



# Racial and ethnic differences in alcohol-, opioid-, and co-use-related deaths in Washington State from 2011 to 2017

Oladunni Oluwoye<sup>a,\*</sup>, Liat S. Kriegel<sup>a</sup>, Karl C. Alcover<sup>a</sup>, Katherine Hirschak<sup>a</sup>, Solmaz Amiri<sup>b</sup>

<sup>a</sup> Elson S. Floyd College of Medicine, Washington State University, Spokane, WA, United States

<sup>b</sup> Department of Nutrition and Exercise Science, Washington State University, Spokane, WA, United States

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## ABSTRACT

**Background:** Few studies exist examining alcohol and opioid co-use mortality rates among racially and ethnically diverse communities, presenting a critical gap in understanding the contribution of alcohol on opioid-related deaths and strategies for prevention. The purpose of the study was to assess whether alcohol and opioid-related deaths differ by race/ethnicity subgroups and if there has been an increase in alcohol and opioid-related deaths between 2011 and 2017.

**Design:** Secondary data analysis of publicly available alcohol and opioid mortality data among non-Hispanic Whites, Black, Hispanic, Asian/Pacific Islander, and American Indian/Alaska Native individuals in Washington State.

**Measurements:** The primary outcomes were alcohol-only, opioid-only, and alcohol-opioid co-use mortality, 2011–2017. Alcohol and/or opioid-related deaths were assigned an International Statistical Classification of Diseases and Related Health Problems (ICD-10) code for the underlying or multiple cause of death.

**Findings:** Between 2011 and 2017, alcohol-only mortality rates increased among non-Hispanic White ( $P = 0.003$ ) and Hispanic individuals ( $P = 0.008$ ). Opioid-only mortality rates increased among American Indian/Alaska Native ( $P = 0.004$ ) and Hispanic individuals ( $P = <0.001$ ). American Indian/Alaska Native individuals had the highest alcohol-only, opioid-only, and co-use-related mortality rates when looking at between-group incidence rates.

**Conclusions:** Although the opioid epidemic has been characterized as a public health crisis that predominantly impacts non-Hispanic White individuals, racial and ethnic minorities are increasingly impacted by fatal and non-fatal overdose related to co-occurring substance use. Our findings using data from Washington State, align with existing data and signal a dire need to address alcohol and opioid misuse through targeted interventions to prevent overdose and poisoning, with special considerations for American Indian/Alaska Native communities.

## 1. Introduction

Mortality rates associated with opioid use in the United States steadily increased between 1999 and 2017 (Gomes, Tadrous, Mamdani, Paterson, & Juurlink, 2018; Hedegaard, Warner, & Miniño, 2017; Scholl, Seth, Kariisa, Wilson, & Baldwin, 2019). In 2017, opioid overdose deaths accounted for approximately 47,000 deaths, which is roughly 70% of all drug overdose deaths (~67,000) (Hedegaard et al., 2017). Alcohol-related deaths receive less attention in the shadow of the opioid epidemic, however recent reports suggest alcohol-related deaths are on the rise (Spillane et al., 2020). Alcohol is often used

simultaneously with other drugs and when combined with opioids increases the risk of overdose and other adverse health consequences (Jones, Paulozzi, & Mack, 2014; Tori, Larochelle, & Naimi, 2020; Witkiewitz & Vowles, 2018). In 2015, data from a study conducted in San Francisco indicated 20% of opioid-related deaths also involved alcohol (Visconti, Santos, Lemos, Burke, & Coffin, 2015). Alcohol- and opioid-related deaths have increased over the last decade, and recent reports have identified higher mortality rates among racial and ethnic minorities (Lippold & Ali, 2020; White, Castle, Hingson, & Powell, 2020).

Evidence from two state reports suggests opioid-related deaths disproportionately affect non-Hispanic (NH) White individuals relative

\* Corresponding author at: Elson S. Floyd College of Medicine, 412 E. Spokane Falls Blvd, Washington State University, Spokane, WA 99202, United States.

E-mail addresses: [Oladunni.oluwoye@wsu.edu](mailto:Oladunni.oluwoye@wsu.edu) (O. Oluwoye), [liat.kriegel@wsu.edu](mailto:liat.kriegel@wsu.edu) (L.S. Kriegel), [alcoverk@msu.edu](mailto:alcoverk@msu.edu) (K.C. Alcover), [katherine.hirschak@wsu.edu](mailto:katherine.hirschak@wsu.edu) (K. Hirschak), [solmaz.amiri@wsu.edu](mailto:solmaz.amiri@wsu.edu) (S. Amiri).

