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RESEARCH REPORT

Mortality from Sexually Transmitted Diseases: Immigration and Socioeconomic Factors

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Abstract

Objectives: The purpose of the study was to investigate associations between immigration status and mortality from sexually transmitted diseases (STDs) in the United States. It was hypothesized that there are no mortality differentials between native-born and foreign-born Americans once controls are made for socioeconomic factors.

Methods: Data were obtained from the United States National Longitudinal Mortality Study. Cox Proportional hazards regression models were fit to the data, with the entire sample of male and female respondents. Analysis was then stratified to do separate models for each sex group.

Results: Immigrants were much less likely to die of sexual diseases than their native-born counterparts. Results held even after controlling for a place of residence, marital status, educational attainment and household income. The sample was disaggregated by sex. In the male sample, immigration was negatively associated with mortality from Sexually transmitted diseases. Among women, negative associations were also observed association between immigration and sexually transmitted diseases. The ever married and the never married were much more likely to die of sexually transmitted disease. Men experienced mortality risk that was over 3 times that of women.

Conclusion: Debates continue in the United States about the possible effects of immigration on health. Findings from this study show that using a relatively large sample of over 1 million individuals, immigrants were much less likely to die from STDs than native-born Americans. It was concluded that foreign-born are not contributing positively to US STD mortality.

Introduction

The World Health Organization suggests that over one million persons acquire a sexually transmitted disease¹ (STDs) daily, and the burden of morbidity and mortality resulting from these infections compromises the quality of life, as well as sexual and reproductive health and newborn and child health. Sexually transmitted diseases also indirectly facilitate the sexual transmission of HIV and cause cellular changes that precede some cancers¹. Furthermore, sexually transmitted diseases impose a substantial strain on the budgets of both households and national health systems in the middle- and low-income countries and have adverse consequences on the overall well-being of individuals and groups.¹

These infectious diseases and their sequelae have been rising in the US since 2015, with 2019 witnessing the sixth year of consecutive increase.² As for examples of their persistence and epidemiology, in 2019, a total of 1,808,703 chlamydia cases were reported to the CDC.² These case counts constituted a rate of 552.8 per 100,000 population and were the most common notifiable infection.² Among females in the 15 to 24 age group, the rate of reported chlamydia was 3,728.1 cases per 100,000 females, representing an increase of 10 from 2015.^{2,3} In the same period, reported cases among men increased by 32.1% from 2015 to 2019. In general, chlamydia is higher among women than men. Differences in screening among women compared to men; the differences are likely due to higher screening for women compared to men.

In 2019, a total of 616,392 cases of gonorrhea were reported to the CDC, making it the second most common notifiable condition in the United States for that year.² Rates of reported gonorrhea have increased by 92.0% since the historic low in 2009. During 2018–2019, the overall rate of reported gonorrhea increased by 5.7% (CDC 2019). Rates increased among both males and females, in all regions of the United States and among all racial/Hispanic ethnicity groups.²

The rate of reported gonorrhea has been higher among men compared to women since 2013. Among men, the rate of reported gonorrhea increased by 5.9% during 2018–2019 and 60.6% during 2015–2019.² Rates among women increased by 5.1% during 2018–2019 and 43.6% during 2015–2019. The higher case rate among men and the magnitude of recent increases suggests either increased transmission, increased case ascertainment (e.g., through increased extra-genital screening among MSM), or both. The concurrent increase in cases reported among women suggests parallel increases in heterosexual transmission, increased screening among women, or both.^{2,3}

In 2019, 129,813 cases of all stages of syphilis were reported, including 38,992 cases of primary and secondary (P&S) syphilis, the most infectious stages of the disease.² Since reaching a historic low in 2000 and 2001, the rate of P&S syphilis has increased almost every year, increasing 11.2% from 2018 to 2019.² Rates increased among both males and females in all regions of the United States and among all racial/ethnic groups.² Since

