Native American "Deaths of Despair" and Economic Conditions

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ABSTRACT

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Non-Hispanic whites who do not have a college degree have experienced an increase in "deaths of despair" – deaths caused by suicide, drug use, and alcohol use. Yet, deaths of despair are proportionally largest among Native Americans and the rate of increase of these deaths matches that of non-Hispanic white Americans. Native American women and girls face the largest differentials: deaths of despair comprise over 10% of all deaths among Native American women and girls – almost four times as high as the proportion of deaths for non-Hispanic white women and girls. However, the factors related to these patterns are very different for Native Americans than they are for non-Hispanic white Americans. Improvements in economic conditions are associated with decreased deaths from drug use, alcohol use, and suicide for non-Hispanic white Americans. On the other hand, in counties with higher labor force participation rates, lower unemployment, and higher ratios of employees to residents, there are significantly higher Native American deaths attributed to suicide and drug use. These results suggest that general improvements in local labor market conditions may not be associated with a reduction in deaths of despair for all groups.

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In the first two decades of the 21st century, non-Hispanic whites in the U.S. who do not have a college degree experienced an increase in middle-age mortality due to "deaths of despair"– deaths caused by suicide, drug use, and alcohol use (Case and Deaton, 2015; Stein et al., 2017). The increase in non-Hispanic white mortality has been attributed to increased economic insecurity (Case and Deaton, 2015, 2017, 2020; Stein et al., 2017; Knapp et al., 2019; Monnat, 2016), the U.S. health care system (Case and Deaton, 2020), decreases in community social capital (Zoorob and Salemi, 2017), the price of heroin (Unick et al., 2014) and a perceived fall in relative group status (Siddiqi et al., 2019). While the literature on deaths of despair is not without critique (Ruhm, 2021), the causes of non-Hispanic white deaths of despair has been the focus of the literature.

Less has been said about the causes of deaths of despair among minority populations (Geronimus et al., 2019), including Native Americans. Deaths of despair among Native Americans are proportionately higher than among any other group and have increased at almost twice the rate of non-Hispanic whites primarily due to drug poisonings, chronic liver disease, and suicide (Chinni, 2020; Shiels et al., 2017; Woolf et al., 2018). In fact, recent research has projected that from 2017 to 2030 Native Americans and Alaska Natives will experience a 10% increase in all-cause premature deaths (Best et al., 2018).

In this paper, we examine deaths attributed to drug use, alcohol use, and suicide among Native Americans and their economic correlates. Consistent with the previous literature, we find that Native Americans have a higher proportion of deaths from suicide and drug and alcohol use than do non-Hispanic whites and the proportion has been increasing over time. Like non-Hispanic whites, among Native Americans deaths from these causes are increasing among those who do not have a college degree.

However, the role of economic activity in deaths attributed to drug use, alcohol use, and suicide among Native American women and girls is very different than for non-Hispanic whites. Native American women and girls die more often from deaths of despair relative to other causes, particularly those attributed to drug use, in counties with larger proportions of working age residents in the labor force, proportion of working age residents that are employed, and employees per resident. In general, these economic conditions would be considered "good" outcomes. However, for Native American women and girls, these economic conditions are related to a higher proportion of deaths attributed to drug and alcohol use, unlike for non-Hispanic white women and girls.

We find little to no overall relationship between deaths of despair among Native American men and boys and county-level economic measures. However, the overall null effect is the result of a combination of a negative relationship between economic measures and deaths attributed to suicide and a positive relationship between economic measures and deaths attributed to drug use that off-set each other. This suggests that local economic environments are associated with different outcomes in deaths of despair by race and gender. Moreover, the concept of "deaths of despair" - grouping deaths attributed to drug use with suicide - obscures important mortality patterns for Native Americans.

1 The Connection Between Mortality and Economic Activity

There are well-documented disparities in health outcomes and mortality rates between Native Americans and other groups in the U.S. (Barnes et al., 2010; Gracey and King, 2009; Service, 2019; Jones, 2006; Sequist, 2017). A recent CDC study found the life expectancy of Native Americans was 71.8 years, compared to 78.8 years for non-Hispanic white Americans (Arias et al., 2021). More recently, in the COVID-19 pandemic era, life expectancy for Native Americans decreased by almost five years while it decreased by 1.4 years for non-Hispanic whites over the same period into 2020 (Arias and Xu, 2022). Similarly, age adjusted mortality rates are 40% higher for American Indian and Alaska Native (AIAN) populations than for all other racial groups (Sarche and Spicer, 2008). Deaths attributed to suicide, drug use, and alcohol use are also higher and increasing among Native Americans (Chinni, 2020; Shiels et al., 2017; Woolf et al., 2018).

During recessions, overall mortality typically declines (Ruhm, 2000; Miller et al., 2009; Van den Berg et al., 2017; Sameem and Sylwester, 2017). This pro-cyclical relationship is not intuitive at first glance and there are multiple theories that explain why this relationship exists. First, some unhealthy behaviors increase during economic growth. For example, smoking and obesity increase during economic expansions while physical activity and consumption of healthy food decreases (Ruhm, 2000). However, Stevens et al (2015) found little evidence that an individual's behavior during economic expansions contributes to their own mortality, but it may be due to a shortage of staff at nursing homes during times of economic growth (Stevens et al., 2015).

Generally, the pro-cyclical relationship between mortality and economic activity is not the same for all causes of death nor race/ethnicity groups. Deaths from suicide consistently fall in booms and increase during recessions (Ruhm, 2000; Miller et al., 2009; Fontenla et al., 2011) especially in urban areas (Luo et al., 2011). Likewise, opioid use, opioid overdoses, and opioid-related deaths typically increase during economic downturns, particularly among white men (Hollingsworth et al., 2017; Carpenter et al., 2017). Aligning with this finding, the "deaths of despair" literature has found that increased deaths attributed to suicide, drug use, and alcohol use among middle aged white men are associated with increased economic insecurity (Case and Deaton, 2015, 2017, 2020; Stein et al., 2017; Knapp et al., 2019; Monnat, 2016). However, other researchers find the relationship between economic expansion and mortality is stronger for Latinos than white Americans, while statistically insignificant for Black Americans (Fontenla et al., 2011). To our knowledge, the relationship for Native Americans remains unexamined, likely due to suppression of mortality rates for Native Americans at the county level. This is one of the primary contributions of this paper.

We may expect different relationships between racial groups for several reasons. First, a distinct thread of research in public health known as the weathering hypothesis highlights how the chronic stress of systemic racism leads to Black Americans aging more quickly - so the *impact* of social determinants of health are different for Black Americans than white Americans (Geronimus, 1992; Geronimus et al., 2006, 2010, 2015). The weathering hypothesis may also be applicable to Native Americans - systemic racism and colonization may alter how economic expansion impacts mortality.

