

The Houston Case-Control Study of Nearly Lethal Suicide Attempts

Special Supplement Co-Editors

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Supplement to *Suicide and Life-Threatening Behavior*, Volume 32(1)

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Supplement to Suicide and Life-Threatening Behavior

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of Nearly Lethal Suicide Attempts

December, 2001

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Suicide Prevention: Broadening the Field toward a Public Health Approach

W. Rodney Hammond, PhD

“The world breaks everyone and afterward some are strong in the broken places...”
Ernest Hemingway (1929)

Like Hemingway himself, far too many people cannot find the strength to overcome the suffering in their worlds and instead choose to end their own lives. Suicide claims more than 30,000 Americans each year. The tragedy of these preventable deaths is compounded by the wake of lasting trauma and guilt left to the victims' loved ones. In addition to the human costs of completed suicides, nonfatal suicide attempts generate devastating health, social, and economic consequences to the nation. The continuing toll of suicide and nonfatal suicide attempts has prompted the surgeon general to advance a national prevention strategy that calls for a comprehensive public health response coordinated at all levels of government.

The *Surgeon General's Call to Action to Prevent Suicide* (U.S. Department of Health and Human Services [USDHHS], 1999) and the national strategy for suicide prevention (USDHHS, 2001) have put forth a three-pronged strategy, which includes: *Awareness*: broadening the public's awareness of suicide and its risk factors; *Intervention*: enhancing population-based and clinical care services and programs; and *Methodology*: advancing the science of suicide prevention, including improving our understanding of risk and protective factors related to suicide, their interaction, and their effects on suicide and suicidal behavior.

As the nation's leading public health agency, the Centers for Disease Control and Prevention (CDC) has developed an expanded research agenda to address the problem of suicidal behavior using a similar organizing framework (National Center for Injury Prevention and Control, 2001). Among other aims, the CDC's agenda emphasizes improving knowledge of the broad risk and protective factors related to suicide, focusing in particular on nonmental illness factors that have rarely been included in traditional suicide research. The studies described in this special supplement reflect both the CDC's expanded suicide research agenda and the goal of the surgeon general to advance the science of suicide prevention.

The methodology of the research described in this special supplement offers an innovative approach that avoids the limitations of earlier suicide prevention studies focused on family members of suicide victims, ecological analyses, or survivors of less lethal attempts (O'Carroll et al., this issue). Few previous studies have focused specifically on subjects who used highly lethal methods or those who likely would have died without medical intervention. These inclusionary criteria make the cases close proxies to actual suicides. By looking beyond mental health problems and focusing on those between the ages of 13 and 34, this study improves our understanding of the range of factors that influence risk for suicide among adolescents and young adults. The individual studies highlight several nonmental

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health issues related to suicidal behavior, such as the acute effects of alcohol consumption, recent change of residence, the presence of medical conditions, past help-seeking behavior, and impulsive suicide attempts. These issues have received relatively less attention than established mental health-related risk factors, such as depression.

The research described in this supplement presents compelling evidence of the need to adopt a public health approach to address the problem of suicide among adolescents and young adults. Findings from the studies illustrate that the historically narrow focus of suicide research on mental illness and depression may cause us to miss other potential contributors.

An increased understanding of all potential suicide risk and protective factors will help us take fuller advantage of prevention opportu-

nities. The CDC's broadened research agenda also stresses the need for rigorous evaluation of the effectiveness of interventions specifically designed to prevent suicide, and encourages the evaluation of interventions designed to address other problem behaviors, such as interpersonal violence and substance abuse, to determine if improvements in these areas are accompanied by a reduction in risk for suicide.

The public health approach offers a guiding framework for continued exploration of the complex factors leading to suicidal behavior among young people and the application of scientific methods to help us learn what works in suicide prevention. Widespread implementation of public health strategies holds promise for saving lives that might have been prematurely lost to suicide.

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Interviewing Suicide “Decedents”: A Fourth Strategy for Risk Factor Assessment

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In this special issue of *Suicide and Life-Threatening Behavior (SLTB)*, a set of research articles is presented deriving from an innovative case-control study of attempted suicide (hereafter, the CCAS study), begun over ten years ago in Houston, Texas. To appreciate the need for a groundbreaking study of this type, it is useful to consider the context in which this research was begun. Beginning in the early 1950s and continuing for the next four decades, suicide rates had gradually but steadily increased among young persons, while generally decreasing among older persons; ultimately, youth suicide rates tripled during this period (Centers for Disease Control and Prevention [CDC], 1985a, 1986). In just the 11-year period between 1970 and 1980, suicide rates increased 50% for males 15-24 years of age (CDC, 1985b). The increasing youth suicide rates during this period resulted in a striking decrease in the median age of persons who committed suicide, from 47.2 years of age in 1970 to 39.9 years in 1980. In 1970, fewer than one fourth (22.8%) of males who committed suicide were under age 30 years; by 1980, more than one third (34.3%) of males who committed suicide were under 30 (CDC, 1985b).

Against the backdrop of this disturbing trend, many called for aggressive research efforts to better understand the causes of suicide among America’s youth. A staple of suicide prevention among older populations had long been (and remains to this day) the early detection, diagnosis, and treatment of clinical de

pression. This strategy is also important for the prevention of youth suicide, but there were then and there continue to be clear reasons to go beyond this single strategy for the prevention of youth suicide. First, many young suicide victims did not seem to fit the classic definition of clinical depression as applied to adults (Shaffer, Garland, Gould, Fisher, & Trautman, 1988). Adolescence is generally a time of great emotional volatility, and we still do not have diagnostic criteria for clinical depression among adolescents that are sufficiently sensitive to detect and refer all those at serious risk of suicide while also being sufficiently specific to screen out large numbers of “false positives.” Second, given the remarkable increases in youth suicide rates, it was imperative that every possible avenue for prevention be explored, and that every opportunity to interrupt the various complex causal chains leading to suicide in this population be tested. A variety of risk factors in addition to mental illness were suggested as possible contributors to increasing youth suicide rates: substance abuse (including alcohol abuse); impulsive, aggressive, and antisocial behavioral traits; family influences, including a history of violence, suicide, and family disruption; severe stress in school or social life; rapid sociocultural change, as reflected in factors such as geographic mobility (i.e., community-to-community migration); and increased access to firearms by the at-risk population (CDC, 1992; Goodwin & Brown, 1989).

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However, for these risk factors, and indeed for suicide prevention research in general, there was a central conundrum: how to explore risk factors for completed youth suicide (in which the victims are deceased, by definition), when exposure to many risk factors of interest is best assessed by interviewing living cases. Prior to the CCAS study, several strategies were employed to circumvent this problem. One strategy was to assess exposure to putative risk factors for completed suicide among suicide attempters. Although this approach allows interviews with living cases, it is inherently limited in that suicide attempters and suicide completers are very different even if overlapping populations. Another strategy involved correlating average risk factor exposure prevalence among certain populations with rates of suicide in those populations. Although such studies are useful for hypothesis generation, they are subject to the ecologic fallacy. In other words, even if risk factor exposure prevalence and suicide rates are correlated in a given population, it cannot be determined through such population-level research whether those persons who died from suicide were ever exposed to the risk factor in question. In consequence, such research alone is not sufficient to determine the causal mechanisms of suicide at the individual level, and so cannot serve as the foundation of targeted prevention programs.

A third strategy involved interviewing proxy informants (e.g., parents and friends) to assess exposure to various putative risk factors among suicide decedents (see, for example, Davidson, Rosenberg, Mercy, Franklin & Simmons, 1989). This creative strategy comes closest to the mark for studying risk factors for completed suicide, but it is unfortunately subject to a variety of recall biases. For example, parents of teenaged suicide victims typically rack their brains for any possible factors that might have contributed to their child's tragic death (e.g., exposure to television depictions of suicidal thinking, or suggestive rock music lyrics), whereas parents of control “victims” have no such motivation. Thus, the quality of the exposure information provided by proxy informants for cases and controls is

inevitably very different, which calls into question the validity of findings based on such research.

The CCAS study on which the papers in this issue are based explored yet a fourth strategy: the identification of persons with “near miss” or “nearly lethal” suicide attempts, the goal being to identify a population of would-be completers who failed to become mortality statistics by only the slimmest margin. Examples of such near-miss suicide attempters would include persons who had attempted to shoot themselves in the head, but whose gunshot went amiss such that the bullet merely grazed their skull; or a person who attempted to hang himself, but who was found hanging and was rescued. At the heart of this strategy is a common-sense recognition that among the general population of suicide attempters, there is a subpopulation of victims who are much more like suicide completers than the general suicide attempter population. The presumption is, first, that research involving these “virtual” suicide victims is likely to provide more valid data than research based on other strategies (since the near-miss suicide victims can directly provide information about their own exposures to various risk factors) and, second, that the *findings of this research will be generalizable to the prevention of completed suicide*. The specific methods employed in identifying cases of nearly lethal suicide attempts for this study, and the epidemiological differences between this population and those making less lethal suicide attempts, are presented in this issue in the papers by Kresnow et al. and Swahn and Potter.

