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RESEARCH ARTICLE

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25-Year fatal workplace suicide trends in North Carolina: 1992–2017

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Abstract

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.

KEYWORDS

employment Status, injury prevention, occupation and industry, suicides, working-aged men, workplace suicides

1 | INTRODUCTION

Suicide is a serious public health problem in the United States that has substantial physical, emotional, and economic impacts.[1–4] The suicide rate in the United States rose by 36% between 2000 and 2021, with the US suicide rate in 2021 (14 per 100,000) being the highest among wealthy nations.[5,6] When considering the workplace, suicide is a growing concern given that, according to the Bureau of Labor Statistics, workplace suicide rates in the United States have increased faster than suicide rates overall.[4,7] The number of workplace fatalities by suicide reached the highest level on record in 2019 (the most recent year for which data are available).[7] Research at the national and international levels have indicated specific industries may be more vulnerable to suicide or suicide ideation, including first responders,[8] agriculture,[9] and construction.[10] In addition to the psychological impact on the employees, families, and communities of the person who died by suicide, workplace suicides incur a significant economic cost due to medical, legal, and lost earnings due to premature mortality.[11,12]

In North Carolina (NC), prior studies that have investigated fatal occupational injuries have often focused on deaths due to homicide and unintentional injury, but did not report on the incidence of suicides at work.[13–17] Given the limited understanding of workplace suicides in NC, the increase in the occurrence of workplace suicides over the last three decades nationally, and the substantial population growth in NC over the last several decades,[18] there is a substantial need for information to characterize workplace suicides in the state to inform suicide prevention interventions and perhaps target those efforts towards high-risk occupational settings and groups.

In this study, we examine workplace suicide rates in NC by worker characteristics, means of suicide used, and industry between 1992 and 2017. This detailed analysis will aid in informing suicide prevention strategies and policies that target the most vulnerable individuals and industries in a state with evolving demographics and industries.

2 | MATERIALS AND METHODS

2.1 | Study design and data

We conducted a retrospective cohort study to investigate trends in workplace suicide deaths in NC from 1992 to 2017. Workplace suicide deaths were defined as intentional fatalities as a result of the worker harming themselves with the intent to end their life while engaged in legal work for pay. Data were abstracted from two sources. The first was the NC Office of the Chief Medical Examiner (OCME) system, of which investigative reports for all 100 counties were available for review by the medical examiner and the research team. The Medical Examiners (ME) determine the manner and means of death for each case that is investigated, and if the fatality occurred "on the job," they document this information on the ME report. The second data source was the NC State Center for Health Statistics death records data. These data contain an "Injury at work" flag based on what is recorded on the death certificate by the medical certifier. Deaths that were flagged as "on the job" in the ME report or "at work" on the death certificate were reviewed. Those who had a cause of death listed as suicide were eligible for inclusion in this study. If a case only had one of the two flags (i.e., flagged either as "on the job" on the ME report or "at work" on the death certificate), then the case was adjudicated by two or more study investigators, and the project manager to make a final determination of whether the death was a workplace suicide. Deaths among active-duty military members were excluded due to inability to account for all military deaths accurately in the OCME (because the Armed Forces Medical Examiner System documents these cases), as well as noting that our population estimates pertain to the civilian noninstitutionalized workforce in NC workforce.

2.2 | Worker characteristics

Age was abstracted in integer years. Sex was classified as male, or female. Race (White, Black/African American, American Indian or Alaska Native, Asian and Pacific Islander, and other race), and ethnicity (Hispanic, Non-Hispanic) were abstracted as separate variables and reclassified as Hispanic, Non-Hispanic black, Non-Hispanic white, and a combined group of Non-Hispanic, non-Black, non-White to avoid cross-classification of Hispanic individuals by race in accordance with recommendations[19] due to a small number of outcomes among certain groups, and to reduce the potential for accidental disclosure of individual identities. The class of workers included self-employed, privately employed, or government employed. The industry of the individual at the time of the fatal injury was abstracted and coded using the United States Census year 2000 guidelines.[20] This coding scheme was chosen due to the use of the United States census denominators to estimate the population at risk.

2.3 | Means of death

Information on means of death was abstracted to categorize suicide death by asphyxia, fall or jump, fire or burns, firearm, hanging, motor vehicle, poisoning, or sharp object.