Second, the higher proportions of deaths attributed to suicide, alcohol use, and drug use among Native Americans, particularly women and girls, may be related to the "Missing and Murdered Indigenous Women and Girls" (MMIWG) epidemic (Young, 2019; Joseph, 2021; Lucchesi and Echo-Hawk, 2018) which may be correlated with local economic conditions. If sexual violence and human trafficking are positively correlated with local economic conditions as crime can be (Ruddell et al., 2014), then we may also see deaths of despair positively correlated with economic conditions as well. Survivors of human trafficking and sexual violence are at increased risk of developing substance use disorders in an attempt to cope with the traumatic experience and symptoms of post traumatic stress disorder (PTSD) (Dawgert, 2009). For these individuals, treating the substance use disorder without addressing the PTSD is ineffective: PTSD symptoms frequently reappear when people stop using drugs or alcohol, leading to relapse (Dawgert, 2009). Likewise, survivors of human trafficking are at higher risk of suicidal ideation, suicide attempts, and suicide (Office for Victims of Crime, 2021).[1]

To summarize, while overall mortality tends to be pro-cyclical and decrease during recessions, deaths attributed to suicide and drug use tend to be counter-cyclical and increase with economic downturns. However, the relationship between economic activity and mortality varies by race. The counter-cyclical relationship between deaths of despair and economic expansion has been found most consistently for non-Hispanic white men. Given the complex relationship between economic activity and sexual and gender-based violence against Native American women, the relationship between economic activity and deaths of despair may be different for Native Americans and differ by gender. In this paper, we examine the relationships between local labor market measures and deaths of despair for Native Americans. Our access to restricted-use mortality data allows us to explore how deaths attributed to suicide, drug use, and alcohol use are related to local economic conditions for Native Americans.

2 Data

2.1 Data on Deaths

One of the limiting factors in understanding deaths of despair among Native Americans is the lack of detailed data. Publicly available data on mortality by sub-national geography (state, county) suppress outcomes with fewer than 10 observations. This means data on specific causes of death (e.g., suicide, drug use, or alcohol use) are suppressed for Native Americans except for a few high population areas with large clusters of Native Americans (such as New York City or Los Angeles). Thus, official public data on Native American mortality are unavailable at the local

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[1]The MMIWG epidemic may be connected to deaths of despair due to mis-coding of the causes of death of Native American women. Stereotyping may result in deaths being attributed to suicide, drug use, or alcohol use when they are in fact murders. If the murders of Native American women and girls increase with local economic expansions, then this could increase recorded deaths of despair. The Urban Indian Health Institute recently tracked missing and murdered Indigenous women cases reported in 40 cities across the United States through news reports, social media, advocacy sites, and government missing persons databases. They found that 42% of cases were not classified in law enforcement records as murders or missing persons, and instead many of these cases were coded as suicides or accidental overdoses (Lucchesi and Echo-Hawk, 2018).

labor market level in most cases. Another way this manifests in data on health outcomes is that small racial or ethnic groups are often categorized as "Other" and are not separately reported due to confidentiality or privacy issues. While this is an important data privacy protection, it makes it exceedingly difficult to identify smaller race and ethnic groups in public-use data.

We overcome this issue by using confidential-use data from the U.S. National Center for Health Statistics (NCHS). This allows us to a) provide a complete picture of Native American causes of death for the period 2005 to 2017; b) disaggregate Native American deaths by cause of death, age, and gender; and c) link additional economic variables at the county level to determine associations between underlying economic conditions and deaths of despair for Native Americans. This data contain all death certificates for U.S. residents issued from 2005 to 2017. We use the NCHS restricted-use microdata in order to identify Native American mortality across different geographic units in the U.S. This allows us to merge economic conditions to precise geographic units to the location where these deaths occurred at a particular time.

The data contain information on the county where the death was recorded; race, gender and age of the person who died; education level; and causes of death (ICD-10 codes). We code whether a person died from a death of despair - specifically, deaths from suicide, drug use, or alcohol use - or from any other cause. In Appendix Table A.1, we provide the list of ICD-10 codes used to categorize "deaths of despair".

Native Americans have some of the highest rates of misclassification on death certificates (Sorlie et al., 1992; Espey et al., 2014; Anderson et al., 2014; Arias et al., 2016; Stehr-Green et al., 2002; Dougherty et al., 2019; Noymer et al., 2011). This stems from a lack of awareness or the inability to assess racial or ethnic differences by coroners, morticians and other medical professionals. Therefore, in many cases, individuals are misrepresented on death certificates leading to an under reporting of deaths. In addition, in recent decades the numbers of American Indians and Alaska Natives have increased at rates exceeding natural population increases (Passel, 1997). These increases have been attributed to changing perceptions and acceptance of multi-racial categories and of Native American heritage (Eschbach, 1993; Eschbach et al., 1998; Liebler et al., 2016). As a result, the definition of Native American and the characteristics of that population has changed dramatically over the past few decades. Some of these changes can be attributed to economic and social changes, while other changes may be due to a change in group composition as people have started to increase their self-identification as Native American in U.S. Census and other survey data.

To address racial misclassification on death certificates, we weight the death certificates in our analysis by the estimated inverse of the probability that the death was recorded correctly. We estimate this probability based on the analysis in Arias et al. (2021) who use linked Census-mortality data to identify the "classification ratio." The classification ratio is the number of deaths among people who self-reported their race as American Indian/Alaska Native (AIAN) on the Census divided by the number of deaths reported on the death certificated as AIAN. These ratios are typically greater than 1, indicating that a significant portion of self-identified AIAN people

are not reported as AIAN on their death certificate Arias et al. (2021). The classification ratios are reported by gender and broad cause of death. In our analyses, we weight each death by the classification ratio to adjust for the racial misclassification on death certificates.

2.2 Conditional probability of death versus mortality rates

Our measure differs from previous work in an important way. Most research in this area analyzes mortality **rates** or deaths per 100,000 people. To compute the annual county mortality rate, we need both the number of deaths and the estimated population in a county each year. Annual county-level population estimates for Native Americans without a college degree are not available in many counties. This means we are unable to compute annual mortality rates, particularly in rural areas.

An alternative approach would be to estimate the mortality rate for Native Americans at all levels of education. Intercensal estimates of the Native American population within each county are available - so these mortality estimates are possible to compute. However, this approach has two serious weaknesses. First, the annual intercensal county population estimates are based on extrapolation from the decennial Census, which has had significant measurement error for Native Americans (US Census Bureau, 2022). Measurement error in population estimates is likely be correlated with local labor market activity due to higher levels of migration, leading to bias in the mortality rate estimate. Second, because the previous literature has found that deaths of despair are far more common among those without a college degree, we do want to focus on this population specifically.

Thus, in this paper, we analyze if an individual's death was attributed to drug use, alcohol, and suicide conditional on the person having died. At the aggregate level, this can be interpreted as the **proportion** of all deaths that are attributed to these causes. Unlike mortality rates, the proportion of deaths attributed to a specific cause will increase for one of two reasons: Either deaths attributed to that specific cause increases or deaths from all other causes decreases. For example, higher levels economic activity could increase the number of miles driven on average; this will increase the number of deaths from car collisions and therefore reduce the proportion of deaths from a "death of despair."

We compare the relationship between economic conditions and the proportion of deaths attributed to despair for Native Americans to that relationship for white Americans. A difference between these relationships would imply either a different relationship between economic conditions and the number of deaths attributed to deaths of despair or the number of deaths attributed to all other causes. Mortality rates while in principle have a clearer interpretation, the noise inherent in these estimates at the county level lead us to focus on the proportion of deaths.