Earlier publications from the CCAS study have described the utility of the Self-Inflicted Injury Severity Form used in the study (Potter et al., 1998) and examined whether exposure to suicide may be socially contagious (Mercy et al., 2001). The study by Potter and colleagues (1998) demonstrated that the form used by physicians to indicate the method and severity of injury for all suicide attempters was reliable and valid. The study by Mercy et al. showed that, contrary to some past research and popular perceptions, exposure to accounts of suicidal behavior in the media and,

to a lesser extent, of friends or acquaintances, were protective of nearly lethal suicide attempts.

The CCAS has yielded some very interesting findings concerning risk and protective factors associated with suicidal behavior. This special supplement includes summaries of findings from five separate analyses using these data. For example, Powell et al. examined the relative importance of different facets of alcohol consumption as risk factors for nearly lethal suicide attempts. The results from this study highlight the important role of alcohol consumption within the context of a suicide event (i.e., within 3 hours prior to the suicide attempt) while taking into consideration more chronic drinking patterns. Potter and colleagues used the CCAS data to describe the link between recent migration and suicidal behavior. This study examined how specific characteristics of moving, such as frequency, distance moved, recency of move, and difficulty staying in touch, are associated with risk for nearly lethal suicide attempts. Physical illness has also been studied as a possible risk factor for suicidal behavior using data from CCAS. The findings from Ikeda et al. suggested that young men with self-reported medical conditions are at increased risk for nearly lethal suicide attempts. This is one of the few studies to examine physical illness as a possible risk factor for suicidal behavior among adolescents and young adults. Another study, by Barnes and colleagues, found the majority of nearly lethal suicide attempters in the CCAS study reported seeking help for health or emotional problems in the 30 days prior to their suicide attempt. However, in comparison with nonsuicidal controls, case patients were actually less likely to seek help, particularly help from health care providers and other professional consultants. In addition, the CCAS has been used to better understand risk factors for impulsive suicide attempts. In the study by Simon et al. hopelessness and involvement in physical fights differentiate impulsive attempters from control subjects. These find-

ings suggest that existing suicide prevention strategies, such as screening programs, crisis centers and hotlines, educating gatekeepers, and peer support programs, may need to expand their conceptualization of suicide risk factors to include those related to impulsive attempts.

The research presented in this special supplement of *SLTB* represents one element of a broader suicide research agenda for the CDC. In addition to risk factor research, the CDC has applied its strengths in surveillance and community health assessment to the topic. For example, the CDC compiles and analyzes health records such as death certificates and emergency department data on suicide and other self-directed violence, and conducts national and state surveys to examine suicidal thoughts and attempts (Injury Control and Risk Identification Survey, Youth Risk Behavior Surveillance System) [Brenner, Krug, & Simon, 2000; Crosby, Cheltenham & Sacks, 1999; Kann et al., 2000]. The CDC also conducts and supports evaluation research to determine what works in suicide prevention at the community level (CDC, 1998). The community-based approach has demonstrated effectiveness in other areas and appears promising for preventing suicidal behavior as well (CDC, 1999; Rosenman, 1998). The CDC works closely with other federal agencies such as the National Institute of Mental Health and the National Institute on Alcohol Abuse and Alcoholism to ensure that its suicide research and prevention program complements related efforts by these agencies.

The research articles presented in this special supplement of *SLTB* represent the first fruits of a rigorous, epidemiologically innovative, and sustained approach to the study of suicide among adolescents and young adults. It is hoped that this case-control study of attempted suicide will yield further research findings over time, and will inspire other creative new approaches to the study and prevention of suicide.

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An Unmatched Case-Control Study of Nearly Lethal Suicide Attempts in Houston, Texas: Research Methods and Measurements

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This article details the research methods and measurements used in conducting a population-based, case-control study of nearly lethal suicide attempts among persons aged 13-34 years, residing in Houston, Texas. From November 1992 to July 1995, we interviewed 153 case subjects presenting at one of three participating hospital emergency departments and used random digit dialing to identify 513 control subjects residing in the same catchment area in which cases were enlisted. Unlike most research in this area, this study was designed to extend our understanding of suicidal behavior and prevention activities beyond identification and treatment of depression and other mental illnesses. We discuss the overall strengths and weaknesses of our study design and conclude that this methodology is well suited for studying rare outcomes such as nearly lethal suicide.

Suicide is a major public health problem in the United States, caused by the interaction of numerous biological, psychosocial, and environmental factors. To date, however, research and prevention efforts to address suicide have focused primarily on recognizing and treating depression and other mental illnesses. Factors not directly related to mental health have received less support and attention in the effort to understand and prevent suicide.

The principal motivation for the Houston Case Control Study of Nearly Lethal Suicide Attempts (hereafter, the CCAS study) was to extend our understanding of suicidal behavior and potential suicide prevention activities beyond the identification and treatment of mental illness. We focused on nearly lethal suicide because past studies have demonstrated that epidemiologic risk factors for medically seri-

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This study was funded in part through an interagency agreement, number 2Y02-AA30017, with the National Institute for Alcohol Abuse and Alcoholism.

The authors would like to thank Carole Craft, writer-editor, National Centers for Injury Prevention and Control, CDC, for her editorial comments.

We wish to thank the members of the Houston Case-Control Study of Nearly Lethal Suicide Attempts team for their contributions to the conceptualization, design and collection of these data.

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ous suicide attempts are similar to those associated with completed suicides (Moscicki, 1995). We specifically focused on suicidal behavior among adolescents and young adults because the suicide rate in these age groups has tripled over the past 40 years (Centers for Disease Control and Prevention [CDC], 1995; Shaffer, Garland, Gould, Fisher, & Trautman, 1998). Improving our understanding of risk factors, therefore, may have greater value for preventing suicide in these younger age groups.

This case-control study was designed to examine the association of two putative risk factors for suicidal behavior among adolescents and young adults—exposure to the recent suicide or suicide attempt of another individual and mobility/migration—and to explore in detail the role of alcohol use and abuse. These factors could independently increase the risk of attempted and completed suicide, or interact with depression or other forms of mental illness to increase such risk. We chose these factors because they were indirectly related to mental illness and, if found to increase or decrease risk, could all be potentially modified through prevention programs. This study also offers the opportunity to examine other issues that may affect risk and protection from suicidal behavior, such as medical illness, racial/ethnic differences in risk factors for suicide, help-seeking behavior, and emotional loss.

The purpose of this article is to provide a detailed summary of the study design and the data collection methods for the CCAS study. Several features of the study methodology are unique and may serve as a model for other suicide and injury research. Specifically, we discuss the case definition and ascertainment procedures for case and control subjects; describe the various data collection instruments used; assess the representativeness of the sample interviewed; provide some of the administrative details regarding interviewer training, informed consent, and data management; define the variables and analytic approaches common to many analyses; and discuss the strengths and weaknesses of using case-control methodology as a tool to further our understanding of nearly lethal suicide attempts.

OVERVIEW

We conducted a population-based, case-control study of nearly lethal suicide attempts occurring within a defined catchment area of Houston, Texas. Nearly lethal suicide attempts were those in which the attempter was likely to have died from suicide had they not received emergency medical or surgical intervention, or where the attempter unequivocally employed a method with a high case fatality ratio (i.e., gunshot wounds and hanging) and sustained an injury, regardless of severity. Interviews took place from November 1992 through July 1995. Participation in the study was limited to youth and young adults between ages 13 and 34 years residing in the central area of Houston, Texas, circumscribed by a major highway (Beltway 8). Case subjects received treatment at Ben Taub Hospital, Hermann Hospital, or Lyndon Baines Johnson (LBJ) Hospital, all located within the Beltway 8 loop. Control subjects were selected from the same catchment area as case subjects.

Participating Hospitals

The three participating hospitals are all major medical training centers. Ben Taub Hospital, affiliated with Baylor College of Medicine, is part of the Harris County Hospital District. It is a Level I Trauma Center with 512 beds, and the emergency department averages approximately 320 visits per day. LBJ Hospital, like Ben Taub, is part of the Harris County Hospital District. It is a Level II Trauma Center, has 252 beds, and treats approximately 175 patients per day in the emergency room. Hermann Hospital, also a Level I Trauma Center, is a private hospital affiliated with the University of Texas. It has 600 beds and averages about 150 cases per day in the emergency room. It receives Harris County patients from outside of Houston, as well as the overflow of Houston patients when Ben Taub Hospital reaches its full capacity.

These three hospitals were selected through a planning sub-study using Houston Fire Department Emergency Medical Service (EMS) data. Results suggested that more than 90% of all patients with serious gunshot, stabbing, and hanging injuries in the greater Houston

metropolitan area who were transported by EMS were taken to one of these hospitals, as were most medically serious poisonings (coma and evidence of severe toxicity). We also reviewed the records of completed suicides during 1988 that were investigated by the Harris County Medical Examiner, with a focus on identifying which hospitals treated people who survived the suicide attempt long enough to be transported to a hospital. Although 71% of those age 35 and under were pronounced dead at the location where they attempted suicide, 80% who arrived at the hospital prior to their death were treated at either Ben Taub or Hermann Hospitals, with the remaining 20% evenly distributed among the more than 30 remaining Houston hospitals (unpublished data). Thus, our system likely captured most of the nearly lethal suicide attempts within a large portion of Harris County, Texas.

