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Suicide: A Ten-Year Retrospective Review of Kentucky Medical Examiner Cases*

ABSTRACT: Suicide, a *manner of death*, ranked as the eleventh leading *cause of death* in the United States and accounted for approximately 30,000 deaths in 2001. A host of biological and psychosocial components interplay in a suicide investigation. Precipitating factors may include domestic quarrels, loss of employment, financial difficulties, substance abuse, chronic disease, or mental illness. The authors conducted a ten-year (1993–2002) retrospective review of suicide from all Medical Examiners' Offices in Kentucky. There were 2,864 suicides ranging between 11 and 96 years (average age 42.0 years). The majority of victims were males (81.7%) and Caucasian (94.8%). African-American females comprised the smallest group, consisting of only 0.59%. The preferred mode of death was by firearm (67.5%), followed by hanging (13.7%), overdose (9.9%), and carbon monoxide poisoning (4.4%). This comprehensive study discusses the trends of suicide in the United States during the twentieth century and underscores the importance of a multidisciplinary approach to the investigation and prevention of suicide.

KEYWORDS: forensic science, forensic pathology, suicide, firearms

A working group consisting of coroners, medical examiners, psychiatrists, statisticians, and public health agencies in 1988 defined suicide as "death arising from an act inflicted upon oneself with the intent to kill oneself" (1). Invariably speculation arises as to why an individual would desire to end his or her life, ranging from an overwhelming feeling of hopelessness and helplessness to a final escape from a heated domestic, financial, or legal hardship. In certain cases, loved ones of the deceased are perplexed by the relative absence of underlying motives behind the suicide, whereas in other circumstances, the decedent had disclosed subtle clues or blatant admissions of suicidal ideation prior to death.

Eight to ten times as many individuals attempt suicide as succeed (2), reflecting either a desperate cry for help or an ineptly executed attempt. Women are four times more likely to attempt suicide than men, utilize methods of lower lethality such as a drug "overdose" or superficial incisions of the wrists, and select a venue with a high likelihood of discovery and rescue (2–4). Risk factors for a completed suicide include male sex, family history of suicide, and a psychiatric diagnosis (2,3,5,6). Marked by inherent labile emotions, aggression, and impulsivity, the three psychiatric conditions most commonly associated with suicide are major affective disorder (depression and bipolar disorder), schizophrenia, and alcoholism. Other suicidal risk factors include medical illness, unemployment, previous attempts, single and never-married status, and social isolation (2–5).

This ten-year (1993–2002) retrospective study summarizes the salient features of Medical Examiner autopsies of suicide in

Kentucky. As Kentucky is a dual Coroner-Medical Examiner system, not all cases of suicide were referred to the Medical Examiner's office for a postmortem examination. We will highlight the unique differences between the deaths deemed suicidal based solely on the scene and historical evidence and those which additionally underwent an autopsy.

Materials and Methods

A ten-year (1993–2002) retrospective review of suicide cases was conducted at the Medical Examiners' Offices in Kentucky. A Coroner-Medical Examiner's system is in place in Kentucky and, therefore, a request for a medicolegal postmortem examination rests on the discretion of the coroner in the county of death. The age, race, and sex of each victim as well as cause of death and time of year were documented. Each chart was reviewed for the location of death, presence of a suicide note, and investigation-derived recent life stressors such as domestic turmoil, financial instability, employment difficulties, and criminal acts.

Results

A total of 2864 cases from all 120 Kentucky counties were deemed a suicide after postmortem examination at the Medical Examiners' Offices in Kentucky between 1993 and 2002. The ages ranged between 11 to 96 years, with an average age of 42.0 years. The race and sex of the victims are displayed in Table 1. The population of Kentucky in the 2000 Census was 4,041,769; the racial composition was 90.1% Caucasian and 7.3% African-American. The majority of suicide victims in this study were Caucasian (94.8%) and male (81.7%). A paucity of African-American women (0.59%) committed suicide. The time of year for suicide was evenly distributed among the months: percentages ranged from 7.2% to 9.6% (Fig. 1). Suicide peaked in July and tapered to the lowest percentage during December.