2.4 | Population at risk

The 1990, 2000, and 2000 decennial US Census was utilized to attain annual estimates of the NC workforce. Workforce annual estimates for intercensal years were estimated using a linear interpolation. The estimated numbers of workers in each stratum were summed to obtain estimates of person-years at risk. These estimates of the working population were used to approximate the number of person-years at risk in each stratum and calendar year. These estimates were calculated for available strata including age groups (18–24, 25–34,

35–44, 45–54, 55–64, and 65+ years old), sex (male, female), race (White, Black, non-White non-Black), ethnicity (Hispanic, Non-Hispanic), and industry groups (51 groups from census codes). These population estimates were used to approximate worker-years (w-y) at risk by each stratum and calendar year.

2.5 | Statistical analyses

Suicide deaths by demographic characteristics, means of death, and time frame (1992–1995, 1996–2000, 2001–2005, 2006–2010, 2011–2015, and 2016–2017) were reported as counts and percentages.

The workplace suicide death rate, defined as the number of workplace suicide deaths divided by the estimated w-y at risk, and expressed as events per 1,000,000 w-y, was calculated by strata defined by age group, sex, race/ethnicity, and class of worker. Unadjusted and age-standardized suicide death rates were calculated by industry group; control for potential confounding by sex was handled by restriction to males in the analysis of suicide death rates by industry (noting that very few workplace suicides were observed among females). Rate ratios and 95% confidence intervals (CIs), were calculated for each stratum relative to the referent categories (Calendar period: 1992–1995; Sex: male; Age: 18–24 years; Race and ethnicity: Non-Hispanic White; Class of worker: privately employed; Industry: overall rate across all industries). If the number of events within a cell of a table was less than 5, then we suppressed that number to ensure results were not identifiable. All data management and statistical analyses were performed in SAS version 9.4 (SAS Institute). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were used for reporting.[21] The STROBE guidelines are recommended guidelines aimed at improving methodological reporting and study results of observational studies to improve transparency, interpretability, and reproducibility of findings.

3 | RESULTS

Between 1992 and 2017, 81 suicide deaths occurred in the workplace in NC over 109,464,430 w-y for an overall crude incidence rate of 0.74 per 1,000,000 w-y (95% CI: 0.58–0.90). The crude annual incidence rate did not exhibit substantial variation over time (Table 1, Figure 1). The overwhelming majority (96%) of suicides were observed among males, among whom the incidence rate was 1.34 per 1,000,000 w-y (Table 1). This remarkable observation indicates that in North Carolina over this study period workplace suicide was extremely rare among females.

Non-Hispanic White (81%), privately employed workers (51%), and aged 35–44 year-old workers (24%) experienced the largest numbers of suicides. Increased suicide rates were noted among self-employed workers (1.79 per 1,000,000) who had 2.89 (95% CI: 1.68, 4.96) times the suicide rate of privately employed workers, and workers 65 years or older who had 3.96 (3.57, 4.39) times the rate of workers 18-24 years of age (Table 1). Firearms were the most common means of death (63%) followed by hanging (16%) (Table 2).

Given the very small number of fatal workplace suicides among females (<5 events) our analysis of suicide rates by industry group was restricted to males. The highest suicide incidence rates were noted among males employed in the following industries: gasoline service stations (crude: 12.6; age-standardized: 9.1 per million w-y), justice, public order, and safety (crude: 4.0; age-standardized: 4.3 per million w-y), paper and allied production manufacturing (crude: 2.32; age-standardized: 4.13 per million w-y), bus, subway, trolley and truck transportation (crude: 3.2, age-standardized: 3.3 per million w-y), and auto sales and service industry (crude: 3.1, age-standardized: 3.0 per million w-y) (Table 3). All of the workers in gasoline service station industry and 85.7% ($n = 6$) of the workers in auto sales and service industry were self-employed. Following narrative review of cases, 57% of workers in the bus, subway, trolley, and truck driver industry were tractor-trailer drivers.

