disregarded the TB cases for 2012 and 2013 as we did not find the complete data for these two periods.

Table 1.

Tuberculosis case, Incidence rate per 100,000, and Incidence Rate Ratio by race/ethnicity and country of origin in New England: 2011, 2014-2018

	TB cases (n=1891)				
	N	%	Population at risk	TB Incidence rate per 100,000	IRR
Race/Ethnicity					
Hispanic	356	18.8	9,295,418	3.8	8.6
Asian	728	38.5	4,135,295	17.6	39.3
Black	473	25.0	5,602,161	8.4	18.9
White	302	16.0	67,532,041	0.4	Ref.
Missing	32	1.7			
Nativity					
U.S.-born	320	16.9	76,792,068	0.4	Ref.
Non-U.S.-born	1560	82.5	11,548,242	13.5	32.4
Missing	11	0.6			

Tuberculosis incidence rate distribution

During 2011 and from 2014 to 2018, TB incidence rates among racial/ethnic groups ranged from 0.4 per 100,000 population for Whites to 17.6 per 100,000 population for Asians. Blacks had a TB incidence of 8.4 per 100,000 and Hispanics accounted a TB rate of 3.8 per 100,000. From the nativity point of view, non-U.S.-born persons accounted for 13.5 per 100,000 of TB incidence rate, compared with 0.4 per 100,000 for U.S.-born persons (table 1).

TB disparities by race/ethnicity

Generally, incidence rate of TB decreased 13%, from 2.3 cases per 100,000 persons in 2011 to 2.0 cases per 100,000 persons in 2018. However, gaps in TB rates remained relatively unchanged (Figure 1). TB rates decreased 91.7% among Whites from 0.6 to 0.5 per 100,000 and 15.4% among Hispanics from 3.9 to 3.3 per 100,000. Blacks experienced an 19.4% decrease in

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TB rates, from 9.3 to 7.5 per 100,000, and Asians an 24.6% decrease, from 21.1 to 15.9 per 100,000 (Figure 1). Whereas TB rates declined for all racial/ethnic groups, TB disparities between minority groups and Whites increased as RRs for all minorities substantially increased, compared with Whites for each year data. Asians showed the highest RR among minority group followed by Blacks and Hispanics, compared with Whites (Figure 2). The study showed that Asians had 39.3 times the rate of having tuberculosis, Blacks 18.9 times, and Hispanics 8.6 times, compared with Whites (Table 1).

Figure 1.

Trends in Tuberculosis Rates Among Racial/Ethnic Groups in New England: 2011, 2014-2018

