

DRAFT

Social Variables and Suicide Risk in Rural California Counties

S. Todd Stolp MD and Chandler Stolp PhD

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Abstract

Research has long sought to identify individual and social risk factors for suicide as a step towards designing effective suicide prevention measures.¹² Rural residency is one clear risk factor for completed suicide.³ However, the specific social factors linked to rurality that influence rates of suicide remain poorly defined. This study examines demographic, social, and economic data for California counties from 2001 to 2005 in an effort to refine our understanding of those factors related to rural residency which correlate with higher suicide rates.

In this cross-sectional observational study, explanatory variables previously recognized as correlating with higher suicide rates were collected for each California county. These data were used to estimate a series of ordinary least squares (OLS) regression models of suicide rate as a function of measures of Substance Abuse, Violence, Firearm Availability, Ethnic Composition, Mental Health Status, Macroeconomic Conditions, Poverty, and Rural-Urban Characteristics.

The strongest correlates of suicide rate are related to the variables accounting for substance abuse, violence, ethnic composition firearm availability and mental health status. Rural-urban characteristics are closely associated with suicide rate, while rural proximity to an urban setting attenuated the effect of rurality on increasing suicides. The Macroeconomic and Poverty models evidenced no meaningful explanatory power relating to suicide rates.

Correlations between certain variables and suicide rates in California counties revealed foci for future study. These realms might also provide the greatest promise for preventative measures. In order to confidently identify the specific features of rural living that contribute to higher suicide rates, future work along these lines should consider using more disaggregated data measured across time.

¹ Richard Friedman, Uncovering an Epidemic: Screening for Mental Illness in Teens, *N Engl J Med*, 355:26 December 2006

² Committee on Pathophysiology and Prevention of Adolescent and Adult Suicide, *Reducing Suicide: A National Imperative*, Institute of Medicine, The National Academies Press 2001

³ Singh, Gopal and Siahpush, Mohammad, Increasing Rural-Urban Gradients in US Suicide Mortality, 1970-1997, *Am J Pub Health*, Vol 92, No. 7 July 2002

Background

Mortality rates for all ages in the United States due to suicide increased from 10.5 per 100,000 population in 1999, to 11.0 per 100,000 in 2005.⁴ Suicide rates in California have trailed national rates, averaging 9.3 per 100,000 between 2003 and 2005. However, suicide rates for some populations have demonstrated disproportionate increases. The CDC reported a sharp increase in suicides among the 10 to 24 year old population in 2004, particularly among females aged 10 – 19 years and males aged 15 – 19 years.⁵ Nationally, the sharpest increase between 1999 and 2005 occurred in the 45–54 year old age group (from 13.9 to 16.5 per 100,000).

While suicide rates in California have changed minimally since 1999, there persists a strong disparity between urban and rural communities in suicide rate. The correlation between high suicide rates and rural settings has long been recognized as a worldwide problem.⁶ Contributing factors to higher rates of completed suicide in rural environments have been suggested to include availability of firearms or other lethal instruments, higher rates of certain kinds of substance abuse, cultural and racial factors, economic conditions, limited access to mental health care, higher senior populations, and social isolation.⁷ However, information about the relative importance of these factors is limited.

Clarifying how these factors influence suicidality marks an important step in mitigating the problems that suicidality poses to society, especially in rural environments. While interventions such as improved access to mental health services and limiting access to lethal means of suicide have shown promising benefits, the results of comprehensive programs aimed at reducing suicide rates have been disappointing.^{8,9}

This study examines county-level data in California from the period 2001 to 2005 in order to refine our understanding of factors related to rurality and to correlates of suicide. In response to widespread appeals for studies to clarify the factors that influence rates of suicide in society, this effort explores the extent to which county-based data help refine our understanding of the social determinants of suicide.

⁴ Centers for Disease Control, *National Vital Statistics Reports, 2005*, Vol. 56, No. 10 April 2008

⁵ Centers for Disease Control and Prevention. Suicide Trends Among Youths and Young Adults Aged 10-24 Years, *MMWR*, 2007;56:905-908