2000, rates of primary and secondary syphilis have increased among men, likely due to increases in cases involving sadomasochism; however, increases among men who have sex with men (MSM) may be slowing.^{2,3} In jurisdictions with a consistent collection of sex partners, case counts among men that have sex with men (MSM) were stable during 2018–2019. Men who have sex with men are disproportionately impacted, accounting for a majority (56.7%) of all male primary and secondary syphilis cases in 2019.² Although rates of primary and secondary syphilis are lower among women, rates have increased substantially in recent years, increasing 30.0% during 2018–2019 and 178.6% during 2015–2019, suggesting the heterosexual syphilis epidemic continues to increase.^{2,3}

Over half (55.4%) of reported cases of STDs in 2019 were among adolescents and young adults aged 15–24 years.^{2,3} Disparities continue to persist in rates of reported STDs among some racial minority or Hispanic groups when compared with rates among non-Hispanic Whites. In 2019, 30.6% of all cases of chlamydia, gonorrhea, and syphilis were among non-Hispanic Blacks, even though they made up only approximately 12.5% of the US population.² MSM are disproportionately impacted by STDs, including syphilis and gonorrhea. These disparities are unlikely explained by differences in sexual behavior but may reflect differences in access to quality sexual health care, as well as differences in sexual network characteristics. For example, in communities with a higher prevalence of STDs, with each

sexual encounter, people face a greater chance of encountering an infected partner than those in lower prevalence settings do, regardless of similar sexual behavior patterns. Prior research on sexually transmitted diseases or infections has focused extensively on behavioral risk factors such as not using condoms, having multiple sex partners, having anal sex or having a partner that injects or has injected drugs before.^{1,4,5} Behavioral risk factors are important in the transmission of STDS, but non-behavioral factors, such as marital status, educational attainment, income status, housing tenure, and immigration/nativity status, may not be ignored as important contributing factors that may elevate the risk of infection, disease and even mortality. In the present study, we concentrate on one non-behavioral status, immigration, as a major risk factor.

In the US, there has been a long-standing perception that immigrants bring diseases into the country.⁵ In the 19th century, it was argued by immigration opponents that foreign-born, especially those from non-white countries, entered with infectious morbid conditions. Accordingly, a high rate of immigration was detrimental to population health. The aim or objective of this research was to investigate whether immigration status elevates the risk of mortality from sexually transmitted diseases. The working hypothesis is that immigration status has no effect on STD deaths.

Materials and Methods

Data were obtained from version 5 of the National Longitudinal Mortality Study (NLMS), released in October 2015.⁶ The NLMS is a follow-up study of mortality among the non-institutionalized population of the US and is sponsored by the National Heart, Lung, and Blood Institute, the National Cancer Institute, the National Institute on Aging, the National Center for Health Statistics, and the U.S. Census Bureau.^{6,7,9} The full NLMS comprises a database developed for the purpose of studying the effects of demographic and socio-economic attributes on disparities in U.S. mortality.^{6,7,9} It is a unique research database as it is based on a multistage stratified sample of the non-institutionalized population and consists of information from the Current Population Surveys (CPS) and the Annual Social and Economic Supplements (ASEC). The full study, which is restricted, currently has approximately 3.8 million records with over 550,000 identified mortality cases. The CPS has a response rate of about 96%. A more detailed description of the CPS, including sample design, design effects, coverage errors, adjustments for nonresponse, and variance estimation, has been presented elsewhere.^{6,7,9}

The NLMS Public Use Microdata Sample (PUMS) used in the present research is a specialized extract of the full NLMS that is designed to provide easy access to the main study while protecting the confidentiality of those who have responded to the original surveys on which the NLMS is based.^{6,9} Data from death certificates on the fact and causes

of deaths occurring from April 1, 1990, to April 30, 2011, were obtained by linking individuals in the CPS samples to a mortality database through the National Death Index (NDI). Created in 1979 and maintained by the National Center for Health Statistics, the NDI is a computerized and centralized index of deaths occurring in the United States.^{6,8,9} It was designed to provide researchers with a simplified method of obtaining mortality information in prospective studies.^{7,8} A piece of more detailed information about the NDI, including data linkage and obtaining death records, has been presented elsewhere.^{9,10} Mortality experiences of cohort members were studied until 2011;⁶ individuals alive at the end of the study received the maximum follow-up period of 4,018 days or 11 years.^{6,10} In the present analysis, only individuals 18 years old and above were utilized; there were, therefore, 1.48 million individuals at the beginning of the study, 1191 of whom had died of STDS during the follow-up period. To estimate STD mortality risk, all individuals surviving beyond the 4,018 days of follow-up and persons dying from other causes were treated as right-censored observations.