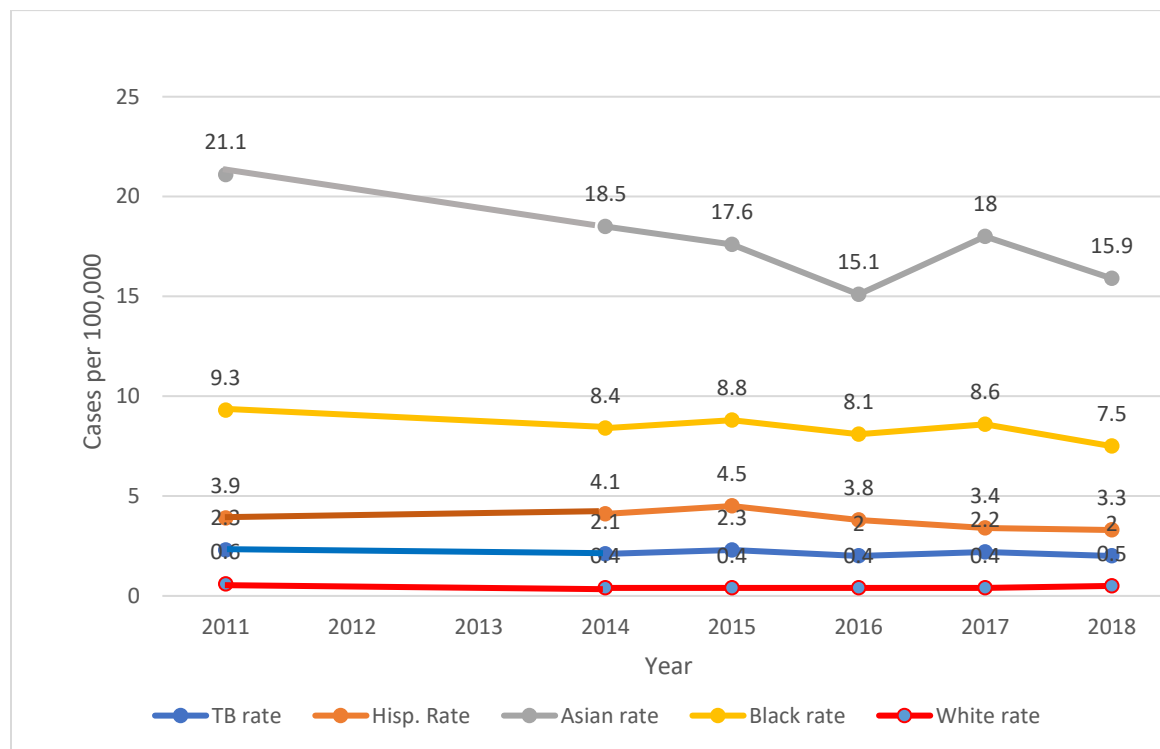
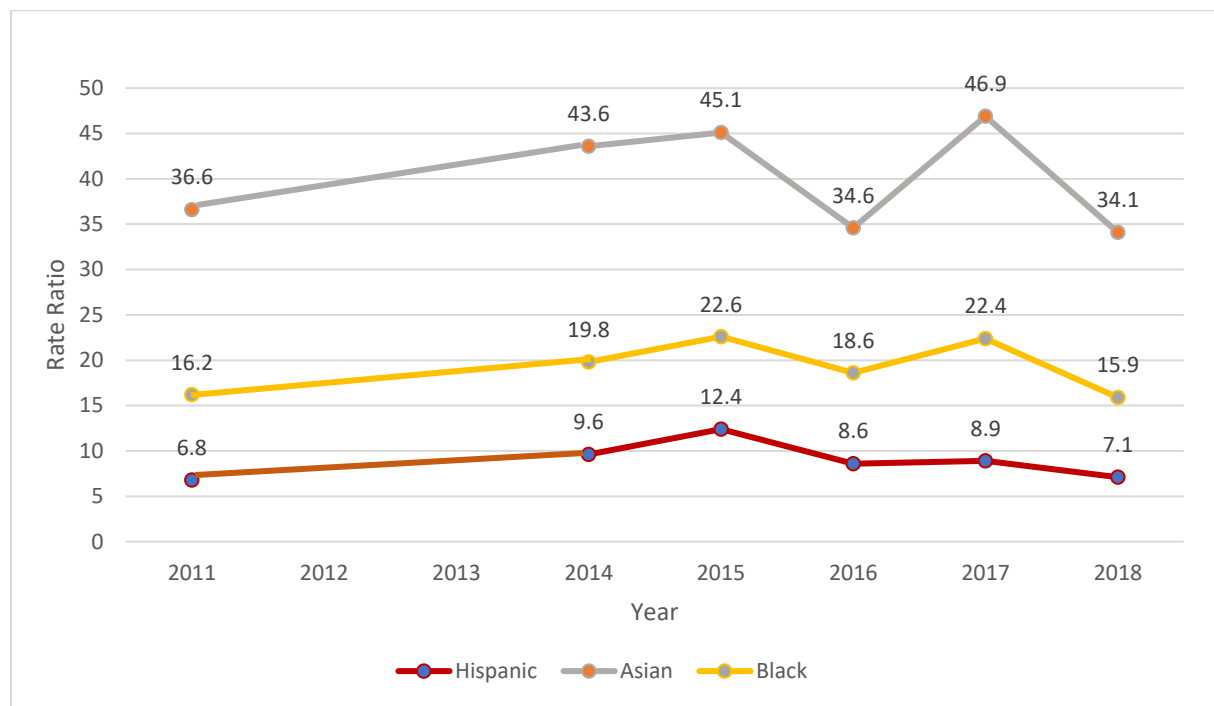


Figure 2.

Trends in Rate Ratios for TB Among Minorities Compared with Whites in New England: 2011, 2014-2018



TB disparities by country of origin

Similarly, TB rates decreased for both U.S-born and non-U.S.-born people. For U.S.-born persons, TB incidence rate declined from 0.5 per 100,000 persons in 2011 to 0.4 per 100,000 persons in 2018, showing a decrease of 20%. It varied from 15.3 per 100,000 persons in 2011 to 12.3 per 100,000 persons in 2018 for non-U.S.- born persons, accounting for a decline of 19.6%. However, RR showing the disparity between the U.S.-born and non-U.S.-born individuals increased (Figure 4). Moreover, non-U.S.-born persons showed an increased risk of tuberculosis as they had 32.4 times the rate of having the disease, compared with Whites (Table 1).