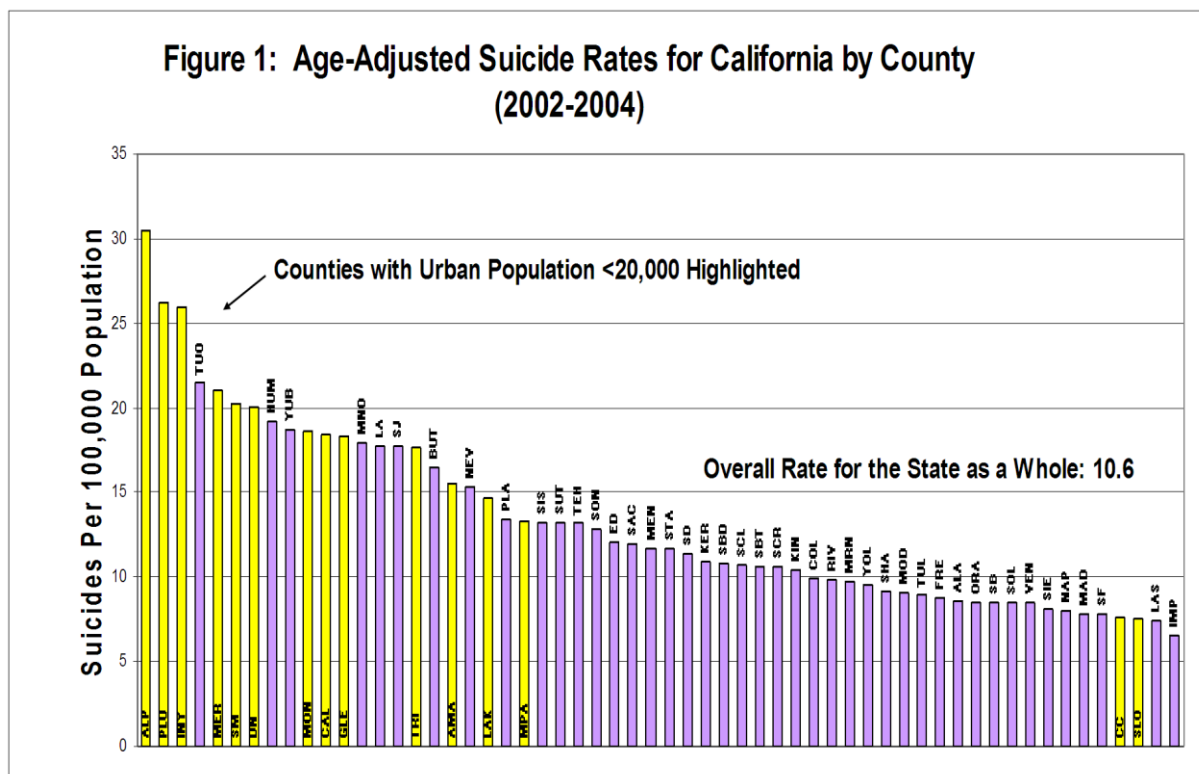
⁶ Centers for Disease Control and Prevention. Suicide and Attempted Suicide – China 1990-2002. *MMWR* 2004;53:481-484.

⁷ California Department of Mental Health, *California Strategic Plan for Suicide Prevention; Draft Report*, January 2008

⁸ U.S. Department of Health and Human Services, *National Strategy for Suicide Prevention*, May 2001

⁹ **Vieland, V. et al** The Impact of Curriculum-based Suicide Prevention Programs for Teenagers: An 18-Month Follow-up 1991, *J Am Acad Child Adolesc Psychiatry*, , 30, 5:811-815 September 1991

Figure 1: Age-Adjusted Suicide Rates for California by County (2002-2004)



Higher rates of suicide in rural communities pose in startling contrast to higher rates of homicide in urban communities (Figure 1). This relationship holds true throughout the world. Trends towards increasing rates of suicide in rural vs. urban communities between 1970 and 1997 have been well documented.¹⁰ Suicide rates for states considered rural, based upon percentage of population living in metropolitan areas,¹¹ average 50% higher than urban states. The rate of increase in suicide rates between 1999 and 2005 for rural states has been three times that of urban states.¹²

Adopting the U.S. Department of Agriculture's Rural Urban Continuum (RUC) coding system¹³ to characterize counties in California allows us to test the degree to which population density at the county level is associated with the prevalence of suicide (Table 1). RUC codes 1 through 3 identify metropolitan areas. The RUC codes 4, 6, and 8 in the table describe counties of progressively smaller populations adjacent to metropolitan areas, while counties with RUC codes 5, 7 and 9 are rural areas that lack proximity to urban population centers. This allows a distinction to be made between sparsely populated areas which have access to metropolitan resources, such as expanded shopping, sports, entertainment, and business/educational opportunities, and sparsely populated areas with limited access to these

¹⁰ Singh, G., Siahpush, M. *Increasing Rural-Urban Gradients in US Suicide Mortality, 1970-1997*, American Journal of Public Health July 2002 Vol. 92, No. 7

¹¹ Bowers, D.E and Reeder, R.. *Rural Conditions and Trends*, United States Department of Agriculture, Economic Research Service, Vol. 9, No. 1, 1998.

