

BRIEF REPORT

Trends in fatal occupational injuries in Latino/a workers relative to other groups, North Carolina 2000–2017

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Abstract

Background: Latino/a workers may experience higher fatal occupational injury rates than non-Latino/a workers. In North Carolina, the Latino/a population more than doubled between 2000 and 2017. We examined fatal occupational injuries among Latino/a and non-Latino/a workers in North Carolina over this period.

Methods: Information on fatal occupational injuries was abstracted from records of the North Carolina Office of the Chief Medical Examiner and the death certificate records held by the North Carolina Office of Vital Records. Estimates of the working population were derived from the decennial census and American Community Survey. Estimates of annual rates of fatal occupational injury for the period January 1, 2000 to December 31, 2017 were derived for Latino/a workers and compared to Black and White workers not identified as Latino/a.

Results: Over the study period, 1,783 fatal occupational injuries were identified among non-Latino/a workers and 259 fatal occupational injuries among Latino/a workers in North Carolina. The majority of fatal occupational injuries among Latino/a workers occurred among males employed in construction and agriculture. While the fatal occupational injury rate among Latino/a workers declined over the study period, the rate among Latino/a workers was higher than among non-Latino/a White and Black workers; moreover, fatal occupational injury rates for Latino/a workers trended upwards during the most recent years of the study period.

Conclusions: Latino/a workers in North Carolina have the highest fatal occupational injury rate of any race/ethnicity group.

KEYWORDS

fatal occupational injury, inequity disparity, Latino/a Latinx Hispanic, North Carolina

1 | INTRODUCTION

We use the term Latino/a to refer to persons from Latin America and the Caribbean, a highly heterogeneous group with a diverse set of cultural practices and language. Historically, in the South of the United States, high rates of fatal occupational injury have

been observed among Latino/a workers, as well as Black non-Latino/a, relative to White non-Latino/a workers.^{1–5} Recently arrived migrant and other under-resourced populations are often employed in occupations that are hazardous and/or may be assigned more hazardous tasks within an occupation/industry group.³

North Carolina has historically had a small Latino/a population. In recent years, there has been a rapid increase in the number of Latino/a residents, growing from 380,000 residents in 2000 to 997,000 residents in 2017.⁶ Despite an overall decline in employment in industries and occupations with high rates of fatal occupational injury, such as agriculture and manufacturing, and an expansion in the comparatively lower-rate service, retail, and information technology sectors, prior studies have found persistent inequities in fatal occupational injury rates across racial and ethnic groups.^{1,4,7-9}

The purpose of this study is to examine recent trends in fatal occupational injury among Latino/a workers in North Carolina, relative to non-Latino/a workers, during the period between 2000 and 2017. We describe the distribution of fatalities by race, ethnicity, and industry, then present temporal trends in fatal occupational injury rates in North Carolina over this period.

2 | METHODS

2.1 | Study setting

North Carolina is located in the Southeastern United States and is the ninth most populous state in the nation. Historically the state's economy was largely based on textile production, furniture manufacturing, and tobacco and other agricultural crops. Since the 1980s the state's urban population has rapidly grown, and the growth of the state's economy has substantially shifted toward service sector and technology industries.¹⁰⁻¹²

2.2 | Deaths due to occupational injury

The North Carolina Office of the Chief Medical Examiner [OCME], part of the Division of Public Health in the North Carolina Department of Health and Human Services, maintains a statewide reporting, coding, and data retrieval system. Investigating fatal injuries is the jurisdiction of local medical examiners in each of the one hundred North Carolina counties. Each medical examiner determines the cause of death and circumstances surrounding it, including whether the injury that led to death occurred at work.¹³ Individual medical examiners' findings are reported to the OCME, whose staff includes forensic pathologists and data coders. This study examined fatal occupational injuries in North Carolina during the period from January 1, 2000, to December 31, 2017. We defined a fatal occupational injury as any injury leading to death within 30 days, both intentional and unintentional, that was determined by a medical examiner to have been sustained by a worker in North Carolina engaged in legal work (i.e., excluding illegal gambling parlors, illicit drug sales) for pay, but regardless of documentation status. Fatal occupational injury cases identified for review were drawn from two data sources; the OCME data system and North Carolina State Center for Health Statistics death certificate data system. Deaths during the study period that were flagged as "at work" in the State Center for Health

Statistics data system or "on the job" in the OCME data system were eligible for study inclusion.