2.3 Economic Conditions at the County Level

To examine the associations between local economic conditions and deaths of despair, we construct four measures of local labor market conditions using U.S. Census and Bureau of Labor Statistics (BLS) data. These data are then merged to the NCHS data at the county level by year. We

construct four measures of local labor market conditions: 1) the proportion of the working age population in each county that is in the labor force, 2) the proportion employed 3) the unemployment rate, and 4) the number of employees (resident and non-resident) divided by the number of residents in the county. The first three measures follow Case and Deaton (2020) and are all examined for the sake of robustness. The fourth measure estimates local employment opportunities, but also measures the size of the potentially transitory workforce in a county. We use this last measure because fossil fuel extraction and mining industries can result in large transitory populations in a region, which has been a concern among advocacy groups for the safety of Native American and Indigenous women (Honor the Earth, 2018).

We construct the employment to population ratio using the BLS Local Area Unemployment Statistics (LAUS) count of employed residents and divide that by the U.S. Census Bureau estimate of the county population for residents aged 15 to 64 (U.S. Bureau of Labor Statistics, 2021; United States Census Bureau, 2021b). We also use the LAUS to determine county-level unemployment rates and the labor force participation rate. We estimate the employee to population ratio by dividing employees reported in the County Business Patterns (CBP) data by the Census Bureau population estimates (United States Census Bureau, 2021a,b).

3 Methods

We use the restricted-use NCHS data to calculate the proportion of all deaths attributed to deaths of despair over time by age, race and gender. Our analysis focuses on individuals who do not have a bachelor's degree to align with existing research on deaths of despair (Case and Deaton, 2020). The 2019 American Community Survey estimates that approximately 79% of Native Americans ages 25 and older have less than a bachelor's degree, thus, our analysis effectively includes most of the Native American population. Research on economic opportunity and deaths of despair initially focused on adult males ages 45 to 54 but we include Native Americans starting at 15 years of age because, as shown below, deaths of despair occur at much younger ages for Native Americans than for non-Hispanic whites.

We begin by confirming previous findings of increased deaths of despair among both non-Hispanic white Americans and Native Americans who do not have a college degree. We then examine the distribution of age at death for deaths of despair among non-Hispanic white Americans and Native Americans. We conclude by examining the association between deaths of despair and local economic conditions.

To examine the association between local economic conditions and deaths of despair, we merge the NCHS data at the county level to the LAUS and CBP data. We then test whether the proportion of deaths linked to deaths of despair varies by the economic opportunities for the county where the death occurred. We use the following linear probability model regression framework for that analysis:

$$Despair_{icy} = \delta_0 + \delta_1 \times x_{cy} + \tau_y + \epsilon_{icy} \tag{1}$$

In Equation 1, $Despair_{icy}$ is a dichotomous variable indicating if person i in county c in year y died from a death of despair (as defined earlier). $Despair_{icy}$ is measured at the individual level. The economic measures are indicated by x_{cy} in the equation above and vary over county and year. These economic measures at the county level are employees per resident, employment rate, labor force participation rate, and unemployment rates. To account for secular changes over time, we include year fixed effects, τ_y in all regressions. We cluster standard errors by county. We also examine whether changes in economic conditions within the same county over time have a relationship with deaths of despair by including county fixed-effects in regressions based on Equation 1. We separate the regression analysis by reported gender and two broad age groups, because there are potentially different relationships by gender and age with deaths of despair for Native Americans. In total, we estimate 16 regressions for Equation 1 for Native Americans (4 measures of county-level economic activity $\times$ 2 genders $\times$ 2 age groups =16 regressions).

We then directly compare the results of Equation 1 for non-Hispanic white Americans with Native Americans. We repeat our analysis but include all deaths that occurred at age 15 or older and compare the regression results for Native Americans with non-Hispanic white Americans. We do not stratify by age in this comparison, because Native Americans and non-Hispanic white Americans die from the same causes at different ages making a within age group comparison difficult to interpret. This analysis will examine whether the relationship between economic measures and deaths of despair differ for Native Americans and non-Hispanic white Americans.

Finally, we examine the component parts of "deaths of despair" by separating out the three categories of deaths comprising the "deaths of despair" measure: deaths attributed to alcohol, suicide, or drug use. We employ the same regression model detailed in Equation 1 with each of these causes of death as a separate outcome variable. This additional analysis will provide insight into whether there are differences in the relationship between economic conditions and these individual causes of death.

4 Results

4.1 Increasing Deaths of Despair

Our analysis focuses on Native Americans and their situation relative to non-Hispanic white Americans. Figure 1 presents the proportion of all deaths that occurred at age 15 and above that are due to deaths of despair for both Native American and non-Hispanic white women and girls in the top two panels.[2] The left side figure shows the proportions of death for Native American women and girls between 2005 and 2017 for three different causes: suicide, alcohol use and drug use. The right side figure shows the same data for non-Hispanic white women and girls over the same time period. We find that the proportion of deaths for Native American women and girls due to despair related causes is around 10% of all deaths while it is less than a quarter of that for non-Hispanic white women and girls. The proportion of total deaths due to drug-related causes for Native

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[2]Results for African American women and girls (and men and boys) are available upon request.

Americans ranges between 2 and 3 % while it ranges between 1 and 2 % for non-Hispanic whites. The proportion of deaths related to alcohol starts at 5% and increases to almost 7% over this time period for Native Americans, while for non-Hispanic whites it is consistently 1.5%. Finally, suicide is approximately 2% of deaths for Native Americans while it is about 1% for non-Hispanic whites.

The bottom panels of Figure 1 provide the same analysis for Native American and non-Hispanic white men and boys over the 2005 to 2017 time period. The left side panel shows that the overall proportion of deaths of despair for Native American men and boys ranges between 14 and 17% while it ranges between 5 and 8% for non-Hispanic white men and boys over this period. The proportion of Native American deaths related to alcohol is quite a large proportion of all of the deaths of despair (approximately two-thirds of all deaths of despair) while it is approximately one third of deaths of despair for non-Hispanic white men and boys. The proportion of deaths due to suicide and drug related causes are broadly similar across the Native American and non-Hispanic white populations as a proportion of total deaths. This differs from what we found for women and girls.

For all four groups, we find that there was a general increase over the 2005 to 2017 period in deaths of despair. Among Native Americans, proportionately more deaths are attributed to "deaths of despair" causes than non-Hispanic whites. Among Native American men and boys, these deaths are more likely to be alcohol-related.

4.2 Age Distribution of Selected Causes of Death by Race Group

In Figure 2, we present the age distribution of deaths that are attributed to alcohol use, suicide, and drug use among Native Americans and non-Hispanic whites by gender. The top row of Figure 2 shows the distribution of age at death due to alcohol-related causes for women and girls (left panel) and men and boys (right panel). The green bars indicate the distribution for Native Americans and the gray bars indicate the distribution for non-Hispanic whites. Alcohol-related deaths occur at younger ages and more frequently for Native Americans than for non-Hispanic whites for both genders. The mean age at death (denoted by a vertical line) for Native Americans is significantly lower than for non-Hispanic whites in both distributions.