One thousand eight hundred twenty-nine victims (63.9%) were pronounced dead at a residential home, while the remainder was

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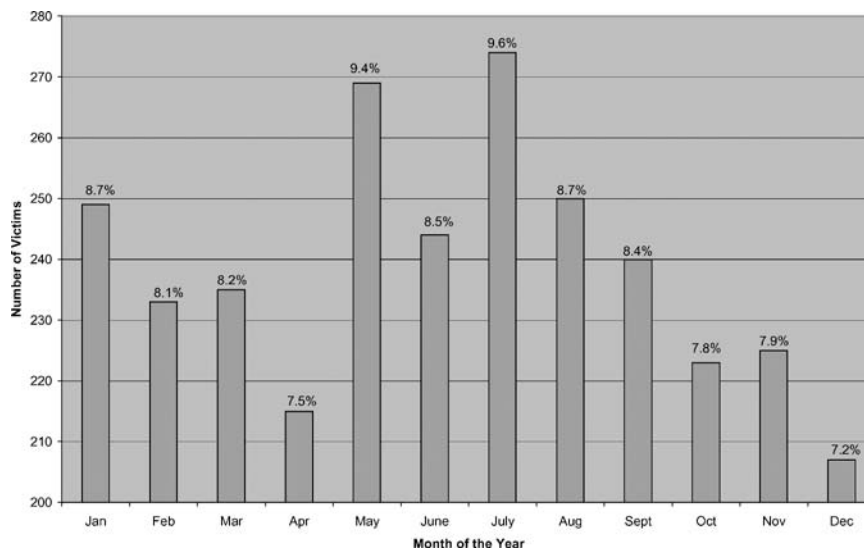


FIG. 1—Suicides examined in Kentucky Medical Examiners' Offices, 1993–2002, by Month.

TABLE 1—Suicides examined in Kentucky Medical Examiners' Offices, 1993–2002, by race and sex.

Race	Males	Females
Caucasian 2716 subjects (94.8%)	2217 (77.4%)	499 (17.4%)
African-American 121 subjects (4.2%)	104 (3.6%)	17 (0.59%)
Other Race 27 subjects (0.94%)	19 (0.66%)	8 (0.3%)
Total 2864 subjects	2340 (81.7%)	524 (18.3%)

pronounced dead at the one of the following locations: hospital, 589 cases (20.6%); public location, 344 cases (12.0%); motel, 45 cases (1.6%); prison, 30 cases (1.0%); and unknown, 27 cases (0.9%). Three hundred and nineteen (11.1%) decedents left a suicide note. A complete postmortem examination was performed on 2398 (83.7%) individuals. The remainder of the victims underwent a limited autopsy, such as in selected cases of a firearm injury of the head, which consisted solely of an external, cranial, and toxicologic examination. In other cases, the subjects underwent organ procurement for donation prior to the autopsy.

Fatality by firearm was the preferred method for suicide, accounting for 1,933 (67.5%) cases. Table 2 illustrates the suicidal causes of death. The category labeled "Others" includes one case each of the following causes of death: explosion by emplacement and detonation of a dynamite blasting cap within the mouth (7); fatal cardiac arrhythmia secondary to electrocution after placing a plugged-in heating pad into the bathtub in which the victim lay; air embolism after self-disassembly of a central venous dialysis catheter; and exsanguination after transection of a catheter connected to a subclavian central venous line. This category also includes one method involving simultaneous firearm wound and hanging. This 76-year-old Caucasian male was found by his family hanging by a ligature in his barn with a 22-caliber rifle suspended from a rafter in close proximity to his body. Investigators surmised that he had utilized a stick to pull the trigger of the rifle as he simultaneously stepped off a crate to effectuate a contemporaneous ligature hanging. His death was attributed to a perforating gunshot wound of the abdomen and asphyxia due to ligature hanging. The victim had written nu-

TABLE 2—Suicides examined in Kentucky Medical Examiners' Offices, 1993–2002, by cause of death.

Cause of Death	Number of Cases
Firearm injuries	1933 (67.5%)
Hanging	393 (13.7%)
Overdose	283 (9.9%)
Carbon monoxide intoxication	127 (4.4%)
Blunt Force Injury ¹	35 (1.2%)
Drowning ²	35 (1.2%)
Incisions/Stabbing	25 (0.87%)
Asphyxia by plastic bag	16 (0.56%)
Self-immolation	8 (0.28%)
Others	9 (0.31%)

¹ Includes the following: fall from a height (21 cases), impact by train (9 cases), pedestrian in traffic (4 cases), self-inflicted hammer to head (1 case).

² Includes 13 cases of drowning after a fall from a height.

TABLE 3—Bodily location of firearm wound(s).

