A. COVER PAGE

Project Title: Trends and disparities in fatal occupational injury in North Carolina	
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Change of Contact PD/PI: NA	
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Human Subjects: NA	**Vertebrate Animals:** NA
hESC: No	**Inventions/Patents:** No

B. ACCOMPLISHMENTS

B.1 WHAT ARE THE MAJOR GOALS OF THE PROJECT?

The general overarching objective of this work was to strengthen our understanding of trends in fatal occupational injury rates in North Carolina. Building upon a highly successful parent study, we were generate a 40-year times series of fatal occupational injuries in North Carolina, to complete three Goals (Specific Aims):
Aim 1: Injury trends and their economic determinants. Describe the distribution and frequency of fatal occupational injuries. Identify emergent patterns in occupational injuries for the state as a whole and in terms of injury trends among the leading industries in North Carolina, with attention to industries that expanded as well as those that downsized over the study period. Conduct sub-analyses of trends in deaths due to specific causes, e.g: unintentional trauma; homicide; and environmental conditions.
Aim 2: Disparities in injury rates by race and ethnicity. Describe the distribution and frequency of fatal occupational injury by race and Hispanic ethnicity. Examine persistent disparities in injury rates by race and ethnicity and the role of segregation in employment.
Aim 3: Deaths among older workers. Describe the distribution and frequency of fatal injuries among older workers, considered differences by race and ethnicity, identifying the leading industries and the leading means of death for older workers.

B.1.a Have the major goals changed since the initial competing award or previous report?

No

B.2 WHAT WAS ACCOMPLISHED UNDER THESE GOALS?

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B.3 COMPETITIVE REVISIONS/ADMINISTRATIVE SUPPLEMENTS

For this reporting period, is there one or more Revision/Supplement associated with this award for which reporting is required?

No

B.4 WHAT OPPORTUNITIES FOR TRAINING AND PROFESSIONAL DEVELOPMENT HAS THE PROJECT PROVIDED?

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B.5 HOW HAVE THE RESULTS BEEN DISSEMINATED TO COMMUNITIES OF INTEREST?

The project convened a stakeholder meeting that comprised officials from the NC agencies, including the chief medical examiner, the division of public health, occupational and environmental health, and department of labor. The stakeholder panel also include representatives from the UNC total worker health center and the NIOSH-supported Education and Training Center, and the executive in residence at UNC's Hussman school of journalism. A total of 9 stakeholders attended a half day meeting on February 20, 2024, held in-person at the UNC Injury Prevention Research Center. Eight members of the research a team attended and presented results from the study, with time for discussion and comments from the stakeholder panel. Of specific interest to the Chief Medical Examiner (Dr. Michelle Aurelius) was importance of improve capture of race and ethnicity in occupational health, which she has identified as a key priority, with the potential for active collaboration by Dr. Mclure from the research team.
The attendees at the Stakeholder Meeting and Agenda Meeting are listed below:
February 20, 2024

9:00 – 9:20 AM Sign in
9:20 – 9:30 Welcome/ Purpose and format
9:30 – 9:45 Introductions
9:45 – 10:05 Project Overview-Aims & Methods-Overall trends
10:05 – 10:15 Data is key to prevention / Partnerships
10:15 – 10:45 Presentation and Discussion of Key findings Part 1
Trends in specific worker populations
10:45 – 11:00 Break
11:00 – 12:00 Presentation and Discussion Key findings Part 2
Intentional injuries
Data Quality/Completeness
12:00 – 12:15 Break [light lunch]
12:15 – 12:45 Future Directions

Panel
Scott Proescholdbell, MPH
Injury and Violence Prevention Branch, Division of Public Health, N.C. Department of Health and Human Services

Michelle Aurelius, MD
Chief Medical Examiner, N.C. Office of the Chief Medical Examiner

John Staley, PhD
Deputy Director, UNC Occupational Safety and Health Education And Research Center

Maija Leff, MPH
Associate Director, Carolina Center for Healthy Work Design and Worker Well-Being

Leyla Santiago
Daniels Executive-In-Residence, UNC Hussman School of Journalism and Media

Ayotunde Ademoyero, MPH
Epidemiologist, N.C. Office of the Chief Medical Examiner

Todd McNoldy
Safety and Health Survey Manager, North Carolina Department of Labor

Steve H Drouin, MPH
Epidemiologist, Occupational & Environmental Epidemiology Branch (OEEB), N.C. Department of Health and Human Services

Pierre Lauffer
Industrial Hygiene Consultant Supervisor, Occupational and Environmental Epidemiology Branch (OEEB), N.C. Department of Health and Human Services

UNC Research Team
Stephen Marshall, PhD
Principal Investigator
Department of Epidemiology, University of North Carolina

David Richardson, PhD
Principal Investigator
Associate Dean of Research
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Shabbar Ranapurwala, PhD
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Elizabeth McClure, PhD
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Amelia Martin, BS
Graduate Research Assistant
Department of Epidemiology, University of North Carolina

Chelsea Martin, PT, DPT, SCS
Graduate Research Assistant
Department of Epidemiology, University of North Carolina

John Cantrell, MA
Data Analyst
UNC Injury prevention Research Center

Maryalice Nocera, MSN
Project Manager
UNC Injury Prevention Research Center

B.6 WHAT DO YOU PLAN TO DO DURING THE NEXT REPORTING PERIOD TO ACCOMPLISH THE GOALS?