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Figure 3.

Comparison of Tuberculosis Rates in U.S.-Born and Non-U.S.-Born Persons in New England: 2011, 2014-2018

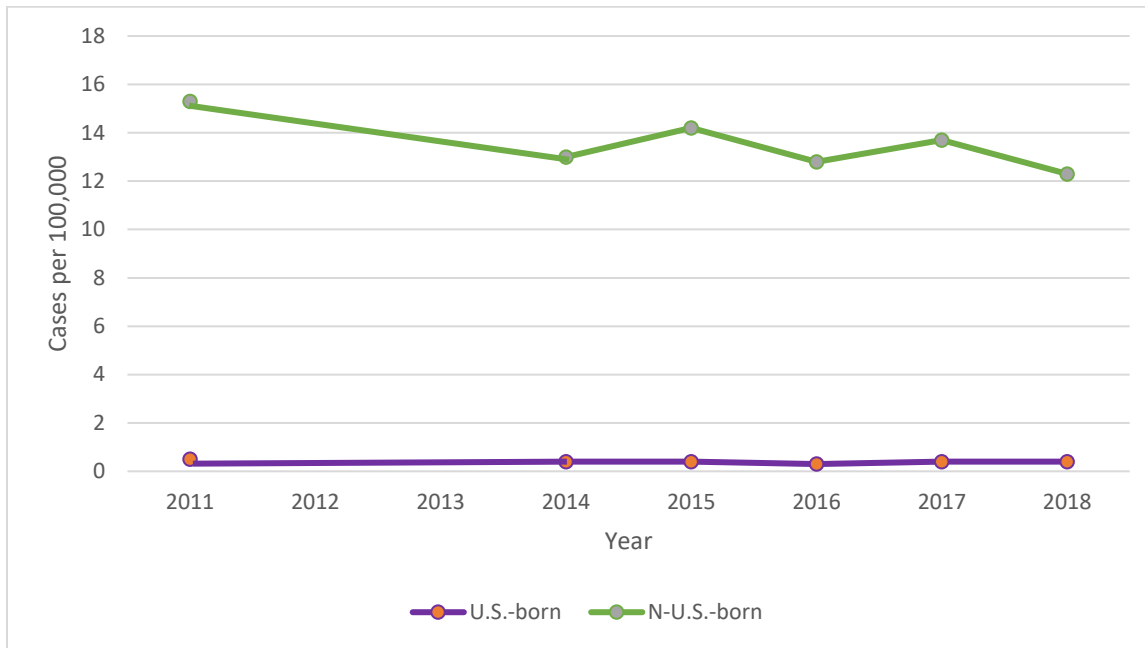
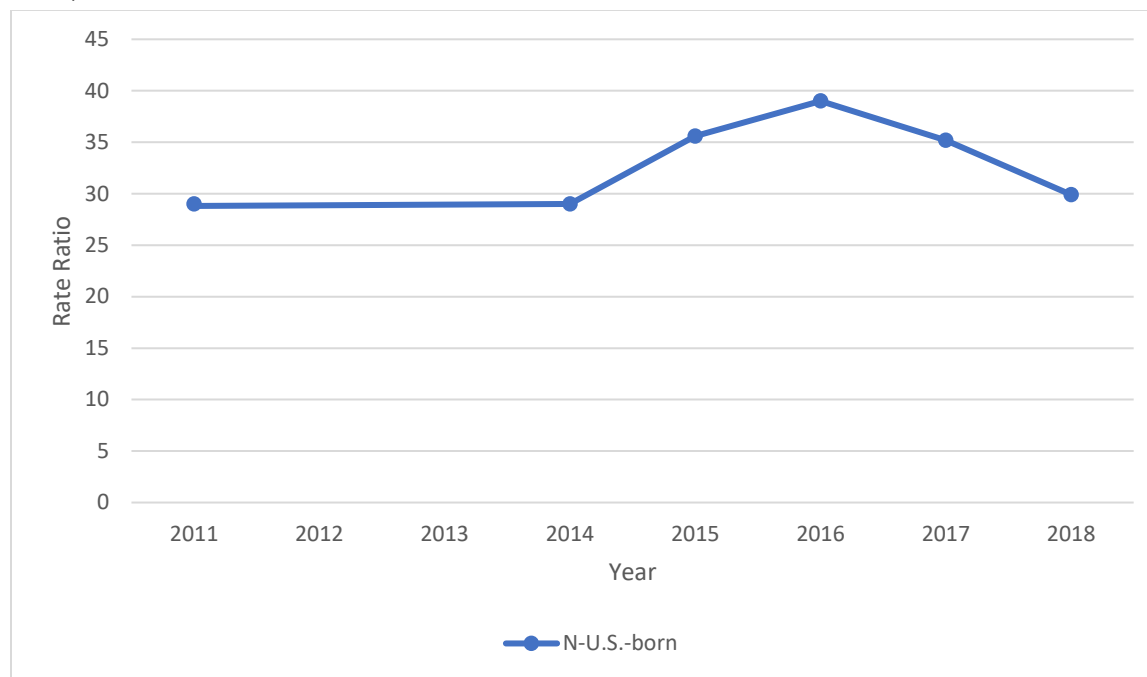