The second row of Figure 2 provides the same analysis for deaths attributable to suicide. There is a pronounced rightward skew for the distribution of deaths for both race groups and genders; suicides tend to occur primarily in young people. However, the skew for both Native American females and males is much more pronounced than for non-Hispanic whites. In fact, the highest incidences of death by suicide (mode) occurs in the late teens and early 20s for Native Americans while it is in the mid 50s for non-Hispanic whites. In general, these results indicate that for Native Americans, suicide occurs at significantly younger ages. This is consistent with previous research on rising suicide rates among young Native Americans (Curtin and Hedegaard, 2019; Dorgan, 2010; Gray and McCullagh, 2014; National Academies of Sciences, Engineering, and Medicine, 2019).

In contrast, the final row in Figure 2 shows the age distribution among deaths attributed to drug use. The Native American and non-Hispanic white age distributions are nearly identical.

Similarly, the average age at death among deaths attributed to drug use for Native Americans is just slightly lower than the age at death for non-Hispanic white Americans whose deaths were attributed to drug use. The three main components of "deaths of despair" - alcohol, suicide, and drug use - have distinct patterns, with Native Americans dying at younger ages from alcohol use, dramatically younger ages from deaths attributed to suicide, but at the same ages from deaths attributed to drug use.

Prior work has focused on diminished economic opportunities for middle aged non-Hispanic white males, but we demonstrate that a large proportion of deaths of despair occur at much younger ages for Native Americans of both genders. This suggests that potentially different forces influence the occurrence of deaths of despair between Native Americans and non-Hispanic whites.

4.3 Association of Economic Conditions and Deaths of Despair at the County Level

The rise in non-Hispanic white deaths of despair has been linked to decreased economic opportunities in traditional blue-collar sectors and a perceived fall in relative group status (Siddiqi et al., 2019) because the deaths are concentrated among those who do not have a college degree (Case and Deaton, 2015) and in areas with lower labor force participation (Case and Deaton, 2020). The results from the previous section indicate that there is a significant concentration of deaths of despair, especially alcohol-related and suicide deaths, at younger ages for Native Americans. In this section, we examine the relationship between economic opportunity and deaths of despair among Native Americans between the ages of 15 and 29 and between 30 and 64. We focus on four measures of economic opportunity in each county: employees per resident, employment rate, labor force participation rate, and unemployment rate.

Table 1 provides the estimated associative relationship, δ_1, between a death being attributed to despair and economic conditions based on Equation 1 in each population category (age group by gender) for Native Americans. To interpret the results in Table 1, it is important to note that the four measures of economic conditions have different units. The first measure, employees per resident, is a ratio that typically varies between 0 and 1, but can go above 1 in counties with large numbers of employees who live outside the county in which they work. The next two measures, employment rate and labor force participation rate, are both proportions and therefore range from 0 to 1. The fourth measure, county unemployment rate, is reported in percentage points and thus ranges between 0 to 100. For all regressions, the outcome variable is a dichotomous variable that indicates if the death was attributed to drug use, alcohol, or suicide. The most important outcomes in Table 1 are the signs of the coefficients rather than the specific magnitudes - the sign on the coefficients show if a higher/lower proportion of deaths is attributed to drug use, alcohol use, or suicide in counties with differing levels of economic activity. Importantly, this does not indicate whether it is more likely for someone to die - only whether a death is more likely to be attributed to drug use, alcohol, or suicide.

For Native American women and girls in the both age groups there is a positive and statistically significant relationship between proportion of the county in the labor force and deaths attributed

to drug use, alcohol, or suicide. We find that there are non-negative relationships between the proportion of deaths attributed to of a death of despair for Native American women and girls and the various county-level measures of employment - the relationships are either positive or not statistically significant. The results found in the first two columns are contrary to the conventional wisdom that deaths of despair are driven by poor economic conditions. For Native American women and girls there is a general a positive or non-negative relationship between "deaths of despair" with economic conditions that has not been shown to exist for other populations.

The next two columns provide analogous results for Native American men and boys in the same two broad age categories. There are two results that are worth noting. The first is that there is no systematic finding across all of the employment related measures and deaths of despair for Native American men and boys. This is a contrast to previous findings for non-Hispanic white men without college degrees where poorer employment opportunities were associated with increased deaths of despair (Case and Deaton, 2015, 2017; Stein et al., 2017; Knapp et al., 2019; Monnat, 2016). We find no statistically significant relationship between employment measures and deaths of despair among either age group. There is neither a consistently positive nor negative relationship between measures of economic activity and deaths of despair. These results indicate that there may be other factors influencing the relatively high proportion of deaths of despair for Native American men. This population may not experience the reduction in economic or social status that was found for non-Hispanic white men because structural racism has already played a role for this community across multiple generations. Thus, the deaths of despair may not be related to current changes and differences in economic opportunities, but instead is a legacy of centuries of racism and deprivation (Feir, 2016; Feir et al., 2019).

To examine the relationship between mortality and economic activity within the same county over time, we use a regression with both county and year fixed effects and present these results in Appendix Table A.2. The patterns for Native American women and girls in this table show little relationship with economic factors, except for a positive relationship between unemployment rate and deaths attributed to drug use, alcohol use, and suicide. We take these results to mean that the relationship between economic activity and deaths of despair is related to cross-county differences rather than within county changes over time for women and girls. This is consistent with the finding from Case and Deaton (2015, 2020) that increasing deaths of despair are due to long term changes rather than short term shocks.

Table 2 analyzes the same regression model for Native Americans and non-Hispanic whites who have less than a college degree aged 15 and above (including those over age 65). Table 2 shows that among Native American women and girls, there is a statistically significant and positive relationship between the proportion of death attributed to a "deaths of despair" and employees per resident, proportion employed, and proportion in the labor force. These coefficients are similar direction to those in Table 1, but are statistically significant because of a larger sample size.

Consistent with the previous literature (Case and Deaton, 2015, 2020), the reverse relationship is true for non-Hispanic white women. Counties with higher employees per resident, proportion

employed, and proportion in the labor force have a lower proportion of deaths that are attributed to alcohol, suicide, and drug use. Among non-Hispanic white women and girls, counties with higher unemployment rates have a higher proportion of deaths of despair. Similarly, counties with higher proportion employed, and proportion in the labor force have a lower proportion of deaths that are attributed to alcohol, suicide, and drug use among non-Hispanic white men.

4.4 Examining Specific Types of Deaths of Despair - Alcohol, Drug use, and Suicide

Three main components are typically included in "deaths of despair" - deaths attributed to alcohol use, drug use, and suicide. These different sub-components could have distinct relationships with economic conditions. For example, increased local employment could simultaneously have a positive impact on psychological well-being while also increasing alcohol and drug use through increased income or local supply of opioids. Previous critiques of the deaths of despair literature have noted that combining these deaths together can obscure the mechanisms behind the rising deaths (Ruhm, 2021). To explore this possibility, we repeated the analysis from Table 1 but replaced $Despair_{icy}$ with the specific type of despair-related death: alcohol use, suicide, or drug use.