¹² CDC. Web-based Injury Statistics Query and Reporting System (WISQARS™). Atlanta GA: US Department of Health and Human Services, CDC 2008. Available at <http://www.cdc.gov/ncipc/wisqars/default.htm>

¹³ USDA web site, www.ers.usda.gov/Briefing/Rurality/RuralUrbCon

expanded opportunities. Suicide rate in metro counties for the period under study averaged 10.59 per 100,000 population; rural counties adjacent to metro areas exhibited a rate of 17.02 per 100,000, while rural counties non-adjacent to metro areas had an average suicide rate of 20.82 per 100,000. Suicide rates are higher as one moves from metropolitan counties to rural counties adjacent to metropolitan areas and then to more remotely rural counties. The rates across these three county categories are all statistically significantly distinguishable from one another.

Table 1: Rural-Urban Continuum Codes*

RUC Code	Population Category		
1	Metro areas of 1 million or more		
2	Metro areas of 250,000 to 1 million		
3	Metro areas of less than 250,000		
4	Non-metro, urban pop >20,000		
5	Non-metro, urban pop >20,000, not adjacent to metro area		
6	Non-metro, urban pop 2,500-20,000		
7	Non-metro, urban pop 2,500-20,000, not adjacent to metro area		
8	Non-metro, urban pop <2,500		
9	Non-metro, urban pop <2,500, not adjacent to metro area		

County Population

* USDA web site, www.ers.usda.gov/Briefing/Rurality/RuralUrbCon

It has been proposed that multiple, as yet poorly defined, sociologic phenomena must be acting to explain the predilection for suicide in rural communities, such as firearm availability,¹⁴ social integration, and access to mental health care. However, for such a consistent bias to be manifest in rural communities worldwide,¹⁵ either the multiple factors increasing rural suicide rates must together apply to rural communities of diverse cultures, or alternatively, a single consistent and cross-cultural feature of rural communities must be exerting an overriding influence on this sociologic phenomenon. While no such consistent feature has been identified, speculation remains active.

¹⁴ Singh, G.K., Siahpush, M. *Increasing Rural-Urban Gradients in US Suicide Mortality, 1970-1997* American Journal of Public Health July 2002, Vol. 92, No. 7

¹⁵ *Reducing Suicide: A National Imperative*, Committee on Pathophysiology and Prevention of Adolescent and Adult Suicide; Institute of Medicine, The National Academies Press 2001

Conceptual Challenges

Estimating the correlates of suicide rates across temporal or spatial units of analysis is a straightforward matter of calculating descriptive statistics. Policy analysts and policy practitioners require more than this. Correlation, after all, does not imply causation. Linking causes to effects requires a substantive theoretical framework within which to operate.

The modern scientific study of suicide owes its origins to Émile Durkheim's pioneering study, *Suicide* (1897). In it, Durkheim, one of the founding fathers of the social scientific discipline of sociology, sought to explain the lower rates of suicide observed among Catholics compared to protestants in Central Europe, largely attributing it to the greater level of "social cohesion" found in Catholic society of the time. However, arguments have been raised against Durkheim's perception of the protective features of social integration.¹⁶ Principles of "social capital" borrowed from the quiver of economists have been portrayed in some cases as protective against suicide and in others as contributing to higher suicide rates. Given the inherent complexity of the phenomenon of interest here, even modest advances in our understanding of the underlying forces leading to suicide are perhaps the best that social science and statistical methods can ever reasonably expect to achieve.

Any non-experimental statistical analysis of suicide faces three fundamental conceptual challenges: (1) identifying variables that are theoretically relevant to the analysis; (2) measuring these variables and establishing their validity and reliability, and; (3) disentangling the signs and effect sizes associated with the theoretical causal pathways that link the exogenous and endogenous variables in the hypothesized system of causal relations. A brief discussion of each of these challenges helps provide a framework for interpreting the empirical findings presented in this paper.

Identifying the Theoretically Relevant Explanatory Variables

Defining the causal factors relevant to explaining the prevalence of suicide depends on the richness of substantive theory and on the appropriate level of empirical analysis that theory suggests is relevant. At its root, it is clear that suicide is the consequence of a decision taken at the level of the individual. This implies that the immediate causes relate to the individual's psychological state at the time (eg, depression, desperation, physical pain). Individual decisions take place within contexts that range from specific fine-grained situational configurations of micro-level events, to broader social realities that individuals share in complex ways with others. Each contextual level of analysis – from the individual to the more broadly social – offers its own panoply of factors plausibly relevant for explaining why people take their own lives. Taken to the limit, each case of suicide can be very reasonably viewed as essentially unique.