Subject Identification

Case Identification. Routine protocol at these three hospitals called for an evaluation of all suicide attempters by a member of the Ben Taub or Hermann Hospital psychiatry service, usually a resident in psychiatry. Because LBJ did not have an emergency room psychiatric consult team, patients requiring psychiatric evaluation were seen by a physician from Ben Taub. During the study period, the evaluating psychiatric physician completed a Self-Inflicted Injury Severity Form (SIISF) for every age- and residence-eligible suicide attempter entering the emergency room. This form, described in detail elsewhere (Potter et al., 1998), was developed specifically for this study as an epidemiologic research tool for identifying individuals in hospital emergency departments who had life-threatening self-inflicted injuries, with no assessment of intent or rescue potential. Briefly, for each patient, physicians indicated the injury method and level. Only patients whose injuries were at higher levels of severity were considered eligible for our study. The codes for these severity levels were shaded on the form. Physicians were paid \$10 for each completed form.

Eligibility varied by method of suicide attempt (see Table 1). Specific criteria were developed for each of the following methods: (1) use of a firearm; (2) jumping or other blunt trauma; (3) hanging; (4) drowning or suffocation; (5) laceration or stabbing; and (6) ingestion, inhalation, or injection. For example, patients who attempted suicide by ingestion, inhalation, or injection were eligible if they had been comatose at presentation or at some point before arriving at a medical facility or if they were admitted to a medical or surgical ward because of laboratory evidence of physiologic abnormalities or clinical abnormalities consistent with the substance taken. The near lethality of the attempt for the 2% of eligible subjects who used some other method (stopping insulin injections, swallowing razor blades, and setting self on fire) was determined on an individual basis.

Case identification using the SIISF was compared with case identification using the Risk-Rescue rating, collected simultaneously. The Risk-Rescue rating is an instrument used to assess the lethality of the suicide attempt by considering not only the severity of the injuries sustained but the potential for rescue as well (Weisman & Worden, 1972). Higher Risk-Rescue rating scores indicate more lethal attempts. We assessed the validity and reliability of the SIISF early on, using data collected during the first 10 months of the study. The validity of the SIISF, assessed by comparing results with the Risk-Rescue rating, was shown to be quite high for method of injury ($\kappa = 0.88$, standard error = 0.03, p -value < 0.001). Where there was agreement on method of injury, we compared the Risk-Rescue rating of injury eligible cases with that of non-injury eligible cases identified by the SIISF. Among injury eligible cases the mean Risk-Rescue rating was 41.3 (95% confidence interval; 38.8-43.8), compared with that of 20.4 (95% confidence interval; 19.9-20.8) among non-injury eligible cases. This suggests that the SIISF effectively distinguished the more severely injured cases. The inter-rater reliability of the SIISF was tested by having a second resident independently complete another SIISF for as many attempters as possible; a second SIISF was available for 295 attempt-

TABLE 1. Self-Inflicted Injury Severity Form Case Criteria

Method	1	2	3	4
Used a gun	Gun fired, bullet missed patient	Gun fired, bullet wound limited to skin and subcutaneous tissue	Gun fired, bullet penetrated muscle, bone, and/or internal organ	
Jumping or other blunt trauma	Evidence of minimal surface trauma	Evidence of substantial surface trauma	Sustained internal trauma	
Tried to hang	Not unconscious, not witnessed in suspension, no clinical evidence of hanging	Not unconscious, but witnessed in suspension, or clinical evidence of suspension	Unconscious after hanging attempt	
Tried to drown or otherwise suffocate	Clinical or physical evidence of the suicide attempt, but patient never unconscious	Unconscious at some point prior to or at presentation		
Laceration or stabbing	Sustained laceration or minor puncture wound, not requiring any sutures or surgery	Sustained wound that required sutures, but did not damage arteries, tendons, large veins, or internal organs	Sustained laceration that <i>DID</i> damage or sever tendons, arteries, or large veins	Sustained a puncture wound penetrating body cavity or major organ
Ingested, inhaled, or injected – level of consciousness	No documented altered level of consciousness	Altered level of consciousness, but patient never comatose	Comatose at presentation or prior to medical facility	
Ingested, inhaled, or injected – biochemical or physiologic abnormalities	Not admitted or transferred to a medical or surgical ward	Admitted or transferred to a medical or surgical ward for observation only	Admitted to a medical or surgical ward because of laboratory or physiologic evidence of potentially life-threatening abnormalities consistent with substance ingested	

Used some other method*

Note. Shaded cells identify criteria for case status. *Case status determined on a case-by-case basis.

ers. Inter-rater reliability for case status was also quite high ($\kappa = 0.93$, standard error = 0.06, p -value < 0.001).

We initially tested the case definition and ascertainment process with nine cases. The ascertainment procedure was modified on the basis of information obtained from these patients. Case surveillance and interviewing for a 50-case pretest began on November 9, 1992, and continued through May 31, 1993. Case identification continued without interruption as the pretest ended and the full study began; it continued through July 31, 1995. Since the procedures used during the 50-case pretest were not changed significantly before the full study began, we incorporated the pretest data into the full study data set.

During the period of case ascertainment, the study coordinator regularly reviewed emergency department (ED) records to ensure that

SIISFs were completed for all patients with possible self-inflicted injuries. We identified 257 case subjects through our case ascertainment procedure and/or through review of ED records. Our case ascertainment system captured data for 95% (244) of injury eligible patients. We were unable to obtain data on the remaining 5% (13) of injury-eligible cases identified through ED records because they had no corresponding SIISF; these patients were excluded from analyses.

Of the 1,648 suicide attempters meeting the requirements for time period, age, and residency, 244 (15%) met the criteria for a nearly lethal suicide attempt (Figure 1). Of the 244 eligible attempters, 153 (63%) completed an interview, 54 (22%) refused to be interviewed, 22 (9%) denied attempting suicide, 4 (2%) were too ill to be interviewed, and 11 (5%) were lost to follow-up.

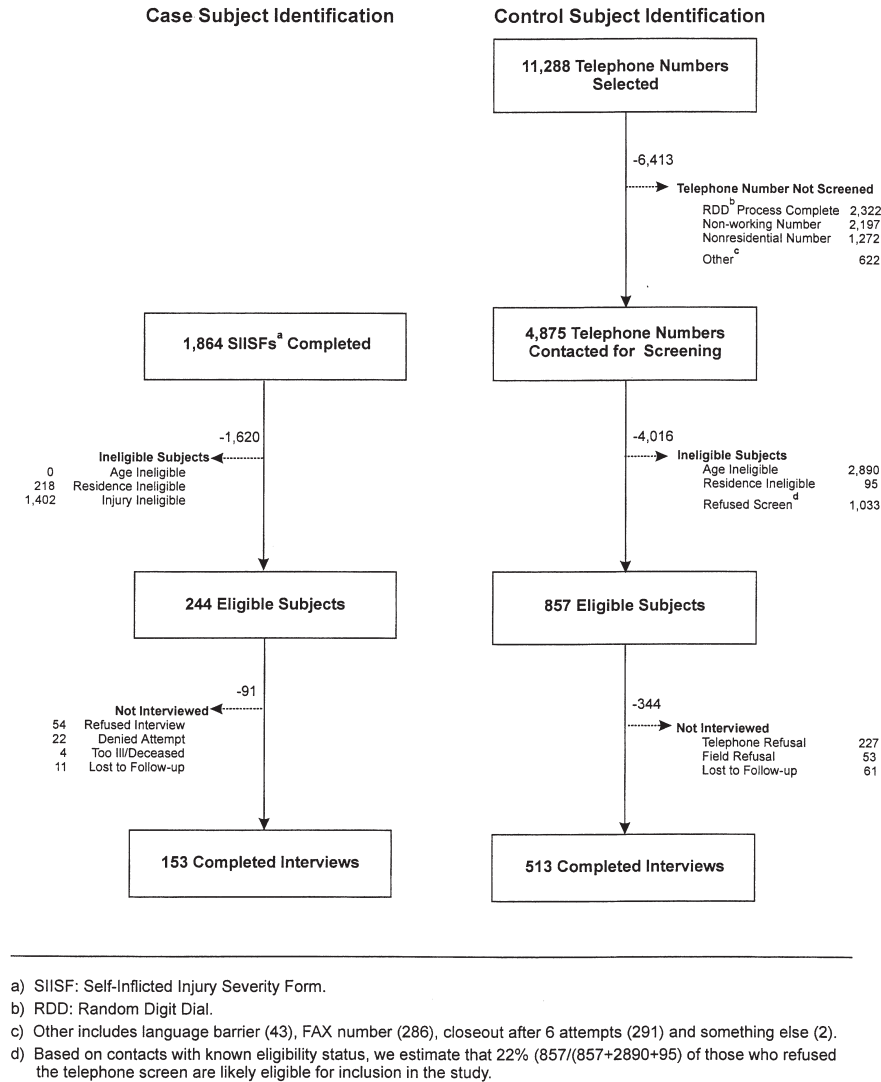


FIGURE 1. Flow Chart of Subject Identification, November 1992 through July 1995.

Bilingual (English/Spanish) project staff interviewed case subjects after obtaining permission from the responsible physician and the patient (and patient's guardian, if a minor). More than 75% of patients were interviewed in a private setting within 7 days of their suicide attempt, and all participants were interviewed within 33 days of the attempt. Seventy-eight percent of cases were interviewed in the hospital, 12% at home, and 10% at other locations. Administration of the

case interview required an average of 44 minutes. After completing the interview, subjects were paid \$15 for their time.