Not Applicable

B.2 What was accomplished under these goals?

The study has generated a total of ten peer-reviewed publications to date. Findings from these papers are summarized below. The published papers are listed in Section C1.

Aim 1: Describe Injury trends and their economic determinants, including subsanalysis by homicide, suicide, and environmental conditions (heat), and economic determinants:

Aim 1.1 Trends in All-Cause Fatal Occupational Injury (MS6, Martin AT et al 2023) over a 25 year period

- Fatal occupational injury rates declined by 0.82 injuries/100 000 person-years over this period, falling consistently from 2004 to 2009, but increasing from 2009 to 2017.
- Fatal injury rates were highest among Hispanic workers, who experienced 2.75 times the fatal injury rate of non-Hispanic White workers (95% CI 2.42 to 3.11)
- Fatal injury rates were elevated among self-employed workers, who experienced 1.44 times the fatal injury rate of private workers (95% CI 1.29 to 1.60).
- Fatal injury rates increased with age group and were higher among male relative to female workers, even after adjustment for differential distributions across occupations.

Aim 1.2 Trends in Unintentional Fatal Occupational Injury (MS5, Richardson et al 2024) over a 40-year period

- There were 4434 unintentional occupational deaths in NC over a 40year period.
- Occupational Fatality Rates from unintentional cauases declined threefold over this period.
    - The fatal occupational injury rate among men declined from 9.6 per 100,000 worker-years in the period 1978-1982 to 3.1 per 100,000 worker-years in the period 2013-2017.
    - The fatal occupational injury rate among women declined from 0.3 per 100,000 worker-years in the period 1978-1981 to 0.1 per 100,000 worker-years in the period 2013-2017.
- Declines in rates were observed for young adults as well as older workers and were observed across all major industry categories.
- Average annual declines in rates were greatest in those industries and occupations that had the highest fatal injury rates at the start of the study period.

Aim 1.3 Occupational Homicide (M3, Martin CL et al. 2024) and Suicide (M4, Martin CL et al. 2024) over a 25 year period

- Overall occupational homicide rates have declined over the past 25 years

- Taxi drivers remain an occupation at high risk of occupational homicide
- Gas service station workers experienced the highest fatal occupational suicide rate
- Workers who were male, self-employed, and 65+ years old are a high risk group for suicide at work

Aim 1.4 Economic Determinants (MS7, Richardson et al 2023)

- Across all industries, nonmanagerial workers in North Carolina experienced fatal occupational injury rates 8 times the rate experienced by managers.
- Disparities in fatal injury rates between managers and the employees they supervise were greatest in forestry, rubber and metal manufacturing, wholesale trade, fishing and extractive industries, and construction.

Aim 1.5 Heat-Related Occupational Deaths (MS1, McClure et al 2024)

- The number of heat-related fatalities has increased, but fewer were identified as workplace fatalities.
- Rates of occupational heat-related deaths are highest among Hispanic workers.
- NC residents identifying as Black are disproportionately burdened by heat-related fatalities

Aim 2: Disparities by race and ethnicity (MS2, McClure et al 2024; MS9 McClure et al 2022; MS10 Richey et al 2022)

- Substantial Black-White and Hispanic-White disparities exist in Occupational Fatality rates in NC. These disparities are widest among workers aged 45 and older
- Segregation into more dangerous industries and occupations played a substantial role in driving disparities.
- Hispanic workers who suffered occupational fatalities lost a median 47 life-years, compared to 37 among Black workers and 36 among White workers.
- If Hispanic and Black workers experienced the workplace safety of their White counterparts, overall fatal injury rates would be substantially reduced.
- There is substantial misclassification of American Indian/Alaska Native race and Hispanic ethnicity on death records in North Carolina occupational fatalities
- LatinX workers experience the highest occupational fatality rates (MS10, Richey et al 2022)

Aim 3: Deaths among older workers. Describe the distribution and frequency of fatal injuries among older workers, considered differences by race and ethnicity, identifying the

leading industries and the leading means of death for older workers, considering economic changes in the older workforce. (MS8, Richey et al, 2023)