4 | DISCUSSION

Between 1992 and 2017, temporal trends did not exhibit substantial variation, with an overall incidence rate of 0.74 per million w-y. Male workers, workers over the age of 65 years, and self-employed workers experienced the highest rates of workplace suicide, with firearm use or death by hanging representing the most common means of committing suicide death on the job. Higher suicide death rates were noted among Hispanic workers compared to non-Hispanic White workers. When considering differences in the occurrence of workplace suicide by industry, the greatest number of suicides were observed among construction workers, while the highest rates of suicide were observed among workers employed in the following industries: gasoline service stations, justice, public order, and safety, paper and allied production and manufacturing, bus, subway, trolley and truck drivers, and auto sales and service. To our knowledge, this is the first report to provide a detailed state-level epidemiological report on suicides that specifically occur on the job, signifying a need for industries to provide suicide prevention programs to employers in vulnerable industries.

4.1 | Characteristics of the person who died by suicide

Workers who were particularly vulnerable were 65 years or older or male. Workers 65 years and older experienced nearly four times the rate of 18–25 year old workers and males 22 times the rate of female workers. Irrespective of location of the suicide death, older adults represent 18% of suicide deaths in the United States, yet makeup just 12% of the US population.[22] Previous literature has found that both older adults and males are more selective in their planning of suicides,

TABLE 1 Characteristics of fatal occupational suicides in North Carolina, 1992–2017.

Characteristic		*N* (%)	Worker-years	Rate[a]	Rate ratio (95% CI)
Calendar period	1992–1995	14 (17)	13,940,991	1.04	1.0
	1996–2000	9 (11)	18,696,593	0.49	0.47 (0.20–1.12)
	2001–2005	18 (22)	20,408,833	0.90	0.87 (0.43–1.77)
	2006–2010	21 (26)	22,609,774	0.94	0.91 (0.46–1.82)
	2011–2015	13 (16)	25,125,266	0.52	0.51 (0.23–1.09)
	2016–2017	6 (7)	10,791,592	0.56	0.54 (0.20–1.48)
	Male	-[b]	-	1.34	1.0
Sex	Female	<5	-	0.06	0.04 (0.01–0.14)
Age	18–25 years	6 (7)	13,575,189	0.44	1.0
	25–34 years	19 (23)	25,579,298	0.74	1.68 (1.45–1.94)
	35–44 years	24 (30)	29,157,868	0.82	1.86 (1.61–2.15)
	45–54 years	13 (16)	25,436,509	0.51	1.16 (0.98–1.36)
	55–64 years	12 (15)	11,719,994	1.02	2.32 (2.06–2.60)
	65+ years	7 (9)	3,995,572	1.75	3.96 (3.57–4.39)
Race and ethnicity	Non-Hispanic White	66 (81)	79,850,257	0.83	1.0
	Non-Hispanic Black	9 (11)	20,169,998	0.45	0.54 (0.23–1.08)
	Hispanic	5 (6)	4,424,975	1.13	1.37 (0.35–5.30)
	Non-Hispanic, non-White, non-Black	<5	-	0.20	0.24 (0.06–1.04)
Class of worker	Privately employed	51 (63)	82,352,763	0.62	1.0
	Government employed	10 (12)	15,926,684	0.63	1.01 (0.47–2.21)
	Self-employed	20 (25)	11,184,983	1.79	2.89 (1.68–4.96)
Education	High school or less	44 (54)	-	-	-
	More than high school	37 (46)	-	-	-

Abbreviation: CI, confidence interval.

[a]Per 1,000,000 w-y.

[b]Due to female counts being <5, male counts were suppressed to ensure de-identification. Incidence rates and rate ratios include females.

and are more likely to use lethal means.[23] Possible explanations for the vulnerability of workplace suicide deaths among older workers may include health ailments such as chronic pain or financial troubles.[22] These factors may be exacerbated among industries that require manual labor that may exacerbate underlying chronic pain conditions, or may be a secondary career after retirement to minimize financial woes. In older workers already predisposed to mental health conditions, these additional stressors may predispose the worker to suicidal ideation or attempts.[22] When considering suicides committed on the job, our study demonstrated males were far more vulnerable at 22 times the rate of females. Reasons for these gender disparities are poorly understood and likely represent a complex interaction of societal expectations, socioeconomic status, and working environments.[24] Further understanding of age and gender disparities are needed to ensure impactful suicidal prevention programs are provided.