Figure 4.

Trend in Rate Ratio for Non-U.S.-Born Persons Compared with U.S.-Born People in New England: 2011, 2014-2018



The average annual percentage change

During 2011 and from 2014 to 2018, the average annual percentage change showed a decline of 1.1%.

Discussion

This study is a part of the aim pursued by CDC that is to “reduce TB morbidity in the United States with a particular focus on reducing disparities in TB morbidity among disproportionately affected groups, including non-U.S.-born persons and racial and ethnic minorities” (CDC, n.d. g). Overall, we found that TB incidence in New England declined during 2011, and from 2014 to 2018. However, gaps in TB rates remained stable (Figure 1). Decreases in

TB incidence may result from decreasing TB transmission (Vynnycky & Fine, 1999), lower prevalence of latent TB infection (LTBI) among new immigrants (Mori and Leung, 2010), and decreasing reactivation rates among foreign-born people resulting from improved nutritional or socioeconomic status, better access to healthcare or increasing treatment of LTBI (Cossa, Kessler, & Harris, 2015).

The study showed that the average annual percent decline in TB incidence was 1.1%, compared with an average percent decline of 1.6% per year observed in the United States during 2014-2018 (CDC, 2019). This identical trend of decline observed in New England and nationwide might be partially explained by the fact that the population composition in New England became more diversified like that of more populous U.S. states containing large and heterogeneous populations at high risk for TB disease (Chemg et al., 2018).

Racial/ethnic minority groups experienced a disproportionate burden of TB disparities during the study period. RRs demonstrated increases over time for all minority groups, compared with Whites. Asians had the most important increase of disparity, followed by Blacks and Hispanics. Particularly, Asians had a significant TB disparity in the average incidence rate compared with Whites, showing a greater risk of tuberculosis, compared with other racial/minority groups. Although Stead, Senner, Reddick, & Lofgren (1990) reported greater racial disparity in TB incidence between Blacks and Whites, our results showed rather the existence of significant racial disparity between Asians and Whites, corroborating to the national surveillance data (CDC, 2014).

Several important factors might contribute to highest rates of Tuberculosis among Asian persons. In 2010, more than one third of the world's TB patients lived in South Asia (CDC, n.d. a)

and many of the non-U.S.-born Asian people could come from this high TB rate region (Stennis et al., 2015). Also, the differences in social, clinical, and genotypic characteristics in Asians, compared with other foreign-born persons constitute other factors contributing to the highest TB rate observed in this population from Asia (Stennis et al., 2015). Moreover, the large proportion of Asian TB patients found in this study might be explained by the fact that this minority group, refusing to take HIV test, shows a high prevalence of HIV infection that could contribute to the increase burden of TB among this population (Stennis et al., 2015).

Better predictors of TB incidence in New England among racial/ethnic minority groups and non-U.S.-born persons might be social and environmental vulnerabilities, such as access to care, poor nutrition, smoking, and alcohol consumption than traditional TB risk factors, such as over-crowding living conditions or high population density (Myers, Westernhouse, Flood, and Riley, 2006).

Conclusion

Overall, the study findings showed that Tuberculosis rate in the New England declined during 2011 and from 2014 to 2018 while tuberculosis disparities increased at the same period. Racial/ethnic minority groups and non-U.S.-born population sustained a disproportionate burden of TB disparities. The greatest disparity among racial/ethnic groups was observed among Asians, followed by Blacks and Hispanics.