- In North Carolina, the population of older workers more than doubled between 2000 and 2017
- The rate of fatal occupational injury among older workers declined 2.8% per year, with a 7.7% yearly decline in 2000-2007 period compared with a 1.4% increase per year in the 2009-2017 period
- The highest rates of unintentional fatal occupational injury (injuries that were not purposefully inflicted) were observed in forestry, fishing hunting and trapping, and wood building manufacturing.
- Intentional fatal occupational injury rates (homicide, suicide) were highest in transportation, gas/service stations and grocery/food stores.
- Older workers have persistently high rates of fatal occupational injury in North Carolina
- Declines in the rates for older workers were substantially slowed by recession of 2008, presumably due to retirees extending their part-time and full-time worker to make up for economic losses during the recession

Listing of Study Publications for R01OH011256 Trends and disparities in fatal occupational injury in North Carolina PIs: Richardson, Marshall

MS1. Heat-related fatalities in North Carolina 1999-2017.*Am J Ind Med. 2024 Jun;67(6):551-555. doi: 10.1002/ajim.23587. Epub 2024 Apr 16. McClure ES(1)(2), Ranapurwala SI(1)(2), Nocera M(2), Richardson DB(3).*

(1)Department of Epidemiology, School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA. (2)Injury Prevention Research Center, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA. (3)Department of Environmental and Occupational Health, Program in Public Health, University of California, Irvine, California, USA.

OBJECTIVES: Research shows the highest rates of occupational heat-related fatalities among farm laborers and among Black and Hispanic workers in North Carolina (NC). The Hispanic population and workforce in NC have grown substantially in the past 20 years. We describe the epidemiology of heat-related fatal injuries in the general population and among workers in NC.

METHODS: We reviewed North Carolina death records and records of the North Carolina Office of the Chief Medical Examiner to identify heat-related deaths (primary International Classification of Diseases, Tenth Revision diagnosis code: X30 or T67.0-T67.9) that occurred between January 1, 1999, and December 31, 2017. Decedent age, sex, race, and ethnicity were extracted from both the death certificate and the medical examiner's report as well as determinations of whether the death occurred at work.

RESULTS: In NC between 1999 and 2017, there were 225 deaths from heat-related injuries, and 25 occurred at work. The rates of occupational heat-related deaths were highest among males, workers of Hispanic ethnicity, workers of Black, multiple, or unknown race, and in workers aged 55-64. The highest rate of occupational heat-related deaths occurred in the agricultural industry.

CONCLUSIONS: Since the last report (2001), the number of heat-related fatalities has increased, but fewer were identified as workplace fatalities. Rates of occupational heat-related deaths are highest among Hispanic workers. NC residents identifying as Black are disproportionately burdened by heat-related fatalities in general, with a wider apparent disparity in occupational deaths.

DOI: 10.1002/ajim.23587 PMID: 38624268 [Indexed for MEDLINE]

MS2. Forty years of struggle in North Carolina: Workplace segregation and fatal occupational injury rates. ***Am J Ind Med. 2024 Jun;67(6):539-550. doi: 10.1002/ajim.23586. Epub 2024 Apr 12. McClure ES(1)(2), Martin AT(1), Ranapurwala SI(1)(2), Nocera M(2), Cantrell J(2), Marshall S(2), Richardson DB(3).***

(1)Department of Epidemiology, School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA. (2)Injury Prevention Research Center, University of North Carolina at Chapel Hill, Chapel Hill, Chapel Hill, North Carolina, USA. (3)Department of Environmental and Occupational Health, Program in Public Health, University of California, Irvine, California, USA.

OBJECTIVE: To assess workplace segregation in fatal occupational injury from 1992 to 2017 in North Carolina.

METHODS: We calculated occupational fatal injury rates within categories of occupation, industry, race, age, and sex; and estimated expected numbers of fatalities among Black and Hispanic male workers had they experienced the rates of White male workers. We also estimated the contribution of workforce segregation to disparities by estimating the expected number of fatalities among Black and Hispanic male workers had they experienced the industry and occupation patterns of White male workers. We assessed person-years of life-lost, using North Carolina life expectancy estimates.

RESULTS: Hispanic workers contributed 32% of their worker-years and experienced 58% of their fatalities in construction. Black workers were most overrepresented in the food manufacturing industry. Hispanic males experienced 2.11 (95% CI: 1.86-2.40) times the mortality rate of White males. The Black-White and Hispanic-White disparities were widest among workers aged 45 and older, and segregation into more dangerous industries and occupations played a substantial role in driving disparities. Hispanic workers who suffered occupational fatalities lost a median 47 life-years, compared to 37 among Black workers and 36 among White workers.

CONCLUSIONS: If Hispanic and Black workers experienced the workplace safety of their White counterparts, fatal injury rates would be substantially reduced. Workforce segregation reflects structural racism, which also contributes to mortality disparities. Root causes must be addressed to eliminate disparities.