Detailed information was abstracted from the records of the Office of the Chief Medical Examiner. These files contain the Medical Examiner's report, the official death certificate, autopsy results, toxicology results and, if available, family interviews, and witness and police statements. A trained team of investigators abstracted study data from the physical death records, as well as from supplemental sources such as news clippings, court transcripts, and crime scene reports. A review of the circumstances surrounding each death was conducted, and complex cases were adjudicated by experienced investigators to make a final determination of "at work" status for the purposes of inclusion. Information on the industry at time of fatal injury was abstracted from the medical examiner report, and coded to the US Census year 2000 guidelines.¹⁴ Information on the age, sex, race, and Latino/a ethnicity of decedents (categorized as Hispanic on the death certificate) was abstracted from the death certificate and the medical examiner report, as well as information on the decedent's country of origin. When Latino/a ethnicity was indicated on the death certificate, most decedents (80%, $n = 207$) were missing information on race (and instead had country of origin hand-written on the death certificate). Therefore, rather than attempt to cross-classify Latino/a decedents by race, we classified decedents as either Latino/a, Black non-Latino/a, or White non-Latino/a for this analysis.

2.3 | Population at risk

Annual estimates of the North Carolina work force, cross-classified by age, sex, race (classified a White, Black, or other), ethnicity (coded as Hispanic or non-Hispanic), and industry (in 51 groups defined by census codes), were derived from the 2000 decennial US Census and the 2004-2017 American Community Survey (ACS). The American Community Survey replaces the long-form decennial census and provides yearly estimates of the population of the United States, including demographic and occupational information, beginning in 2004. Linear interpolations between the 2000 decennial census and the first ACS survey were used to estimate the population at risk for the years 2001-2003. We use annual census estimates of the working population to enumerate the number of person-years at risk in each stratum in each calendar year. As all subjects were deceased, and thus unable to give informed consent, this study was considered non-human subjects research and approved by the University of North Carolina Institutional Review Board (#20-3674).

2.4 | Statistical methods

The number of deaths due to fatal occupational injury in a given calendar year, cross-classified by categories of age, sex, race, ethnicity, and industry was modeled as a Poisson distributed variable, with the natural logarithm of the annual estimate of the population at risk included as a regression model offset. We used a simple model for the linear trend in

rates given by: $E[\ln(\text{Annual Rate})] = \beta_0 + \beta_1(\text{year} - 2000)$. Calendar year was included as a continuous variable to estimate the average change in rate per year, centered by subtracting 2000 so that the regression model intercept, β_0 , can be interpreted as the log of the baseline fatality rate in the year 2000. Estimated trends in the rate of fatal injury are reported as the annual percent change in rate, obtained from the model as $100 [\exp(\beta_1) - 1]$. We also estimated age and sex-adjusted fatal occupational injury rates by adding a binary indicator variable for sex (1 if male, else 0) in the regression model, and ordinal variables for age group (10-year age groups beginning at 18) in the regression model.

3 | RESULTS

Between 2000 and 2017, the Latino/a labor force in North Carolina increased by approximately 226%, from 183,800 workers to 414,800 workers. The proportion of Latino/a workers in the workforce increased from 4.8% of the workforce in 2000 to 8.7% of the workforce in 2017. The total North Carolina labor force increased by 28%, from 3.8 million to 4.8 million workers.

Between 2000 and 2017 a total of 2,042 occupational fatalities were observed. Of these, 259 (12.7%) decedents were identified as Latino/a. Of the Latino/a deaths, 250 (96.5%) were male. The majority (69%) of fatal occupational injuries among Latino/a workers occurred in construction and agriculture. Other leading industries (where five or more deaths were observed) were: wholesale (seven deaths); forestry/logging (six deaths); sawmills/wood products (six deaths); retail (six deaths); eating/drinking places (five deaths); and business/repair services (five deaths).

The industries with the highest estimated rate of fatal occupational injury among Latino/a workers are detailed in Table 1. In most of the high-rate Latino/a industries, both Black and Latino/a workers had higher rates of fatal occupational injury per 100,000 worker-years compared to White workers. In construction, Black workers had the highest rate of fatal occupational injury (12.3 [95% CI 9.5, 15.9]), followed by Latino/a workers (11.1 [9.4, 13.2]) compared to

White workers (7.2 [6.4, 8.1]). The largest estimated rate difference was between Latino/a and White workers in forestry and logging. Latino/a forestry workers had an estimated rate of 103.6 deaths (36.6, 230.7) per 100,000 worker-years compared to 41.3 deaths (30.5, 55.9) among White workers. Black workers had similarly high rates in forestry and logging, with an estimated rate of 97.1 deaths (62.7, 150.5) per 100,000 worker-years. This trend of non-White workers experiencing the highest rates of fatal occupational injury did not hold true for all industries. The fatal occupational injury rate among agriculture workers was 38% lower among Latino/a workers (10.6, [7.9, 14.2]) than White workers (17.1 [14.8, 19.8]).