Taking Durkheim's lead, the practical solution to this dilemma, and the one almost universally adopted in practice, is to aggregate suicide data over some well defined geographical unit of analysis. Data are much more readily available at the level of cities, counties, Metropolitan Statistical Areas, states, and countries than they are at the micro level

¹⁶ Kushner, H and Sterk, C. *The Limits of Social Capital: Durkheim, Suicide, and Social Cohesion* American Journal of Public Health July 2005, Vol. 95, No. 7

of the individual. Theoretical uncertainties about the causes of suicide aside, aggregation poses an additional dimension of quandary. First, aggregation entails an unavoidable loss of information. Working with community-level data on suicide rates, for example, makes it impossible to account for any micro-level psychological or situational causes of suicide. Second, working with aggregated data invites the possibility of falling victim to the “ecological fallacy” in statistical inference, the temptation to make inferences concerning individual behavior based on conclusions drawn from aggregate statistics that characterize the larger group to which individuals belong. The relationships that *average* characteristics of a community bear on a community’s overall suicide rate are likely to be quite different from the corresponding relationships obtained at the individual level. These differences become more strikingly misleading as the composition of individuals within communities becomes more varied. It is not at all uncommon to find that the signs of estimated causal effects at the aggregate level are the very opposite of those actually operating at the micro level, a phenomenon known as Simpson’s Paradox.¹⁷ Such a phenomenon might explain the apparent paradox in the debate surrounding the role of social capital as either protecting from or contributing to higher suicide rates.¹⁸

Measurement

Despite the misleading inferences to which aggregated data may lead, collecting data at a spatial level of analysis is easier, and less frequently challenged, than cobbling together data at the level of the individual. At the same time, explanatory variables that theory suggests are relevant for explaining individual suicides (eg, “violent living situation”, “mental health status”, “availability of firearms”) take on additional subtle nuances when summarized at a geographical level of analysis. The number of violent crimes per 100,000 population, for example, does not “cause” the county suicide rate to increase in the same sense that instances of violence within a family may be causally linked to an individual’s decision to commit suicide.

A related challenge arises in translating any theoretically relevant variable, at whatever level of analysis, into terms that are measureable and operationally meaningful. For a host of reasons, any candidate variable chosen to capture the abstract notion of “violence within a community”, for example, will invariably be an imperfect proxy for the ideal theoretical construct. This raises two statistical problems: (1) measurement error, which shrinks the effect size of estimated impacts, increasing the likelihood of finding no effect even when it exists, and; (2) estimates that are systematically biased to the degree to which the proxy variable falls short of fully capturing the target concept, something that is, moreover, essentially untestable. These issues relating to the reliability and internal validity of variables explaining the prevalence of suicide bedevil any scientific study of the phenomenon.

Some variables commonly used in descriptive work, like “race/ethnicity” and “community”, are more problematic when employed as proxy variables in causal analysis. It is important to recognize that they are not, in themselves, properly causal variables, but rather placeholders for a composite of unmeasured patterns of behavior that result from underlying

¹⁷ Edward Simpson (1951), “The Interpretation of Interaction in Contingency Tables”, *Journal of the Royal Statistical Society, Ser. B*, 13:238-241.

¹⁸ Kushner, H and Sterk, C. *The Limits of Social Capital: Durkheim, Suicide, and Social Cohesion* American Journal of Public Health July 2005, Vol. 95, No. 7

social, cultural, and economic differences. Their estimated impacts in any statistical model suicidality should be interpreted with care.

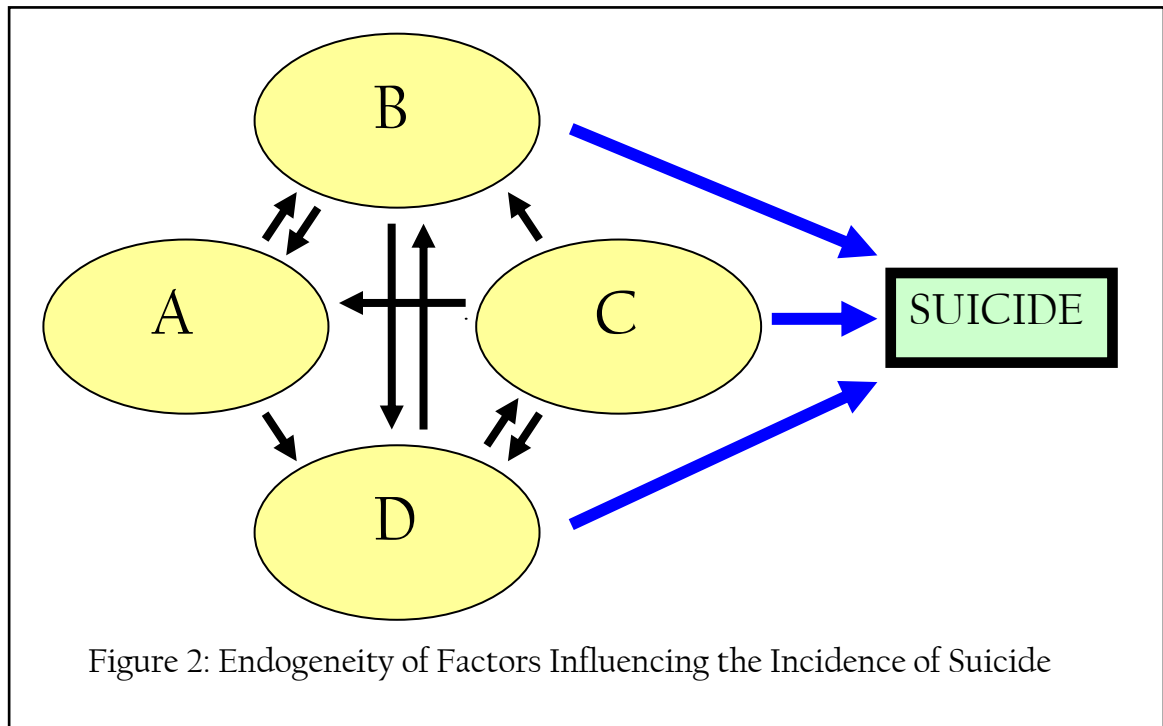
Finally, some data is rendered faulty simply by the nature in which it is collected. It is generally accepted that suicide rates are underestimated as a result of health system and law enforcement protocols that elevate the threshold for declaring a death a suicide, requiring that there be no “reasonable doubt.”¹⁹ Rates of incompleting suicide are even more difficult to ascertain by virtue of the difficulty of determining the degree to which an injury was intentionally inflicted.