As shown in Table 3, among young Native American women and girls, the proportion of deaths from suicide are negatively associated with positive economic conditions. However, the proportion of drug-related deaths are positively associated with economic conditions. For older Native American women, the proportion of deaths attributed to suicide have a weak negative association with economic conditions, while the proportion of deaths from alcohol use drug use have a positive but not statistically significant association with economic conditions. Among Native American women and girls, the proportion of deaths attributed to drug and alcohol use function very differently than the proportion of deaths attributed to suicide, even though all three are considered "deaths of despair" in the literature on non-Hispanic white Americans. Similarly, Table 4 shows that the proportion of deaths attributed to suicide has a strong negative association with economic conditions for Native American men in both age groups. The proportion of deaths attributed to drug use are positively associated with economic conditions for the younger age group and to a lesser extent among the older age group.

In contrast, Table 5 displays the results for non-Hispanic white deaths for those age 15 and above when examining the specific type of despair-related death: alcohol use, suicide, or drug use. For non-Hispanic white deaths, the overall results are consistent with the deaths of despair literature: the proportion of deaths attributed to drug use, suicide, and alcohol use are all typically higher in areas with lower economic activity. The three types of deaths tend to move together - the proportion of deaths attributed to all three types of deaths of despair decrease as economic measure increase (eg, higher proportion employed, higher proportion in the labor force, lower unemployment rate). The only exception to this pattern is for the employees/resident measure: there is a slight positive relationship for the proportion of suicide-attributed deaths (non-Hispanic white women) and the proportion of alcohol-related and suicide-attributed deaths (non-Hispanic

white men).

To compare the Native American results to the non-Hispanic white results in the previous table, Table 6 combines all age groups for Native Americans. The results show a persistent positive relationship between economic outcomes and higher the proportion of deaths due to alcohol or drug use for Native American males and females. This is in stark contrast to the results for non-Hispanic whites presented in Table 5.

5 Discussion

We find that deaths attributed to drug use, alcohol use, and suicide comprise a larger proportion of deaths among Native Americans than non-Hispanic whites in the U.S. In particular, the proportion of deaths associated with alcohol use is substantially larger for Native Americans than for non-Hispanic whites. In addition, the proportion of deaths due to suicide among Native American women and girls is larger than for non-Hispanic white women and girls. We also find that these deaths occur at predominantly younger ages for Native Americans - deaths by suicide and alcohol-related deaths are most common during young adulthood for Native Americans and mid-life for non-Hispanic whites. Clearly, different factors are influencing the incidence of deaths from these causes across these racial groups.

"Deaths of despair" among Native Americans are not just more common than among non-Hispanic white Americans, but are also related to county-level economic opportunities in different ways - complicating the previous conclusions that these deaths reflect "despair" from declining economic opportunities. The proportion of deaths attributed to drug use and alcohol use are *higher* in counties with greater employment - the opposite is true for non-Hispanic white Americans. For Native American women and girls, stronger local labor markets are so strongly associated with the proportion of deaths from drugs and alcohol use that it overwhelms the declines in the proportion of deaths attributed to suicide. In other words, the proportion of deaths attributed to "despair" for Native American women and girls increase as the local labor market measures increase, even though the proportion of deaths attributed to suicide decline. For Native American men and boys, the decline in the the proportion of deaths attributed to suicide with stronger labor markets counteracts the increased the proportion of a death attributed to drugs or alcohol, resulting in an overall zero relationship between the local labor market and the proportion of deaths attributed to "deaths of despair." This positive relationship between economic conditions and the proportion of deaths attributed to drug and alcohol use directly contrasts the findings for non-Hispanic white Americans. This highlights an important element that has been overlooked in previous discussions related to deaths of despair - general measures of local employment may have very different effects on different social groups.

The specific mechanisms for the positive relationship between economic conditions and the proportion of deaths attributed to drug and alcohol use remain unclear. It is possible that economic activity increases income and/or the local supply of drugs or alcohol, making both more accessible. In addition, if increases in local employment drive an increase in human trafficking and sexual

violence, then it may result in more deaths from drug or alcohol use as a downstream effect of sexual violence and trafficking. Deaths of despair may be a hidden component of the Murdered and Missing Indigenous Women and Girls epidemic.

If more economic activity increases violence against Native American women and girls, then our finding that increased local employment is associated with more deaths attributed to accidental overdose among Native American women and girls is consistent with murders being incorrectly recorded. However, we do not find an association between local economic conditions and deaths from homicide or murder, which suggests that this channel of misclassification would have to be extreme and selective to explain our results.

Our results may be due to the fact that local measures of average employment may not reflect employment opportunities for Native American men and women. Unemployment rates for Native American men are consistently higher than the overall unemployment rate (Allard and Brundage, 2019) but as long as they track with general local unemployment rates, we would expect to see some positive relationship. However, our results indicate that poor local economic conditions are not associated with higher proportions of Native deaths from "deaths of despair." Rather, it seems that "good" local employment conditions may be associated with worse outcomes for Native women and girls.

Deaths from drug use, alcohol use, and suicide are of extreme importance for public health. Deaths attributed to these causes account for a larger proportion of deaths among Native American men and boys and women and girls than other populations and they occur at significantly younger ages. It is essential to recognize that county-level employment may have different relationship to deaths from drug use and alcohol use among different groups - lower among non-Hispanic white Americans but higher among Native Americans. As policy makers consider how to reduce deaths of despair, disparate impacts of general local economic conditions must be taken into account. Our research provides some evidence that improvements in economic conditions alone may not sufficiently reduce the continuing problem of deaths of despair among Native Americans.