By ethnicity, Hispanic workers demonstrated the highest fatal workplace suicide rate followed by non-Hispanic White workers. The US Bureau of Labor Statistics found that Hispanic workers have the highest fatality rates on the job compared to non-Hispanic White workers, but minimal distinction is made on cases related to suicide death on the job.[25–27] Although our study found that non-Hispanic Black and non-Hispanic, non-White, non-Black workers demonstrated lower rates of suicides that occurred on the job, prior reports from the Centers for Disease Control and Prevention (CDC) indicate that the racially minoritized groups are vulnerable to suicide deaths irrespective of location of the suicide act.[28] Further, prior research shows that race and ethnicity in death records can have varying degrees of misclassification, which largely affects Hispanic and American native populations who are often misclassified as non-Hispanic White.[29] Such misclassification can produce large rate changes for these populations, especially given the relatively smaller

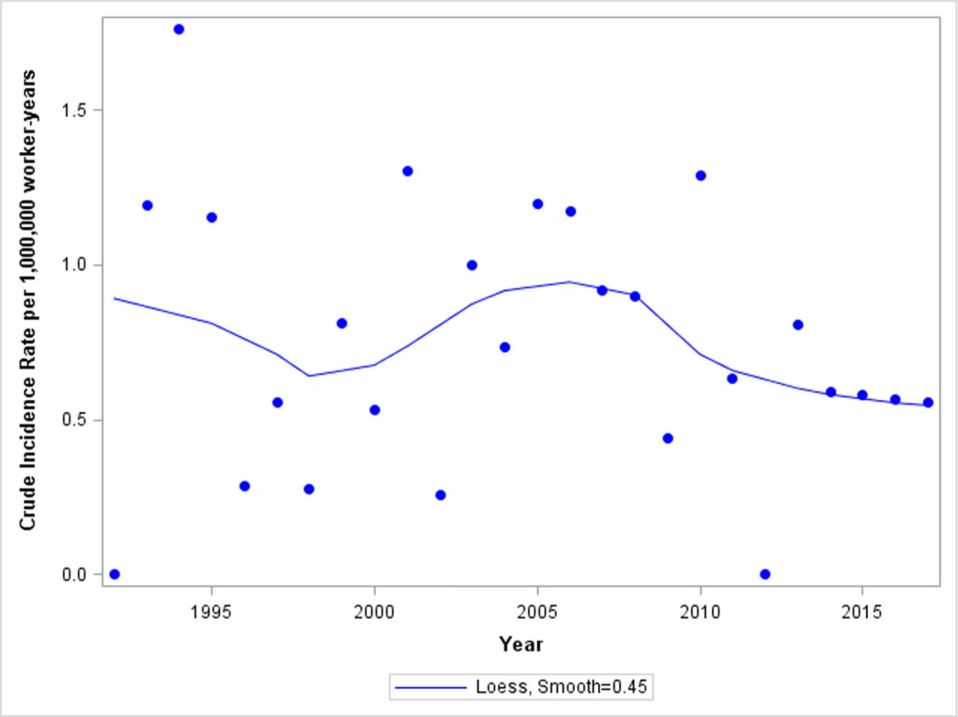

FIGURE 1 Annual fatal occupational suicide rate, and smoothed trend line, North Carolina, 1992–2017.

TABLE 2 Means of fatal occupational suicide, North Carolina, 1992–2017.

Means	Overall, *N* (%)
Firearm	51 (63.0)
Hanging	13 (16.1)
Poisoning	6 (7.4)
Fall, Jump	5 (6.2)
Other means	6 (7.4)

Note: Other means: Fires/burns, asphyxia, motor vehicle, sharp object.

denominators (w-y). Previous research has demonstrated that prevention programs that are culturally informed have led to a 73% reduction in suicide gestures and attempts in tribal communities in the United States.[30] Further research is needed to determine how workplace environments can provide prevention strategies that may better target racially minoritized people.

4.2 | Workplace suicides among self-employed workers

Self-employed workers were nearly three times the rate of workplace suicide compared to privately employed workers. Although self-employment can be associated with increased business autonomy,[31,32] self-employment may present unique challenges that negatively impact mental health, predisposing these workers to suicidal ideation. These challenges may include atypical work schedules or decreased healthcare benefits.[31] This may negatively impact access to necessary healthcare services that can provide essential mental health services to prevent suicides.[31] Self-employment has also been associated with decreased social interaction, which may contribute to perceived social isolation, further negatively impacting mental health.[33] A multi-disciplinary approach that addresses the unique challenges self-employed workers face may be necessary to ensure easier access to vital mental health services, positive social environments, and suicide prevention educational content.