Over the study period, the age and sex-adjusted rate of fatal occupational injury among Latino/a workers tended to decline (Figure 1). For example, over the first half of the study period (2000–2008), the rate of fatal occupational injury among Latino/a workers was 6.7 per 100,000 worker-years, while over the second half of the study period (2009–2017) the rate was 4.0 per 100,000 worker-years. White and Black workers also tended to experience a decline in the rate of occupational fatalities (from 3.2 to 1.9 and from 3.6 to 2.1, respectively). While this overall decline in rate is encouraging, we note a concerning increase among all groups in the final years of the study period.

4 | DISCUSSION

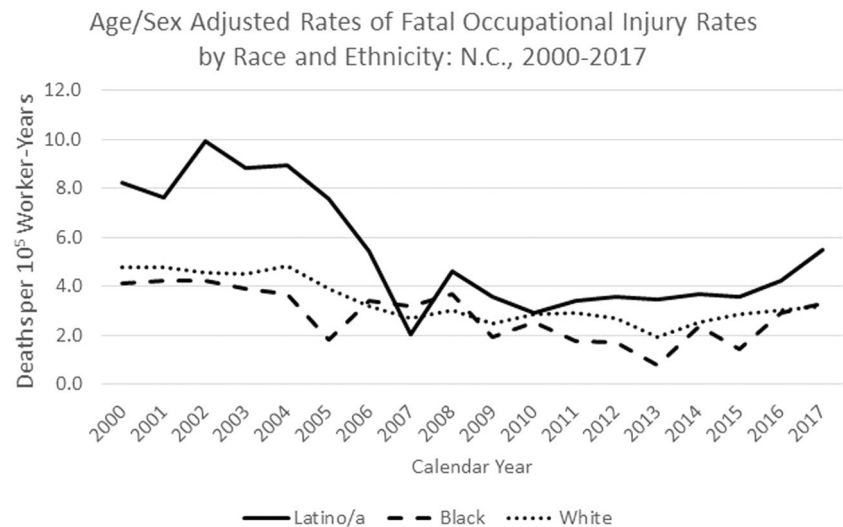
The rate of fatal occupational injury among Latino/a workers declined in North Carolina between 2000 and 2017, a period that saw a rapid increase in the number of Latino/a workers employed in the state. However, in all but one year of the study period, Latino/a workers had the highest rate of fatal occupational injury among the race-ethnicity groups examined. Historical forces underpin differential fatal occupational injury rates in southern states, including structural segregation of employment in which racial or ethnic groups are overrepresented in occupations with the highest rates of fatality.^{15–17}

Our results are consistent with research showing Latino/a workers as experiencing the highest rate of fatal occupational injury

TABLE 1 Fatal occupational injury rates, and number of deaths, by race and Latino/a ethnicity North Carolina 2000–2017

Industry	Latino/a deaths	Latino/a rate/10 ⁵	Black non-Latino/a deaths	Black rate/10 ⁵	White non-Latino/a deaths	White rate/10 ⁵
Construction	135	11.1 (9.4, 13.2)	59	12.3 (9.5, 15.9)	281	7.2 (6.4, 8.1)
Agriculture	45	10.6 (7.9, 14.2)	26	16.0 (10.9, 23.5)	180	17.1 (14.8, 19.8)
Wholesale	7	5.5 (2.6, 11.5)	13	4.1 (2.4, 7.0)	50	2.9 (2.2, 3.8)
Forestry/Logging	6	103.6 (46.6, 230.7)	20	97.1 (62.7, 150.5)	42	41.3 (30.5, 55.9)
Sawmills/Wood Products	6	9.3 (4.2, 20.8)	3	4.1 (1.3, 12.8)	4	1.7 (0.6, 4.4)
Retail	6	2.2 (1.0, 4.8)	11	1.1 (0.6, 1.8)	55	1.3 (1.0, 1.7)
Eating/Drinking Places	5	0.9 (0.4, 2.1)	11	1.2 (0.7, 2.2)	29	1.2 (0.8, 1.7)
Business/Repair Services	5	2.2 (0.9, 5.3)	9	1.9 (1.0, 3.6)	22	1.1 (0.7, 1.6)