DOI: 10.1002/ajim.23586 PMCID: PMC11081859 PMID: 38606790 [Indexed for MEDLINE]

MS3. Twenty-five year occupational homicide mortality trends in North Carolina: 1992-2017.*Inj Prev. 2024 Feb 14:ip-2023-044991. doi: 10.1136/ip-2023-044991. Martin CL(1)(2), Richardson D(3), Richey M(4), Nocera M(5), Cantrell J(6), McClure ES(2)(6), Martin AT(6), Marshall SW(7)(8), Ranapurwala S(9).*

(1)Department of Epidemiology, Gillings School of Global Public Health, UNC-Chapel Hill, Chapel Hill, North Carolina, USA martinlc@unc.edu. (2)Injury Prevention Research Center, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA. (3)Susan and Henry Samueli College of Health Sciences, University of California Irvine, Irvine, California, USA. (4)National Foundation for the Centers for Disease Control and Prevention Inc, Atlanta, Georgia, USA. (5)University of North Carolina Injury Prevention Research Center, Chapel Hill, North Carolina, USA. (6)Department of Epidemiology, Gillings School of Global Public Health, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA. (7)Epidemiology, UNC Gillings School of Global Public Health, Chapel Hill, North Carolina, USA. (8)Injury Prevention Research Center, The University of North Carolina at Chapel Hill Injury Prevention Research Center, Chapel Hill, North Carolina, USA. (9)Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

INTRODUCTION: Determining industry of decedents and victim-perpetrator relationships is crucial to inform and evaluate occupational homicide prevention strategies. In this study, we examine occupational homicide rates in North Carolina (NC) by victim characteristics, industry and victim-perpetrator relationship from 1992 to 2017.

METHODS: Occupational homicides were identified from records of the NC Office of the Chief Medical Examiner system and the NC death certificates. Sex, age, race, ethnicity, class of worker, manner of death, victim-perpetrator relationship and industry were abstracted. Crude and age-standardised homicide rates were calculated as the number of homicides that occurred at work divided by an estimate of worker-years (w-y). Rate ratios and 95% CIs were calculated, and trends over calendar time in occupational homicide rates were examined overall and by industry.

RESULTS: 456 homicides over 111 573 049 w-y were observed. Occupational homicide rates decreased from 0.82 per 100 000 w-y for the period 1992-1995 to 0.21 per 100 000 w-y for the period 2011-2015, but increased to 0.32 per 100 000 w-y in the period 2016-2017. Fifty-five per cent (252) of homicides were perpetrated by strangers. Taxi drivers experienced an occupational homicide rate that was 110 times (95% CI 76.52 to 160.19) the overall occupational homicide rate in NC; however, this rate declined by 76.5% between 1992 and 2017. Disparities were observed among workers 65+ years old, racially and ethnically minoritised workers and self-employed workers.

CONCLUSION: Our findings identify industries and worker demographics that experienced high occupational homicide fatality rates. Targeted and tailored mitigation strategies among vulnerable industries and workers are recommended.
DOI: 10.1136/ip-2023-044991 PMCID: PMC11322415 PMID: 38355295

MS4. 25-Year fatal workplace suicide trends in North Carolina: 1992-2017. ***Am J Ind Med. 2024 Mar;67(3):214-223. doi: 10.1002/ajim.23563. Epub 2024 Jan 10. Martin CL(1)(2), Richey M(3), Richardson DB(4), Nocera M(1), Cantrell J(2), McClure ES(1)(2), Martin AT(1)(2), Marshall SW(1)(2), Ranapurwala SI(1)(2).***

(1)Department of Epidemiology, Gillings School of Global Public Health, Chapel Hill, North Carolina, USA. (2)Injury Prevention Research Center, Chapel Hill, North Carolina, USA. (3)Department of Population Sciences, Duke University, Durham, North Carolina, USA. (4)Susan and Henry Samueli College of Health Sciences, Irvine, California, USA.

BACKGROUND: Suicide is a serious public health problem in the United States, but limited evidence is available investigating fatal suicides at work. There is a substantial need to characterize workplace suicides to inform suicide prevention interventions and target high-risk settings. This study aims to examine workplace suicide rates in North Carolina (NC) by worker characteristics, means of suicide used, and industry between 1992 and 2017.

METHODS: Fatal workplace suicides were identified from records of the NC Office of the Chief Medical Examiner system and the NC death certificate. Sex, age, race, ethnicity, class of worker, manner of death, and industry were abstracted. Crude and age-standardized homicide rates were calculated as the number of suicides that occurred at work divided by an estimate of worker-years (w-y). Rate ratios and 95% confidence intervals (CIs) were calculated, and trends over calendar time for fatal workplace suicides were examined overall and by industry.

RESULTS: 81 suicides over 109,464,430 w-y were observed. Increased rates were observed in workers who were male, self-employed, and 65+ years old. Firearms were the most common means of death (63%) followed by hanging (16%). Gas service station workers experienced the highest fatal occupational suicide rate, 11.5 times (95% CI: 3.62-36.33) the overall fatal workplace suicide rate, followed by Justice, Public Order, and Safety workers at 3.23 times the overall rate (95% CI: 1.31-7.97).

CONCLUSION: Our findings identify industries and worker demographics that were vulnerable to workplace suicides. Targeted and tailored mitigation strategies for vulnerable industries and workers are recommended.

DOI: 10.1002/ajim.23563 PMID: 38197263 [Indexed for MEDLINE]

MS5. Forty-year trends in fatal occupational injuries in North Carolina. ***Am J Ind Med. 2024 Feb;67(2):87-98. doi: 10.1002/ajim.23549. Epub 2023 Nov 16. Richardson DB(1), Martin AT(2), McClure ES(2)(3), Nocera M(3), Cantrell J(3), Ranapurwala SI(2)(3), Marshall S(2)(3).***

(1)Department of Environmental and Occupational Health, Program in Public Health, University of California, Irvine, California, USA. (2)Department of Epidemiology, School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA. (3)Injury Prevention Research Center, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA.

BACKGROUND: We describe progress in the control of deaths on-the-job due to fatal occupational injury in North Carolina over the period 1978-2017.

METHODS: Forty years of information on fatal occupational injuries in North Carolina has been assembled from medical examiners' reports and death certificates, supplemented by newspaper and police reports. Cases were defined as unintentional fatal occupational injuries among adults. Annual estimates of the population at risk were derived from US Census data, and rates were quantified using Poisson regression methods.

RESULTS: There were 4434 eligible deaths. The unintentional fatal occupational injury rate at the beginning of the study period was more than threefold the rate at the end of the study. The fatal occupational injury rate among men declined from 9.6 per 100,000 worker-years in the period 1978-1982 to 3.1 per 100,000 worker-years in the period 2013-2017. The fatal occupational injury rate among women declined from 0.3 per 100,000 worker-years in the period 1978-1981 to 0.1 per 100,000 worker-years in the period 2013-2017. Declines in rates were observed for young adults as well as older workers and were observed across all major industry categories. Average annual declines in rates were greatest in those industries and occupations that had the highest fatal injury rates at the start of the study period.

CONCLUSIONS: The substantial decline in fatal injury rates underscores the importance of injury prevention and demonstrates the ability to make meaningful reductions in unintentional fatal injury.

DOI: 10.1002/ajim.23549 PMID: 37970734 [Indexed for MEDLINE]

MS6. Fatal occupational injuries in North Carolina, 1992-2017. *Occup Environ Med. 2023 Nov 23;80(12):680-686. doi: 10.1136/oemed-2023-109050. Martin AT(1), McClure ES(2)(3), Ranapurwala SI(2)(3), Nocera M(3), Cantrell J(3), Marshall SW(2)(3), Richardson DB(4).*

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OBJECTIVES: After declining for several decades, fatal occupational injury rates have stagnated in the USA since 2009. To revive advancements in workplace safety, interventions targeting at-risk worker groups must be implemented. Our study aims to identify these at-risk populations by evaluating disparities in unintentional occupational fatalities occurring in North Carolina (NC) from 1992 to 2017.

METHODS: Our retrospective cohort study drew on both the NC Office of the Chief Medical Examiner system and the NC death certificate data system to identify unintentional fatal occupational injuries occurring from 1992 to 2017. Unintentional fatal occupational injury rates were reported across industries, occupations and demographic groups, and rate ratios were calculated to assess disparities.

RESULTS: Among those aged 18 and older, 2645 unintentional fatal occupational injuries were identified. Fatal occupational injury rates declined by 0.82 injuries/100 000 person-years over this period, falling consistently from 2004 to 2009 and increasing from 2009 to 2017. Fatal injury rates were highest among Hispanic workers, who experienced 2.75 times the fatal injury rate of non-Hispanic White workers (95% CI 2.42 to 3.11) and self-employed workers, who experienced 1.44 times the fatal injury rate of private workers (95% CI 1.29 to 1.60). We also observed that fatal injury rates increased with age group and were higher among male relative to female workers even after adjustment for differential distributions across occupations.

CONCLUSIONS: The decline in unintentional fatal occupational injury rates over this period is encouraging, but the increase in injury rate after 2009 and the large disparities between occupations, industries and demographic groups highlight the need for additional targeted safety interventions.

DOI: 10.1136/oemed-2023-109050 PMCID: PMC11515926 PMID: 37940382 [Indexed for MEDLINE]

MS7. Disparities in Fatal Occupational Injury Rates in North Carolina, 1978-2017: Comparing Nonmanagerial Employees to Managers ***Epidemiology. 2023 Sep 1;34(5):741-746. doi: 10.1097/EDE.0000000000001632. Epub 2023 Jul 31. Richardson DB(1), Cole SR(2), Martin AT(2), McClure ES(2)(3), Nocera M(3), Cantrell J(3), Ranapurwala SI(2)(3), Marshall SW(2)(3).***

(1)From the Department of Environmental and Occupational Health, Program in Public Health, University of California, Irvine, CA. (2)Department of Epidemiology, School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC. (3)Injury Prevention Research Center, University of North Carolina at Chapel Hill, Chapel Hill, NC.

BACKGROUND: We examined fatal occupational injuries among private-sector workers in North Carolina during the 40-year period 1978-2017, comparing the occurrence of fatal injuries among nonmanagerial employees to that experienced by managers.

METHODS: We estimated a standardized fatal occupational injury ratio by inverse probability of exposure weighting, taking nonmanagerial workers as the target population. When this ratio measure takes a value greater than unity it signals settings in which nonmanagerial employees are not provided as safe a work environment as that provided for managers.

RESULTS: Across all industries, nonmanagerial workers in North Carolina experienced fatal occupational injury rates 8.2 (95% CI = 7.0, 10.0) times the rate experienced by managers. Disparities in fatal injury rates between managers and the employees they supervise were greatest in forestry, rubber and metal manufacturing, wholesale trade, fishing and extractive industries, and construction.

CONCLUSIONS: The results may help focus discussion about workplace safety between labor and management upon equity, with a goal of providing a work environment for nonmanagerial employees as safe as the one provided for managers.

DOI: 10.1097/EDE.0000000000001632 PMID: 37255241 [Indexed for MEDLINE]

MS8. Trends in fatal occupational injury rates among older workers before and after the Great Recession of 2008. ***Occup Environ Med. 2023 Mar;80(3):154-159. doi: 10.1136/oemed-2022-108587. Epub 2023 Jan 30. Richey MM(1), Golightly*** **Y(2), Marshall SW(3), Novicoff W(4), Keil A(3), Nocera M(3), Richardson DB(5).**

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BACKGROUND: Older workers experience higher rates of fatal occupational injury than younger workers worldwide. In North Carolina, the population of older workers more than doubled between 2000 and 2017. In 2008, the Great Recession changed occupational patterns among all age groups. We examined annual rates and distribution of fatal occupational injuries experienced by older workers, comparing the pre-recession period (2000-2007) to the post-recession period (2009-2017).

METHODS: Detailed information on all fatal occupational injuries during the period between 1 January 2000 and 31 December 2017 were abstracted from the records of the North Carolina Office of the Chief Medical Examiner and the office of vital records. The decennial Census and American Community Survey were used to estimate the population at risk and derive annual rates of fatal occupational injury.

RESULTS: During the study period, 537 occupational fatalities occurred among workers 55+ years of age. The rate of fatal occupational injury among older workers declined 2.8% per year, with a 7.7% yearly decline in the pre-recession period compared with a 1.4% increase per year in the post-recession period. Workers 65+ years of age experienced rate increases in both periods. The highest rates of unintentional fatal occupational injury (injuries that were not purposefully inflicted) were observed in forestry, fishing hunting and trapping, and wood building manufacturing. Intentional fatal occupational injury rates (homicide, suicide) were highest in transportation, gas/service stations and grocery/food stores.

CONCLUSIONS: Older workers have persistently high rates of fatal occupational injury in North Carolina before and after the Great Recession.

DOI: 10.1136/oemed-2022-108587 PMID: 36717256 [Indexed for MEDLINE]

MS9. Challenges with misclassification of American Indian/Alaska Native race and Hispanic ethnicity on death records in North Carolina occupational fatalities surveillance. ***Front Epidemiol. 2022 Oct 21;2:878309. doi: 10.3389/fepid.2022.878309. eCollection 2022. McClure ES(1), Gartner DR(2), Bell RA(3)(4)(5), Cruz TH(6)(7), Nocera M(8), Marshall SW(8)(9), Richardson DB(9)(10).***

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As frequently segregated and exploitative environments, workplaces are important sites in driving health and mortality disparities by race and ethnicity. Because many worksites are federally regulated, US workplaces also offer opportunities for effectively intervening to mitigate these disparities. Development of policies for worker safety and equity should be informed by evidence, including results from research studies that use death records and other sources of administrative data. North Carolina has a long history of Black/white disparities in work-related mortality and evidence of such disparities is emerging in Hispanic and American Indian/Alaska Native (AI/AN) worker populations. The size of Hispanic and AI/AN worker populations have increased in North Carolina over the last decade, and North Carolina has the largest AI/AN population in the eastern US. Previous research indicates that misidentification of Hispanic and AI/AN identities on death records can lead to underestimation of race/ethnicity-specific mortality rates. In this commentary, we describe problems and complexities involved in determining AI/AN and Hispanic identities from North Carolina death records. We provide specific examples of misidentification that are likely introducing bias to occupational mortality disparity documentation, and offer recommendations for improved data collection, analysis, and interpretation. Our primary recommendation is to build and maintain relationships with local community leadership, so that improvements in the ascertainment of race and ethnicity are grounded in the lived experience of workers from communities of color.

DOI: 10.3389/fepid.2022.878309 PMCID: PMC10910913 PMID: 38455305

MS10. Trends in fatal occupational injuries in Latino/a workers relative to other groups, North Carolina 2000-2017. ***Am J Ind Med. 2022 Apr;65(4):242-247. doi: 10.1002/ajim.23331. Epub 2022 Feb 6. Richey MM(1)(2), Golig*****htly Y(1), Marshall SW(1), Novicoff W(3), Keil AP(1), Nocera M(1), Richardson DB(1).**

(1)Department of Epidemiology, University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, North Carolina, USA. (2)Department of Population Health Sciences, Duke University School of Medicine, Durham, North Carolina, USA. (3)Department of Public Health Sciences, University of Virginia School of Medicine, Charlottesville, Virginia, USA.

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.

DOI: 10.1002/ajim.23331 PMID: 35128690 [Indexed for MEDLINE]

B.4 (F RPPR OINC Section B4.pdf)

B.4 What opportunities for training and professional development has the project provided?

During the period of work, the project generated multiple opportunities for training and professional development for doctoral students in the Department of Epidemiology, Gillings School of Global Public Health. These were:

- Elizabeth McClure MPH PhD, former doctoral student, specializing in occupational health and environmental justice. Graduated in 2020, currently an Assistant Professor, Department of Epidemiology, Gillings School of Global Public Health.
- Amelia T. Martin MPH, current doctoral student, specializing in occupational safety and health, Department of Epidemiology, Gillings School of Global Public Health.
- Chelsea L. Martin DPT, current doctoral student, specializing in injury prevention, Department of Epidemiology, Gillings School of Global Public Health, UNC.
- Robert Rowe, MD, MPH, MBA. Completed an analysis of fatal occupational electrocutions using these data as part of his Preventive Medicine Residency in 2022. Currently an Assistant Professor in Department of Family Medicine, UNC.
- Morgan M Richey, MPH PhD, former doctoral student graduated in 2020, now an Assistant Professor, Department of Epidemiology, Gillings School of Global Public Health. Currently a Post Doctoral Researcher, Department of Population Health Sciences, School of Medicine, Duke University.

C. PRODUCTS

C.1 PUBLICATIONS

Are there publications or manuscripts accepted for publication in a journal or other publication (e.g., book, one-time publication, monograph) during the reporting period resulting directly from this award?

Yes

Publications Reported for this Reporting Period

Public Access Compliance	Citation
N/A: Not NIH Funded	Richardson DB, Cole SR, Martin AT, McClure ES, Nocera M, Cantrell J, Ranapurwala SI, Marshall SW. Disparities in Fatal Occupational Injury Rates in North Carolina, 1978-2017: Comparing Nonmanagerial Employees to Managers. Epidemiology (Cambridge, Mass.). 2023 September 1;34(5):741-746. PubMed PMID: 37255241; DOI: 10.1097/EDE.0000000000001632.
N/A: Not NIH Funded	Martin AT, McClure ES, Ranapurwala SI, Nocera M, Cantrell J, Marshall SW, Richardson DB. Fatal occupational injuries in North Carolina, 1992-2017. Occupational and environmental medicine. 2023 November 23;80(12):680-686. PubMed PMID: 37940382; PubMed Central PMCID: PMC11515926; DOI: 10.1136/oemed-2023-109050.
N/A: Not NIH Funded	Richardson DB, Martin AT, McClure ES, Nocera M, Cantrell J, Ranapurwala SI, Marshall S. Forty-year trends in fatal occupational injuries in North Carolina. American journal of industrial medicine. 2024 February;67(2):87-98. PubMed PMID: 37970734; DOI: 10.1002/ajim.23549.
N/A: Not NIH Funded	Martin CL, Richey M, Richardson DB, Nocera M, Cantrell J, McClure ES, Martin AT, Marshall SW, Ranapurwala SI. 25-Year fatal workplace suicide trends in North Carolina: 1992-2017. American journal of industrial medicine. 2024 March;67(3):214-223. PubMed PMID: 38197263; DOI: 10.1002/ajim.23563.
N/A: Not NIH Funded	McClure ES, Ranapurwala SI, Nocera M, Richardson DB. Heat-related fatalities in North Carolina 1999-2017. American journal of industrial medicine. 2024 June;67(6):551-555. PubMed PMID: 38624268; DOI: 10.1002/ajim.23587.

C.2 WEBSITE(S) OR OTHER INTERNET SITE(S)

Category	Explanation
Other	https://iprc.unc.edu/trends-and-disparities-in-fatal-occupational-injuries-in-north-carolina/

C.3 TECHNOLOGIES OR TECHNIQUES

NOTHING TO REPORT

C.4 INVENTIONS, PATENT APPLICATIONS, AND/OR LICENSES

Have inventions, patent applications and/or licenses resulted from the award during the reporting period? No

If yes, has this information been previously provided to the PHS or to the official responsible for patent matters at the grantee

organization? No

C.5 OTHER PRODUCTS AND RESOURCE SHARING

NOTHING TO REPORT

D. PARTICIPANTS

D.1 WHAT INDIVIDUALS HAVE WORKED ON THE PROJECT?

Commons ID	Sr/Key	Name	Degree(s)	Role	Cal	Aca	Sum	Foreign Org	Country	SS
DAVID_RICHARDSON	Y	RICHARDSON, DAVID B	BA,MOTH,PHD	PD/PI	1.1	0.0	0.0			NA
STEVE_MARSHALL	Y	Marshall, Stephen William	PHD,BS,OTH	Principal Investigator	1.1	0.0	0.0			NA
MARYALICE_NOCERA	N	Nocera, Maryalice	MSN	Project Manager	0.3	0.0	0.0			NA
ESMCCLUR	N	McClure, Elizabeth Sarah	MS,BS,PHD	Non-Student Research Assistant	2.7	0.0	0.0			NA
	N	Martin, Chelsea		Graduate Student (research assistant)	4.2	0.0	0.0			NA
	N	Cantrell, John		Technician	6.0	0.0	0.0			NA
	N	Shirley, Carol		Communications Specialist	0.1	0.0	0.0			NA

Glossary of acronyms:
Sr/Key - Senior/Key
Cal - Person Months (Calendar)
Aca - Person Months (Academic)
Sum - Person Months (Summer)
Foreign Org - Foreign Organization Affiliation
SS - Supplement Support
RS - Reentry Supplement
DS - Diversity Supplement
OT - Other
NA - Not Applicable

D.2 PERSONNEL UPDATES

D.2.a Level of Effort

Not Applicable

D.2.b New Senior/Key Personnel

Not Applicable

D.2.c Changes in Other Support

Not Applicable

D.2.d New Other Significant Contributors

Not Applicable

D.2.e Multi-PI (MPI) Leadership Plan

Not Applicable

E. IMPACT

E.1 WHAT IS THE IMPACT ON THE DEVELOPMENT OF HUMAN RESOURCES?

Not Applicable

E.2 WHAT IS THE IMPACT ON PHYSICAL, INSTITUTIONAL, OR INFORMATION RESOURCES THAT FORM INFRASTRUCTURE?

NOTHING TO REPORT

E.3 WHAT IS THE IMPACT ON TECHNOLOGY TRANSFER?

Not Applicable

E.4 WHAT DOLLAR AMOUNT OF THE AWARD'S BUDGET IS BEING SPENT IN FOREIGN COUNTRY(IES)?

NOTHING TO REPORT

G. SPECIAL REPORTING REQUIREMENTS SPECIAL REPORTING REQUIREMENTS

G.1 SPECIAL NOTICE OF AWARD TERMS AND NOTICE OF FUNDING OPPORTUNITIES REPORTING REQUIREMENTS

NOTHING TO REPORT

G.2 RESPONSIBLE CONDUCT OF RESEARCH

Not Applicable

G.3 MENTOR'S REPORT OR SPONSOR COMMENTS

Not Applicable

G.4 HUMAN SUBJECTS

G.4.a Does the project involve human subjects?

Not Applicable

G.4.b Inclusion Enrollment Data

NOTHING TO REPORT

G.4.c ClinicalTrials.gov

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

G.5 HUMAN SUBJECTS EDUCATION REQUIREMENT

NOT APPLICABLE

G.6 HUMAN EMBRYONIC STEM CELLS (HESCS)

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

G.7 VERTEBRATE ANIMALS

Not Applicable

G.8 PROJECT/PERFORMANCE SITES

Not Applicable

G.9 FOREIGN COMPONENT

No foreign component

G.10 ESTIMATED UNOBLIGATED BALANCE

Not Applicable

G.11 PROGRAM INCOME

Not Applicable

G.12 F&A COSTS

Not Applicable

I. OUTCOMES

I.1 What were the outcomes of the award?

A comprehensive 4-decade series of fatal occupational deaths were generated through data abstraction from the files of the NC Office of the Chief Medical Examiner, using a standardized and consistent case definition. Rates were computed using census denominations and analyzed using Poisson models. Results were published in peer-reviewed journals, and disseminated to a stakeholder meeting though in-person presentations. The project provided training and career developments opportunities for 5 professionals in training.
This study was able to include trends fatal suicides and fatal homicides at work. Rates of fatal suicide in the workplace have increased over time. Taxi drivers and some retail workers have persistently high rates of on the job homicide.
In general, the results of study describe declining rates overall, however, economic hardships have strengthened and reinforced disparities in fatal occupational rates, with the benefits of falling rates being greatest among those workers who already had the lowest rates (white race, managerial professions). As a result, disparities have increased, despite falling rates. Additionally, there is a pressing need to improve procedures for assessment of race and ethnicity in fatal workplace injuries.