Endogeneity and the Identification of Causal Effects

The most daunting challenge of modeling the prevalence of suicide follows from the very complexity of the forces that theoretically explain it. The difficulties of determining the theoretically appropriate variables to include in a statistical model mentioned earlier are compounded by deciding how they interrelate among themselves. Theory is unsettled in this area; many plausible alternatives and variations are credible. As an illustration, Figure 1 presents an arrow diagram of one plausible framework for explaining how a set of ideal explanatory variables may relate to the prevalence of suicide. Variables A, B, C and D are at the receiving end of one or more arrows and are therefore “endogenous”, that is, they are determined by one or more of the other explanatory factors within the system. As is apparent from the figure, all of the variables in this hypothesized framework are endogenous.

The problem that endogeneity of this sort poses is not so much statistical as it is the logical challenge of separating direct impacts from indirect impacts. For example, variable “D” at the bottom of the figure might represent “economic conditions.” Such a variable might not only affect the prevalence of suicide directly, but also indirectly via complex interactions with explanatory variables “B” and “C,” which might represent “mental health care” and “criminal prosecution.” Unfortunately, in a system like this, no amount of data can be marshaled to estimate the marginal effects associated with each of the arrows in the diagram, something that has to be achieved in order to disentangle direct effects from indirect effects. Econometricians refer to this challenge as the “identification problem”. Resolving the problem requires, among other things, finding an appropriate set of exogenous variables determined from outside the system that affect one or more of the existing endogenous variables, but which theory explicitly suggests do not affect the others. Needless to say, this is not an easy task.

¹⁹ *Reducing Suicide: A National Imperative*, Committee on Pathophysiology and Prevention of Adolescent and Adult Suicide; Institute of Medicine, The National Academies Press 2001



Research Design

Compromises are clearly unavoidable in the face of these challenges. The approach taken in this paper is a modest one. It is purely observational, based on what are essentially cross-sectional secondary data aggregated across the years 2001-2005 and measured at the county level for the state of California. The impacts of selected sets of explanatory variables on county suicide rate are estimated using least squares regression. Data limitations, described below, preclude any attempt to explore a causal system of relationships as ambitious as the one outlined in Figure 2 and, indeed, even severely constrain the ability to estimate regression models with any more than a few explanatory variables.

As a consequence, the findings presented in what follows should be interpreted as descriptive, exploratory, and suggestive rather than as offering anything definitive about the magnitudes, statistical significance, or even the directions, of causal relations in the complex nexus that surrounds observed patterns of suicide in the state of California. Associational rather than causal as our findings essentially are, the exercise nevertheless helps focus attention on key correlates of suicide in California.

Data and Methods

The study period for this analysis focuses on county-level California demographic data from 2001 to 2005. Suicide rates in California counties are collected and reported annually by the California Department of Public Health.²⁰ Annual age-adjusted death rates due to suicide

²⁰ California Department of Health Services, *California Health Status Profiles*, Center for Health Statistics, April 3, 2006

were averaged during the study period. Variables were selected which, based upon a search of suicidology literature, are believed to correlate with higher suicide rates (Table 2).

These explanatory variables were organized into seven clusters of affinity: Substance Abuse; Violence; Ethnic Composition; Firearm Availability; Mental Health Status; Poverty, and Macroeconomic Conditions. Ordinary least squares regression analysis was used to model age-adjusted county suicide rates as a function of each of these clusters of explanatory variables. All models were estimated by weighing the observations by county population to render them comparable and to permit inferences to be valid for the state as a whole.

Table 2: Clusters of Explanatory Variables	
Substance Abuse Model	
Age Adjusted Binge Drinking Prevalence Among Adults in California, 2001	
Age Adjusted Drug Induced Deaths, 2002-2004	
Violence Model	
Age adjusted Homicide Rates 2002-2004	
Children with Child Maltreatment Referrals, Substantiations, and Entries 2004	
Ethnic Composition Model	
White, Black, Native American or Pacific Islander, Asian populations, extrapolated from the 2000 Census	
Firearm Availability Model	
Hand Gun Transactions 2005	
Long Gun Transactions 2005	
Mental Health Status Model	
Percent with Serious Emotional Disturbances, 0 - 17 yrs, 2000	
Percent of Population Under 200% of Fed Poverty Level with Serious Mental Illness, 2000	
Poverty Model	
Proportion of Households Receiving Food Stamps, 2004	
Macroeconomic Conditions Model	
Per Capita Personal Income, 2002-2004 average	
Percent Change in Total Personal Income 2003-2004	
Mean Unemployment Rate, 2002-2004	

The Substance Abuse model utilized binge drinking rates from the California Department of Health Services Center for Health Statistics and reports of drug-induced deaths from death certificates in 2002-2004.²¹ Overdose deaths do partly overlap with suicidal deaths, introducing a bias into any potential correlation between overdose fatalities and suicide rates in California counties. However, it is also acknowledged that a certain proportion of overdose deaths recorded as “accidental” or “natural” on death certificates may actually have resulted from an intentional but unrecognized or unconfirmable suicidal action. Therefore, the extent of correlation between overdose death rates and suicide incidence is of interest.

The Violence model was compiled from age-adjusted homicide rates and child abuse referral rates. Homicide rates were collected from the statewide report, California County Health Status Profiles, prepared by the California Department of Public Health and child abuse

²¹ California Department of Health Services, *California Health Status Profiles*, Center for Health Statistics, April 3, 2006

referral rates from statewide statistics collected by the Center for Social Services Research at the University of California at Berkeley on child maltreatment referrals.

The Ethnic Composition model tested for a correlation between White Non-Hispanic, Hispanic, Black, Asian, and Native American/Pacific Islander ethnicity and suicide. A correlation between White and Native American ethnicity and suicide is well recognized.²² Whether this correlation persists when ethnic data is adjusted for rural residency deserves scrutiny.

The relationship between firearm availability and suicide has been well established.^{23, 24} As a reflection of firearm availability, California Department of Justice statistics on firearm transactions conducted in each California county were collected separately for hand guns and long guns. Both statistics were analyzed for the Firearm Availability Model. It should be noted that this data reflects legal firearms sales and registrations, and therefore may not correlate with the number of firearms acquired illegally.

The Mental Health model was comprised of prevalence data for serious emotional disturbances (SED) in youth 9 – 17 years of age and adults below 200% of the Federal Poverty Level (FPL) who have serious mental illness (SMI). This data is based upon the Epidemiologic Catchment Area studies conducted by the University of Texas, the National Co-morbidity Study (NCS), and rates of SED for youth published in the Federal Register. While these rates are extrapolated from year 2000 census data, surveys indicate that demographic shifts have been insignificant in regards to rates of SED and SMI between the time of census data collection in 2000 and the study period, 2001 – 2005.^{25 26} Because of variable policies regarding 72-hour psychiatric hospitalizations and disparities in inpatient resources between counties, emergency psychiatric hospitalization rates did not accurately reflect rates of psychiatric emergencies in the populations and were therefore not included in the model.

The Poverty model included the number of households receiving food stamps during 2004. As a reflection of household economics, it was designed to assess a possible correlation between economic dependence and suicide rate.

The Macroeconomic model was constructed from per-capita personal income, percent change in personal income, and mean unemployment rates during the study period. Historical suicide trends have inversely followed economic fluctuations over time.²⁷ However, the relationship between regional cost of living standards and suicide rates is a consideration that has been subjected to less study. In states such as California, disparity in regional economics

²² California Department of Mental Health, *California Strategic Plan for Suicide Prevention; Draft Report*, January 2008

²³ California Department of Mental Health, *California Strategic Plan for Suicide Prevention; Draft Report*, January 2008

²⁴ Zwerling C, McMillan D, Cook PJ, et al. Firearm injuries: public health recommendations. *Am J Prev Med*. 1993;9(suppl 1): 52-55

²⁵ <http://psy.utmb.edu/estimation/estimation.htm>

²⁶ Holzer CE, Goldsmith HF, Jackson DJ, and Swanson JW Chapter 6: Indirect Indicators of Need for Mental Health Services: Comments and an Independent Formulation In Needs Assessment, DHHS, 1988.