FIGURE 1 Age/sex adjusted rates of fatal occupational injury rates by race and ethnicity: N.C., 2000–2017



nationwide.^{8,18–24} Workers in southern states, especially those who labor outside, are at special risk of illness due to heat and humidity, especially in agriculture and construction.^{9,25–29} Early work on construction safety noted characteristics of the worker, including English-language proficiency, documentation status, cultural factors, and the desire to appear industrious, as contributors to inequities between groups of workers.^{30,31} Recent work has increasingly focused on the occupational environment surrounding the workers, suggesting that understanding of labor laws and protections available to workers, perceptions by employers that Latino/a workers will accept risky assignments, and poor communication (including by supervisors and coworkers) are likely factors that contribute to inequities in fatal occupational injury between Latino/a and White workers.^{32,33} For example, workers unfamiliar with American labor laws may not be provided personal protective equipment, may be threatened with termination for reporting injuries, and experience higher levels of job insecurity.^{34–36} Workers may also be less likely to decline overtime, not be provided training for unfamiliar equipment, or feel empowered to decline a hazardous task or report an unsafe work environment.^{20,37} Immigrant workers, especially those in temporary or entry-level positions, have been shown to experience additional pressure to meet deadlines driven by fear of termination, and are more vulnerable to employer abuse that contributes to occupational health inequities.^{38,39} Declining to perform a dangerous component of a job due to inclement weather or other safety concern may also result in job loss, which may affect their ability to get another job through “blacklisting,” or by affecting immigration status.³⁶ Of interest is the comparatively lower rate of fatal injury among Latino/a agriculture workers compared to their White non-Latino/a colleagues, which may be explained by differences in age and job duties, including the operation of heavy machinery.

Our study has several strengths, including the robust system of medical examiners in North Carolina who are required to investigate accidental and intentional deaths, and are empowered to seek administrative search warrants as part of their investigations. We employed a case ascertainment process that leveraged multiple state databases to

identify potential occupational fatalities. That said, workers who sustain cumulative injuries, such as silicosis or asbestosis, would not be included in our estimates of fatal occupational injury. There are several limitations to our study, including the fact that 80% of Latino/a decedents were missing data on race, thus limiting our ability to distinguish between groups of Latino/a workers whose workplace experience was likely to have differed. Bias may be present in our denominator due to sampling limitations of the decennial and ACS population estimates. We also note that prior research suggests that undercounting of Latino/a workers may be present in Census data, especially in areas of larger Latino/a populations.^{40–42} Systematic undercounting of the Latino/a workforce could yield an overestimate of the yearly rate; however, we note that estimates of trend are robust to misclassification of the population at risk, provided that misspecification of the workforce is consistent over time. Our aim in conducting statistical analysis of these observational data is summarization, smoothing, and pattern recognition,⁴³ and we therefore focus on reporting events, rates, and trends, rather than statistical null hypothesis testing and *p*-values.

The overall decrease in fatality rates among all groups is encouraging. Black non-Latino/a workers in North Carolina, historically a group experiencing high levels of fatal occupational injury, have rates similar or lower than White non-Latino/a workers. However, we note evidence of an increase in the fatal occupational injury rate among all groups of workers during the final years of the study. This and other recent work suggest that continued surveillance coupled with state-level investigation of the etiology of high rates of fatal occupational injury is warranted.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this study.

AUTHOR CONTRIBUTIONS

Morgan M. Richey conceived the study aim, assisted with data acquisition, built the study data set, led the analysis, and wrote the manuscript. Morgan M. Richey is accountable for the integrity and accuracy of the work. David B. Richardson provided intellectual and methodological guidance on developing the study aim and analysis, was the leader of the data acquisition process, and assisted with intellectual and editorial development of the manuscript. Yvonne Golightly, Stephen W. Marshall, Wendy Novicoff, and Alexander P. Keil provided methodological and editorial guidance during the study development, manuscript writing, and editing process. Maryalice Nocera lead the data acquisition team, managed data quality efforts, and provided methodological and editorial guidance during the study development, manuscript writing, and editing process. All authors approved the final version of the manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the North Carolina State Center for Health Statistics and the Office of the Chief Medical Examiner. Restrictions apply to the availability of these data, which were used with permission for this study. Data are available from the authors with the permission of the Office of the Chief Medical Examiner, the Institutional Review Board of the University of North Carolina at Chapel Hill, and the State Center for Health Statistics.

INSTITUTION AND ETHICS APPROVAL AND INFORMED CONSENT

This study was performed at the University of North Carolina, Gillings School of Global Public Health. As all subjects were deceased, and thus unable to give informed consent, this study was considered non-human subjects research and approved by the UNC Institutional Review Board (#20-3674).

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