Population factors and rates of suicide in U.S. counties

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Methodological Question Being Addressed
What data and analyses can inform development of policy and education recommendations for suicide prevention?

Introduction
Geographic, environmental, demographic, socioeconomic and health-related factors may contribute to population suicide risk. In order to inform national and regional policy recommendations for suicide prevention, we assessed the relationship between potential predictive factors and U.S. county suicide rates.

Methods
We performed bivariate correlations incorporating age-adjusted suicide rates and measures of race/ethnicity, population dispersion (reciprocal of population density), altitude (adjusted for population), poverty, educational attainment, social affiliation, physical health, mental health, access to healthcare and to suicide methods (federally licensed firearm dealer prevalence (FLFDP) and firearm regulations) in a random sample of U.S. counties (N=751). Non-normally distributed variables underwent transformation. Candidate variable pairs yielding a Pearson correlation coefficient > 0.1 and two-tailed significance < 0.05 were included in multiple regression analyses. Additionally, dummy variables representing grades on a state firearm law scorecard[1] were incorporated in the regression analysis for firearm suicide.

Results
Variables correlated with all-cause suicide were population dispersion (R=0.596), FLFDP (0.561), poverty (0.167), no college education (0.279), physically unhealthy days (0.193), mentally unhealthy days (0.131), no health insurance (0.225), cost-related healthcare delay (0.226), population-to-physician ratio (0.143), and Native American population (0.375, $p<0.001$ for all). Significant correlations differed by suicide method: population-to-mental health provider ratio correlated with firearm suicide (R=0.195, $p<0.001$); excessive drinking with suicide by hanging (R=0.326, $p<0.001$) and poisoning (R=0.186, $p=0.016$); and white population with hanging (R=0.223, $p=0.001$) and poisoning (R=0.300, $p<0.001$). Population-adjusted altitude, income inequality, single parent households and lack of social/emotional support were not significantly correlated with suicide outcomes.

In stepwise multiple regression for all-cause suicide, adjusted R^2 was .406 (F[4,556]=96.888, $p<0.001$); significant, positive predictors were population dispersion, FLFDP, physically

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[1] Brady Campaign to Prevent Gun Violence and the Law Center for Gun Violence: 2013 State Scorecard. http://www.bradycampaign.org/2013-state-scorecard

unhealthy days and percent uninsured (β=.294, .303, .175 and .142, respectively; p<0.001 for all).

For firearm suicide (adjusted R^2=.661, F[7,474]=134.930, p<0.001), significant, positive predictors were population dispersion (β=.434, p<0.001), FLFDP (β=.161, p<0.001), physically unhealthy days (β=.188, p<0.001) and no college (β=.078, p=0.034). The unadjusted, individual coefficient was .304 for the dummy variable representing state firearm scorecard grade F (β=.466, p<0.001). After back-transformation, this corresponds to a predicted value of approximately 84 firearm suicides/year in a state of 10 million with a scorecard grade of F compared to one graded A, beyond the effects of other model factors.

Regression models for suicide by hanging, poisoning or medication overdose accounted for less of the variance in suicide rates, with adjusted R^2 values of .322, .326 and .195, respectively (p<0.001 for all).

Conclusions
Analysis of county-level, population measures demonstrate the association of suicide risk with geographic, economic and health-related factors; however, the previously reported association of altitude and suicide is not supported when adjusted for population. Methodologic considerations include incorporation of healthcare access indicators and measures representing access to firearms or other suicide methods. These analyses can inform development of policy and education initiatives for suicide prevention.

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