REFERENCES

- Atrash, H.K. (2018). Health disparities: challenges, opportunities, and what you can do about it. *Journal of Human Growth and Development*, 28(3), 223-231.
- Bell, J., & Lee, M.M. (2011). Why place and race matter: Impacting health through a focus on race and place. Oakland, CA: *PolicyLink*.
- Boston University School of Public Health. (n. d). *Incidence rata ratios and incidence rate Difference*. <https://sphweb.bumc.bu.edu/otlt/MPH-Modules/PH717-QuantCore/PH717-Module3-Frequency-Association/PH717-Module3-Frequency-Association11.html>
- Braveman, P. (2006). Health disparities and health equity: concepts and measurement. *Annu Rev Public Health*, 27, 167-94.
- Campanelli, R.M. (2003). Addressing racial and ethnic health disparities. *Am J Public Health*, 93(10), 1624-6.
- US Census Bureau. (n.d. a). *Population estimates for July 1, 2015*.
<http://www.census.gov/popest/data/national/totals/2015/index.html>
Accessed October 3, 2020
- US Census Bureau. (n.d. b). *Population estimates for July 1, 2016*.
<https://www2.census.gov/programs-surveys/popest/tables/2010-2016/state/totals/nst-est2016-01.xlsx> Accessed October 3, 2020
- US Census Bureau. (n.d. c). *Population estimates for July 1, 2017*.
(<https://www2.census.gov/programs-surveys/popest/tables/2010-2017/state/totals/nst-est2017-01.xlsx>excel iconexternal icon)
Accessed October 3, 2020.

Disparities in Tuberculosis Rates in New England: 2011, 2014-20

US Census Bureau. (n.d. d). *Population estimate for July 1, 2018.*

[U.S. Census Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Ricoexternal icon](#)

Accessed October 3, 2020

US Census Bureau. (n.d. e). Population estimate for July 1, 2019

https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html#par_textimage_1574439295 Accessed October 4, 2020

US Census Bureau. (n. d. f). *State population by characteristics 2010-2019.*

https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-detail.html#par_textimage_785300169 Accessed March 22, 2020

Centers for Disease Control and Prevention. (n.d.). *Data & statistics.*

<https://www.cdc.gov/tb/statistics/default.htm>

Accessed September 20, 2020.

Centers for Disease Control and Prevention. (n. d. a). Asian Persons.

<https://www.cdc.gov/tb/topic/populations/tbinasians/default.htm>

Accessed December 2, 2020

Centers for Disease Control and Prevention. (n.d. g). *Division of tuberculosis elimination.*

Strategic plan 2016-2020. <https://www.cdc.gov/tb/about/strategicplan.htm>

Accessed June 28, 2020

Centers for Disease Control and Prevention. (1989). *A strategic plan for the elimination tuberculosis in the United States.*

<https://www.cdc.gov/mmwr/preview/mmwrhtml/00001375.htm>

Accessed March 4, 2020

Centers for Disease Control and Prevention. (2009). *Notice to readers. Final 2008 reports of nationally notifiable infectious diseases.*

<https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5831a5.htm> Accessed July 2, 2020.

Disparities in Tuberculosis Rates in New England: 2011, 2014-20

Centers for Disease Control. (2013). *Summary of notifiable diseases- United States, 2011*.

<https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6053a1.htm> Accessed July 7, 2020.

Centers for Disease Control and Prevention. (2014). *Tuberculosis trends-United States*.

<https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6410a2.htm>

Accessed May 18, 2020

Centers for Disease Control and Prevention. (2016). *Reported tuberculosis in the United States, 2015*.

https://www.cdc.gov/tb/statistics/reports/2015/pdfs/2015_Surveillance_Report_FullReport.pdf

Accessed June 9, 2020.

Centers for Disease Control and Prevention. (2017). *Reported tuberculosis in the United States, 2016*.

https://www.cdc.gov/tb/statistics/reports/2016/pdfs/2016_Surveillance_FullReport.pdf

Accessed July 27, 2020.

Centers for Disease Control and Prevention. (2018). *Reported tuberculosis in the United States, 2017*. https://www.cdc.gov/tb/statistics/reports/2017/2017_Surveillance_FullReport.pdf

Accessed September 3, 2020

Centers for Disease Control and Prevention. (2018 a). *Reported tuberculosis in the United*

States, 2017 <https://www.cdc.gov/tb/statistics/reports/2017/table28.htm> Accessed August

26, 2020

Centers for Disease Control and Prevention. (2019). *Tuberculosis-United States, 2018*.