Variables and Measurement

The dependent variable was sexually transmitted disease, identified by codes 10 and 15 from the generalized 113 cause of death codes published by the National Center for Health Statistics,¹⁰ which are derived from the *Statistical Classification of Diseases and Related Health Problems* (ICD-10), tenth Revision.¹¹ *Immigration Status*: Persons born elsewhere (outside the US) were treated as

immigrants or foreign-born. This excludes Americans born to American parents abroad. Individuals born in the US (including Hawaii and Alaska) were native-born, and this category was used as the reference group. Ideally, we would have liked to have the duration of US residence, but this was not present in the data set. *Marital status* was measured by two dummy variables. There was one each for the ever-married (divorced, separated, and widowed individuals), the never married (single/never-married persons). Those married at the beginning of the study constituted the reference category. *Race/ethnicity* was defined in terms of 5 dummy variables, 1 for non-Hispanic African Americans, 1 for Non-Hispanic Asians, 1 for Non-Hispanic Native Americans, 1 for Hispanics, and 1 for individuals to be classified into a separate race. Non-Hispanic whites constituted the reference group. *Education* was measured by a series of dummy variables, one for less than high school education and 1 for high school education (12 years completed). Persons with some colleges (13 or more years completed) were the reference group. *Family Income* was indexed by annual family income adjusted for inflation. It was indexed by 6 dummy variables, 1 each for less than \$20,000, \$20,000-29,999, \$30,000-\$39,999, one for \$50,000-\$59,999, one for \$60,000 and above, and 1 for the unknown or missing income. Those with a family income of \$40,000-\$49,999 were the omitted group. Housing tenure was measured in terms of whether the respondent owned or rented. *Housing tenure* may be a proxy measure of social integration in the sense that owners

typically live in the same neighborhood for a longer time, given mortgage obligations and the difficulty involved in disposing of a house within a short period of time. Renters, on the other hand, may have greater flexibility to move out of their current place of residence. Those who rented were given a code of 1, and owners were the reference group for comparison. The location of *Residence* was measured as a dummy variable. Individuals living in central cities of urbanized areas were coded 1; those living in areas within the urban environment but outside the central city (e.g., suburbs) were coded 1, and persons living outside urban (metro areas), including rural towns, villages, and farms were the reference category. Sex was measured as a dummy variable with males coded 1; women were the reference group for comparison. All the independent variables were measured at baseline, and their effects on follow-up STDS were assessed. This holds for all other associations mentioned in the text. The risk of STDS (by years of follow-up) was estimated as a function of baseline immigration status, marital status, region of residence, place of residence, age, sex, race/ethnicity, education, family income, and place of residence.

Statistical Methods

Cox's proportional hazards regression models were applied to the data to compare the risk of mortality among immigrants and non-immigrants while controlling for confounders.¹² The Cox model may be specified as:

$$h(t) = h_0(t)\exp(\sum k\beta_k X_k) \quad [\text{eq 1}]$$

Where $h(t)$ is the hazard or risk of mortality at time t , β_k 's are a set of unknown parameters to be estimated, and X_k 's are k covariates. $h_0(t)$ is a baseline hazard function and is defined when all the covariates in the model are set to zero. The proportionality of hazards assumption inherent in the Cox model was tested by inspecting the plots of $\ln[-\ln\{S(t)\}]$ against survival time t for the various covariate categories. The plots were found to be approximately parallel, and so the proportionality assumption was taken to be satisfied by the data. The parameters in the Cox models were calculated by partial maximum likelihood using the PHREG procedure available within SAS, version 9.4.¹³ The Cox proportional hazards model was selected over the logistic model because the latter fails to account for differences in survival from the start of follow-up until event occurrence. For example, in a logistic model, a person dying of an STD immediately after follow-up is treated the same way as one dying after eight years of follow-up. In a logistic model, the dependent variable is usually dichotomous, with observations coded as either experienced suicide or not experienced STD/alive. As a result, one loses important information regarding variations in survival times. If the follow-up period is related to the dependent variable and other variables in the model, the results of logistic and hazards models will differ and controlling for the confounding influence of follow-up may be necessary.^{14,15} Where there is no relationship between follow-up and the dependent variable, results provided by both logistic and proportional hazards are

generally equivalent, leaving choice options open to the analyst.

Results

The presentation of results goes in two steps. First, findings based on the entire sample are presented. This is followed by findings stratified by sex. There were 1,384,507 men and women aged 18 years or more in the National Longitudinal Mortality Study with known values for Immigration status and control variables at baseline. Of this number, 1191 were identified as having died from sexually transmitted diseases (STDs) during the follow-up period, 1990 through 2011.

Table 1 shows findings on the association between immigration status and STDS controlled for relevant independent variables for the full sample. As may be seen in the table, immigrants (foreign-born) were over 60 percent less likely to die of STD than their native-born counterparts (RR=0.399, 95% CI=0.258,0.615). Males were over 3.9 times more as likely to die than females (RR=3.910, CI=3.421,4.469). As for marital status, the ever-married (RR=2.335, CI=1.965, 2.775) and the never married (RR=6.180, CI=5.296, 7.211) were much more likely to die from STD than the married. For race/ethnicity, Non-Hispanic African Americans experienced elevated mortality risk (RR=2.116, CI=1.825, 2.454), and persons of Hispanic origin were nearly 35 percent more likely to die of STD than their non-Hispanic white counterparts. Individuals living in central cities were more likely to die than those living in suburban areas. Lower household income elevated STD

mortality risk. In general, the greater the age group, the higher the mortality risk. The likelihood ratio statistic (1889.66, $p=0001$) shows that the model was adequate.

Table 1: Effect of Immigration on Mortality Risk from Sexually Transmitted Diseases Entire Sample, 1990-2011

Parameter	β	Hazard Ratio	95% CI	
Immigration Status				
Native Born		1.000		
Foreign Born	-0.919***	0.399	0.258	0.615
Sex				
Female		1.000		
Male	1.363***	3.910	3.421	4.469
Marital Status				
Married		1.000		
Ever Married	0.847***	2.335	1.965	2.775
Never Married	1.821***	6.180	5.296	7.211
Race/Ethnicity				
Non-Hispanic White		1.000		
Non-Hispanic African American	0.749***	2.116	1.825	2.454
Non-Hispanic Native American	0.002	1.002	0.498	2.017
Non-Hispanic Asian, Pacific Islander	-0.379	0.684	0.415	1.127
Hispanic	0.304***	1.356	1.135	1.621
Non-Hispanic Other Race	0.039	1.040	0.465	2.328
Place of Residence				
Suburban Residence		1.000		
Central City within SMSA	0.556***	1.744	1.519	2.002
Outside SMSA/Rural Residence	-0.313***	0.731	0.614	0.870
Housing Tenure				
Owens Home/Has Mortgage		1.000		
Rents	0.329***	1.391	1.221	1.583
Education				
Some College/Prof degree/PhD		1.000		
Less than High School Educ	-0.295***	0.744	0.634	0.874
High School Education	-0.078	0.924	0.807	1.058
Household Income				
Income \$50,000 +		1.000		
Income Less than \$20,000	0.574***	1.777	1.464	2.157