4.3 | Workplace suicides by industry

By industry, workers among (1) gasoline service stations, (2) justice, public order, and safety, (3) paper and allied production and manufacturing, (4) bus, subway, trolley, and truck drivers, and (5) auto sales and service industries were the most vulnerable industry groups. Due to the near-zero suicide cases of female workers, analysis was restricted by industry to male workers. Previous literature has documented high levels of intentional work deaths caused by homicides among gasoline service station workers, particularly those who are self-employed, but suicide deaths on the job were sparsely reported.[34,35] For occupations that are within the justice, public order, and safety industry, previous literature has

TABLE 3 Fatal occupational suicide rate by industry among males, North Carolina, 1992–2017.

Industry	Cases	Worker years	Crude rate[a]	Std rate (95% CI)	RR (95% CI)
Gasoline Service Stations- Retail	<5	-	24.29	15.36 (−2.6 to 33.33)	11.48 (3.62–36.33)
Justice, Public Order, & Safety	5	1,263,204	3.96	4.33 (0.18–8.47)	3.23 (1.31–7.97)
Paper & Allied Prod-MFG	<5	-	2.32	4.13 (−3.96 to 12.21)	3.08 (0.43–22.14)
Transport- Bus, Subway, Trolley, Truck	7	1,841,790	3.8	3.96 (0.86–7.05)	2.96 (1.37–6.4)
Auto Sales & Services-Retail & Repair	7	1,951,544	3.59	3.52 (0.89–6.15)	2.63 (1.21–5.69)
Agriculture	<5	-	4.13	3.51 (−0.14 to 7.16)	2.62 (0.96–7.16)
Eating & Drinking Places- Retail	5	2,083,801	2.4	3.08 (−0.45 to 6.62)	2.3 (0.93–5.68)
Lodging Services	<5	-	2.69	2.67 (−2.56 to 7.89)	1.99 (0.28–14.31)
Food & Kindred Prod-MFG	<5	-	2.48	2.63 (−1.01 to 6.27)	1.96 (0.48–7.98)
Detective & Protective Services	<5	-	3.41	2.3 (−2.21 to 6.81)	1.72 (0.24–12.36)
Entertainment & Recreation Services	<5	-	1.37	2.13 (−2.05 to 6.31)	1.59 (0.22–11.44)
Warehouse, Storage, & Transport SVCS	<5	-	1.88	1.94 (−1.87 to 5.76)	1.45 (0.2–10.44)
Textile Mill Prod-MFG	<5	-	1.64	1.68 (−0.66 to 4.02)	1.25 (0.31–5.09)
Water, Supply, & Sanitation Utility	<5	-	1.96	1.67 (−1.6 to 4.94)	1.25 (0.17–8.97)
Grocery, Dairy, & Food Stores- Retail	<5	-	1.94	1.54 (−0.81 to 3.89)	1.15 (0.28–4.68)
Finance, Insurance, & Real Estate	<5	-	1.6	1.49 (0.03–2.96)	1.12 (0.41–3.05)
Construction	11	8,336,214	1.32	1.45 (0.57–2.33)	1.08 (0.58–2.03)
Electric, Gas, Pipelines, & Nonspec Utility	<5	-	1.61	1.35 (−1.3 to 4)	1.01 (0.14–7.25)
Chemicals & Petroleum Prod-MFG	<5	-	1.13	1.16 (−1.12 to 3.44)	0.87 (0.12–6.24)
General Retail Trade	<5	-	0.99	1.06 (0.01–2.11)	0.79 (0.29–2.17)
Business & Repair Services	<5	-	1.24	1.04 (−0.14 to 2.21)	0.77 (0.24–2.45)
Radio, TV, Phone, & MISC Communications	<5	-	1.13	0.93 (−0.89 to 2.75)	0.69 (0.1–4.98)
Professional & Related Services	6	7,677,990	0.78	0.8 (0.15–1.44)	0.59 (0.26–1.36)
Wholesale Trade	<5	-	0.79	0.73 (−0.28 to 1.75)	0.55 (0.13–2.22)