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to other racial and ethnic groups. Contrary to these findings, however, studies in New York and California indicate that opioid overdose disproportionately impacts Black individuals in both states. In San Francisco, the age-adjusted mortality rate for opioid overdose among Black individuals was 51.1 per 100,000 compared to 26.5 per 100,000 among NH White individuals (Visconti et al., 2015). A recent study demonstrated that NH White individuals and American Indian/Alaska Native (AI/AN) individuals accounted for the highest alcohol-related mortality rates between 1999 and 2017, as compared to other racial and ethnic groups (White et al., 2020). Among Hispanic individuals, there are relatively few studies that have explored alcohol- and opioid-related mortality (Cano, 2020).

Numerous studies independently examined mortality rates due to opioid and alcohol use. However, less research examined alcohol and opioid co-use mortality rates, presenting a critical gap in understanding the impacts of alcohol co-use on opioid-related deaths. For this reason, we examined alcohol-related, opioid-related, and co-use-related deaths using Washington State mortality data from 2011 to 2017. We sought to analyze patterns of alcohol- and opioid- and co-use-related death rates by race/ethnicity and separately assess racial/ethnic differences in mortality rates by the type of underlying cause of death.

## 2. Methods

### 2.1. Data source and study population

This study used mortality data based on registered deaths reported to the Washington State Department of Health Services Center For Health Statistics (2018). Data was publicly available and obtained from Washington State Department of Health. According to US Census data the poverty rate in Washington is 9.8% and the racial and ethnic distribution is as follows: NH White individuals account for 70% to 73%, NH Black individuals account for 3%, AI/AN individuals account for 1%, Asian and Pacific Islander individuals account for 8% to 9%, Latinx individuals account for 11% to 12%, and NH Other individuals account for 4% to 5%. This study did not require approval from an Institutional Review Board for human subjects' research because all subjects were deceased. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (von Elm et al., 2007).

### 2.2. Variables

To be consistent with previous research, this study used the same *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)* codes and to capture deaths for which alcohol and/or opioids were the underlying cause and/or multiple cause of death (Lippold & Ali, 2020; Spillane et al., 2020; White et al., 2020). Alcohol or opioid-related deaths were assigned an ICD-10 code for underlying or multiple cause of death. Alcohol-related deaths included the following ICD-10 codes for underlying cause: X45, Y15, T51.0, T51.1, T51.9, X65, and R78.0; and alcohol-attributable causes: F10 through F10.9, G62.1, G31.2, G72.1, I42.6, K29.2, K70, K86.0, Q86.0, P04.3, O35.4. Opioid-related deaths included the following ICD-10 codes for underlying cause of death: R78.0, X40 through X45, X60 through X65, X85, Y10 through Y15; and ICD-10 codes opioid-attributable causes: T40.0 through T40.4, T40.6, and T51.9. Alcohol and opioid co-use related deaths were defined as any alcohol and opioid-related ICD-10 code (as described above) as either the underlying cause or contributing to the multiple cause of death.

The reporting of race/ethnicity for registered deaths in Washington is consistent with census reporting practices for race and ethnicity used by the US Office of Management and Budget (United States Office of Management and Budget, 1997). Race/ethnicity was recoded into six categories consistent with US Census reporting as follows: NH White, NH Black, NH AI/AN, NH Pacific Islander, and Hispanic/Latino, and NH

Other. Age at the time of death was stratified into 10-year age groups and included as a covariate.

### 2.3. Statistical analysis

Data were analyzed using Stata statistical software 15.1. Using ICD-10 specifications to identify the cause of death, we calculated the cause-specific number of deaths by race/ethnicity. Age-adjusted cause-specific mortality rates were estimated using the cause-specific number of deaths each year by fitting a Poisson regression model, controlling for age (categories: 15–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, 65–74 years, 75–84 years, and 85 years and older). Age adjustment was conducted using the 2011–2017 Washington State Department of Health population estimates of individuals age 15 and older (N = 5,461,155 in 2011 to N = 5,933,394 in 2017) (Center for Health Statistics, xxxx). To assess trends in mortality rates from 2011 to 2017, a Poisson regression model was fitted with year as the predictor, and then another model was fitted with age as covariate. We repeated each model for each race/ethnicity subgroup. To compare mortality rates between race/ethnicity subgroups, we estimated incidence rate ratios using Poisson regression model adjusting for year and age. All estimates are presented with their variance estimates, either P-value or 95% confidence intervals (CI).

## 3. Results

### 3.1. Trends in alcohol, opioid, and co-use related deaths by race/ethnicity

From 2011 to 2017, there were 13,011 deaths attributed to only alcohol-related causes, 4025 deaths attributed to only opioid-related causes, and 947 deaths attributed to both alcohol and opioid co-use. The number of deaths ranged from 1659 in 2011 to 2029 in 2017 for alcohol-only deaths, from 524 in 2011 to 629 in 2017 for opioid-related deaths, and from 123 to 151 in 2017 for co-use-related deaths. The mean (SD) age of mortality ranged from 57.5 (13.5) to 58.8 (13.0) for alcohol-only deaths, 42.6 (14.4) to 44.6 (14.4) for opioid-related deaths, and 43.3 (12.4) to 46.4 (13.4) for alcohol-opioid-related deaths.

Table 1 shows age-adjusted rates of alcohol-only-, opioid-only-, and co-use-related mortality. Subgroup analyses show increasing trends in rates from 2011 to 2017 (Table 2). Alcohol-only mortality rates increased among NH White individuals ( $\beta = 0.022$ ;  $P < 0.001$ ; adjusted  $\beta = 0.014$ ;  $P = 0.003$ ), from 6.5 (per million population, 95% CI = 6.1–6.8) in 2011 to 7.4 (95% CI = 7.0–7.7) in 2017. Similarly, mortality rates increased among Hispanic individuals ( $\beta = 0.062$ ;  $P = 0.001$ ; adjusted  $\beta = 0.051$ ;  $P = 0.008$ ), from 5.0 (95% CI = 3.9–6.2) in 2011 to 7.7 (95% CI = 6.4–9.0) in 2017. Opioid-only mortality rates increased among AI/AN individuals ( $\beta = 0.103$ ;  $P = 0.006$ ; adjusted  $\beta = 0.109$ ;  $P = 0.004$ ), from 7.2 (95% CI = 4.4–10.1) in 2011 to 11.9 (95% CI = 8.3–15.4) in 2017. Hispanic individuals also had increased mortality rates  $\beta = 0.139$ ;  $P < 0.001$ ; adjusted  $\beta = 0.138$ ;  $P < 0.001$ ), from 0.8 (95% CI = 0.4–1.1) in 2011 to 1.1 (95% CI = 0.7–1.4) in 2017. There were no differences in trends for co-use-related mortality rates within each racial/ethnic group.

### 3.2. Differences in alcohol, opioid, and co-use related deaths by race/ethnicity

Subgroup differences were observed when comparing between-group mortality rates (Table 3). Crude incidence rate ratios of alcohol-only mortality showed lower mortality rates among Black (IRR = 0.7; 95% CI = 0.6–0.8), Asian/Pacific Islanders (IRR = 0.2; 95% CI = 0.2–0.2), Hispanic (IRR = 0.5; 95% CI = 0.4–0.5), and Other individuals (IRR = 0.2; 95% CI = 0.2–0.3), compared to NH White individuals. AI/AN individuals had higher mortality rates (IRR = 3.9; 95% CI = 3.6–4.2). After controlling for age and year, similar patterns were observed. There were no differences in alcohol mortality rates between

**Table 1**  
Estimated adjusted rate of alcohol-only-, opioid-only-, and alcohol-opioid-mortality by race/ethnicity in Washington State from 2011 to 2017.