Parameter	β	Hazard Ratio	95% CI	
Income \$20,000-\$29,999	0.378***	1.460	1.191	1.790
Income \$30,000-\$39,999	0.145	1.156	0.918	1.457
Income \$40,000-\$49,999	-0.209	0.811	0.592	1.111
Income Unknown/Missing	-0.336	0.714	0.477	1.070
Age				
Age 18-28 years		1.000		
Age 29-39 years	1.278***	3.591	3.035	4.248
Age 40-49 years	1.263***	3.537	2.880	4.344
Age 50-59 years	1.100***	3.005	2.352	3.840
Age 60 + years	1.722***	5.599	4.562	6.872
LRS	1889.66***			
Events	1191			
Population at Risk	1384507			

*Significant at $p=.05$; **Significant at $p=.01$; ***Significant at $p=.001$

Table 2 shows results for males only. As may be seen, foreign-born men were 62.7 percent less likely to die of STD than their native-born counterparts (RR=0.373, 95% CI=0.225, 0.620). Ever-married men (RR=3.080, CI=2.486, 3.816) and never married men (RR=8.299, CI=6.923, 9.948) were significantly more likely to die of STD than married. African American and Hispanic men experienced a higher mortality risk than non-Hispanic whites.

Men residing in central cities were 94.7 percent as likely to die compared to their counterparts residing in suburban areas. Men living in rural places were less likely to die of STD than those in suburban areas (RR=0.633, CI=0.510, 0.784). Results for age were similar to those observed in the whole sample. The likelihood ratio statistic was significant, suggesting model adequacy.

Table 2: Effect of Immigration Status on Mortality Risk from Sexually Transmitted Diseases: Men

Covariate	β	Hazard Ratio	95% CI	
Immigration Status				
Native Born		1.000		
Foreign Born	-0.985***	0.373	0.225	0.620
Marital Status				
Married		1.000		
Ever Married	1.125***	3.080	2.486	3.816
Never Married	2.116***	8.299	6.923	9.948
Race/Ethnicity				
Non-Hispanic White		1.000		

Covariate	β	Hazard Ratio	95% CI	
Non-Hispanic African American	0.618***	1.855	1.555	2.214
Non-Hispanic Native American	0.008	1.008	0.450	2.260
Non-Hispanic Asian/Pacific Islander	-0.694*	0.499	0.266	0.937
Hispanic	0.295**	1.344	1.097	1.646
Non-Hispanic Other Race	-0.205	0.815	0.304	2.183
Place of Residence				
Suburban Residence		1.000		
Central City within SMSA	0.666***	1.947	1.662	2.282
Outside SMSA/Rural Residence	0.458***	0.633	0.510	0.784
Housing Tenure				
Owns Home/Has Mortgage		1.000		
Rents	0.342***	1.408	1.212	1.635
Education				
Some College/Prof degree/PhD		1.000		
Less than High School	-0.477***	0.620	0.513	0.751
High School Education	-0.217**	0.805	0.689	0.940
Household Income				
Income \$50,000 +		1.000		
Income Less than \$20,000	0.483***	1.622	1.304	2.018
Income \$20,000-\$29,999	0.459***	1.583	1.266	1.979
Income \$30,000-\$39,999	0.176	1.192	0.925	1.537
Income \$40,000-\$49,999	-0.188	0.828	0.587	1.169
Income Unknown/Missing	-0.264	0.768	0.481	1.225
Age				
Age 18-28 years		1.000		
Age 29-39 years	1.386***	3.999	3.322	4.813
Age 40-49 years	1.392***	4.024	3.202	5.057
Age 50-59 years	1.125***	3.081	2.310	4.111
Age 60 + years	1.642***	5.164	4.023	6.630
LRS	1366.68***			
df	22			
Events	884			
Population at Risk	650767			

*Significant at $p=.05$; **Significant at $p=.01$; ***Significant at $p=.001$

Relevant results for women are presented in Table 3. As may be observed in the table, immigrant women experienced STD mortality risk that was 51.5 percent less than that experienced by their native-born counterparts (RR=0.485, CI=0.211, 1.118). Findings for marital status are difficult to ascertain. Never-married women were over two times more likely to die from STD than married women, but the effect of

ever-married women did not reach statistical significance. Non-Hispanic African American women and Hispanic women increased mortality risk. The place of residence did not reach statistical significance. A dose-response relationship between age and STD was observed among women. Overall, findings showed model adequacy as the likelihood ratio statistic was 346.98 (df=22), with p=0.001