<https://www.cdc.gov/mmwr/volumes/68/wr/mm6811a2.htm> Accessed September 2,

2020

Centers for Disease Control and Prevention. (2019 a). *Reported tuberculosis in the United States,*

2018. <https://www.cdc.gov/tb/statistics/reports/2018/table28.htm> Accessed June 17, 2020

Disparities in Tuberculosis Rates in New England: 2011, 2014-20

Centers for Disease Control and Prevention. (2019 b). *Reported tuberculosis in the United States, 2018*. <https://www.cdc.gov/tb/statistics/reports/2018/table31.htm> Accessed April 2, 2020.

Centers for Disease Control and Prevention. (2019 c). *Reported tuberculosis in the United States, 2018*. <https://www.cdc.gov/tb/statistics/reports/2018/table32.htm> Accessed July 20, 2020

Centers for Disease Control. (2020). *Tuberculosis-United States, 2019*.

<https://www.cdc.gov/mmwr/volumes/69/wr/mm6911a3.htm#:~:text=During%202019%2C%20a%20total%20of,rates%20among%20U.S.%2Dborn%20persons.> Accessed May 25, 2020

Centers for Disease Control and Prevention. (2020 a). *Lesson 3: Measures of risk. Section 2: Morbidity frequency measures*.

<https://tools.cdc.gov/medialibrary/index.aspx#/media/id/402803>

Chemg, S.T., Shrestha, S., Reynolds, S., Hill, A.N., Marks, S.M., Kelly, J., & Dowdy, D.W. (2018). Tuberculosis incidence among populations at high risk in California, Florida, New York, and Texas (2011-2015). *AJPH, Supplement 4*, vol 108, No S4.

Connecticut Department of Public Health. (2017). *Tuberculosis cases at a glance: Connecticut, 2016*. https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/infectious_diseases/tb/pdf/TBglancepdf.pdf?la=en Accessed April, 2020

Connecticut Department of Public Health. (2020). *Tuberculosis cases at a glance: Connecticut, 2019*. https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/Infectious-Diseases/TB/tb_glance.pdf?la=en Accessed August 4, 2020

Connecticut Health I-Team. (2016). Tuberculosis cases rise in Connecticut, nationally first increase in 23 years.

<http://c-hit.org/2016/11/16/tb-cases-rise-in-connecticut-nationally-first-increase-in-23-years/>

Accessed June 18, 2020

Disparities in Tuberculosis Rates in New England: 2011, 2014-20

Crossa, A., Kessler, J., & Harris, T.G. (2015). Enhanced Tuberculosis Infection Treatment Outcomes after Implementation of QuantiFERON(R)-Gold Testing. *PLoS One*, *10*(9), e0138349.

US Department of Health and Human Services. (2015). *HHS action plan to reduce racial and ethnic health disparities: implementation progress report 2011-2014*. ASPE.

<https://aspe.hhs.gov/basic-report/hhs-action-plan-reduce-racial-and-ethnic-health-disparities-implementation-progress-report-2011-2014> Accessed January 6, 2020

US Department of Health and Human Services. (2016). *Health, United States, 2015: with special feature on racial and ethnic health disparities*. Hyatt: National Center for Health Statistics

<https://www.cdc.gov/nchs/data/hus/hus15.pdf> Accessed March 6, 2020

Donald, P.R., Maher, D., & Qazi, S. (2007). A research agenda for childhood tuberculosis. Geneva, Switzerland: World Health Organization

http://whqlibdoc.who.int/hq/2007/WHO_HTM_TB2007.381_eng.pdf

Accessed June 8, 2020

Dehlendorf, C., Bryant, A.S., Huddleston, H.G., Jacoby, V.L., & Fujimoto, V.Y. (2010). Health disparities: definitions and measurements. *Am J of Obstetrics and Gynecology*.

<https://www.ajog.org/action/showPdf?pii=S0002-9378%2809%2902245-5>

Accessed November 15, 2020.

El Sahly, H.M., Adams, G.J., Soini, H., Teeter, L., Musser, J.M., & Graviss, E.A. (2001) Epidemiologic differences between United States-and foreign-born tuberculosis patients in Houston, Texas. *J Infect Dis*, *183*(3), 461-468.