Entrance of Firearm Wound(s)	Our Study 2005 (n = 1933)	Kohlmeier et al. 2001 (n = 1704)	Eisele et al. 1981 (n = 226)
Head only	1485 (76.8%) (includes 15 multiple)	1424 (83.7%)	165 (74%)
Chest only	343 (17.8%) (includes 14 multiple)	239 (14%)	40 (18%)
Abdomen	46 (2.4%)	32 (1.9%)	8 (3.5%)
Neck	35 (1.8%) (includes 1 multiple)	N/A	10 (4.5%)
Combinations of above	20 (1.0%)	7 (0.4%)	N/A
Other bodily areas	4 (0.2%)	N/A	N/A

merous letters to his family that were scattered throughout his home.

Of the 1,933 victims succumbing to firearm injuries, the primary target was the head only, accounting for 76.8% of such deaths and 51.9% of all suicide deaths (Table 3). Table 4 depicts the most common causes of death in relation to the race and sex of the victims. Head wounds by firearm constituted the leading cause

TABLE 4—Race and sex in relation to most common causes of death.

Caucasian Males: <i>n</i> = 2216 FI: 1583 (71.4%); Head: 1244 (78.6%) Hanging: 318 (14.4%) Overdose: 134 (6.0%) Carbon monoxide: 98 (4.4%)	Caucasian Females: <i>n</i> = 499 FI: 257 (51.5%); Head: 182 (70.8%) Overdose: 135 (27.0%) Hanging: 49 (9.8%) Carbon monoxide: 25 (5.0%)
African-American Males: <i>n</i> = 104 FI: 73 (70.2%); Head: 61 (83.6%) Hanging: 16 (15.4%)	African-American Females: <i>n</i> = 17 FI: 7 (41.2%); Head: 6 (85.7%) Overdose: 7 (41.2%)

FI = Firearm Injury.

of death for both sexes and for both Caucasians and African-Americans.

Various life stressors were identified as potentially contributing to a subject's suicide. Five hundred and eighty-eight (20.5%) victims experienced domestic turmoil predominantly as arguments with family and friends or divorce. Eighty-nine (3.1%) individuals complained of employment-related unrest, characteristically expressed as either loss of employment or animosity with coworkers at the workplace. Fifty-two (1.8%) decedents reported financial hardships prior to death. Two hundred twenty-four (7.8%) subjects encountered recent legal difficulties; 56 (2.0%) victims committed suicide while incarcerated.

Discussion

Analysis of suicide trends over the past century in the United States reveals several distinctive findings in regard to age, race, sex, and the most common cause of death. Throughout the twentieth century, the majority of suicide victims were Caucasian males (8,9). The overall suicide rate minimally fluctuated over the decades, at a rate of 10.2/100,000 in 1900 and 10.7/100,000 in 2001 (8,9). The highest rate of 15.6/100,000 was documented in 1930, most likely reflecting the devastation of the Great Depression in 1929.

The 8th Census of the United States in 1860 reported hanging as the primary method of suicide, followed by poisoning and firearm (10). At the turn of the twentieth century, poisoning prevailed as the most common cause of suicidal death, followed by gunshot and hanging/strangulation (9). By 1910 and every decade thereafter, suicide by firearm emerged as the primary means of committing suicide.

The suicide rate increased dramatically in the younger age range of 15 to 24 years for both males and females between 1940 and 1980. Of particular note was a 231% increase for white males and a 262% increase for nonwhite males ages 15 to 19 years (11). Between 1980 and 1992 the rates continued to rise in the younger age group, which were coupled with increased rates in the elderly population over 75 years (12). Suicide rates decreased by 14% for all ages, races, and sexes in the United States during the 1990's, at which time suicide as a manner of death declined from the eighth to the eleventh leading cause of death (5). Suicide as a manner of death ranked as the third leading cause of death in 2001 between the ages of 10 and 34 years (8).

Death by firearm was the leading method of suicide in this study, accounting for 67.5% of all deaths. The second and third most common causes of death, hanging and drug toxicity, amounted to only 13.7% and 9.9%, respectively. Approximately one million firearm deaths were reported between 1933 and 1982 in the United States. Among these, suicides comprised 49% (13). Throughout

this period, the firearm suicide rate exceeded that of homicide. Furthermore, all deaths by firearm increased by 137% between 1962 and 1993, of which suicide made up the largest percentage (14). A regional and state-level analysis (1988–1997) of the United States demonstrated a “robust association” between the rates of household firearm ownership and suicide (15). Individuals living in a “high-gun state” (Louisiana, Alabama, Mississippi, Wyoming, West Virginia, and Arkansas) were 3.8 times more likely to commit suicide by firearm as compared to a “low-gun state” (Hawaii, Massachusetts, Rhode Island, and New Jersey).

Our study corresponds closely to previous studies of suicidal firearm deaths (Table 3). Kohlmeier et al. conducted a retrospective study of 1704 suicides by firearms at the Bexar County Medical Examiner's office between 1984 and 1998 (16). Eisele et al. performed a three-year (1976–1978) review of gunshot entrance wound sites of 226 suicide victims evaluated at the King County Medical Examiner's Division (17). Our study is in consonance with these earlier studies documenting the head as the most likely target chosen by suicide victims.

It is a common myth that multiple firearm wounds of the head indicate homicide. Several studies have described cases of multiple self-inflicted cranial gunshot wounds utilizing one firearm or two firearms concurrently (18–20). In the present study, 15 victims sustained multiple gunshot injuries of the head only, one individual experienced two gunshot wounds to the right side of his neck, and two victims succumbed to multiple gunshot wounds of the head and neck. Furthermore, one decedent died as a result of three gunshot wounds to the head and one to the chest, another experienced two gunshot wounds to the head and one to the thigh, and one victim sustained two shotgun wounds to the head and one to the chest. Of the fifteen victims who sustained only multiple cranial gunshot injuries, two cranial entrance sites were noted in fourteen of the victims, and three entries were observed in one case. Three of the decedents had two intraoral gunshot wounds. We have previously reported a case included in the present study of a 62-year-old Caucasian male who sustained two self-inflicted gunshot wounds of the head caused by the simultaneous firing of a 0.45-caliber semi-automatic rifle and a 0.38-caliber special handgun (20). Either of the wounds was capable of independently causing sufficient neurological damage to be immediately incapacitating and lethal. The phenomenon of multiple gunshot wounds of the head culminating in a death may be due to the subject's lack of knowledge of cerebral anatomy with minimal initial destruction of the brain, a failure to injure vital centers, or a defective weapon and/or ammunition (21).

Both males and females selected a firearm as the preferred method of suicide in this study (Table 4). Of the individuals who succumbed to a gunshot wound, the vast majority of both sexes and both Caucasians and African-Americans sustained an entrance wound of the head. In contrast to suicide by other means such as overdose or wrist incisions, cephalic injury is a method with a higher likelihood causing death. The second most common cause of death for both Caucasian and African-American males was hanging. Caucasian females preferred drug toxicity or overdose. An equal number of African-American females chose both a gunshot wound and an overdose as their primary causes of death. While only 17 African-American females committed suicide in this study, six (35.5%) died as a result of a cranial gunshot wound.

According to the Center for Disease Control (CDC), 5,048 individuals committed suicide in Kentucky between 1993 and 2002 (8). Kentucky legislation (KRS Chapter 72) provides for a Coroner-Medical Examiner system. Not all suicides underwent autopsy, as the Coroner has statutory authority to conduct only an external inspection. During this time period, 2,863 deaths were deemed

suicidal after a postmortem examination, reflecting 56.7% of the total suicide deaths. A referral of cases to the Medical Examiner's office is subject to the discretion of the Coroner who investigated the case. A decedent may not be referred for an autopsy in certain situations of a highly presumptive suicide based on physical findings at the scene and historical evidence such as an elderly victim with a history of medical diseases who had professed suicidal ideation verbally and through a suicide note to his or her family and friends.

Suicide victims referred to the Medical Examiner's office for a postmortem examination were younger than those who did not undergo autopsy. The highest age-specific suicide rate of 17.1/100,000 fell into the age group 45–49 at the Kentucky Medical Examiner's offices in 1993. By contrast, the overall suicide rates in Kentucky and the United States were highest for the age groups 80–84 at 36.01 and 24.39, respectively (8). This trend of a younger aged suicide victim evaluated at the Medical Examiner's office compared to an older suicide victim in the general population continued throughout the 1990's, most likely reflecting the importance of an autopsy to confirm the suicidal manner of death in younger individuals.

Men were 4.5 times more likely to commit suicide than women as demonstrated by this study focusing on Kentucky, which parallels the national male-to-female suicide ratio of 4 to 1 in 2001 (8). Numerous suggestions have been proposed to explain why fewer women commit suicide. It is hypothesized that men have been socialized to act decisively in their professional and personal lives without sharing feelings of depression or suicidal ideation with others (22). In this regard, negative thoughts by males are permitted to fester without a socially accepted release. On the other hand, women are deemed to be more inclined to discuss emotional concerns with friends and family, which may ease the inherent disagreeable tensions. Comparing the differences in openly expressive tendencies between men and women, researchers opine that women are more inclined to curtail suicidal thoughts prior to acting upon such ideas.

Suicide frequencies generally peak in the spring and summer months and are at their lowest in the autumn and winter months (2,23). Christmas and New Years are the least common times to commit suicide over the entire year (23,24). December frequencies fall 10% below other months. In the present study, individuals were more likely to commit suicide in the months of May and July and least likely in December (Fig. 1). These findings conflict with the common view about suicide that many individuals, reflecting on negative holiday memories or experiencing social isolation around the holiday season, embrace suicide during these holidays. However, family gatherings are very frequent in December and may offer a support system as a protective barrier to suicide.

The determination of manner of death poses a challenge to forensic investigators and relies upon a multiagency collaboration. A death is deemed suicidal when evidence establishes both the volitional, self-inflicted nature of the act and the intentional motivations (1). Scientific exploration into a self-inflicted death includes a detailed scene analysis replete with photographs specifying the location of the body. In cases of firearm deaths, attention should be addressed to the blood spatter patterns, position of the firearm in relation to the victim, and tests of hand wipings for gunshot residues (25,26). Discussions with the victim's family and friends may elucidate events of the final hours and days of the decedent's life that may have prompted the suicide. Not infrequently, however, the victim's relatives may be reluctant to disclose vital details such as expression of suicidal ideation by the victim or previous suicide attempts. They may alter the scene in an effort to avoid the social stigma, guilt, or loss of insurance benefits often associated with suicide. A thorough postmortem and toxicological examina-

tion commonly confirms or dispels the possibility of a death being self-inflicted.

Inherent in a suicide is the victim's explicit or implicit intention to kill self while comprehending the actions may lead to fatal consequences (1). Verbal or nonverbal communications indicative of self-injury represent explicit intent. A suicide note reflects both explicit evidence and the self-inflicted nature of a suicide. Previous studies have documented that between 20–30% of suicide victims leave suicide notes (27,28). In this review, a minority (11.1%) of decedents expressed suicidal thoughts in a note. This low percentage compared to other studies may reflect a drawback in the Coroner-Medical Examiner system in Kentucky, in which not all cases of presumptive suicide are referred to the Medical Examiner's office for a postmortem examination. The cases involving the discovery of a suicide note at the scene in combination with other historical evidence of suicidal intent may satisfy the Coroner's conclusion about the suicidal nature of the death and, therefore, not undergo autopsy. Implicit intent refers to indirect actions stemming from feelings of hopelessness, emotional or physical pain, or a previous failed suicide attempt. If necessary, a psychological assessment performed by mental health professionals may shed light on the victim's state of mind at the time of death and recent life stressors that may have prompted the suicide (1,29).

Conclusion

A multifaceted investigation is warranted in a suicide to explore and support the self-inflicted and intentional nature of the death. Police and coroners should meticulously inspect the suicidal location and document vital information that may uncover a motive for the suicide: recent domestic turmoil, loss of employment, or legal difficulties. A history of suicide attempts or a family member's suicide may reflect a prolonged duration of suicidal ideation; however, a suicide may also represent an instantaneous reaction to a seemingly horrific circumstance. In certain situations, a psychological profile of the victim developed by a psychologist or psychiatrist may offer a unique insight into the mental status of the decedent with a particular emphasis on factors representing explicit or implicit evidence of intent. Furthermore, this analysis may disclose psychiatric illnesses that had plagued the victim, including major depression, bipolar disorder, schizophrenia, or alcohol dependence. The forensic pathologist plays an invaluable role in ultimately determining the cause and manner of death after evaluating the historical and scene evidence and documenting the pathological and toxicological findings. Particular attention should be addressed to features uncovered during autopsy which, though initially be construed as homicidal such as multiple gunshot wounds of the head, are deemed suicidal after a thorough review of the decedent's history and detailed postmortem examination confirming the self-inflicted nature of the wounds. In developing comprehensive intervention strategies and programs to prevent suicide, public health officials should closely collaborate with medicolegal death investigation agencies by evaluating the patterns and investigatory approaches addressed in this study as another valuable monitoring system in support of data collection and etiologic research (30).

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