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Figures

Figure 1: Proportion of all deaths from deaths of despair for Native American women and girls (top left panel), non-Hispanic white women and girls (top right panel), Native American men and boys (bottom left panel), and non-Hispanic white men and boys (bottom right panel), 2005 to 2017. Includes deaths at age 15 or older for those who do not have a college degree. Includes deaths where the primary cause of death is suicide, alcohol use, or drug use. Graphs for Native Americans use weights to correct racial misclassification on the death certificate.
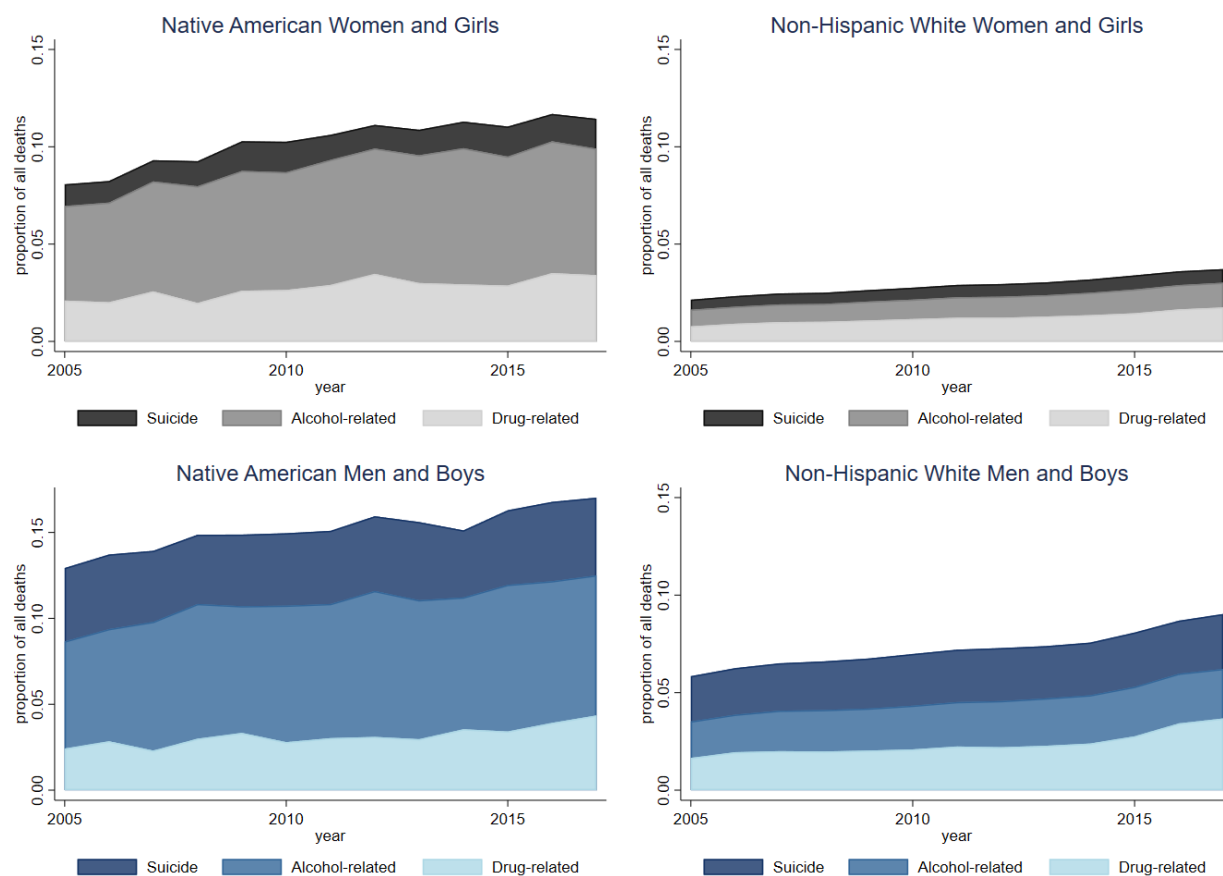
Figure 2: Distribution of age at death for deaths attributed to alcohol use, suicide, and drug use among Native Americans and non-Hispanic whites who do not have a college degree, 2005 to 2017. Women and girls are shown in the left panel; men and boys are shown in the right panel. Average age at death is indicated with a vertical line.
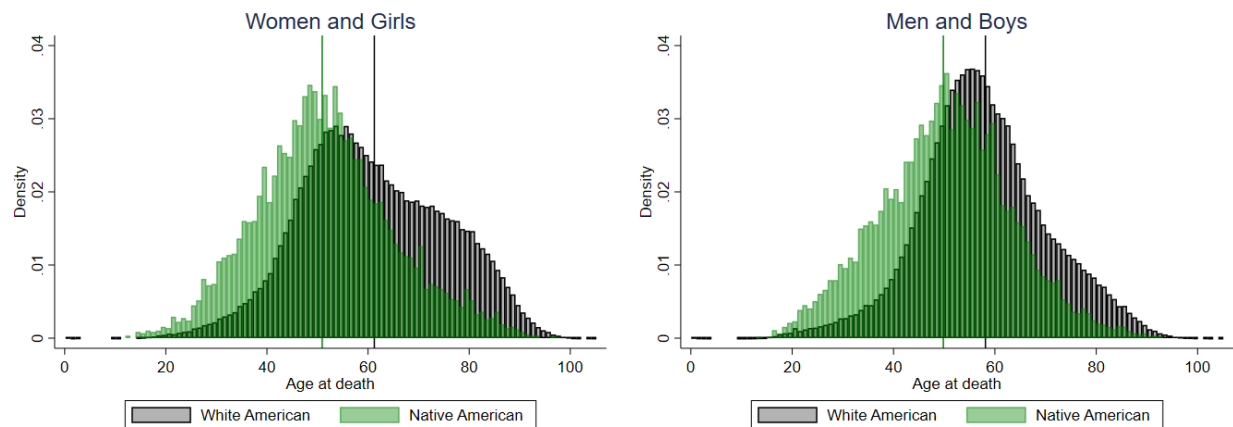
(a) Deaths attributed to alcohol
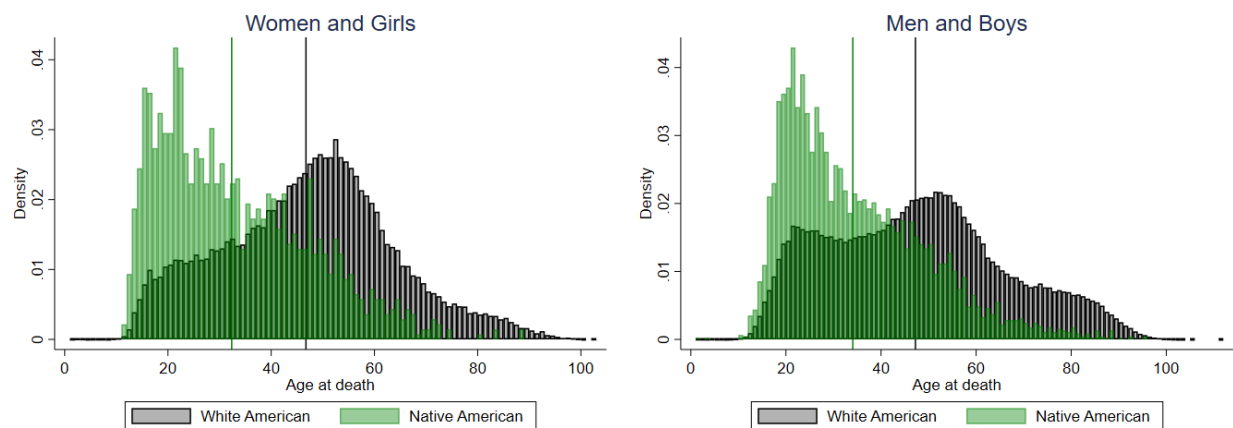
(b) Deaths attributed to suicide
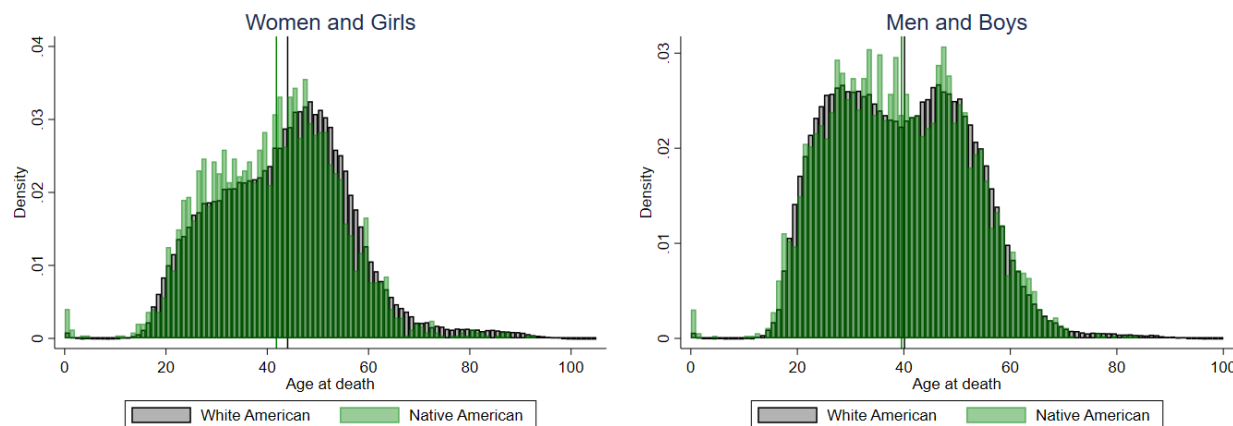
(c) Deaths attributed to drug use

Table 1: Regression results for Native Americans - Relationship between having died from a "death of despair" and employment measures in the county where the death occurred

Age group	Women and Girls		Men and Boys	
	15 to 29	30 to 64	15 to 29	30 to 64
Model 1: Employees per resident	0.109	0.0226	-0.0219	-0.0441
Mean: 0.340	(0.0778)	(0.0567)	(0.0632)	(0.0455)
Model 2: Proportion employed	0.140	0.103	0.0347	0.00217
Mean: 0.676	(0.102)	(0.0669)	(0.0807)	(0.0804)
Model 3: Proportion in the labor force	0.192*	0.118*	0.0525	0.0142
Mean: 0.723	(0.104)	(0.0706)	(0.0794)	(0.0855)
Model 4: Unemployment rate	0.00249	-0.000667	0.00192	0.00213
Mean: 6.74	(0.00377)	(0.00198)	(0.00335)	(0.00234)
% of Deaths	32.5	21.1	38.5	23.0
# of Deaths	3,906	31,851	9,133	49,098

Results of 16 linear probability model regressions using Equation 1 for Native American women and girls and Native American men and boys. All regressions include year fixed effects and are restricted to individuals with less than a bachelor's degree and age 15 or older. Regressions and summary statistics use weights to correct for racial misclassification on death certificates. Percent of deaths = percentage of deaths due to deaths of despair. Robust standard errors are in parentheses, clustered by county. Significance stars: *** p<0.01, ** p<0.05, * p<0.1

Source: Restricted-use NCHS mortality data, County Business Patterns, Local Area Unemployment Statistics, and intercensal population estimates, 2005 to 2017.

Table 2: Regression results for both non-Hispanic white Americans and Native Americans - Relationship between having died from a "death of despair" and employment measures in the county where the death occurred. Population with less than a bachelor's degree.

	Women and Girls (15+)		Men and Boys (15+)	
	Native	White	Native	White
Model 1: Employees per resident	0.0650*	-0.00451*	-0.0236	-0.00435
	(0.0354)	(0.00249)	(0.0363)	(0.00430)
Model 2: Proportion employed	0.108***	-0.0399***	0.00894	-0.0322***
	(0.0370)	(0.00392)	(0.0618)	(0.00749)
Model 3: Proportion in the labor force	0.116***	-0.0408***	0.0132	-0.0325***
	(0.0385)	(0.00395)	(0.0640)	(0.00759)
Model 4: Unemployment rate	-0.00185	0.000986***	0.000925	0.000852***
	(0.00121)	(0.000162)	(0.00197)	(0.000278)
Number of deaths	87,398	11,041,833	105,611	9,942,648

Results of 16 linear probability model regressions using Equation 1 for non-Hispanic white and Native American women and men. All regressions include year fixed effects and are restricted to individuals who have less than a bachelor's degree and are age 15 and older. Robust standard errors are in parentheses, clustered by county. Significance stars: *** p<0.01, ** p<0.05, * p<0.1

Source: Restricted-use NCHS mortality data, County Business Patterns, Local Area Unemployment Statistics, and intercensal population estimates, 2005 to 2017.

Table 3: Regression results for Native American women and girls - Relationship between having died from alcohol use, drug use, or suicide with employment measures in the county where the death occurred.

	Women and Girls (15 to 29)			Women and Girls (30 to 64)		
	Alcohol use	Suicide	Drug use	Alcohol use	Suicide	Drug use
Model 1: Employees per resident	0.0117	-0.111***	0.208***	0.0358	-0.0203***	0.00709
Mean: 0.340	(0.0372)	(0.0409)	(0.0635)	(0.0467)	(0.00613)	(0.0293)
Model 2: Proportion employed	-0.0207	-0.144**	0.305***	0.0795	-0.0103	0.0335
Mean: 0.676	(0.0470)	(0.0658)	(0.0752)	(0.0800)	(0.00893)	(0.0355)
Model 3: Proportion in the labor force	-0.00983	-0.148**	0.350***	0.0795	-0.00712	0.0460
Mean: 0.723	(0.0479)	(0.0701)	(0.0776)	(0.0854)	(0.00943)	(0.0362)
Model 4: Unemployment rate	0.00203	0.00375*	-0.00328	-0.00201	0.000772**	0.000573
Mean: 6.74	(0.00192)	(0.00199)	(0.00264)	(0.00210)	(0.000313)	(0.00113)
Percent of deaths from this cause	7.1	13.9	11.5	13.3	1.8	6.0
Number of deaths	3,906	3,906	3,906	31,851	31,851	31,851

Results of 24 linear probability model regressions using Equation 1 for non-Hispanic white and Native American women and men. All regressions include year fixed effects and are restricted to individuals with less than a bachelor's degree and age 15 or older. Regressions and summary statistics use weights to correct for racial misclassification on death certificates. Robust standard errors are in parentheses, clustered by county. Significance stars: *** p<0.01, ** p<0.05, * p<0.1

Source: Restricted-use NCHS mortality data, County Business Patterns, Local Area Unemployment Statistics, and intercensal population estimates, 2005 to 2017.

Table 4: Regression results for Native American men and boys - Relationship between having died from alcohol use, drug use, or suicide with employment measures in the county where the death occurred.

	Men and Boys (15 to 29)			Men and Boys (30 to 64)		
	Alcohol use	Suicide	Drug use	Alcohol use	Suicide	Drug use
Model 1: Employees per resident	-0.000923	-0.254***	0.233***	0.00589	-0.0704***	0.0204
Mean: 0.340	(0.0276)	(0.0535)	(0.0351)	(0.0405)	(0.0138)	(0.0162)
Model 2: Proportion employed	-0.00607	-0.208***	0.249***	0.0298	-0.0691***	0.0414*
Mean: 0.676	(0.0400)	(0.0762)	(0.0458)	(0.0801)	(0.0212)	(0.0229)
Model 3: Proportion in the labor force	-0.00652	-0.197***	0.256***	0.0283	-0.0667***	0.0527**
Mean: 0.723	(0.0406)	(0.0743)	(0.0486)	(0.0839)	(0.0225)	(0.0226)
Model 4: Unemployment rate	0.000312	0.00881***	-0.00720***	-0.000557	0.00266***	2.29e-05
Mean: 6.74	(0.00167)	(0.00330)	(0.00148)	(0.00237)	(0.000851)	(0.000930)
Percent of deaths from this cause	6.1	23.0	9.4	13.4	4.5	5.0
Number of deaths	9,133	9,133	9,133	49,098	49,098	49,098

Results of 24 linear probability model regressions using Equation 1 for non-Hispanic white and Native American women and men. All regressions include year fixed effects and are restricted to individuals with less than a bachelor's degree and age 15 or older. Regressions and summary statistics use weights to correct for racial misclassification on death certificates. Robust standard errors are in parentheses, clustered by county. Significance stars: *** p<0.01, ** p<0.05, * p<0.1

Source: Restricted-use NCHS mortality data, County Business Patterns, Local Area Unemployment Statistics, and intercensal population estimates, 2005 to 2017.