(Continues)

TABLE 3 (Continued)

Industry	Cases	Worker years	Crude rate[a]	Std rate (95% CI)	RR (95% CI)
Public Admin	<5	-	0.66	0.55 (−0.53 to 1.64)	0.41 (0.06–2.97)
Furniture & Fixtures - MFG	<5	-	0.73	0.54 (−0.52 to 1.6)	0.4 (0.06–2.91)

Note: Age Standardized RR = Select Industry standardized incidence rate/combined industry incidence rate (1.33 per 1 million w-y). The following industries represented 0 workplace suicide deaths over 18,918,536 worker years: Warehouse, Storage, & Transport SVCS, Entertainment & Recreation Services, Lodging Services, Electric, Gas, Pipelines, & Non-specified Utility, Furniture & Fixtures – MFG, Textile Mill Prod-MFG, Business & Repair Services, Grocery, Dairy, & Food Stores- Retail, Chemicals & Petroleum Prod-MFG, Radio, TV, Phone, & MISC Communications, General Retail Trade, Wholesale Trade, Public Admin: 18 workplace suicide deaths over 26,254,272 worker years*; Agriculture service, Fishing, Hunting & Trapping, Mining & Oil, Tobacco Manufactures, Apparel & Finished Textile Prod-MFG, Printing & Publishing, Rubber Leather & Misc Plastic Prod-MFG, Forestry & Logging-MFG, Sawmills Planning & Misc Wood Prod-MFG, Wood Buildings & Mobile Homes - MFG, Stone, Clay, Glass, & Concrete Prod-MFG, Primary Metal-MFG, Fabricated Metal Prod-MFG, Machinery & Transport Equip-MFG, Computer, Medical, ETC, Equip-MFG, Misc- MFG, Transport- Railroad, Water, Air, Transport- Taxi, Drug Stores- Retail, Personnel Supply Services, Personal Services, Auto Repair & Related Services, Auto Repair & Related Services.

Abbreviations: 95% CI, 95% confidence interval; MFG, manufacturing; Misc, miscellaneous; Prod, production; RR, rate ratio; Std, standardize.

[a]per 1,000,000 w-y.

found emergency responders demonstrate a higher suicide rate compared to the general population.[36] This has prompted a call to action by multiple governing bodies and funding for improved surveillance efforts among emergency responders due to the insufficient data in this group of workers.[37]

In 2016, the CDC released a report on suicide deaths by industry, occupation, and gender using the National Violent Death Reporting System, indicating that males who were truck drivers (30.4, 95% CI: 27.8–33.0 per 100,000 civilian noninstitutionalized population), auto body and related repairer (54.9, 95% CI: 34.4–83.9) and auto service technicians and mechanics (64.8, 95% CI: 57.4–72.3) were among the most vulnerable workers.[38] These occupations are nested within the industry groups that are most vulnerable in our study (Table 3). Our study also demonstrated an elevated suicide rate on the job among paper, allied production, and manufacturing; however, when manufacturing was analyzed with all combined subcategories, the 2016 CDC report found a similar suicide rate as the population rate (manufacturing: 23.6, 95% CI 22.5–24.8, all male workers: 27.4, 95% CI: 26.9–27.9).[38] The CDC report did not make the distinction if the suicide death occurred on the job, making comparison of estimates of suicide death rates to our study difficult. However, one report from 1992 to 2019 from the Bureau of Labor Statistics demonstrated a 49.8% increase in suicides on the job with truck drivers representing the highest frequency by occupation.[7]