We compared demographic characteristics of the 153 study participants with the remaining 91 individuals who met age, residence, and injury eligibility criteria but declined to participate in our study. While participants and nonparticipants were similar with respect to age, sex, and race, a higher percentage of nonparticipants were of Hispanic ethnicity

TABLE 2. Characteristics of Harris County Residents, Controls, Cases, and Completed Suicides in Harris County, Ages 15–34 years,* 1992–1995

Characteristic	Harris County Residents 1992–1995 ¹ (<i>n</i> = 4,014,285)	Control Subjects (<i>n</i> = 473)	Case Subjects (<i>n</i> = 143)	Harris County Completed Suicides 1992–1995 ² (<i>n</i> = 621)
Sex				
Male	50.8%	42.6%	57.3%	80.4%
Female	49.2%	57.4%	42.7%	19.6%
Age Group**				
15–19 years	21.3%	26.3%	29.4%	18.2%
20–24 years	23.2%	23.1%	21.0%	24.8%
25–34 years	55.5%	50.6%	49.7%	57.0%
Race**				
White	74.4%	73.7%	60.8%	80.4%
Black	20.3%	23.1%	37.1%	15.9%
Other	5.3%	3.2%	2.1%	3.7%

*A suitable population file could not be found for Harris County population and mortality data for ages 13–34, therefore, we report on ages 15–34 for all columns and categories above. **Categories changed to allow compatibility with population and mortality data for Harris County. ¹Census data, Centers for Disease Control and Prevention [CDC], 2001. Population is the total over the 4-year period. ²Compressed mortality data, Centers for Disease Control and Prevention [CDC], 2001. Suicide deaths defined as ICD 950.0–959.9 are the total over the 4-year period.

(chi-square 8.27, 1 df, *p*-value = 0.004). Distribution of method of attempt among study participants and nonparticipants was similar for most categories with two exceptions: a higher percentage of eligible study participants ingested or inhaled poison, pills, or gas (67% compared with 51% of nonparticipants), while a lower percentage used a gun (11% of participants compared with 22% of nonparticipants).

We then compared selected demographic characteristics of participating case subjects with the 621 individuals who completed suicide in Harris County, Texas, from 1992 to 1995 (Table 2). Persons who completed suicide were more likely to be male (chi-square 33.79, 1 df, *p*-value = 0.001), older (chi-square 9.99, 3 df, *p*-value = 0.011), and white (chi-square 32.71, 2 df, *p*-value = 0.001).

Control Identification. Control subjects from the same catchment area as cases were enlisted for a face-to-face interview through a random digit dial (RDD) telephone survey from November 24, 1992, to July 31, 1995. A random sample of approximately 13,000 residential telephone numbers from all zip codes located within the Beltway 8 loop of Houston, Texas, was purchased from Survey Sampling,

Inc (SSI). SSI pre-screened numbers provided for residences, eliminating most business and inactive numbers. Using the RDD lists provided by SSI, we contacted potential control subjects, explained the study, screened for both residence (Harris County) and age (13–34 years) eligibility, selected interviewees (the one with the most recent birthday when multiple eligible respondents were present), invited them to participate in the study, and scheduled an appointment for an in-person interview. We obtained permission from a parent or guardian before scheduling an appointment with a minor. Potential control subjects were contacted during the same time period in which case subjects were enrolled to ensure seasonal comparability, with an effort to interview controls somewhat evenly over the days of the week.

Bilingual (English, Spanish) recruiters made a total of 18,137 calls to the 11,288 numbers selected; 4,875 were contacted for screening (see Figure 1). Of the 4,875 telephone numbers contacted, 857 (18%) produced an eligible control subject, 2,890 (59%) had no resident within the age range, 1,033 (21%) refused to be screened, and 93 (2%) were residences outside of Beltway 8. Of the 857 eligible control subjects, 513

(60%) completed the in-person interview, 230 (27%) refused to participate when first contacted by telephone, 53 (6%) refused an interview in the field, and 61 (7%) failed to complete the field interview for some other reason (e.g., could not be located, did not show for interview). We compared control subjects with Harris County residents over the 4-year period and found that the two groups were similar with respect to sex, age, and race (see Table 2).

Control subjects were interviewed at their home (61%), their workplace (11%), or a public location (28%) such as a library or restaurant, depending on the preference of the subject. The average length of the control interview was 37 minutes. After completing the interview, control subjects were paid \$15 for their time.

Instruments. The interview collected information about demographics, emotional loss, exposure to completed and attempted suicide, past suicidal behavior, circumstances surrounding the current attempt (case subjects only), mobility/migration, alcohol use (in the 24 hours before the attempt for cases or in the 24 hours beginning when the subject awoke the day before the interview for controls; in the 3 hours before the attempt for case subjects only; quantity, frequency, and binge drinking for all subjects), illicit drug use (in the 24 hours before the attempt for cases or in the 24 hours beginning when the subject awoke the day before the interview for controls; in the 3 hours before the attempt for case subjects only), depression, hopelessness, health habits, impulsivity, medical history, current living situation, and help-seeking behavior. The final sections allowed the respondent to talk about anything important that was not covered in the interview and asked the interviewer to comment on the quality of the interview. Wording for case and control interviews was identical except in instances where case or control status demanded otherwise, in which case wording was as similar as was possible. For time-framed questions, the reference point for cases was the suicide attempt (for example, "In the 30 days before your attempted

suicide, did you . . . ?"); for controls, it was the interview date.

Control subjects were asked during the interview to fill out drinking and drug use forms. On the drinking form, a 24-hour alcohol consumption history, the subject was instructed to record the number of alcoholic drinks (wine, beer, and liquor) consumed in each hour for the 24-hour period beginning when the subject awoke the day before the interview. Similarly, on the drug form subjects were asked to check a box for each hour an illegal drug (marijuana, cocaine, and other) was used during the same 24-hour period. Gathering data concerning controls' ingestion of alcohol and drugs during the entire day preceding the interview, and staggering the interviews throughout all 7 days of the week, enabled us to develop a temporal profile of alcohol and drug ingestion among controls with which to compare cases' pre-attempt alcohol consumption and drug use patterns.

For all case subjects who completed an interview, a hospital record abstraction form was filled out. This form included date of birth, date and time of arrival at the hospital, mode of arrival, details surrounding the injury, and type of discharge from the emergency department, as well as data from the toxicology report and on blood alcohol levels. We used this information to verify self-reported alcohol consumption in the 3 hours before the suicide attempt for case subjects. Among the 153 case-subjects, 82 were tested for blood alcohol level as part of their initial hospital evaluation. Thirty-one tested positive for alcohol, 81% of whom reported drinking alcohol in the previous 24 hours. Of the 51 cases with negative blood alcohol tests, 25% reported that they had consumed alcohol in the 24 hours prior to the attempt, 10% of them within 3 hours of the attempt.

Process

Training. Emergency department residents and other hospital staff were trained before taking part in the case ascertainment process. Training sessions were conducted when new residents started their emergency department

rotation, with additional training provided as needed. All trainees received a manual which included a letter from the principal investigators introducing the study and emphasizing the importance of the physicians' role, guidelines for completing the SIISF and the Risk-Rescue rating, and copies of the study forms.

Case and control subject interviewers participated in a two-day training session where they received a training manual with information about the background and purpose of the study, case surveillance and selection, case interviewing, control selection, and control interviewing, along with copies of all forms and administrative details. Additional training was conducted for interviewers as needed.

Informed Consent. For injury-eligible patients, physicians indicated on the SIISF if the patient was well enough to be interviewed and if the attending or responsible physician had given permission to interview the patient. In many instances, the physician also mentioned the study to the patient; however, it was the interviewer who obtained informed consent from the subject (and the parent or guardian if the subject was a minor) before the interview. Interviewers obtained signed informed consent from control subjects at the time of the face-to-face interview. Both case and control subjects could refuse to participate at the time of the interview or could stop the interview at any point. The internal review boards for each hospital and for the collaborating university approved the study protocol before we initiated the study.

Data Quality/Management. Each case and control subject was assigned a unique identifier. Personal identifiers such as name, hospital identification number, and telephone number were not entered onto the computerized data base. The SIISF did collect patient identification information but to preserve confidentiality, this page was removed and stored in a locked file cabinet along with consent forms before data processing began. All forms were reviewed in the field by the site coordinator and in the data management of

by an editor trained specifically for this study. Edited forms were then coded, double-entered into the computer system, and reviewed to identify errors in logic or skip patterns. Errors and discrepancies were resolved by referring to the original form. All editing and coding decisions were maintained in a log book.

We used the following definitions of demographic and other potentially confounding variables for many data analyses. These variables were identified through the literature as risk factors for both suicide and the main exposure variables for which the study was originally designed to address (exposure to suicide, geographic mobility/migration, and alcohol use and abuse).

Demographic Variables

Age. Study participants were grouped into three age categories: 13-17 years, 18-24 years, and 25-34 years.

Race/Ethnicity. We created four categories for race/ethnicity: Black non-Hispanic, White non-Hispanic, White Hispanic, and other. The "other" category included persons who identified themselves as either Black Hispanic, Asian/Pacific Islander, or American Indian/Alaskan Native.