|                       | Incidence of Mortality Per Million Population |                   |                   |                 |                   |                 |                  |
|-----------------------|---|-------------------|-------------------|-----------------|-------------------|-----------------|------------------|
|                       | 2011  | 2012              | 2013              | 2014            | 2015              | 2016            | 2017             |
| <b>Alcohol-only</b>   |   |                   |                   |                 |                   |                 |                  |
| White                 | 6.5 (6.1, 6.8)                                | 6.8 (6.4, 7.1)    | 7.1 (6.8, 7.5)    | 7.1 (6.8, 7.5)  | 7.6 (7.3, 8)      | 7.1 (6.8, 7.5)  | 7.4 (7, 7.7)     |
| Black                 | 7.0 (5.1, 8.9)                                | 6.5 (4.7, 8.4)    | 5.6 (4.0, 7.3)    | 6.7 (4.9, 8.5)  | 7.0 (5.2, 8.8)    | 5.0 (3.5, 6.6)  | 7.4 (5.6, 9.2)   |
| AI/AN                 | 33.2 (26.7, 39.6)                             | 36.7 (29.9, 43.5) | 31.6 (25.3, 37.9) | 38.2 (31.3, 45) | 32.2 (25.9, 38.4) | 31 (24.9, 37.1) | 29.1 (23.3, 35)  |
| Asian/PI              | 2.0 (1.4, 2.7)                                | 1.0 (0.5, 1.4)    | 1.4 (0.8, 1.9)    | 1.8 (1.2, 2.3)  | 1.8 (1.3, 2.4)    | 1.4 (0.9, 1.9)  | 2 (1.4, 2.6)     |
| Hispanic              | 5.0 (3.9, 6.2)                                | 5.3 (4.1, 6.5)    | 5.8 (4.6, 6.9)    | 6.4 (5.1, 7.6)  | 5.4 (4.3, 6.6)    | 6.2 (5.1, 7.4)  | 7.7 (6.4, 9)     |
| Other                 | 2.9 (1.3, 4.4)                                | 1.9 (0.7, 3.2)    | 2.8 (1.4, 4.3)    | 4 (2.2, 5.7)    | 3.8 (2.1, 5.5)    | 2.6 (1.2, 3.9)  | 2.1 (0.9, 3.3)   |
| <b>Opioid-only</b>    |   |                   |                   |                 |                   |                 |                  |
| White                 | 2.5 (2.3, 2.7)                                | 2.5 (2.3, 2.7)    | 2.3 (2.1, 2.5)    | 2.3 (2.1, 2.5)  | 2.4 (2.2, 2.6)    | 2.4 (2.2, 2.6)  | 2.5 (2.3, 2.7)   |
| Black                 | 2.7 (1.6, 3.8)                                | 2.1 (1.2, 3.1)    | 2.1 (1.2, 3)      | 2.7 (1.7, 3.8)  | 2.2 (1.3, 3.1)    | 2.5 (1.5, 3.4)  | 3.5 (2.4, 4.7)   |
| AI/AN                 | 7.2 (4.4, 10.1)                               | 5.5 (3, 7.9)      | 5.2 (2.8, 7.6)    | 7.7 (4.8, 10.6) | 6.5 (3.9, 9.2)    | 8.4 (5.4, 11.4) | 11.9 (8.3, 15.4) |
| Asian/PI              | 0.4 (0.1, 0.6)                                | 0.9 (0.5, 1.3)    | 0.5 (0.2, 0.8)    | 0.7 (0.3, 1.0)  | 0.6 (0.3, 0.9)    | 0.7 (0.4, 1)    | 0.6 (0.3, 0.9)   |
| Hispanic              | 0.8 (0.4, 1.1)                                | 0.5 (0.3, 0.8)    | 0.6 (0.3, 0.9)    | 0.7 (0.4, 1.0)  | 1.0 (0.6, 1.4)    | 1.4 (1, 1.8)    | 1.1 (0.7, 1.4)   |
| Other                 | 0.7 (0.1, 1.4)                                | 0.3 (0, 0.7)      | 0.1 (0, 0.4)      | 0.6 (0.1, 1.2)  | 0.5 (0, 1.0)      | 0.3 (0, 0.7)    | 0.1 (0, 0.3)     |
| <b>Alcohol-Opioid</b> |   |                   |                   |                 |                   |                 |                  |
| White                 | 0.5 (0.4, 0.6)                                | 0.9 (0.8, 1.1)    | 0.6 (0.5, 0.7)    | 0.5 (0.4, 0.6)  | 0.7 (0.6, 0.8)    | 0.8 (0.7, 1)    | 0.6 (0.5, 0.8)   |
| Black                 | 0.5 (0.1, 1)                                  | 0.6 (0, 1.3)      | 0.7 (0.1, 1.3)    | 0.9 (0.3, 1.5)  | 1 (0.3, 1.6)      | 1.2 (0.4, 2)    | 0.4 (0, 0.9)     |
| AI/AN                 | 2.9 (1.1, 4.7)                                | 3.1 (0.8, 5.3)    | 2.7 (0.8, 4.6)    | 2.8 (1.1, 4.6)  | 5.1 (2.5, 7.7)    | 2.5 (0.5, 4.5)  | 3.3 (1.3, 5.4)   |
| Asian/PI              | 0 (0, 0.1)                                    | 0.4 (0.1, 0.8)    | 0.1 (0, 0.2)      | 0.1 (0, 0.2)    | 0.1 (0, 0.2)      | 0.6 (0.3, 1.0)  | 0.1 (0, 0.3)     |
| Hispanic              | 0.4 (0.1, 0.6)                                | 0 (0, 0)          | 0.2 (0, 0.4)      | 0.3 (0.1, 0.5)  | 0.3 (0.1, 0.6)    | 0 (0, 0)        | 0.2 (0, 0.4)     |
| Other                 | 0.3 (0, 0.7)                                  | 0 (0, 0)          | 0 (0, 0)          | 0.1 (0, 0.4)    | 0 (0, 0)          | 0 (0, 0)        | 0 (0, 0)         |