²⁷ *Reducing Suicide: A National Imperative*, Committee on Pathophysiology and Prevention of Adolescent and Adult Suicide; Institute of Medicine, The National Academies Press 2001

between rural and urban communities makes this distinction particularly relevant to rural suicide research.

An additional statistical model was explored, using hours of household television viewing as a potential measure of social disconnectivity. Research has raised questions regarding the impact of “social isolation” in rural communities as a partial explanation for increased suicidal risk.²⁸ Exploratory data was compiled from Nielsen Media Research regarding household television viewing among demographically uniform California county groups for the 2002 to 2004 period, but no meaningful correlation with suicide rate was evident. Therefore, individual county-level data was not further pursued.

Results and Discussion

Table 3 summarizes the results of the regression analyses in decreasing order of statistical credibility. The ranking of the findings by their model F-statistics is the same as by the Akaike Information Criterion (AIC). The latter penalizes the goodness of fit for including additional explanatory variables to a greater extent than the F-statistic does. The strongest explainers of suicide rate related to the Substance Abuse, Violence, Ethnicity, Firearm Availability, and Mental Health models (Table 3).²⁹ The Macroeconomic and Poverty models that were designed here had no meaningful explanatory power relating to suicide rates. While some studies have confirmed that longitudinal economic downturns correlate with increased suicide rates, the influence of socioeconomic factors upon the occurrence of completed suicide is complex.³⁰

Table 3: Comparative Explanatory Power of the Models

Explanatory Cluster	Adjusted R-squared	F-Stat	Akaike Information Criterion (AIC)
Substance Abuse	.59	42.28*	214.43
Violence	.55	35.51*	220.36
Ethnicity	.42	15.01*	235.26
Firearm Availability	.27	11.49*	248.20
Mental Health	.14	5.46*	257.93
Poverty	.002	0.95	266.48
Macroeconomy	-0.003	0.94	267.49

* Statistically significant at $p < 0.05$

²⁸ Kushner, H and Sterk, C. The Limits of Social Capital: Durkheim, Suicide, and Social Cohesion, *Am J Public Health*, July 2005, Vol 95, No. 7:1139-1143

²⁹ Explanatory power is greater the higher the adjusted R-squared statistic and F-statistic and the lower the log likelihood statistic and Akaike Information Criterion (AIC). With the exception of the log likelihood statistic, all of these summary measures adjust for the number of explanatory variables included in the model.

³⁰ *Reducing Suicide: A National Imperative*, Committee on Pathophysiology and Prevention of Adolescent and Adult Suicide; Institute of Medicine, The National Academies Press 2001: 207-209

The Substance Abuse Model proved to be a stronger predictor of higher suicide rates than the Mental Health Model. The relative rates of substance abuse in urban and rural communities in the United States for 2002 – 2004 demonstrate a significantly higher rate of methamphetamine abuse and abuse of certain prescription opiates in rural communities, particularly for those aged 18 to 25.³¹ However, overall rates of substance abuse are actually noted to be higher in metropolitan settings. Access to substance abuse treatment facilities is decreased in rural communities, with only 9 percent of rural residents living within one mile of a treatment facility, but 49 percent of urban residents living within this distance. Addressing both the travel and insurance obstacles to substance abuse treatment may help address substance abuse issues as they relate to suicide.

The Violence model correlated strongly with suicide rate during the study period. The fact that homicide rates actually proved to be a significant negative predictor of suicide illustrates the kinds of challenges posed by the identification problem related to endogeneity discussed earlier. While the data analysis presented here does not help to explain trends towards homicide in urban communities and suicide in rural communities, it does confirm this sociological phenomenon.

Native American ethnicity was associated with the highest suicidal risk in this analysis, and White ethnicity the second highest. These findings are consistent with correlations between ethnicities and suicide rates that have been well described in prior studies.³² However, to the extent that certain cultural conditions contribute to the incidence of what Durkheim described as anomic suicide,³³ suicide prevention efforts for virtually all ethnic groups must include a culturally appropriate context. Suicide prevention interventions should consider the cultural belief systems of individual patients and explore ethnically rooted self perceptions.

Firearm availability has long been recognized as a factor in suicide rates, and this correlation is supported by this analysis. From 20% to 30% of gun transactions may be missed by California Department of Justice firearm transaction statistics due to illegal secondary commerce.³⁴ Additionally, whether firearms purchased and registered within the political borders of counties remain in those counties is an issue that may constrain interpretation. Regardless of these limitations, based upon known patterns of handgun commerce and as a measure of firearm availability in California homes, legal transactions provide a measurable and adequately reliable indicator.³⁵ As an aside, it is interesting that handgun transactions explained the statistically significant effect (p-value = 0.001), and not long gun transactions.