Years of Education Completed. Because our study participants were young (13-34 years), we used information about both the number of years of education completed and the status of the study participant at the time of the interview (student or nonstudent) to create a four-level variable. Respondents were categorized as follows: persons who had completed less than a high school education and were students at the time of the interview, those who had completed less than a high school education and were not students at the time of the interview, those who had completed high school and were currently not students, and those who had greater than a high school education.

Household Income. Four categories were created: respondents with household incomes

ranging from \$0 to \$20,000, those with incomes from \$20,001 to \$30,000, those with incomes greater than \$30,000, and those whose household income was unknown.

Employment. Interviewees were asked “What did you do most of the last 12 months?”. Respondents were grouped into four categories: those who were students, those who were homemakers, those who were employed or self-employed, and other. The “other” category consisted of persons who were looking for employment, incarcerated, or sick/disabled. This category also included those who reported they “did nothing” or “sold drugs.”

Main Exposure Variables

Alcoholism. To identify respondents exhibiting symptoms of alcoholism in the past year, we used a modified version of the 24-item (yes/no) Veterans’ Alcoholism Screening Test (VAST; Magruder-Habib, Harris, & Fraker, 1982). In addition to asking whether a specific problem has ever occurred, the original 24-item VAST inquires whether the problem occurred within the past year, within 1-5 years, and more than 5 years ago. We included only the query about the past year. Subjects were categorized as alcoholics if they scored 5 or more points on the VAST.

Geographic Mobility/Migration. We created a dichotomous variable describing respondents’ geographic mobility in the past 12 months. Subjects who answered yes to either “Have you moved from one place to another in the past 12 months?” or “Have you moved from your parent’s home to college/technical school or back to your parent’s house from college/technical school” were coded as having experienced recent geographic mobility.

Exposure to Suicide. Two separate variables related to respondents’ exposure to suicide were created. The first variable assessed the respondents’ exposure to suicide through the media. Persons who indicated that they

had seen movies, TV shows, or videos or had read news articles, books, or stories about suicide in the 30 days before the attempt for cases (or date of interview for controls) were considered exposed to suicide. The second variable assessed whether or not respondents had exposure to suicide among relatives, friends, or other known persons they came into contact with. Respondents were categorized as exposed to suicide if they had personally known relatives or had friends who had ever either committed or attempted suicide. In addition, respondents who knew someone in their school, workplace, church, club, or neighborhood who committed suicide in the past 12 months were considered exposed to suicide.

Other Variables

Hopelessness. We used Beck’s Hopelessness Scale (Beck, Weissman, Lester, & Trexler, 1974), which measures negative expectations and pessimism, to assess respondents’ level of hopelessness in the week before their suicide attempt for case subjects, and the week before the interview for control subjects. The scale, composed of 20 (true/false) items, has demonstrated good item reliability (Cronbach’s $\alpha = 0.87$). Participants who scored 9 or higher on the scale components were categorized as hopeless, while those scoring 1 to 8 were categorized as not hopeless.

Depression. The Center for Epidemiologic Studies Depression (CES-D) scale was used to assess depressive symptoms during the week before the suicide attempt (cases) or the interview (controls). The 20-item CES-D has adequate test-retest reliability and a high degree of internal consistency (Radloff, 1977). Because the distribution of the CES-D scale is highly skewed in general populations, a dichotomous variable was created in which study participants were categorized as either depressed (those scoring 16 or higher on the scale components) or not depressed (those scoring 1 to 15). This choice of cut-off point is consistent with that reported in the literature (Radloff, 1977).

TABLE 3. Percent Power to Detect the Specified Odds Ratio for a Given Exposure in the Control Group (1.53 cases, 513 controls, and $\alpha = 0.05$ [2-sided])

Odds Ratio	Exposure in the control group								
	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
0.50	44	71	85	92	95	96	96	93	78
0.75	13	21	27	32	34	34	32	26	17
1.50	32	48	56	59	58	54	46	35	21
2.00	78	93	96	96	95	92	85	71	44
2.50	97	100	100	100	100	99	97	88	60
3.00	100	100	100	100	100	100	99	94	71
3.50	100	100	100	100	100	100	100	97	77

Note. Power estimates computed using formulas provided in Schlesselman (1982) pp. 151–152. Shaded areas represent odds ratio by exposure combinations with > 80% power.

Description of Analytic Approaches Commonly Used

Although the approach used to analyze these data was left to the discretion of each individual researcher, the following were common to many of the analyses conducted. Researchers used Pearson's chi-square test to assess the association between each main exposure variable or potential confounder and case-control status. Crude and adjusted odds ratios and 95% confidence intervals were generated using logistic regression. Variables identified in the literature as potential confounders of the relationship between a given main exposure variable and case-control status were entered into the model simultaneously. The importance of each variable in the model was assessed using the Wald chi-square test. Effect modification, usually in the form of two-way interactions between the exposure of interest and selected potential confounders, was assessed using a likelihood ratio test. In most instances, all interaction terms were entered into the model and assessed simultaneously. Final logistic regression models were often rerun to determine if results were sensitive to whether cases had telephones in their households (excluded cases with no telephone), since controls were screened through random digit dialing. Based on our sample sizes for case and control subjects, and an alpha-level of 0.05 (2-sided), we had more than adequate power to detect an increased risk of 2.0 and greater at most observed exposures in the control group, as well as protective effects of 0.50 (Table 3).

For most statistical tests performed, p -values < 0.05 were considered statistically significant unless otherwise specified.

DISCUSSION

Case-control study methodology is widely used today to assess a variety of public health and medical issues; however, use of this type of design to evaluate risk factors for suicide and suicidal behavior is relatively recent. Compared with other health topics, relatively few case-control studies focused on suicide have appeared in the literature (Appleby, Dennehy, Thomas, Faragher, & Lewis, 1999; Boardman, Grimbaldeston, Handley, Jones, & Willmott, 1999; Brent, Perper, Moritz, Baugher, Schweers, & Roth, 1993; Cheng, 1995; Grossman, Soderberg, & Rivara, 1993; Jacobson & Bygdeman, 1998; Kellermann, et al., 1992; Kung, Liu, & Juon, 1998; Lesage et al., 1994; Pickett et al., 1998; Shah, Hoffman, Wake, & Marine, 2000; van Winngaarden, Savitz, Kleckner, Cai, & Loomis, 2000). Even fewer have focused on nearly lethal suicide attempts (Beautrais, Joyce, & Mulder, 1996; Beautrais et al., 1996), as ours did. Because case-control methods are particularly useful for studying rare events, this type of design is well-suited for outcomes such as nearly lethal suicide.

Textbooks (Rothman & Greenland, 1998; Schlesselman, 1982) and recent reviews of case-control study methods (Austin, Hill, Flanders, & Greenberg, 1994; Correa, Stew-

art, Yeh, & Santos-Burgoa 1994; Lasky & Stolley, 1994; Roberts, 1995; Wacholder, McLaughlin, Silverman, & Mandel, 1992a, 1992b, 1992c) have described several major areas of methodologic concern: case definition, case ascertainment, selection of the control population, and measurement-related issues. We briefly discuss each of these, drawing examples from our case-control study.

With respect to case definition, we chose nearly lethal suicide as the focus for this investigation because past studies have demonstrated that the epidemiologic risk factors for medically serious suicide attempts are very similar to those associated with completed suicides (Moscicki, 1995). Thus, information useful for the prevention of both nearly lethal attempts and completed suicides would be obtained from this investigation. Moreover, persons with a history of a nearly lethal suicide attempt are at twice the risk of subsequent completed suicide compared with those with other suicide attempts (Rosen, 1976), making nearly lethal suicide attempts an important public health problem to study. Given the broad range of behavior and injury that may be described as a "suicide attempt," our restriction of the case definition to those with nearly lethal attempts also decreased the potential for misclassification of cases and controls.

As described, case patients were identified in the emergency departments of three hospitals in the Houston area. In general, the primary methodologic problem with using emergency departments for case identification is that patients with minor injuries or patients who die before arrival in the emergency department are not represented (Cummings, Koepsell, & Weiss, 1998). Our case definition avoided this problem: Only patients who sustained a serious injury during their suicide attempt, but did not complete the act, were eligible for enrollment. Case patients were enrolled on an incident basis during the study period, thus eliminating bias that might occur if prevalent cases were used (i.e., changes in the exposure resulting from the gap between the time when the outcome of interest is identified and the time when data are gathered for the study). The method used to ascertain and as-

sess case patients (SIISF) was shown to have both excellent reliability and validity and appears to have been quite complete (Potter et al., 1998); an estimated 95% of all cases were identified using this method.

Selecting a control population is often one of the most difficult decisions facing investigators during the development of a case-control study (Austin et al., 1994; Lasky & Stolley, 1994; Wacholder et al., 1992a, 1992b, 1992c). Researchers must consider a number of issues, including the desire to reduce bias, feasibility concerns, and available resources. In addition, the exposure(s) of interest also greatly influences the appropriateness of the various possible control populations. This was true for our study, with several competing demands surrounding the selection of the control population, given our three primary exposures of interest (alcohol use/abuse, mobility/migration, and exposure to suicidal behavior). Although using hospitalized controls, rather than the population-based controls recruited for this investigation, might have been more convenient and less costly, this might also have introduced an unacceptable level of bias, since hospitalization is related to alcohol use.

With respect to alcohol use, using hospitalized controls would likely bias findings toward the null, because alcohol use would be higher among hospitalized controls compared with those drawn from the general population. On the other hand, using case patients identified from emergency departments and population-based controls, as in our study, introduces a different type of bias related to differential recall between cases and controls. As an example, hospitalized case patients may be more likely to recall exposures related to hospitalization, such as alcohol use, than population-based control subjects. This differential recall for case patients and control subjects would likely have the opposite effect as that described above, biasing results away from the null.

Another problem we encountered with our use of population-based controls is the bias related to the use of random digit dialing (RDD). This technique results in an oversampling of homes with telephones and

those with more than one telephone, both of which indirectly reflect a higher household socioeconomic status. Another problem related to RDD is that our cases were not identified on the basis of whether or not they had a telephone. This introduces a selection bias into the study. However, because we knew whether our case patients had telephones, we were able to examine the sensitivity of our results to this potential bias. For the three primary exposures of interest (alcohol use/abuse, migration/mobility, exposure to suicide and suicidal behavior), findings remained the same in each instance (Potter et al., this issue; Kresnow et al., 2001; Mercy et al., 2001).

A number of techniques were employed to improve the accuracy of the data elicited from both cases and controls (Correa et al., 1994). We obtained multiple measures for each of the primary exposures and, where possible, used well-established scales (e.g., VAST). In addition, we were able to verify self-reported alcohol consumption before the suicide attempt by gathering information from a second data source. A standardized questionnaire was used to obtain data from all study participants and was pretested before implementation of the full-scale study. Training materials were developed and all interviewers attended a two-day training session. By interviewing case patients soon after the attempt (most within 7 days of the attempt, all within 33 days), we minimized the possibility of error or inaccurate recall related to the various exposures.

Despite these efforts to improve the validity of the data collected, other features of the study may have biased the data collection. Neither the investigators nor interviewers were blinded to case-control status or to the study hypotheses, which might have influenced the information obtained from the study participants. Drawbacks to face-to-face interviews have also been well-described. Study participants may be less willing to answer questions about sensitive subjects, or may be more inclined to give socially desirable answers. Although we do not know whether the unblinded nature of this study or the use of face-to-face interviews led to a systematic bias

during the data collection phase, these are points to consider given our methods.

Another problematic issue related to measurement was the need to use different reference points for time-framed questions. The date of the suicide attempt was the point of reference for case patients, whereas the date of the interview served as the anchor for control subjects. This resulted in difficulties analyzing one of our main exposures of interest, alcohol use in the 3 hours before the suicide attempt. While determination of alcohol consumption by case patients before the event was straightforward, determination of consumption status among control subjects was difficult because control subjects were not individually matched to cases and there was no specific time of day or event for the control subjects to use as a reference point. Because alcohol consumption for any individual will vary in a non-random fashion during a 24-hour period, we could not simply use the time of the interview to serve as the reference point for our control subjects. We needed to develop a method to impute this information for a 3-hour time window comparable to that of our case patients. Using the 24-hour drinking histories provided by control subjects, the distribution in time of suicide attempts among our case patients, and the random assignment of a specific time period to control subjects, we were able to construct a multiple imputation procedure to compute alcohol consumption status among control subjects immediately before the case patients' suicide attempt (Kresnow et al., 2001).

With regard to the representativeness of our sample, most demographic characteristics were similar for eligible case patients who elected to participate in our study and those who did not. The control subjects willing to participate in our interview were similar to the Harris County population with respect to age, sex, and race. An important question about this study is whether or not we can generalize our findings to completed suicides. The gender ratio of nearly lethal suicide attempts in this study was about 1.2 males for every female, while males outnumbered females by four to one among completed suicides in Harris County. Consequently, the male to female

ratio in this study is higher than for suicide attempts in general, but lower than that for completed suicides. This is not unexpected, since men are more likely to commit suicide than women (Moscicki, 1995), but we must exercise caution in generalizing our results to completed suicides. However, our results are generalizable to nearly lethal suicide attempts and, as discussed, these events are important health outcomes in and of themselves.

Another key issue to remember is that this type of study could not be conducted with completed suicides, since it would be impossible to interview cases directly, and the validity of proxy interviews for the types of information we collected is unknown. While the extent to which these results are generalizable to completed suicides is open to question, we be-

lieve our results can and should be used to raise questions and guide further research on completed suicide. Despite its limitations, this investigation documents the feasibility of using case-control study methodology to evaluate risk factors for suicidal behavior and has several other important strengths. We hope that the detailed description of our methods and the procedures used for this study, as well as the discussion about our study's overall strengths and weaknesses, will guide and encourage others contemplating or initiating similar research efforts. The prevention of suicide and suicidal behavior requires a strong scientific understanding of the potentially modifiable risk factors—using case-control study methodology is one way to obtain this essential information.

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Factors Associated with the Medical Severity of Suicide Attempts in Youths and Young Adults

Monica H. Swahn, PhD, and Lloyd B. Potter, PhD, MPH

This study examined factors associated with the medical severity of suicide attempts focusing on demographic characteristics, mental health characteristics, and the circumstances of the suicide attempt. Analyses were based on 153 nearly lethal suicide attempters and 47 less lethal suicide attempters aged 13-34 years who presented to emergency departments in Houston, Texas. The results show that young age was significantly associated with a nearly lethal suicide attempt. Prior suicide attempts, hopelessness, depression, and help-seeking (ever) were significantly and negatively associated with a nearly lethal suicide attempt. None of the suicide attempt factors occurring prior to the attempt were associated with a nearly lethal suicide attempt.

The primary purpose of increasing our understanding about medically serious suicide attempters is that we can apply this knowledge to prevent potential serious suicide attempts and perhaps also suicide deaths. Relatively few recent studies have examined factors associated with the medical severity of suicide attempts (Beautrais, Joyce, & Mulder, 1996, 1997, 1998, 1999; Beautrais, Joyce, Mulder, Fergusson, et al., 1996; Elliott, Pages, Russo, Wilson, & Roy-Byrne, 1996), and the vast majority of these investigations have compared these attempters to community controls. The findings show that medically serious suicide attempters are significantly more likely to have mood disorders, substance use disorders, conduct disorders, or antisocial personality disorders than are community controls (Beautrais, Joyce, Mulder, Fergusson, et al., 1996). One of the studies that focused specifically on youth between the

ages of 13 and 24 years of age found that those who made a medically serious suicide attempt had higher rates of sociodemographic disadvantage, higher rates of disadvantaged childhood experiences, as well as elevated rates of psychiatric disorders (affective disorders, anxiety disorders, eating disorders, antisocial disorders) than did community controls (Beautrais, Joyce, Mulder, Fergusson, et al., 1996). In a different investigation, youth who made a medically serious suicide attempt were more likely than controls to report high levels of hopelessness, neuroticism, introversion, low self-esteem, impulsiveness, and external locus of control (Beautrais et al., 1999). These investigations clearly show that medically serious suicide attempters have higher rates of psychiatric disorders, substance use disorders, psychological problems, and more disadvantaged backgrounds and childhood experiences compared to community controls.

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We wish to thank the members of the Houston Case-Control Study of Nearly Lethal Suicide Attempts team for their contributions to the conceptualization, design and collection of these data.

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Medically serious suicide attempters represent a relatively small proportion of suicide attempters. Estimates suggest that only about one quarter of suicide attempters receive treatment as a result of their attempt (Crosby, Cheltenham, & Sacks, 1999), indicating that there is a wide range of medical outcomes due to suicide attempts. In order to better understand the range of suicidal attempt behaviors and outcomes it is necessary to examine the factors that are associated with a medically serious suicide attempt relative to a non-medically serious suicide attempt. A recent study of 97 suicide attempters found that those who made a non-medically serious suicide attempt were more likely to have chronic psychiatric characteristics; an increased number of previous suicide attempts; longer duration of suicidality; and higher rates of sexual abuse, physical abuse, and traumatic life events than those making a medically serious suicide attempt (Elliott et al., 1996). These findings indicate that attempters who make a non-medically serious suicide attempt have very different mental health problems and past experiences than those who make a medically serious suicide attempt. Based on the scarcity of research in this area it is still unclear if other factors are associated with the medical severity of suicide attempts.

Prior research has often focused on the role of hopelessness, depression, alcohol abuse, and prior suicide attempts in suicide deaths and attempts. Researchers have identified hopelessness as an important predictor of death by suicide in adults (Beck, Brown, Berchick, Stewart, & Steer, 1989; Beck, Brown, & Steer, 1989; Beck, Steer, Kovacs, & Garrison, 1985; Glanz, Haas, & Sweeney, 1995; Weishaar & Beck, 1992) and in youth (Shaffer et al., 1996). Moreover, research shows that medically serious suicide attempters are more likely than community controls to report hopelessness (Beautrais et al., 1999). Likewise, several investigations show that depressive disorders are the most common disorder among young suicide victims (Gould & Kramer, 2001) and that depression is an important predictor of suicide death (Shaffer et al., 1996) and medically serious suicide attempts (Beautrais, Joyce, & Mulder, 1996).

Alcohol abuse is a risk factor for both suicide attempts (Tiller et al., 1998) and death by suicide (Shaffer et al., 1996; Tiller et al., 1998). Finally, research also shows that a prior suicide attempt is an important predictor of death by suicide (Shaffer et al., 1996) and that 54 percent of those making a medically serious suicide attempt had made a prior suicide attempt (Beautrais et al., 1998). Based on previous research, it is expected that hopelessness, depression, alcohol abuse, and prior suicide attempts are associated with the medical severity of the suicide attempts.

There are many other factors that may also be linked with the medical severity of the suicide attempts. Of particular interest are prior help-seeking behaviors and the characteristics of the suicide attempt. Information about prior help-seeking behavior is important because intervention and prevention programs are often delivered through mental health services; it is also very likely that help-seeking behaviors are associated with the medical severity of a suicide attempt. Previous research shows that non-medically serious suicide attempters are more likely to have chronic psychiatric characteristics and have more prior suicide attempts than medically serious suicide attempters (Elliott et al., 1996), which may increase their likelihood of having sought help for emotional problems.

It may also be the case that the characteristics of the suicide attempt itself (telling people about the suicide plan, expecting to die as a result of the attempt, making an impulsive suicide attempt) are associated with the medical severity of suicide attempts. For example, people who tell people about their suicide plan, who are not expecting to die as a result of the attempt, or who make the attempt where the likelihood of discovery is high, may be more likely to make a non-medically serious suicide attempt because the attempt may be a cry for help or a coping strategy to handle poor mental health. Information about the characteristics of suicide attempts is very important for prevention purposes. We know very little about the choices people make, and the expectations they have, before attempting suicide. Moreover, we do not know whether these

choices and expectations are associated with the medical outcome of the suicide attempt.

In this study we examine a sample of suicide attempters who presented to an emergency department (ED) in Houston, Texas, to determine how demographic factors, symptoms of mental health problems, help-seeking behaviors, and the characteristics of the suicide attempts are associated with the severity of outcomes from non-fatal suicide attempts. Information about the extent to which these factors are associated with the severity of outcomes could prove useful in the development of efforts to reduce morbidity from suicide attempts.

METHOD

Participants

The findings are based on 153 nearly lethal suicide attempters who represented cases in a case-control study of nearly lethal suicide attempters and 47 less lethal suicide attempters (noncases) who did not meet the inclusion criteria in the study. The nearly lethal suicide attempters (cases), their recruitment, and the inclusion criteria in the study are described in detail elsewhere in this issue (Kresnow et al.).

Less lethal suicide attempters (noncases) were recruited during the last six months of the study. The recruitment of less lethal suicide attempters was not part of the initial study protocol but was added while the study was in progress. The inclusion criteria for the less lethal suicide attempters was the same as for the nearly lethal suicide attempters in terms of the age and residence requirements; however, there were no inclusion criteria pertaining to the medical severity of the suicide attempt for the less lethal suicide attempters. During the six months of recruitment, 169 suicide attempters met the age and residence criteria. Of these, 47 (28%) were interviewed, 41 (21%) refused, 10 (6%) denied attempting suicide, 3 (2%) were too ill to be interviewed, and 68 (40%) were lost and could not be contacted. Interviewed and non-interviewed less lethal suicide attempters did not differ signifi-

cantly in terms of age, gender, or race/ethnicity.

The less lethal suicide attempters used the following suicide methods: 35 (74.5%) poison/pills/gas, 9 (19.2%) cutting/stabbing, and 3 (6.4%) jumping. The nearly lethal suicide attempters used the following methods: 102 (51.3%) poison/pills/gas, 13 (6.6%) cutting/stabbing, 8 (4.0%) jumping, 10 (5.0%) hanging, 17 (8.5%) shot, and 2 (10%) other method. Nearly lethal suicide attempters and less lethal suicide attempters were interviewed using the same questionnaires after permission was obtained from the responsible physician and the patient or patient's guardian.

Measures

The current investigation used six measures of mental health status and help-seeking behavior (hopelessness, depression, alcoholism, help-seeking ever, help-seeking in the past 30 days, and prior suicide attempts). A score of 9 and above (Beck & Weishaar, 1990) on the Beck's Hopelessness scale (Beck, Weissman, Lester, & Trexler, 1974) was used to indicate the presence or absence of hopelessness in the week prior to the attempt. A score of 16 and above on the Center for Epidemiologic Studies-Depression (CES-D) scale (Radloff, 1977) was used to measure depression in the week prior to the attempt. A score of 5 and higher on the Veterans Alcohol Screening Test (VAST) was used to assess if participants met criteria for alcoholism (Magruder-Habib, Harris & Fraker, 1982). The current alcoholism measure has three levels: nondrinkers; drinker but no or few problems (0-4 points on the scale); alcoholic (5 or more points on the scale). The study participants were also asked if they had ever seen anyone for emotional problems, if they had sought help in the 30 days prior to the suicide attempt, and if they had made prior suicide attempts.

Participants were asked seven questions about the circumstance of the suicide attempt: (1) if they told someone or left any clues that they might be thinking about suicide; (2) how much time passed between the time they decided to commit the attempt and the time they actually made the attempt (impulsive attempts

TABLE 1. Demographic Characteristics of Nearly Lethal and Less Lethal Suicide Attempters and their Associations with Nearly Lethal Suicide Attempts

	NLSA <i>n</i> = 153 <i>n</i> (%)	LLSA <i>n</i> = 47 <i>n</i> (%)	<i>p</i> -value ¹	Logistic Regression Crude OR (95%CI)
Gender				
Males	83 (54.3)	18 (38.3)	<i>p</i> = 0.058	1.91 (0.97–3.75)
Females	70 (45.8)	29 (61.7)		1
Age (years)				
13–17	37 (24.2)	3 (6.4)	<i>p</i> = 0.042	5.04 (1.42–17.83)
18–24	45 (29.4)	15 (31.9)		1.23 (0.59–2.55)
25–34	71 (46.4)	29 (61.7)		1
Race/Ethnicity				
Black Non-Hispanic	55 (36.0)	14 (29.8)	<i>p</i> = 0.69	1.41 (0.63–3.16)
White Hispanic	44 (28.8)	14 (29.8)		1.13 (0.50–2.55)
White Non-Hispanic	50 (32.7)	18 (38.3)		1
Marital Status				
Sep/Wid/Div	24 (15.7)	13 (27.7)	<i>p</i> = 0.059	1.99 (0.86–4.62)
Never Married	104 (68.0)	23 (48.9)		0.81 (0.30–2.17)
Married	25 (16.3)	11 (23.4)		1
Employment Status				
Student	37 (24.2)	5 (11.9)	<i>p</i> = 0.26	2.63 (0.91–7.59)
Homemaker	18 (11.8)	8 (17.0)		0.80 (0.30–2.11)
Other	36 (23.5)	12 (25.5)		1.06 (0.47–2.42)
Employed	62 (40.5)	22 (46.8)		1
Household Size				
Live Alone	11 (7.5)	6 (14.0)	<i>p</i> = 0.57	0.44 (0.13–1.44)
Live w/ 1 person	34 (23.1)	14 (32.6)		0.74 (0.29–1.89)
Live w/ 4–14 persons	52 (35.4)	12 (27.9)		0.89 (0.37–2.13)
Live w/ 2–3 persons	50 (34.0)	11 (25.6)		1
Education				
<HS, Student	33 (21.9)	3 (6.4)	<i>p</i> = 0.021	7.19 (1.88–27.53)
<HS, Non Student	62 (41.0)	17 (36.2)		2.38 (1.05–5.42)
HS Non Student	30 (19.9)	10 (21.3)		1.96 (0.76–5.07)
>HS	26 (17.2)	17 (36.2)		1
Income				
<\$20,000	67 (59.6)	29 (63.6)	<i>p</i> = 0.18	1.26 (0.55–2.90)
20,001–30,000	24 (22.0)	4 (9.1)		3.27 (0.91–11.79)
>30,001	22 (18.4)	12 (27.3)		1

Note. NLSA = near lethal suicide attempt; LLSA = less lethal suicide attempt; OR = odds ratio; CI = confidence interval.
¹Wald χ^2 .

were those where less than 5 minutes passed between deciding and making the attempt); (3) if they expected to die; (4) if they called or told anybody that they had attempted suicide; (5) what the chances were of them being found (low, medium, high); (6) how much time had passed between the attempt and arrival at the hospital; and (7) if they brought themselves to the hospital.

Analytic Procedures

Attempters were classified as either a nearly lethal suicide attempter (NLSA) or a less lethal suicide attempter (LLSA). Unadjusted (crude) logistic regression analyses were computed to assess the association between demographic characteristics and a NLSA. Logistic regression analyses, adjusted for age, were com-

puted to assess the association between each mental health indicator or suicide attempt factor and a NLSA. Odds ratios (OR) are presented together with 95 percent confidence intervals (CI) and the p -value (Wald chi-square test). Confidence intervals that include 1.00 and p -values greater than 0.05 are not significant.

RESULTS

Our analyses showed that only two of the eight demographic characteristics (age and education) were significantly associated with a nearly lethal suicide attempt relative to a less lethal suicide attempt ($p = 0.04$ and $p = 0.02$, respectively) (see Table 1.). Younger age and less than a high school education were both positively associated with high risk of a near lethal suicide attempt; however, education was no longer significant after controlling for age. Because age was significantly associated with near lethal suicide attempts, the logistic regression analyses that follow statistically control for age.

Adjusted logistic regression analyses of the association between mental health indicators and the lethality of the suicide attempt showed that four (prior suicide attempts, hopelessness, help-seeking, and depression) of the six mental health indicators were significantly and negatively associated with a nearly lethal suicide attempt (see Table 2). Those participants who had made prior suicide attempts were *less* likely to commit a nearly lethal suicide attempt than those who never made prior suicide attempts (Adj.OR = 0.47; CI: 0.23-0.95). Although, a higher percentage of less lethal suicide attempters (68.1%) had made a prior suicide attempt compared to near lethal suicide attempters (47.4%), there were no statistical differences in terms of the number of prior suicide attempts for the two groups.

Similarly, participants who reported hopelessness were *less* likely to commit a nearly lethal suicide attempt than were those without hopelessness (Adj.OR = 0.33; CI: 0.13-0.86). Analyses of the continuous hopelessness scale revealed that the less lethal suicide attempters had a significantly higher mean score ($M =$

12.89, $SD = 4.17$) on the hopelessness scale than did the near lethal suicide attempters ($M = 10.21$, $SD = 5.15$) ($p = 0.0004$). Depression was not significantly associated with the medical severity of the suicide attempt according to the confidence interval around the odds ratio. However, the significant p -value based on the Wald chi-square test suggested that those who were depressed were *less* likely to commit a nearly lethal suicide attempt than those who were not depressed. Note, also, that both nearly lethal suicide attempters and less lethal suicide attempters had very high rates of depression (85.6% and 97.9%, respectively). Analyses of the continuous depression scale showed that the less lethal suicide attempters had a higher mean depression score ($M = 42.53$, $SD = 9.42$) than the near lethal suicide attempters ($M = 33.50$, $SD = 14.32$) ($p = 0.0001$). Participants who reported seeking professional help (ever) were *less* likely to commit a nearly lethal suicide attempt (Adj.OR = 0.36; CI: 0.18-0.73) compared to those who had not sought help. The other mental health indicators, alcoholism and help-seeking the month prior to the attempt, were not significantly associated with the severity of the suicide attempt.

Logistic regression analyses of the suicide attempt factors show that only one factor, bringing oneself to the hospital, was significantly associated with a nearly lethal suicide attempt. Persons who had made a nearly lethal suicide attempt were significantly less likely to bring themselves to the hospital (Adj.OR = 0.21; 95% CI: 0.07-0.60) (see Table 3). Persons who had made a nearly lethal suicide attempt or a less lethal suicide attempt were about equally likely to have told someone or left clues about their suicide plans (34.6% and 36.2%, respectively) and expect to die as a result of their suicidal act (72.7% and 72.1%). There were also no differences between nearly lethal suicide attempters and less lethal suicide attempters in terms of having made an impulsive suicide attempt (24.0% and 21.3%, respectively) and making the suicide attempt in a place where they were likely to be discovered (35.7% and 39.5%, respectively).

TABLE 2. Mental Health Characteristics of Nearly Lethal and Less Lethal Suicide Attempters and their Associations with Nearly Lethal Suicide Attempts

	NLSA <i>n</i> = 153 <i>n</i> (%)	LLSA <i>N</i> = 47 <i>n</i> (%)	<i>p</i> -value ¹	Logistic Regression Adj. ² OR (95%CI)	
Prior Suicide Attempts					
Yes	72 (47.4)	32 (68.1)	<i>p</i> = 0.034	0.47 (0.23–0.95)	
No	80 (52.6)	15 (31.9)			1
Depression					
Yes	131 (85.6)	46 (97.9)	<i>p</i> = 0.049	0.13 (0.02–1.00)	
No	22 (14.4)	1 (2.1)			1
Hopelessness					
Yes	102 (68.5)	41 (87.2)	<i>p</i> = 0.022	0.33 (0.13–0.86)	
No	47 (31.5)	6 (12.8)			1
Alcoholic					
Yes	52 (34.7)	20 (43.5)	<i>p</i> = 0.38	1.11 (0.53–2.32)	
No	22 (14.7)	4 (8.7)			2.31 (0.69–7.65)
Non-Drinker	76 (50.7)	22 (47.8)			1
Sought Professional Help (ever)					
Yes	52 (34.4)	28 (59.8)	<i>p</i> = 0.004	0.36 (0.18–0.73)	
No	99 (65.6)	19 (40.4)			1
Sought Help (past 30 days)					
Yes	82 (53.6)	28 (59.6)	<i>p</i> = 0.61	0.84 (0.42–1.65)	
No	71 (46.4)	19 (40.4)			1

Note. NLSA = near lethal suicide attempt; LLSA = less lethal suicide attempt; OR = odds ratio; CI = confidence interval.
¹Wald χ^2 . ²Adjusted for age.

DISCUSSION

In our study, prior suicide attempts, depression, hopelessness and professional help-seeking were associated with a lower risk of a nearly lethal suicide attempt. These results suggest a higher level of mental health problems among the less lethal suicide attempters. This pattern is consistent with a previous study concluding that non-medically serious suicide attempters had greater psychiatric problems than medically serious suicide attempters (Elliott and colleagues, 1996).

An important difference between the results observed by Elliott and colleagues (1996) and the current study pertain to depression. They found higher levels of major depression among the medically serious suicide attempters. It is important to note that the prevalence of depressed mood was much higher in our study (86% of nearly lethal suicide attempters and 98% of less lethal suicide attempters) compared to the study by Elliott et al (34% of

hospitalized attempters and 19% of non-hospitalized attempters) which may be explained by the different criteria used to assess depression. Our measure (CES-D) assessed current depressed mood while the study by Elliott and colleagues used a current diagnosis (DSM-IV criteria) of major depression.

The findings from our study, as well as the study by Elliott and colleagues (1996), show that those who made a non-medically serious suicide attempt were more likely to have attempted suicide in the past. Prior research shows that persons with multiple attempts display more clinically severe and chronic features compared to first time attempters (Reynolds & Eaton, 1986; Rudd, Joiner & Rajab, 1996). Additionally, those with multiple attempts are more often diagnosed with mental disorders including phobias, panic disorders, post-traumatic stress disorders and they also appear to be more hopeless relative to first time attempters and suicide ideators (Rudd, Joiner & Rajab, 1996). One possible

TABLE 3. Suicide Attempt Factors Reported by Nearly Lethal and Less Lethal Suicide Attempters and their Associations with Nearly Lethal Suicide Attempts

	NLSA <i>n</i> = 153 <i>n</i> (%)	LLSA <i>n</i> = 47 <i>n</i> (%)	<i>p</i> -value ¹	Logistic Regression Adj. ² OR (95%CI)	
Told/Clues Prior Attempt					
Yes	53 (34.6)	17 (36.2)	<i>p</i> = 0.85	0.94 (0.47–1.86)	
No	100 (65.4)	30 (63.8)			1
Called Anyone After Attempt					
Yes	45 (30.0)	19 (40.4)	<i>p</i> = 0.20	0.63 (0.32–1.28)	
No	105 (70.0)	28 (59.6)			1
Chances of Being Found					
High	51 (35.7)	17 (39.5)	<i>p</i> = 0.98	0.92 (0.41–2.04)	
50/50	34 (23.8)	10 (23.3)			0.94 (0.37–2.41)
Low	58 (40.6)	16 (37.2)			1
Expected to Die					
Yes	104 (72.7)	31 (72.1)	<i>p</i> = 0.98	0.99 (0.44–2.22)	
No	39 (27.3)	12 (27.9)			1
Time til Arrival at Hospital					
<1 hr	83 (60.1)	26 (60.5)	<i>p</i> = 0.064	0.43 (0.11–1.59)	
1–4 hrs	28 (20.3)	14 (32.6)			0.22 (0.06–0.86)
>4 hrs	27 (19.6)	3 (7.0)			1
Brought self to Hospital					
Yes	8 (5.6)	11 (23.4)	<i>p</i> = 0.004	0.21 (0.07–0.60)	
No	134 (94.4)	36 (76.6)			1
Impulsive Suicide Attempt					
Yes	36 (24.0)	10 (21.3)	<i>p</i> = 0.52	1.30 (0.58–2.90)	
No	114 (76.0)	37 (78.7)			1

Note. NLSA = near lethal suicide attempt; LLSA = less lethal suicide attempt; OR = odds ratio; CI = confidence interval.
¹Wald χ^2 . ²Adjusted for age.

explanation as to why higher rates of prior suicide attempts, depressed mood and hopelessness were observed for the less lethal suicide attempts in our study is that suicide attempters who have higher levels of depression and hopelessness may be less able to plan and carry out a suicide plan. Subsequently, their suicide attempts are less lethal. Prior research has also found that multiple attempters are poorer problem solvers (Rudd et al., 1996) relative to first-time attempters which may also reduce their ability to plan and carry out a more lethal suicide attempt.

Most of the factors we examined were not associated with the severity of the suicide attempt. Alcohol problems have been identified as relatively prevalent among youth who complete and attempt suicide (Tiller et al., 1998); therefore it was surprising to note that symp-

oms of alcoholism were not positively associated with the medical severity of the suicide attempt. