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Cluster and regional influences on suicide in a Southwestern American Indian tribe

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Abstract

Suicide is the second leading cause of death among American Indian youth. Elevated rates of suicide in Indian communities have been attributed both to outbreaks and to regional trends. We assessed the contribution of these two factors for a single tribe, and attempted to define a profile of individuals at risk. Data came from the tribe's registry of suicide attempts and completions for 1990–1993 and analysis of death certificates for the period 1985–1996. Using combined tribal and death certificate data, the average annual (age-adjusted) rate of completed suicide among tribal members was 44.7/100,000 for 1990–1993. Within the 45 suicide deaths and serious attempts in this time period, we identified one grouping of seven cases taking place in a 40-day period. All seven involved hanging and youth (13–28 years old). Using death certificate data alone, the average annual rate of suicide death for non-natives in the surrounding county in the period 1985–1996 was 22.7/100,000. Age-adjusted to the county population, the tribal rate for the same period was not significantly different (24.6/100,000). Tribal and county suicide patterns differed by age distribution and method but not by gender. We concluded that both regional trends and clustering contribute to suicide in this community. Further prevention efforts may need to focus on both unique tribal characteristics and shared factors among non-native neighbors.

Keywords: Suicide; Youth; American Indian; Clustering

Introduction

Suicide is a problem that spans the world's cultures, causing an estimated 1.4 million deaths a year (Desjarlais, Eisenberg, Good, & Kleinman, 1995). Suicides take place in both industrialized and developing societies, and in both rural and urban areas. Suicide has long been recognized as an important public health issue for American Indian communities: it is the eighth leading cause of death for Indians of all ages (compared to the ninth leading cause for the United States as a whole), and second only to non-intentional injuries as a cause of death among those 15–24 years old (compared to being the third-ranked cause for this age group overall in the United States) (Indian Health Service, 1996) (Peters, Martin, Ventura, & Maurer, 1997).

Indian Health Service (IHS) compilations for 1991–1993 put the (age-adjusted) rate of completed suicides among Native Americans at 16.2/100,000/year, about 50% higher than the rate among US residents as a whole. Compilations of national data have found marked variation in suicide patterns among tribal

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groups (Wallace, Calhoun, Powell, O'Neil, & James, 1996). For example, across 'service areas' (administrative regions) of the Indian Health Service, the ratio of male-to-female completed suicides for 1979–1992 ranged from a low of 3.7 (in the Bemidji area, which includes Minnesota, Wisconsin, Michigan, and Indiana) to a high of 17 (in the Albuquerque area, which includes Colorado, New Mexico, and parts of Texas). The age groups most affected by suicide among American Indians have also varied over time. For the period 1979–1992, males aged 15–34 made up 64% of all American Indian and Alaska native suicides (Wallace et al., 1996). In some tribes, however, this predominance of youth suicide appears to have emerged only in the last 40–50 years (Kraus & Buffler, 1979; Levy & Kuhitz, 1987). National data suggest that age patterns may now, again, be shifting. From 1979 through 1992, suicide rates among American Indians in the 15–24 years age group have been decreasing, while rates among those aged 65 and over increased by almost 200%. The increase in suicide among the overall US elderly population was about 15% (Wallace et al., 1996). Indian rates among the elderly, however, are still less than half of those among the overall US elderly population (about 8 versus 20/100,000) (Indian Health Service, 1996).

The work described in this report evolved from the authors' collaboration with an American Indian tribe living on a portion of their ancestral lands in what is now the southwestern United States. The tribe had become concerned about an increase in the number of suicides in their community and sought help with analyzing their records and prevention efforts. This report addresses three main questions:

First, given the variation in suicide patterns among tribes, the tribe wanted to determine characteristics of individuals at risk among its own members. Although the tribe lacked detailed information about suicide victims, basic demographic descriptions were available and, it was hoped, could be used to inform planning for prevention programs.

Second, the tribe was concerned about the possibility that some suicides might be related to each other, either through agreements to act together or through suggestion or imitation. Groupings or outbreaks of suicides have been reported in several Native American communities in both the US and Canada (Bechtold, 1988, 1994; Kirmayer, 1994; Levy & Kunitz, 1987; Zitzow & Desjarlait, 1994). To define the scope of these outbreaks, authors of these reports relied on impressions of community members and on simple statistical comparisons with presumed "baseline" numbers of cases. No further analysis may be required to justify investigation and consideration of preventive steps, but epidemiologic studies may need to go a step further. In particular, simple statistical comparisons, because they do not include a systematic search for and comparison with fluctuations in the number of cases over time, risk labeling as statistically significant what may be random variations that have drawn the attention of the community (Kahn & Sempos, 1989). We elected to use a "sliding window"-type test, the "scan" statistic (Wallenstein, 1980), which is designed to distinguish "significant" elevations from random fluctuations within a larger study period. In addition, the scan procedure is felt to be well suited to situations, such as suicide outbreaks, where there are relatively few events spread out over time (Wartenberg & Greenberg, 1993). The guiding principle behind our use of statistics, however, followed the advice of Aldrich and Drane (1993), and O'Carroll and Mercy (1990), that statistical analyses of disease outbreaks, for many reasons, are best used as "exploratory methods" whose results should be seen not as definitive but rather weighed along with other evidence. In particular, we were interested in using statistical methods alongside other data to help us determine not only if an outbreak had occurred, but also to define as best as we could when the outbreak began and ended.

We subsequently added a third question related to regional variation in suicide rates. Some comparisons of suicide rates in Arizona and New Mexico, for example, find that American Indian rates are similar or only marginally higher than those for non-Hispanic White residents (Becker, Samet, Wiggins, & Key, 1990; Phoenix Area Indian Health Service, undated). In the general population, for the period 1990–1994, the age-adjusted rate of suicide in the western US (14.1/100,000) was 70% higher than the rate of suicide in the northeast (8.6/100,000) (Centers for Disease Control, 1997). These comparisons raise the question of whether elevated rates of suicide among the tribe with which we worked might be determined, in part, not so much by tribal membership but by factors shared by other residents of the southwest. The design of preventive efforts might shift if suicide among non-Indians in surrounding communities took place at similar rates and with similar demographics.

This report focuses most closely on the four-year period 1990–1993, a time when the tribe's own records were kept most meticulously. We also report data based on state death certificates for the 12-year period 1985–1996.

Methods

Population

The study population consists of approximately 12,000 individuals who live on a reservation in the southwest United States. The reservation is in a rural area more than 150 miles from the nearest large city.

More than 50% of the population lives below the federal poverty level (State Data Center, 1990) compared to 32% for all American Indians living on reservations (Indian Health Service, 1993). About half of the adults in the population have graduated from high school; less than 2% have a college degree.

The tribal lands are sparsely populated. About a third of residents live in one of three communities that surround tribal industries and administrative offices, the rest live in more rural areas. We assigned suicides and attempts analyzed in this report to one of 13 districts designated by the Tribal Planning Council.

Data sources

We developed a list of completed suicides by reviewing three sources: (1) a registry of suicidal acts maintained by the Tribal Health Authority, (2) records of the tribal police department and corresponding hospital records, and (3) state death-certificate data.

Tribal data were available for the period 1990–1995. The suicide registry had been maintained by Tribal mental health and outreach workers who interviewed surviving relatives within 8 days of a death (mode 1 day) using a one-page form designed by the regional office of the Indian Health Service. The registry included demographic information, circumstances of the suicidal act, and elements of the victim's history (use of alcohol, past suicide attempts, use of mental health services) as they were reported by family members and friends. Some victims were not included in the registry and were identified from police records. In these cases, information about the victims was abstracted from Indian Health Service hospital charts using the same form.

A file of death certificates (minus names, but with dates of birth and death, cause of death, place of residence, place of death, and ethnicity) was provided by the State Center for Health Statistics. Cases of completed suicide were identified by their International Classification of Disease (ICD) code (E950.0–E959.9). For suicides among tribal members, we included all persons, regardless of their place of death, who were said to have lived on this tribe's lands at the time of their death, and whose ethnicity was reported as "Indian". (We used a similar rule to find suicide deaths among non-Indian residents of surrounding counties.) We then matched the state death-certificate file with the information developed from the tribe's records. In some cases, dates of death differed by a few days between state and tribal sources. In those cases, we used the death certificate date in our tabulations and calculations.

Of 31 deaths known to the tribe (police or Health Authority registry) for 1990–1995, six (19%), were not classified as suicide by state death certificates. One individual was listed by the tribe as a suicide from hanging, but we could not find a death certificate (with any diagnosis) that matched by date of death, gender, and age. Five of the suicide deaths reported by the tribe (16%) were listed by the state as dying from other causes: four deaths listed by the tribe as suicides by hanging were classified by the state as either being of unknown cause ($n = 2$, ICD 799.9) or hanging of undetermined intent ($n = 2$, E983.0); one death listed by the tribe as a probable suicide when the individual was struck by a car was classified by the state as a pedestrian involved in a motor vehicle accident (E814.7). We used the tribe's classification for all six of these deaths. Checking in the other direction, of the 26 cases identified from state records, all but one were found in the tribe's listing. That individual died by hanging outside the reservation lands; the individual was identified because the reservation was listed as place of residence on the death certificate.

The tribe's suicide outreach and tracking activities were particularly active in the period 1990–1993, resulting in a registry that included, in addition to deaths, many suicide attempts. We used the registry to identify 22 attempted suicides that we classified as "serious" because they (a) involved violent means (hanging or shooting), and (b) had evidence of a medically serious injury (noted in the registry to have had in-patient treatment). Although, in general, the demographics of those who attempt are different from those who complete suicide, as the medical seriousness of attempts increases, the characteristics of attempters (in particular, their gender and suicidal intent, as well as the presence of biochemical markers such as decreased metabolites of serotonin in the cerebrospinal fluid) come to closely resemble those of completers (Brent, 1987; Centers for Disease Control, 1995; Mann et al., 1996; Rosen, 1970). We identified the 22 serious attempts on an entirely a priori basis simply by searching the records of attempts for individuals with the characteristics described above. As we had hoped, this group of cases was similar in its age (attempters' mean age 21.6 years, completers' 23.0, $p = 0.38$), gender (both groups 86% male), and seasonal pattern (attempters 59% in quarters 1 and 4, completers 64%, $p = 0.51$) to the completed suicides for that time period. We combined the serious attempts and completions in our analyses of grouping by time.

Statistics

We calculated crude and age-adjusted suicide rates (events per person-year) using population estimates for 1991 provided by the tribal government and 1990 US Census data. Confidence limits for rates were calculated using Poisson assumptions. Statistical tests comparing rates of events (suicides or attempts) between years or other fixed time periods were made using exact Poisson

calculations. Probability values given are for two-tailed tests of significance, except for time clustering calculations and some Poisson calculations which yield one-tailed tests.

Clustering in time was examined using the "scan" statistic, a method commonly used in evaluations of possible disease clusters (Wallenstein, 1980; Wallenstein & Neff, 1987; Wallenstein, Naus, & Glaz, 1993). Scan tests determine the maximum number of cases found as a "window" of a given length of time is "scanned" across the total time being examined. For example, one of our analyses looked for the largest number of suicides and attempts found within all possible one-month periods between 1990 and 1993. The test then gives the probability that this largest number could have occurred just from random changes in the number of suicides, or if it might represent a truly unusual grouping of events.

The scan statistic yields an interpretable probability figure for statistical significance when used with a single, a priori defined window size. However, a common problem in cluster investigations is the fact that the window size (that is, the length of the suspected cluster) is not known. Determining the length of the cluster may actually be a main goal of the investigation (Aldrich & Drane, 1993). Some analyses present results for a range of a priori cluster lengths (Gould, Wallenstein, & Kleinman, 1990a; Gould, Wallenstein, Kleinman, O'Carroll, & Mercy, 1990b). Aldrich and Drane (1993), in their discussion of the use of the scan statistic, suggest "experimenting" with various cluster lengths. They hasten to point out that, if their suggestion is followed, the probability value produced by the scan calculation cannot be used directly because of the problem of "multiple looks". At present, there is no single accepted way of adjusting the critical level of statistical significance when using exploratory methods to determine window size (Wallenstein, personal communication). Currently available means of adjustment — for example, the widely used Bonferroni correction for multiple comparisons — are felt to be too "conservative" statistically, but are the best available (Kulldorff & Nagarwalla, 1995).

For the present study, we chose initial scanning window sizes of one month, three months, and six months. We then took the window size that came closest to defining a statistically significant cluster (which we found to be one month) and modified it (our plan was to add or subtract 10-day intervals) to see if a significant cluster could be defined. We used both Bonferroni and Sidák methods to adjust the critical level for statistical significance (Cook & Dunnett, 1998). The two methods gave identical results. Our actual calculations involved four "trials" to determine window size (our original three trials — one, three, and six months, and one subsequent trial based on those results). This yielded a corrected significance threshold for the scan calculations of $p = 0.013$ (0.05/4).[2] One concern about the use of the scan procedure is that, for some data, it may have relatively low statistical power to detect outbreaks (Aldridge & Drane, 1993). We estimated the procedure's power to detect outbreaks of various sizes using the approximation derived by Wallenstein et al. (1993).

Human subjects

This work was approved by the Johns Hopkins School of Hygiene and Public Health Committee on Human Research. The decision to carry out the study was made during a meeting, convened at the tribe's request, among tribal officials and staff of the Center for American Indian and Alaska Native Health. On several occasions, we discussed conclusions with tribal health officials and incorporated their comments into our analyses. Final reports were presented to the Tribal Health Authority and the Tribal Council.

Results

Characteristics of suicide completions, 1990–1993

Based on combined tribal and state data, there were 23 completed suicides among reservation residents during the four-year period 1990–1993, an annual rate of 46.0/100,000 (95% confidence limits 29.1–66.7/100,000). Age-adjusted to the US population, the rate was 44.7/100,000. Among youth 15–24 years old the rate of death by suicide was 133/100,000 (95% confidence limits 66–233/100,000).

Persons who completed suicide ranged in age from 13 to 53; all but two were under 35 and five (22%) were under 18. Twenty of the 23 (87%, 95% confidence limits 73–100%) were male. Hanging was the most common means of completed suicide ($n = 15$, 65%), followed by firearms ($n = 6$, 26%). Two persons died of self-inflicted stab wounds to the trunk. No deaths occurred from ingestion or asphyxiation with gas.

We had no information on family income or traditional versus Western life-style or practices. It was the impression of tribal officials that deaths were not confined to particularly disadvantaged families (although, as noted above, over half of tribal members live below the federal poverty line) nor to those known for social problems. Most of those who died were said to

[2] We wrote computer programs in GW-Basic following formulae provided by Wallenstein (1980) and Wallenstein and Neff (1987), to calculate power for the scan statistic and to calculate probability values for maximum numbers of events in a window. We checked the output of these programs against examples provided in the literature, and against output from software provided by the ATSDR (Aldrich & Drane, 1993).

come from families that predominantly used the tribe's native language at home rather than English.

Alcohol was involved as a chronic problem or acute contributor in 15 of 18 cases (83%) where information on drinking had been provided. Ten of 19 for whom the information was available (53%) were known by either family or tribal professionals to have made prior suicide attempts; nine were thought to have never made prior attempts. Only three of 23 (13%) had known prior mental health contact.

Evidence for grouping of cases

Fig. 1 shows the distribution of 45 cases (23 deaths and 22 serious attempts) from 1990 to 1993. The number of deaths in 1993 was significantly increased compared to the average number of deaths for the overall four-year period 1990–1993 (one-tailed Poisson probability $p = 0.031$). Five deaths occurred in the first quarter of 1993, the maximum number of deaths in any calendar quarter; this was also significantly greater than would be expected ($p = 0.013$).

Using the "scan" procedure with a "window" of 40 days, we found a grouping of seven cases of deaths and serious attempts within the first quarter (February and March) of 1993. The one-tailed probability that this grouping occurred by chance was $p = 0.027$, which is above our corrected critical significance threshold of $p = 0.013$. If there had been eight events, the associated p value would have been 0.006. Seven events in a period of 40 days is equivalent to an annual rate (given a population estimate of 12,500) of 509/100,000; the 45 completions and serious attempts over four years is equivalent to an annual rate of 90/100,000. Thus, the "relative risk" (ratio of the rate within the grouping compared to overall) is 5.7. We calculated the power of the scan procedure to detect an outbreak of that magnitude as 0.48 (given a p level of approximately 0.05 [a critical value of seven events], a relative risk of 5.7, a window of 40 days, and a total of 45 cases over four years).

The seven cases in the 40-day grouping differed by method but not age or gender from the overall group of deaths and serious attempts. All seven cases in the grouping involved hanging, compared to 16 of the remaining 38 cases (42%) ($p < 0.01$). All but one involved alcohol, but this was not different from the proportion of remaining cases involving alcohol. All involved young people, ranging in age from 13 to 28 (versus 82% in the overall 45 cases, $p = 0.2$). The proportion of females was the same as in the overall 45 cases (14%). Only one case (a fatality) was suspected at the time to have been related to another suicide. Two of the seven cases in the group were examples of disagreements between tribal and state data for cause of death. The tribe indicated that both had died by self-inflicted hanging; one was classified by the state as a hanging of unknown cause (E983.0), and the other was listed by the state as having an unknown cause of death (799.9).

Comparison of 12-year rates between the tribe and surrounding counties using death-certificate data alone

As noted above, one of our concerns had been that patterns of suicide among the tribe might, in fact,

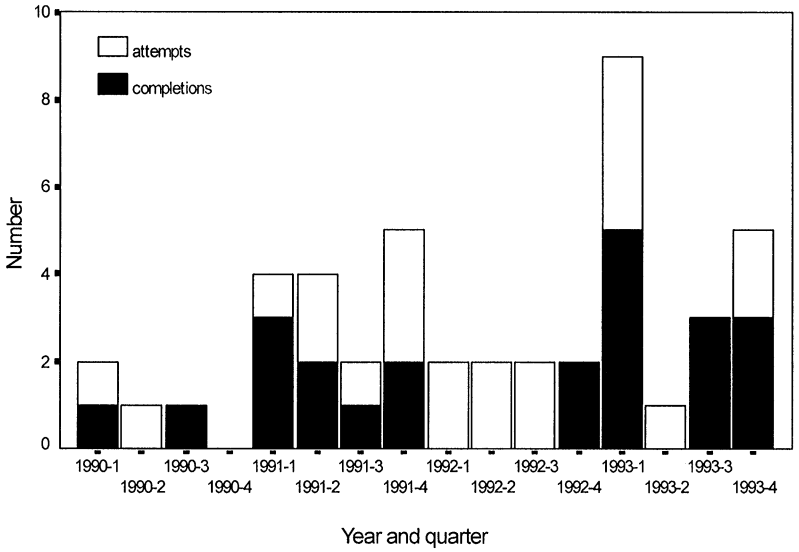

Fig. 1. Tribal suicide completions and serious attempts, 1990–1993, by calendar quarter.

reflect regional trends rather than be unique to a Native American community. Because our most reliable tribal police and Health Authority data were limited to the period 1990–1993, we used only death certificate data in the following 12-year comparison analyses.

The crude rate for non-native residents of surrounding counties was 22.7/100,000/year (95% confidence limits 19.9–25.7) over the 12-year period. The comparable crude rate for the tribe was 30.7/100,000 (95% confidence limits 22.4–40.2). When the tribe's rate was age-adjusted (a requirement because about 50% of the tribe's population is under 20 compared to about a third of the county's non-Indian population), it was 24.6/100,000, much closer to the crude rate of the county residents ($p = 0.25$). However, as shown in Fig. 2, the age-specific patterns are very different for the two populations. Average annual tribal suicide death rates peak in the 20–29 year age group, at 7.64/10,000, while county rates have a smaller increase in that age group (3.84/10,000) but have their main increase among the elderly. From age 30 through 49 tribal and county rates are similar, but county rates markedly exceed tribal rates over age 50. There are no tribal suicides reported for individuals of age 60 and over, while county rates increase with age from 60 to 80 and older age group.

County deaths were much more likely to involve firearms (82% compared to 51%) ($p < 0.001$) and much less likely to involve hanging (7% versus 39%) ($p < 0.001$). Tribal and county deaths did not differ by gender, however. Nearly 90% of the deaths in both groups were of males.

Discussion

This analysis suggests that two factors may contribute to elevated rates of suicide among tribal members. The first may be related to some kind of regional influence. Measured by death certificates over a 12-year period, the tribe's age-adjusted suicide rate is only slightly higher than that of the surrounding community, which in turn is about twice the overall rate for the United States (11.8/100,000 for 1990–1994) (Centers for Disease Control, 1997). The state that encompasses the tribe's lands has an overall suicide rate that is 50% higher than the national average. On a statewide basis, suicide rates among non-Hispanic Whites are only marginally lower than among Indians (19.6 versus 20.8/100,000/year for 1985–1995) (State Center for Health Statistics, Internet site).

Studies have thus far not determined why suicide rates are higher in the southwest US. Factors considered include poverty, low educational status, unstable social environments, and firearm ownership, but only limited data on these factors have been available in studies of individual suicides. Furthermore, what is known of the regional variation of these factors does not seem sufficient to account for the differences observed in suicide (Centers for Disease Control, 1997).

Despite regional similarities in overall rates, however, tribe and county suicides differed markedly in their age distribution and means of death, suggesting that some factors contributing to suicide uniquely affect Indian communities. Again, these differences are reflected in statewide data; overall in the state, 68% of non-Hispanic White suicide victims were over 35, compared to only

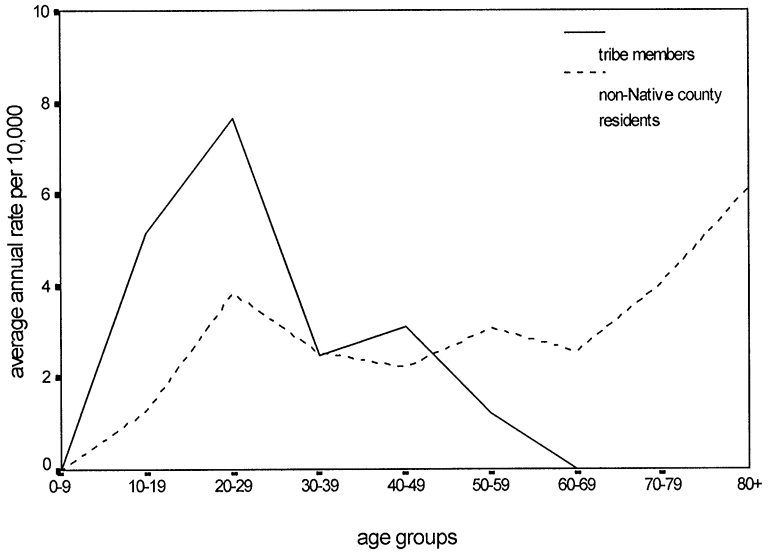

Fig. 2. Age-specific suicide rates, 1985–1996, comparing tribal members and non-Indian residents of the surrounding counties.

34% of American Indians. Overall in the state, 67% of suicide deaths involved firearms or explosives, compared to only 36% of Indian suicide deaths (State Center for Health Statistics, Internet site).

Clustering of suicidal behavior is a second specific factor that may contribute to increased rates of suicide among the tribe's members. The tribe's registry was a critical tool for attempting to define a cluster because it listed serious attempts as well as completed suicides, something which is needed to study suicide in small populations. Although, as a group, attempters differ markedly in their characteristics from suicide completers, as the potential lethality of attempts increases, the demographic characteristics of attempters come to closely resemble those of completers (Brent, 1987; Rosen, 1970). Thus, combining potentially lethal attempts with completed suicides can be critical to understanding the extent of serious suicidality in a population (Centers for Disease Control, 1988, 1991; Potter et al., 1998). Combining these two types of cases also helps increase the number of cases available for study, an important issue when studies involve relatively rare events in small populations.

Although we had limited data with which to select serious attempts, our findings were similar to those of Brent (1987) in that our serious attempters' age, gender, and seasonal pattern did not differ significantly from completed suicides. Access to more detailed hospital or emergency room records, however, would have allowed us to be more certain about individuals' degree of injury and could have resulted in a somewhat different selection of cases to combine with the completions. For example, Potter et al. (1998) designed and validated a method of assessing attempt severity using injury and treatment information specific to various suicide methods. Mann et al. (1996), interviewing hospitalized attempters with the lethality and intent scales of Beck, Beck, and Kovacs (1975), showed that severity of injury and objective evidence of intent (for example, leaving notes, taking precautions against discovery) were highly correlated with each other and with differences in cerebrospinal fluid metabolites found among suicide completers. On a post hoc basis, we repeated our analyses by expanding the definition of serious attempts to include cutting and stabbing that required in-patient care in addition to gun injuries and hangings. Our results were similar to those using the original definition. We identified a possible cluster at the same time period; it contained one additional event (an attempt by cutting/stabbing). The scan-derived probability of finding this grouping was 0.035, which is greater than our corrected significance level of 0.013.

Although we fell short of a conservative test of statistical significance for defining a cluster, simple statistical tests, and the victims' overwhelming use of a single means of harming themselves suggest that a cluster did, in fact, take place. Data from detailed interviews with survivors and family, however, would be required to confirm links between the victims (Lester, 1997, p. 35). Another clue to clustering would have been information about other traumatic deaths or injuries in the community that could have triggered suicidal ideation. It is possible that suicidal ideation was spread in the community as a response to trauma other than a suicide. For example, during one of our visits to the community, a young child died after having been hit by a motor vehicle. Several individuals said they felt that such tragedies contributed to suicidal feelings. Finally, we had only very limited information about predisposing factors such as alcohol use, and no information about family history. Drinking hard liquor (versus beer or wine) has been associated with increased risk of suicide attempts among Indian adolescents (Grossman, Milligan, & Deyo, 1991) and victims of violent suicides are more likely to have a family history of suicidal behavior (Linkowski, de Maertelaer, & Mendlewicz, 1985).

Our study illustrates one major problem with using statistical procedures for defining clusters — statistical power. To gain an idea of the number of events we might have needed to reach acceptable levels of power, we estimated relative risks associated with reported suicide clusters (Bechtold, 1988; Centers for Disease Control, 1988, 1991; Davidson, Rosenberg, Mercy, Franklin, & Simmons, 1989) and found that they ranged from about 3 to 17, with periods ranging from 1 to 16 months. The relative risk associated with the possible 40-day cluster in our study was 5.7, toward the low end of this range. Based on this value, and using Wallenstein's method (1993), we calculated our power to find a cluster among 45 events, if one existed, as only 0.48. Better mental health registries, maintained consistently, would be of enormous use in small populations like the tribes. They would allow sufficient numbers of events — suicides, attempts, changes in the patterns of visits to various services — to be thoughtfully combined and analyzed to determine the forces behind temporal trends.

Nationally, clusters are thought to involve only a relatively small proportion of suicide deaths (Gould et al., 1990a). Gould and colleagues analysis of US national data for 1979–1984 estimated that between 1.9 and 2.3% of completed teen suicides were related to each other, as measured by their proximity in time and the victims' residence in the same county. Gould and colleagues made separate estimates for 11 states; using a time period of 30 days (as the length of potential clusters). Seven states had estimates of less than 5% of suicides occurring in clusters, and two states had higher estimates (11.6 and 13.4%, respectively). The one cluster that we believe took place in our study (seven cases), accounted for about 16% of the completed suicides and

serious attempts in a four-year period. We cannot directly compare our figure with that of Gould and colleagues because they used a different statistical method to determine clusters (one based on both time and physical proximity), they examined only deaths, and they adjusted their estimates for underlying rates of suicide. However, it is plausible that clustering of suicides might occur to a greater extent among Native Americans because of their generally younger populations. Gould and colleagues national analysis estimated that clustering of suicides was 2–4 times more common among adolescents and young adults compared to older individuals (Gould et al., 1990b). Unfortunately, we do not have comparable data sets to be able to directly compare clustering in the tribe with clustering in the surrounding community.

We want to be clear about what we believe to be the uses and limits of using a statistical test to identify clustering. As O'Carroll and Mercy (1990) point out, statistical confirmation is not a requirement for investigating or even confirming clusters. In addition to problems with statistical power, statistical tests can be falsely positive or negative because of errors defining a time frame or geographic area, or difficulty fully and accurately ascertaining events. Accordingly, we used a statistical procedure that allowed us to test time intervals that were not based on arbitrary divisions of the study period into weeks or months (Wallenstein, 1980). A problem we could not overcome, however, was the relatively short period of time (four years) during which the tribal registry was most complete. Van Winkle and May (1993), analyzing death certificate data from related tribes in an adjacent state, found increases in suicides occurring at five-year intervals. We were able to take advantage of the fact that there are a limited number of sites for medical services within the tribe's community, making it harder — though not impossible — that attempts requiring emergency care would be missed. In the end, although we are not able to state unequivocally that a cluster took place, our estimates of the relative risk and cluster length in this instance may help future investigators make better a priori judgments about the values to use in their calculations, thus avoiding having to take "multiple looks".

Using our combined tribal and death certificate data, the suicide rate for the tribe's 15–24 year olds was 133/100,000 (95% confidence limits 66–233/100,000). While this rate is extremely high, it is within the range reported for some groups of Indian youth. Van Winkle and May (1993) estimated that the suicide rate among 15–24 year old Apache Indians in New Mexico was 86.2/100,000 for the period 1980–1987; the rate among 25–34 year olds was 117.3/100,000. Nationally, the Centers for Disease Control estimated that, from 1979 to 1992, the suicide rate for Indian males aged 15–24 was 62.0/100,000 (Wallace et al., 1996). The youth-predominance of Indian suicide makes its impact on the community even more devastating. It is not known why, in some populations, age-specific rates of suicide vary to such a great extent. In Canada, for example, age patterns resemble more those of Native Americans in that the rate of youth suicide exceeds that of the elderly (Desjarlais et al., 1995, p. 69). The similarity in overall rates between the county and tribe, with differences in age and method, would appear to offer a unique opportunity for better understanding these discrepancies.

Our comparison of the tribal and state data points out the common difficulty of creating an accurate and complete listing of suicides. Our finding that death certificates underestimated suicide deaths compared to tribal records is similar to prior studies with both Indian and non-Indian populations. Sievers, Nelson, and Bennett (1990), in their work with the Gila River Indian Community, found that the state had identified 28 of 31 (90%) suicide deaths in a 10-year period. Moyer, Boyle, and Pollock (1989), examining deaths of Vietnam-era army veterans, found that death certificates were about 90% sensitive, and 100% specific, for suicide deaths when compared with independent review of available medical and legal documents. We found that the state had identified 25 of 31 cases (81%) over a four-year period, plus one case that the tribe had not identified (because, we believe, the death occurred outside of tribal lands). As in the work of Moyer et al. (1989), some death certificate discrepancies involved problems determining intentionality rather than cause: three of the six certificates matched tribal data for cause of death (two hangings and one pedestrian struck by a motor vehicle) but noted that intention was not known (hangings) or judged the death to be an accident (pedestrian).

Conclusions

Both regional differences and clusters or groups of suicide may contribute to elevated rates of suicidal behavior among native Americans in the southwest United States. Regional similarities in overall rates, however, obscure important differences in the age of victims and the means they use to harm themselves. Research aimed at preventing native American suicide needs to focus both on the unique cultures of specific tribal communities and on the environment that they share in common with their non-native neighbors.

Suicide registries are invaluable tools for understanding suicidal behavior in native communities and need to be encouraged and supported. Registries might be expanded to allow tribal mental health workers to rapidly collect more detailed information, especially as it relates to connections between suicidal events. Developing complementary registries in adjacent, non-native communities would aid prevention efforts for natives

and non-natives alike. Encouraging regional cooperation along these lines could be an important vehicle for fostering better understanding in the face of a common challenge.

Statistical procedures are useful for defining possible groupings of suicides. They offer the possibility of helping to define not only if a grouping took place, but also more precisely where, in time, its boundaries might be drawn. Limits on the use of statistical procedures include low "power" when dealing with rare events and lack of consensus on how to use them as exploratory tools without destroying the ability to interpret statistical significance.

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