³¹ The 2007 Report to the Secretary: Rural Health and Human Service Issues, The National Advisory Committee on Rural Health and Human Services, USDHHS. January 2007

³² *Reducing Suicide: A National Imperative*, Committee on Pathophysiology and Prevention of Adolescent and Adult Suicide; Institute of Medicine, The National Academies Press 2001: 207-209

³³ Durkheim, E. *Suicide: A Study in Sociology*. Spaulding J, Simpson G, trans. Glencoe, Ill: The Free Press; 1951

³⁴ Bureau of Alcohol Tobacco and Firearms. Commerce in firearms in the United States. Washington D.C.: US Department of the Treasury, Bureau of Alcohol, TOBaccfo and Firearms, 2000

³⁵ Centers for Disease Control and Prevention. First Reports Evaluating the Effectiveness of Strategies for Preventing Violence: Firearm Laws. MMWR 2003;52:11-20.

The methods employed to commit suicide in a given society are often the most readily accessible lethal modalities. Thus, in contrast to the use of firearms as the most predominant means of suicide in the U.S., 58% of suicide victims in a recent study of suicide in China ingested rat poison or pesticides.³⁶ Access to firearms is more common in rural than in urban areas of the United States.³⁷

The Mental Health Model alone was a weak predictor of suicide risk. Nevertheless, effective and accessible mental health care has been identified as a protective factor against suicide. Addressing tangible obstacles to mental health care access, such as insurance coverage or transportation, may mitigate some of the issues contributing to higher suicide rates in rural communities.

Occupations that are associated with higher suicidal risk fall within both the upper socioeconomic strata of society, such as the health professions, and in the blue collar workforce, such as military personnel.³⁸ More specific to suicidal risk than static socioeconomic condition is the expectation of downward social mobility and reduced income in the future. Therefore the lack of correlation between the Macroeconomic Model and suicide incidence is not surprising in this study population during this selected study period. However, recent global downward economic trends might be expected to significantly increase suicidal behavior based upon known historical patterns.

Limitations

Suicide death rates are thought to be underestimated from death certificate data because of the extensive criteria that must be met in order to convincingly certify that a death was intentional. The test for suicidal intent is often not met in such cases as overdose deaths, particularly when a note is not left by the victim.

Several factors that have been previously described as influencing suicide rates were not included in this study. Religious practice and church attendance has been described as having a moderating effect on suicide in communities, but was not designed into a model for this analysis. The issue of television viewing was explored as a measure of social isolation, but was found to correlate neither with rural residency nor with suicide rates in an exploratory model. However, further efforts at refining the definition of suicide-associated social isolation are worthy of consideration.

Opportunities for statistical bias have been described for the Substance Abuse model. Also, firearm transaction data excludes illegal transactions from the tally. Because of gaps and overlaps between community statistics that describe various sociological and psychological stressors, caution will continue to be required while making inferences about correlation with suicide rates.

³⁶ Centers for Disease Control and Prevention. Suicide and Attempted Suicide – China 1990-2002. *MMWR* 2004;53:481-484.

³⁷ Wiktor SZ, Gallaher MM, Baron RC, Watson ME, Sewell CM. Firearms in New Mexico. *West J Med.* 1994; 161:137-139

³⁸ Kung KC, Liu X, Juon HS: Risk factors for suicide in Caucasians and in African-Americans: a matched case-control study. *Soc Psychiatry Psychiatr Epidemiol* 1998; 33:155–166

Whether in fact suicide rates in a particular population diminish with the per capita number of communication events can be studied. However, gathering data about internet communication is problematic due to difficulties in distinguishing different and divergent uses of new communication tools, like the internet and text messaging.

Summary

The completed suicidal act typically includes four components: (1) the decision to act, (2) some degree of commitment to assure death, (3) availability of a lethal means, and (4) greater or lesser degrees of interest in communication on the part of the victim, resulting in finding a suicide note in fewer than 50% of suicides. The goal of improving our understanding of suicide is to design and implement effective suicide prevention interventions at the primary, secondary and tertiary levels (or in accordance with an operational classification of mental health prevention efforts, *universal, selective and indicated* prevention activities³⁹), addressing each of the above elements of the suicidal act as well as the sociologic phenomena which contribute to suicidal ideation.

Regardless of how a suicide prevention campaign is organized, to address the special needs of rural communities in such an endeavor, the complex factors that cultivate suicide in rural settings must be considered, as well as the multifactorial nature of suicidal psychopathology itself. Further research should continue to be pursued to refine evidence-based interventions for all communities, rural and urban alike.

³⁹ Gordon, R. S. *An operational classification of disease prevention*. Public Health Reports 98:107-109, 1983.