\*Note: AI – American Indian; AN – Alaska Native; PI – Pacific Islander.

**Table 2**  
Estimated slopes of rates of alcohol-only-, opioid-only-, and alcohol-opioid-mortality by race/ethnicity in Washington State from 2011 to 2017.

|                       | Bivariate |         | Age-Adjusted |         |
|-----------------------|-----------|---------|--------------|---------|
|                       | β         | P-value | β            | P-value |
| <b>Alcohol-only</b>   |           |         |              |         |
| White                 | 0.022     | <0.001  | 0.014        | 0.003   |
| Black                 | -0.001    | 0.96    | -0.010       | 0.70    |
| AI/AN                 | -0.021    | 0.25    | -0.028       | 0.13    |
| Asian/PI              | 0.026     | 0.44    | 0.025        | 0.45    |
| Hispanic              | 0.062     | 0.001   | 0.051        | 0.008   |
| Other                 | -0.006    | 0.98    | -0.016       | 0.74    |
| <b>Opioid-only</b>    |           |         |              |         |
| White                 | -0.006    | 0.45    | -0.001       | 0.95    |
| Black                 | 0.053     | 0.16    | 0.052        | 0.16    |
| AI/AN                 | 0.103     | 0.006   | 0.109        | 0.004   |
| Asian/PI              | 0.023     | 0.64    | 0.024        | 0.63    |
| Hispanic              | 0.139     | <0.001  | 0.138        | <0.001  |
| Other                 | -0.122    | 0.27    | -0.123       | 0.27    |
| <b>Alcohol-Opioid</b> |           |         |              |         |
| White                 | -0.007    | 0.70    | <-0.001      | 0.99    |
| Black                 | 0.014     | 0.85    | 0.013        | 0.86    |
| AI/AN                 | 0.012     | 0.85    | 0.018        | 0.77    |
| Asian/PI              | 0.158     | 0.36    | 0.159        | 0.35    |
| Hispanic              | -0.015    | 0.82    | -0.015       | 0.82    |
| Other                 | -0.270    | 0.51    | -0.261       | 0.52    |

Note: AI – American Indian; AN – Alaska Native; PI – Pacific Islander.

NH White and Black individuals. The excess rate of AI/AN individuals compared to NH White individuals increased (aIRR = 4.6; 95% CI = 4.3–5.0).

The opioid-only crude incidence rate ratios showed lower mortality among Asians/Pacific Islander (IRR = 0.3; 95% CI = 0.2–0.3), Hispanic (IRR = 0.4; 95% CI = 0.3–0.5), and Other individuals (IRR = 0.2; 95% CI = 0.1–0.2), compared to NH White individuals. AI/AN individuals had higher opioid-only mortality rates (IRR = 3.2; 95% CI = 2.8–3.8). Similar patterns were observed after adjusting for age and year. Compared to NH White individuals, co-use-related mortality crude rates were lower among Asian/Pacific Islander individuals (IRR = 0.1; 95% CI = 0.1–0.3) and Hispanic individuals (IRR = 0.5; 95% CI = 0.4–0.7), and were higher among AI/AN individuals (IRR = 5.0; 95% CI =

**Table 3**  
Incidence rate ratios of alcohol-only-, opioid-only-, and alcohol-opioid-mortality by race/ethnicity in Washington State from 2011 to 2017.