Table 5: Regression results for non-Hispanic white Americans - Relationship between having died from alcohol use, drug use, or suicide with employment measures in the county where the death occurred.

	Women and Girls (15+)			Men and Boys (15+)		
	Alcohol use	Suicide	Drug use	Alcohol use	Suicide	Drug use
Employees per resident	-0.00497***	0.00421***	-0.00375***	0.00897***	0.0113***	-0.0247***
	(0.00142)	(0.00103)	(0.000742)	(0.00262)	(0.00195)	(0.00238)
Proportion employed	-0.0274***	-0.00700***	-0.00546***	-0.0181***	-0.00694***	-0.00720**
	(0.00252)	(0.00148)	(0.00111)	(0.00617)	(0.00252)	(0.00345)
Proportion in the labor force	-0.0277***	-0.00699***	-0.00606***	-0.0165***	-0.00702***	-0.00893**
	(0.00253)	(0.00154)	(0.00112)	(0.00633)	(0.00259)	(0.00352)
Unemployment rate	0.000749***	0.000181***	5.64e-05	0.000758***	0.000136	-4.20e-05
	(0.000103)	(5.42e-05)	(4.39e-05)	(0.000201)	(9.03e-05)	(0.000126)
Percent of deaths form this cause	1.1	0.6	1.2	2.3	2.6	2.4
Number of total deaths	11,041,833	11,041,833	11,041,833	9,942,648	9,942,648	9,942,648

Results of 24 linear probability model regressions using Equation 1 for non-Hispanic white women and men. All regressions include year fixed effects and are restricted to individuals who have less than a bachelor's degree and are age 15 and older. Robust standard errors are in parentheses, clustered by county. Significance stars: *** p<0.01, ** p<0.05, * p<0.1

Source: Restricted-use NCHS mortality data, County Business Patterns, Local Area Unemployment Statistics, and intercensal population estimates, 2005 to 2017.

Table 6: Regression results for Native American deaths - Relationship between having died from alcohol use, drug use, or suicide with employment measures in the county where the death occurred.

	Women and Girls (15+)			Men and Boys (15+)		
	Alcohol use	Suicide	Drug use	Alcohol use	Suicide	Drug use
Model 1: Employees per resident	0.0500**	-0.0127***	0.0278*	0.0186	-0.0745***	0.0323***
Mean: 0.340	(0.0254)	(0.00476)	(0.0162)	(0.0274)	(0.0133)	(0.0108)
Model 2: Proportion employed	0.0692*	-0.00843	0.0471***	0.0280	-0.0670***	0.0480***
Mean: 0.676	(0.0363)	(0.00693)	(0.0159)	(0.0517)	(0.0231)	(0.0130)
Model 3: Proportion in the labor force	0.0698*	-0.00730	0.0536***	0.0247	-0.0650***	0.0535***
Mean: 0.723	(0.0383)	(0.00714)	(0.0161)	(0.0537)	(0.0233)	(0.0131)
Model 4: Unemployment rate	-0.00182*	0.000452*	-0.000480	-0.000908	0.00262***	-0.000789
Mean: 6.74	(0.00104)	(0.000253)	(0.000527)	(0.00156)	(0.000977)	(0.000503)
Percent of deaths from this cause	6.2	1.3	2.8	7.8	4.2	3.2
Total number of deaths	84,636	84,636	84,636	101,988	101,988	101,988

Results of 24 linear probability model regressions using Equation 1 for Native American women and men. All regressions include year fixed effects and are restricted to individuals with less than a bachelor's degree and age 15 or older. Regressions and summary statistics use weights to correct for racial misclassification on death certificates. Robust standard errors are in parentheses, clustered by county. Significance stars: *** p<0.01, ** p<0.05, * p<0.

Source: Restricted-use NCHS mortality data, County Business Patterns, Local Area Unemployment Statistics, and intercensal population estimates, 2005 to 2017.

ONLINE APPENDIX

A   Appendix Tables

Table A.1: The ICD-10 codes used for "deaths of despair"

ICD-10 code	Description
X40 to X44	Drug overdose - accidental
F11, F12, F13, F14, F15, F16, F18, F19	Drug related disorder
Y10 to Y14	Drug overdose - undetermined intent
Y45, Y47, Y49	Adverse reaction to drug (opioid, barbiturate, amphetamine)
X45	Alcohol poisoning - accidental
F10	Alcohol abuse
Y15	Alcohol poisoning – undermined intent
K70, K73, K74	Alcohol-related liver issues
X60-84, Y87	Suicide
T40.0-T40.4, T40.6	Drug and alcohol contributing

Table A.2: Regression results for Native Americans - Relationship between having died from a "death of despair" and employment measures in the county where the death occurred. Includes county fixed effects.

	Women and girls		Men and boys	
	Ages 15 to 29	Ages 30 to 64	Ages 15 to 29	Ages 30 to 64
Model 1: Employees per resident	-0.142	-0.0637	0.243	0.0307
Mean: 0.340	(0.521)	(0.163)	(0.260)	(0.109)
Model 2: Proportion employed	-0.299	-0.0366	0.0559	0.109
Mean: 0.676	(0.270)	(0.106)	(0.167)	(0.0691)
Model 3: Proportion in the labor force	-0.0815	-0.0145	0.0661	0.172**
Mean: 0.723	(0.289)	(0.108)	(0.178)	(0.0753)
Model 4: Unemployment rate	0.0228***	0.00226	0.00283	0.00520**
Mean: 6.74	(0.00766)	(0.00237)	(0.00497)	(0.00233)
% of Deaths	32.5	21.1	38.5	23.0
Number of deaths	3,906	31,851	9,133	49,098

Results of 16 linear probability model regressions using Equation 1 with year and county fixed effects for Native American women and girls and Native American men and boys. All regressions include year fixed effects, county fixed effects, and are restricted to individuals who have less than a bachelor's degree and are age 15 years or older. Regressions and summary statistics use weights to correct for racial misclassification on death certificates. Robust standard errors are in parentheses. Errors are clustered by county. Significance stars: *** p<0.01, ** p<0.05, * p<0.

Source: Restricted-use NCHS mortality data, County Business Patterns, Local Area Unemployment Statistics, and intercensal population estimates, 2005 to 2017.

Data Availability

We will provide all public data and replication files used in this article via the authors' websites.

In addition, we will provide the replication files used on the restricted-use data. While we are not able to provide the restricted-use data itself, this will allow other researchers with NCHS-approved access to replicate our findings.