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# Bulletin

Recommendations  
and  
Reports

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## Risk Factors for Suicide at the Community Level — Alaska, 2003–2011

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## Background

Alaska had the second highest suicide rate in the United States in 2010, the most recent year for which national comparison data are available.<sup>1</sup> From 2003–2010, the age-adjusted rate for suicide in Alaska was almost twice the national average (21.6 vs. 11.3 deaths per 100,000 persons per year, respectively).<sup>2</sup> In 2010, suicide was the sixth leading cause of death in Alaska and the leading cause of death among persons aged 15–24 years.<sup>3</sup> In Alaska, the years of potential life lost from suicide before 65 years of age are second only to unintentional injury.<sup>2</sup> According to the Alaska Violent Death Reporting System (AKVDRS), there was an average of 147 suicides in Alaska per year during 2003–2011.

Suicide is a complex social phenomenon that depends on unique historical, personal, social, and other situational circumstances. In 2012, the Alaska Department of Health and Social Services published a report on characteristics of suicide among Alaska Native people and Alaska non-Native people.<sup>4</sup> The authors used descriptive statistics to identify higher suicide rates among males, people in rural communities, Alaska Native people, people aged 15–29 years, and other demographic groups. The focus of the report was to describe disparities in suicide epidemiology between Alaska Native and Alaska non-Native people; however, multivariable modeling was not used to characterize the predictors for suicide and control for possible confounding.

The purpose of the current study was to investigate potential associations between selected community characteristics and suicide incidence in Alaska using ecological modeling.

## Methods

Suicides were identified by census designated place (CDP) of injury in Alaska from 2003–2011, using the Alaska Violent Death Reporting System (AKVDRS). CDPs are settled populations, identifiable by name, that are used for statistical purposes by the U.S. Census Bureau.<sup>5</sup> The AKVDRS uses death certificate ICD-10 codes, Alaska State Medical Examiner reports, law enforcement reports, forensic laboratory analysis, and occasionally hospital reports and court documents to assign a cause of death.<sup>6</sup> It also collects circumstantial and environmental factors coincident

with the suicide death. AKVDRS defines a suicide as “a death resulting from the use of force<sup>i</sup> against oneself when a preponderance of the evidence indicates that the use of force was intentional.”<sup>6</sup> Only suicides for which the location of injury was known were included in the analysis.

To prevent misclassification by location, closely associated CDPs around large population centers were aggregated into a single unit. This strategy was necessary because death certificates and other documentation typically listed a place of injury by the mailing address of the injury location rather than the CDP. For example, suicides and population statistics for College, South Van Horn, and several other CDPs were assigned to Fairbanks because Fairbanks was written on death certificates and other documentation for deaths in these areas.

Variables collected for multivariable regression were selected because they were known or postulated risk factors for suicide, including median income, community type (e.g., rural or city), educational attainment (as measured by a high school diploma, GED, or equivalent), the percentage of the population composed of high-risk demographic groups (e.g., Alaska Native people, males, and people aged 20–29 years), and community accessibility via the road system. Variables pertaining to active duty, veteran and military reserve status were not included due to a lack of data. Therefore, the model did not control for recent or pending deployment.

Risk factor data were compiled from the 2010 U.S. Census and the 2011 5-year averages from the American Community Survey. The age category of 20–29 years was chosen because this cohort was within the highest risk age demographic during the years covered in the study. The percentage of males in the population was not included in the analysis of rural communities that were off the road system. Although suicide rates are three to four times higher among males, the proportions of males in villages were too similar for the model coefficient to reflect a real phenomenon. Because geographic latitude has been postulated to be a risk factor for suicide by several researchers,<sup>7,8,9</sup> we included this variable in

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<sup>i</sup> National Violent Death Reporting System interprets use of force to include the use of poisons or drugs.