Governing the Future of States and Localities (n.d.). *State population by race, ethnicity data.*

<https://www.governing.com/gov-data/census/state-minority-population-data-estimates.html>

Accessed September 6, 2020

Graham, H. (2004). Social determinants and their unequal distribution: Clarifying policy understandings. *Milbank Q* 82(1), 101-124.

Index Mundi. (n.d.). *United States- Foreign-born population percentage by state*

<https://www.indexmundi.com/facts/united-states/quick-facts/all-states/foreign-born-population-percent#table> Accessed June 6, 2020

Jung, R.S., Bennion, J.R., Sorvillo, F., & Bellomy, A. (2010). Trends in tuberculosis mortality in the United States, 1900-2006: A population-based case-control study. *Public Reports*, Vol. 125.

Katrak, S., & Flood, J. (2018). Latent tuberculosis and current tuberculosis disparities in California: Making the invisible visible. *Am J Public Health*. Supplement 4, vol 108, No S4

Khan, A., Marks, S., Katz, D., Momis, S.B., Lambert, L., Magee, E., Bowman, S., & Grant, G. (2018). Changes in tuberculosis disparities at a time of decreasing tuberculosis incidence in the United States, 1994-2016. *Am J Public Health*. Supplement 4, vol 108, No S4.

Lara, M., Health, R., & Rand, C. (2005). Acculturation and Latino health in the United States: A review of the literature and its sociopolitical context. Santa Monica, CA: *RAND Corporation*. NCHS, 2016

Lattice Publishing. (n.d.). *States with the most immigrants.*

<https://www.latticepublishing.com/blog/states-with-the-most-immigrants> Accessed

October 8, 2020

Disparities in Tuberculosis Rates in New England: 2011, 2014-20

Lippold, S.A., Carter, J.M., Armstrong, L., & Hardison, X. (2014). Trends and disparities in TB among US born Black and White Chicago residents, 1998-2008. *J Health Dispar Res Pract*, 7(2), 6.

Malcolm, V.W., Laurie, T.M., Lois, M.D., Linnea, W.M., & Alice, K., (n.d). Evaluation of the national CLAS standards. *DHHS/OMH*.
https://minorityhealth.hhs.gov/assets/PDF/Evaluation_of_the_Natn_CLAS_Standards_Toolkit_P_R3599_final.508Compliant.pdf Accessed November 2, 2020.

Marais, B.J., Obihara, C.C., Warren, R.M., Schaaf, H.S., Gie, R.P., & Donald, P.R. (2005). The burden of childhood tuberculosis: a public health perspective. *Int J Tuberc Lung Dis*, 9(12), 1305-1313.

Mass.gov. (n. d.). Tuberculosis data and statistics.
<https://www.mass.gov/lists/tuberculosis-data-and-statistics#annual-summary-statistics->
Accesses June 5, 2020

Michael, R.L. (2019). How to calculate an annual percentage growth rate.
<https://www.wikihow.com/Calculate-an-Annual-Percentage-Grow-Rate>
Accesses April 23, 2020

Migration Policy Institute. (n. d. a). *Connecticut. Demographics & Social*
<https://www.migrationpolicy.org/data/state-profiles/state/demographics/CT>
Accessed October 6, 2020.

Migration Policy Institute (n. d. b). *Maine. Demographics & social*.
<https://www.migrationpolicy.org/data/state-profiles/state/demographics/ME>
Accessed October 7, 2020

Miramontes, R., Hill, A.N., Yelk Woodruff, R.S., et al. (2012). Tuberculosis infection in the United States: prevalence estimates from the National Health and Nutrition Examination Survey. *PLoS One*. 2011-2012, 10(11), e0140881.

- Mori, T., & Leung, C.C. (2010). Tuberculosis in the global aging population. *Infect Dis Clin North Am.*, 24(3), 751–68.
- Myers, W.P., Westernhouse, J.L., Flood, J., & Riley, L.W. (2006). An ecological study of tuberculosis transmission in California. *AM J Public Health*, 96, 685-90.
- Narasimhan, P., Wood, J., Macintyre C.R., & Mathai, D. (2013). Risk factors for tuberculosis. *Pulm Med*, Vol 2013
- Nelson, L.J., Schneider, E., Wells, C.D., & Moore, M. (2004). Epidemiology of childhood tuberculosis in the United States, 1993—2001: the need for continued vigilance. *Pediatrics*, 1114, 333-341.
- Nelson, L.J., & Wells, C.D. (2004). Global epidemiology of childhood tuberculosis. *Int J Tuberc Lung Dis*, 8(5), 636-647.
- Noppert, G.A., Wilsom, M.L., Philippa, C., Ye, W., Davidson, P., & Yang, Z. (2017). Race and nativities are major determinants of tuberculosis in the United States: evidence of disparities in tuberculosis incidence in Michigan, 2004-2012. *BMC Public Health*, 17(1), 538.
- Nuzzo, J.B., Golub, J.E., Chaulk, P., & Shah, M. (2015). Postarrival tuberculosis screening of high-risk immigrants at a local health Department. *Am J Public Health*, 105, 1432-8.
- Oeltmann, J.E., Kammener, J.S., Pevzner, E.S., & Moonan, P.K. (2009). Tuberculosis substance abuse in the United States, 1997-2006. *Arch Intern Med*, 169(2), 189-197.
- Passannate, M., Sevilla, A., & Ahamed, N. (2005). *Basic epidemiology for tuberculosis staff*. 2nd Edition. Global Tuberculosis Institute.
- Pew Research Center. (n. d. a). *Characteristics of the U.S. foreign population: 2017*
<https://www.pewresearch.org/hispanic/wp-content/uploads/sites/5/2019/06/Pew-Research-Center-Current-Data-Statistical-Portrait-of-the-Foreign-Born-2017-2019-05.pdf>
Accessed June 23, 2020

Disparities in Tuberculosis Rates in New England: 2011, 2014-20

Pew Research Center. (n. d. b). *2011, foreign-born population in the United States statistical portrait*

<https://www.pewresearch.org/hispanic/2013/01/29/2011-statistical-information-on-immigrants-in-united-states/#foreign-born-by-region-of-birth-2000-and-2011>

Accessed June 7, 2020.

Rhode Island Department of Public Health. (2016). Tuberculosis: Rhode Island, 2006-2015.

<https://health.ri.gov/data/diseases/TuberculosisDemographics.pdf>

Accessed October 25, 2020

Rhode Island Department of Public Health. (2018). Tuberculosis: Rhode Island, 2008-2017.

<https://health.ri.gov/publications/databriefs/TBFrequency.pdf>

Accessed October 12, 2020

Salinas, J.L., Mindra, G., Haddard, M.B., Pratt, R., Price, S.F., & Langer, A.J. (2016). Leveling of tuberculosis incidence – United States, 2013-2015. *MMWR Morb Mortal Wkly Rep.*, 65(11), 273-8

Sarkar, B.B. (2014). Patterns of socio-economic deprivation and its impact on quality of life: case of a less developed region in West Bengal, India, 271-86

Schneider, E. (2005). Tuberculosis among American Indians and Alaska Natives in the United States, 1993-2002. *Am J Public Health*, 95(5), 873-880.

Smedley, B.D., Stith, A.Y., & Nelson, A.R. (2003). Unequal treatment: confronting racial and ethnic disparities in health care. Washington (DC). *National Academies Press*

Stead, W.W., Senner, J.W., Reddick, W.T., & Lofgren, J.P. (1990). Racial differences in susceptibility to infection by Mycobacterium tuberculosis. *New Engl J*, 322, 422-7

Stennis, N., Trieu, L., Perri, B., Anderson, J., Mushtaq, M., & Ahuja, S. (2015). Disparities in tuberculosis burden among south Asians Living in New York city, 2001-2010. *Am J Public Health*, 105(5), 922-929.

Disparities in Tuberculosis Rates in New England: 2011, 2014-20

Thomas, S.B., Fine, M.J., & Ibrahim, S.A. (2004). Health disparities: the importance of culture and health communication. *Am J Public Health*, 94(12), 2050.

Vermont Department of Public Health. (2017). Tuberculosis in Vermont.

https://www.healthvermont.gov/sites/default/files/documents/2016/11/TBProgram_16.pdf

Accessed June 30, 2020

Vynnycky, E., & Fine, P.E. (1999). Interpreting the decline in tuberculosis: the role of secular trends in effective contact. *Int J Epidemiol.*, 28(2), 34.

Williams, D.R., Mohammed, S.A., Leavell, J., & Collins, C. (2010). Race, socioeconomic status, and health: Complexities, ongoing challenges, and research opportunities. *Annals of the New York Academy of Sciences*, 1186, 69-101.

World Health Organization. (2020). Tuberculosis. Key facts.

<https://www.who.int/news-room/fact-sheets/detail/tuberculosis>

Accessed October 30, 2020