Until recently, workplace suicide prevention and related mental health initiatives for workplace settings have garnered minimal attention. Fatal workplace suicide risk factors have been identified, including low job security and pay,[39] poor colleagues and supervisor support,[39] job stress,[40] access to lethal means,[41] long work hours,[40,42] and workplace bullying.[43] Previous intervention programs aimed at preventing workplace violence across various industries (i.e., workers in taxi driver, gas station, and retail)[44–46] saw a reduction in homicides and related violent acts. By providing additional suicide prevention programs in conjunction with these workplace violence initiatives, employers in vulnerable industries may mitigate intentional deaths that occur on the job. However, the occurrence of a suicide death on the job may not necessarily mean the death stemmed from workplace causes; other interpersonal, mental health,[47] and environmental factors may lead to people opting to end their lives while at work. The US Surgeon General's Framework for Workplace Mental Health and Well-Being was introduced which is centered on the worker's perspective and focuses on harm reduction, community connection, worker growth, life balance, and purpose.[48] This new framework may serve as a guide to inform multi-dimensional approaches that address the interpersonal, mental health, and environmental factors that may contribute to suicides. The National Institute for Occupational Safety and Health has provided general recommendations to workplaces, including limiting access to lethal means, increasing peer support, access to mental health services, and reducing stigma around suicide ideation and mental health treatment.[49] Beginning in 2010, The American Association of Suicidology Workplace Postvention Task Force began to create guidelines for specific occupations (e.g., firefighters) and manager guides for coping with the aftermath and prevention of suicide in the workplace.[50] Other available resources developed for workplaces include The American Foundation for Suicide Prevention,[51] and the United Suicide Survivors International National Guidelines for Workplace Suicide Prevention.[52] However, further research is needed to determine industry-specific prevention programs to address risk factors that may be unique across each industry.

4.4 | Limitations

Our study has several limitations. First, this surveillance data is limited to information abstracted from administrative data, and therefore inferences about multiple factors that may contribute to workplace suicide risk are not possible (i.e., employee access to lethal means). Second, bias is possible in the medical examiners'

documentation of race and ethnicity.[29] Persons who died by suicide from minoritized racial and ethnic backgrounds may be underrepresented or misclassified, leading to underestimation of workplace suicide death rates among racially minoritized groups. Third, although likely rare, industry misclassification is possible in certain similar industries, such as across manufacturing industries or across various retail industries. However, steps were taken to mitigate this possibility, including linking two data systems and case review by the research team across both data systems. Fourth, due to the low numbers of suicide deaths across industries (i.e. less than five suicides), further strata by industry and worker characteristics were not reported to protect the identity of decedents. Fifth, in large industries with few suicides, we report wide confidence intervals. Standardized methods for observational studies were used to estimate confidence intervals, but these methods are based on methods that assume a probability sample, such as simple random sampling. However, our population count data and death records from the OCME represent a full census of workers and suicide deaths on the job, therefore, the statistical imprecision in these estimates does not reflect uncertainty in the number of workplace suicides observed, and are a consequence of a small number of cases.

We found that workplace suicide death rates were stable over the study time frame. Specific industries and worker demographics, including male, older, Hispanic, and self-employed workers, experienced the highest workplace suicide fatality rates compared to female, younger, non-Hispanic white, and privately employed counterparts. Suicide prevention programs to be studied in future research initiatives may include efforts to reduce industry-specific job strain, foster self-care, worker training for suicide risk identification, linkage to mental health services, and improving crisis response.[49] Based on these findings, unique industry demands and vulnerable populations need to be considered when developing and implementing suicide prevention programs.

AUTHOR CONTRIBUTIONS

Chelsea Leonard Martin: Conceptualization; methodology; formal analysis; investigation; writing. **Morgan Richey:** Methodology; investigation; writing. **David B. Richardson:** Conceptualization; methodology; investigation; project administration; funding acquisition; writing; resources; supervision. **Maryalice Nocera:** Conceptualization; methodology; visualization; project administration; funding acquisition; writing. **John Cantrell:** Conceptualization; investigation; data management; formal analysis. **Elizabeth S. McClure:** Conceptualization; methodology; formal analysis; investigation; writing. **Amelia T. Martin:** Conceptualization; methodology; investigation; writing. **Stephen W. Marshall:** Conceptualization; methodology; investigation; project administration; funding acquisition; writing, resources. **Shabbar I. Ranapurwala:** Conceptualization; methodology; investigation; project administration; funding acquisition; writing; resources; supervision.

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CONFLICTS OF INTEREST STATEMENT

The authors declare that there are 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 article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS APPROVAL AND INFORMED CONSENT

The study was reviewed by the University of North Carolina Office of Human Research Ethics which determined that this study does not constitute human subjects research as defined under federal regulations [45 CFR 46.102 (d or f) and 21 CFR 56.102(c)(e)(l)].

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