our multivariable model to assess its potential role as an independent risk factor for suicide in Alaska (Alaska's latitude spans nearly 20 degrees, from 51.8 degrees to 71.3 degrees). Latitude data were collected from the U.S. Census Gazetteer file for Alaska.<sup>10</sup>

Communities were divided into three classifications: cities, hubs/towns, and rural areas. Cities were classified as population centers with >10,000 people off the road system or >4,500 people on the road system. An exception was made for Eielson Air Force Base, which was classified as a city. Hubs/towns were defined as communities with populations >2,000 people that did not meet the criteria for classification as cities. All other communities were classified as rural. The rural classification included communities along the Alaska road system such as Delta Junction and Haines, as well as large remote villages such as Hooper Bay and Unalakleet. The distinction of whether or not the community was on the road system was added as a separate variable. Communities were classified as being on the road system if travel to and from Anchorage could be made year-round by car, without the use of ferries or other significant hindrances.

Using suicide counts by community, a Poisson regression was used to assess the association between multiple independent variables and suicide incidence in Alaska. Regressions were performed for all communities in Alaska, then for a restricted subgroup of rural communities off the road system because these communities had the highest rate of suicide and were thought to potentially interact differently with the selected predictor variables. In each cohort, a bivariate regression was run for each independent variable individually, followed by a multivariable regression using variables that reached a  $p < 0.10$  in bivariate analysis. An enter model was chosen to demonstrate the reduced significance of several variables in the multivariable model. Incidence rate ratios (IRRs) were defined as the increased rate in suicide incidence given a one unit change in the independent variable (e.g., an IRR of 1.18 for latitude suggested that for every 5 degree change in latitude, the rate of suicide was 18 percent higher). Multicollinearity was assessed using the variance inflation factor (VIF).<sup>11</sup> All variables with  $VIF > 5$  were removed from multiple regression analyses to

reduce biased standard errors. Robust standard errors were used to correct for the lack of complete independence among variables and the slight effect of heteroskedasticity in calculating confidence intervals for model coefficients. The extent of systematic bias due to missing data was assessed using a worst-case scenario analysis. All calculations were performed using R version 3.0.1.

## Results

The AKVDRS database identified 1,325 suicides in Alaska from 2003 to 2011; 1,053 (79%) of the decedents were male. Of the 1,319 suicides for which location of the event was recorded, 794 (60%) occurred in cities, 186 (14%) occurred in small towns and village hubs (e.g., Bethel, Valdez, Dillingham, etc.), and 339 (26%) occurred in rural towns and villages. Using 2010 U.S. Census populations, the overall rates in cities, hubs/towns, and rural communities were 16.8, 27.9, and 41.7 per 100,000 persons per year, respectively. In rural, non-hub communities located off the road system, the rate was 48.6 per 100,000 persons per year.

The IRRs and measures of statistical significance from the bivariate and multivariate analyses in both village cohorts are shown in Tables 1 and 2. Both statewide and in rural communities, the proportion of the population that was Alaska Native was the most statistically significant independent predictor of suicide incidence. Statewide, the incidence rate ratio for every 10% increase in the population that was Alaska Native was 1.13 (1.07–1.20, 95% CI,  $p < 0.001$ ; Table 1).

Statewide, the IRR for every 5 degree increase in latitude was 1.18 (1.04–1.36, 95% CI,  $p = 0.01$ ; Table 1). In rural communities off of the road system, the valence of the association between latitude and suicide incidence was greater, with an IRR of 1.52 per 5 degrees of latitude (1.23–1.87, 95% CI,  $p < 0.001$ ; Table 2).

Of the 321 communities in Alaska, 38 (12%) were excluded from statewide analysis due to missing median income or educational attainment data. Of the 255 rural communities off the road system, 24 (11%) were excluded accordingly. Because percentage of omitted cases exceeded the threshold for potential systematic bias, a worst-case scenario analysis was

performed, showing that exclusion of these observations did not bias model results.

### Discussion

During the study period, the statewide suicide rate among Alaska Native people was more than twice that for Alaska non-Natives (40.4 vs. 17.7 per 100,000 persons, respectively).<sup>4</sup> Moreover, of the selected community characteristics, bivariate and multivariable models identified the percentage of Alaska Native people within the population as the greatest predictor of suicide incidence both statewide (IRR=1.13 per 10 percent,  $p<0.001$ ) and in rural communities off the road system (IRR=1.20 per 10 percent,  $p<0.001$ ). This observed association may reflect unique personal, situational, and historical circumstances, some of which elude strict definition or quantification for the purpose of statistical analysis.

Within rural communities off the road system in Alaska, latitude was identified as a statistically significant independent predictor of suicide (IRR=1.52 per 5 degrees,  $p<0.001$ ). Statewide, the independent association between latitude and suicide incidence was also statistically significant (IRR=1.18 per 5 degrees,  $p=0.01$ ). Reasons for this association are unclear. At higher latitudes, communities in Alaska experience longer winters with fewer hours of daylight. However, as first noted by Durkheim and confirmed by more recent investigation, there is a slight seasonal variation in suicide rates, with peaks occurring not in the depths of winter, but in May or June, “during the fine season when nature is most smiling and the temperature mildest.”<sup>12</sup>

Research in both the northern and southern hemispheres has shown that as latitude increases, this summer peak may also increase slightly.<sup>12,13,14</sup> This leaves open the possibility that dramatic fluctuations in daylight or one of its correlates may be superimposed on human mood, leading to elevated rates where these variations are most extreme. However, the association might also reflect coincidental factors such as lifestyle, diet, physical activity, access to lethal means, or funding for suicide prevention, as more than asymmetry in seasonal daylight separates the communities of the boreal Arctic from their more temperate peers to the south.

The association between latitude and suicide rates has been studied since at least 1897, when Emile Durkheim published a paradigmatic study showing variations in suicide by latitude in central Europe.<sup>15</sup> More recently, suicide rates in Japan have been shown to correlate with latitude, with higher rates occurring in more northern prefectures, even after controlling for socioeconomic status and unemployment rates.<sup>7</sup> Rates in Canada are also higher in the north.<sup>8</sup> These results are mirrored in the southern hemisphere. For example, in Argentina, suicide rates in the three provinces nearest the South Pole are greater than those of the national population.<sup>9</sup> In contrast to these examples, rates in Australia in 1973 were higher in territories closer to the equator.<sup>8</sup> Much of the prior work on latitude as a risk factor did not adjust adequately for population statistics, such as the proportion of the population in high risk groups or the types of communities found closer to the poles.

Suicide is a complex phenomenon that involves a wide-ranging constellation of subjective (e.g., individual and cultural) and objective (e.g., biological and environmental) factors. The analyses shown here could be further improved by investigating associations between suicide risk and access to behavioral health care, presence of law enforcement personnel in the community, and presence of community members with suicide prevention training. Rather than using a worst-case scenario analysis, employing a multiple imputation method to address possible systematic bias introduced by excluding communities would further increase model validity. A multi-level modeling approach accounting for individual, familial, and community factors would similarly improve understanding of suicide risk factors in Alaska. Furthermore, the current model treats suicides as if they are statistically independent events, despite evidence that suicides tend to cluster in time and space, particularly among teenagers.<sup>16</sup>

Availability of high quality data for communities is a recurrent issue when conducting ecological modeling in Alaska. For small communities, data from the American Community Survey were reported with margins of error that sometimes exceeded the reported mean value itself. However, analysis on a broader scope (e.g., by region) obscures valuable

trends by grouping data into geographic areas of political rather than statistical importance. Moreover, the lack of CDP-specific information on additional known and likely risk factors such as adverse childhood experiences, ready access to lethal weapons, and reliable markers of cultural connectivity further prevents a comprehensive analysis of community-level risk factors for suicide. As such, identified risk factors and their statistical significance should be interpreted with caution.