|                       | Unadjusted Incidence Risk Ratio |         | Adjusted Incidence Risk Ratio |         |
|-----------------------|---------------------------------|---------|-------------------------------|---------|
|                       | IRR                             | 95% CI  | aIRR                          | 95% CI  |
| <b>Alcohol-only</b>   |                                 |         |                               |         |
| White                 | ref                             |         | ref                           |         |
| Black                 | 0.7                             | 0.6–0.8 | 0.9                           | 0.8–1.0 |
| AI/AN                 | 3.9                             | 3.6–4.2 | 4.6                           | 4.3–5.0 |
| Asian/PI              | 0.2                             | 0.2–0.2 | 0.2                           | 0.2–0.3 |
| Hispanic              | 0.5                             | 0.4–0.5 | 0.8                           | 0.8–0.9 |
| Others                | 0.2                             | 0.2–0.3 | 0.4                           | 0.3–0.5 |
| <b>Opioid-only</b>    |                                 |         |                               |         |
| White                 | ref                             |         | ref                           |         |
| Black                 | 1.1                             | 1.0–1.3 | 1.1                           | 0.9–1.2 |
| AI/AN                 | 3.2                             | 2.8–3.8 | 3.1                           | 2.7–3.6 |
| Asian/PI              | 0.3                             | 0.2–0.3 | 0.3                           | 0.2–0.3 |
| Hispanic              | 0.4                             | 0.3–0.5 | 0.4                           | 0.3–0.4 |
| Other                 | 0.2                             | 0.1–0.2 | 0.2                           | 0.1–0.2 |
| <b>Alcohol-Opioid</b> |                                 |         |                               |         |
| White                 | ref                             |         | ref                           |         |
| Black                 | 1.2                             | 0.9–1.7 | 1.2                           | 0.8–1.6 |
| AI/AN                 | 5.0                             | 3.9–6.4 | 4.9                           | 3.8–6.3 |
| Asian/PI              | 0.1                             | 0.1–0.3 | 0.1                           | 0.1–0.3 |
| Hispanic              | 0.5                             | 0.4–0.7 | 0.5                           | 0.4–0.7 |
| Other                 | 0.4                             | 0.1–1.1 | 0.4                           | 0.1–1.2 |

\*Note: AI – American Indian; AN – Alaska Native; PI – Pacific Islander.

3.9–6.4). Similar patterns were observed after adjusting for age and year.

**4. Discussion**

When adjusted for age, we found trends of increased mortality among certain racial and ethnic groups for alcohol-only and opioid-only mortality. Specifically, between 2011 and 2017, alcohol-only mortality rates increased among NH White individuals and Hispanic individuals, and opioid-only mortality rates increased among AI/AN individuals and Hispanic individuals. Data from 2011 to 2017 also showed that AI/AN individuals had higher unadjusted and adjusted alcohol-only, opioid-only, and co-use-related mortality rates compared to NH White

individuals.

Our findings support existing evidence, from national and state reported data, that AI/AN individuals are at increased risk of alcohol and opioid-related death and overdose (White et al., 2020). AI/AN individuals have similar drinking patterns and some of the highest alcohol abstinence rates compared with all other racial/ethnic groups, yet have a 520% greater rate of alcohol-related mortality compared with other racial and ethnic groups (Cunningham, Solomon, & Muramoto, 2016; IHS, 2014; Substance Abuse and Mental Health Administration, 2018). This may be a consequence of higher drinking intensity among AI/AN individuals (Cunningham et al., 2016; Substance Abuse and Mental Health Administration, 2018). For instance, while NH White individuals comprise most alcohol poisoning deaths (67.5%; 1500 deaths), age-adjusted death rates are highest among AI/AN adults (49.1 per 1 million people) (Kanny et al., 2015). With respect to opioid mortality in other states in the US, opioid overdose rates among AI/AN adults have continued to rise—matching and, in some cases, surpassing NH White individuals. AI/AN adults in the Pacific Northwest and Midwest have higher opioid-related mortality rates while AI/AN people in the Southwest and Northern Plains regions are less likely to have an opioid-attributed death, which our findings also support (Deschine Parkhurst, Burke, Montiel, Davis, & Ritchey, 2018). Between 2008 and 2015, AI/AN individuals per 100,000 persons residing in metropolitan and non-metropolitan areas, had the highest rate of opioid overdose deaths compared with other racial and ethnic groups (Mack, Jones, & Balles-teros, 2017). Efforts to increase cultural acceptability and access to medication for opioid use disorder among tribal communities are also promising. As sovereign nations, tribes have acted through policy to implement and promote harm reduction strategies (e.g., Naloxone use and training among agencies and tribal first responders) (Deschine Parkhurst et al., 2018; Tipps, Buzzard, & McDougall, 2018; Venner et al., 2018). Some sovereign nations have also filed lawsuits against opioid manufacturers and distributors to better protect their reservations (Tipps et al., 2018).

We also found that Hispanic individuals had an increase in age-adjusted alcohol-only and opioid-only related mortality trends from 2011 to 2017. These findings can potentially be explained through a geographic contextualization of alcohol and opioid use (e.g., large metropolitan vs medium-small metropolitan areas) (Lippold & Ali, 2020). A recent study, using nationally representative data, indicated that Hispanic men had significantly higher age-adjusted alcohol-related mortality rates than NH White individuals between 1999 and 2014, though the same study also showed slight annual decreases in alcohol-related mortality for Hispanic men (de Grubb, Salemi, Gonzalez, Zoorob, & Levine, 2016). Given the limited research on alcohol-only and opioid-only mortality rates among Hispanic individuals, our findings, coupled with the findings of these studies, evidences a continued need to understand and address disproportionate rates of substance use among Hispanic individuals in the US.

Among Black individuals, alcohol-only and opioid-only mortality rates declined between 2011 and 2015. Alcohol-only related mortality increased about 7% (i.e., 5.0 to 7.4 per 100,000) between 2016–2017 whereas opioid-only related mortality increased by <1% (i.e., 2.5 to 3.5 per 100,000). Regarding alcohol-only mortality, our findings are somewhat consistent with recent reports showing increases in alcohol-attributed acute causes of death (e.g., traffic collisions) among Black individuals (White et al., 2020). Similar to AI/AN and Hispanic individuals, drinking intensity among Black individuals also increased more than among NH White individuals, which could contribute to the spike in alcohol-related mortality (Gruzca et al., 2018). Although AI/AN and NH White individuals presently have among the highest opioid-related mortality rates, over the last two decades (1999–2017) Black individuals have had the greatest increase in opioid mortality rates (Alexander, Kiang, & Barbieri, 2018; Drake, Charles, Bourgeois, Daniel, & Kwende, 2020). While there may be a stabilization of prescription opioid deaths primarily among NH White individuals, the emergence of

synthetic opioids might account for the recent trends in opioid-related mortality among Black individuals (Center for Disease Control Injury Center, 2020). Several studies have posited that increased opioid-related mortality may be due to the disproportionate impact of synthetic fentanyl-laced cocaine and heroin on Black and Hispanic communities (Alexander et al., 2018; Cano, 2020; Hedegaard et al., 2017; James & Jordan, 2018).

#### 4.1. Limitations

There are important limitations that should be considered when interpreting our findings. First, there could be several issues related to racial misclassification among Hispanic, Asian/Pacific Islander, and AI/AN individuals, with some reports indicating racial misclassification of more than 50% of AI/AN adult death certificate data (Arias, 2008; Jim et al., 2014; Landen, Roeber, Naimi, Nielsen, & Sewell, 2014 Jun). As such, it is likely this has led to an underestimation of age-adjusted mortality among AI/AN individuals. Second, a consistent limitation associated with the use of vital records, is the underreporting of alcohol- and opioid-related deaths (Rubin, 2020; White et al., 2020). Third, the relatively smaller sample sizes impacted our ability to estimate rates by racial and ethnic group in several categories (i.e., alcohol-opioid mortality rates). This further limited our ability to prevent us from further parsing apart data according to opioid type (e.g., incidence rate was already close to 0 when all opioids were grouped together).

## 5. Conclusions

This study sheds light on a public health crisis that has disproportionately impacted AI/AN individuals and historically underserved racial/ethnic minorities in the US. Although the findings presented in this study highlight racial/ethnic differences in mortality rates in Washington, the trends for each racial/ethnic group signal an increased need to address alcohol and opioid misuse and to develop more targeted interventions to prevent overdose and poisoning. This is particularly significant given the behavioral health and mortality disparities across different racial/ethnic groups that has impacted Washington and other states in the US. The role of alcohol as a contributing factor in opioid-related mortality has been relatively understudied in the current opioid epidemic, but given the variable mortality rates resulting from the use of both alcohol and opioids among historically underserved racial and ethnic minorities, their co-use should be monitored more closely in future research.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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