Table 3 Effect of Immigration Status on Sexually Transmitted Diseases: Women

Covariate	β	Hazard Ratio	95% CI	
Immigration Status				
Native Born		1.000		
Foreign Born	-0.722	0.485	0.211	1.118
Marital Status				
Married		1.000		
Ever Married	-0.044	0.956	0.717	1.275
Never Married	0.721***	2.058	1.480	2.863
Race/Ethnicity				
Non-Hispanic White		1.000		
Non-Hispanic African	1.285***	3.616	2.735	4.782
Non-Hispanic Native American	0.122*	1.130	0.279	4.584
Non-Hispanic Asian/Pacific Islanders	0.482	1.621	0.709	3.704
Hispanic	0.465**	1.593	1.099	2.308
Non-Hispanic Other Race	0.815	2.260	0.557	9.177
Place of Residence				
Suburban Residence		1.000		
Central City within SMSA	0.164	1.179	0.889	1.563
Outside SMSA/Rural Residence	-0.062	0.940	0.694	1.273
Housing Tenure				
Owns Home/Mortgage		1.000		
Rents	0.303*	1.355	1.047	1.755
Educational Attainment				
Some College/Prof degree/PhD		1.000		

Covariate	β	Hazard Ratio	95% CI	
Less than High School	0.311	1.366	0.973	1.917
High School	0.468**	1.597	1.170	2.180
Household Income				
Income \$50,000 +				
Income Less than \$20,000	0.862***	2.370	1.545	3.635
Income \$20,000-\$29,999	0.038	1.040	0.631	1.712
Income \$30,000-\$39,999	-0.003***	0.997	0.570	1.744
Income \$40,000-\$49,999	-0.344	0.708	0.325	1.544
Income Unknown/Missing	-0.375	0.687	0.304	1.552
Age				
Age 18-28		1.000		
Age 29-39	0.712***	2.039	1.369	3.039
Age 40-49	0.751***	2.120	1.330	3.380
Age 50-59	0.939***	2.560	1.584	4.137
Age 60 +	1.719***	5.584	3.745	8.325
LRS	346.98***			
df	22			
Events	307			
Population at Risk	733740			

*Significant at p=.05; **Significant at p=.01; ***Significant at p=.001

Discussion

The present research examined mortality risk from sexually transmitted diseases across immigration status groups (foreign-born and native-born) using a large nationally representative sample from the National Longitudinal Mortality Study.⁶

Data analysis revealed that immigration status is associated substantially with STD mortality risk. Immigrants were much less likely to die from STDs than non-immigrants, and this finding held across men and women and for the combined sample. Results also held even after controlling for potentially confounding factors such as age, race/ethnicity, marital

status, place of residence, educational level and family income.

Our findings advance the existing literature on factors that increase mortality risk from sexually transmitted diseases. It adds to the literature by analyzing status variables. Many previous studies concentrated on behavioral factors that increased the risk of transmission or acquisition of a sexually transmitted disease.^{4,15,16,17,18}

Some observed risky behaviors may indeed increase transmission rates of STDs, but these may vary across social status characteristics. Risky behaviors are influenced by one's social

status, such as marital status, location within the racial/ethnic hierarchy in the US, place of residence (urban or rural), housing tenure, educational and income levels, and poverty, whether absolute or relative. A comprehensive understanding of STD risk is obtained only if both behavior and status are combined.

Prior studies have concentrated on the acquisition and transmission of sexually transmitted diseases. Relatively few have investigated mortality risk from these infections. While some infections, especially bacterial ones, are curable and may not immediately lead to death, it is unclear patterns of mortality risk for acquisition from viral sexually transmitted diseases.

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