Alaska's communities tend to be geographically distinct and isolated from one another, likely making analysis at the community level less problematic than in other states, where population movements between communities are more frequent. Further research is necessary to investigate the possible association of suicide incidence and geographic latitude, which has been identified here as a possible risk factor for suicide in Alaska.

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**Table 1. Suicide Incidence Rate Ratios for All Communities, by Selected Risk Factor — Alaska, 2003–2011 (n=283 communities)**

Variable	Bivariate Analysis		Multivariable Regression	
	Incidence Rate Ratio (95% CI)*	P value	Incidence Rate Ratio (95% CI)*	P value
Latitude (per 5 degrees)	1.29 (0.98–1.70)	0.07	1.18 (1.04–1.36)	<b>0.01</b>
Hub/Town <sup>†</sup>	1.66 (1.31–2.10)	<b>&lt;0.001</b>	1.35 (0.90–2.03)	0.1
Rural <sup>†</sup>	2.48 (2.04–3.02)	<b>&lt;0.001</b>	1.16 (0.75–1.79)	0.5
On Road System	0.43 (0.36–0.52)	<b>&lt;0.001</b>	1.01 (0.69–1.49)	0.9
Median Household Income (per \$1,000)	0.98 (0.97–0.98)	<b>&lt;0.001</b>	0.99 (0.98–1.00)	0.06
Population Size (per 1000) <sup>‡</sup>	0.998 (0.997–0.999)	<b>&lt;0.001</b>	1.00 (1.00–1.00)	0.8
Percent with a High School Diploma or Equivalent (per 1%)	0.96 (0.95–0.97)	<b>&lt;0.001</b>	1.01 (1.00–1.02)	0.1
Percent Male (per 1%)	0.99 (0.96–1.02)	0.7		
Percent aged 20 to 29 (per 1%)	0.98 (0.95–1.01)	0.1		
Alaska Native Population <sup>**</sup>	1.17 (1.14–1.20)	<b>&lt;0.001</b>	1.13 (1.07–1.20)	<b>&lt;0.001</b>

\*Confidence limits and p values calculated using robust standard errors

<sup>†</sup>Incidence rate ratios for rural and hub/town communities were calculated relative to cities

<sup>‡</sup>IRR reported to the thousandths place to show that rate decreased

<sup>\*\*</sup>Modeled per 10% increase in the proportion of the community population that was Alaska Native

**Table 2. Suicide Incidence Rate Ratios for Rural Communities Located Off the Road System, by Selected Risk Factor — Alaska, 2003–2011 (n=204 communities)**

Variable	Bivariate Analysis		Multivariable Regression	
	Incidence Rate Ratio (95% CI)*	P value	Incidence Rate Ratio (95% CI)*	P value
Latitude (per 5 degrees)	1.81 (1.50–2.19)	<b>&lt;0.001</b>	1.52 (1.23–1.87)	<b>&lt;0.001</b>
Median Household Income (per \$1,000 increment)	0.99 (0.97–1.00)	<b>0.005</b>	0.99 (0.98–1.00)	0.2
Percent with a High School Diploma or Equivalent (per 1%)	0.98 (0.97–0.99)	<b>0.005</b>	1.01 (1.00–1.02)	0.1
Percent aged 20 to 29 (per 1%)	1.62 (0.94–2.80)	0.08	1.03 (0.63–1.70)	0.9
Alaska Native Population <sup>†</sup>	1.25 (1.17–1.34)	<b>&lt;0.001</b>	1.20 (1.11–1.29)	<b>&lt;0.001</b>
Population Size (per 100)	0.94 (0.89–0.99)	0.02	0.99 (0.94–1.05)	0.8

\*Confidence limits and p values calculated using robust standard errors

<sup>†</sup>Modeled per 10% increase in the proportion of the community population that was Alaska Native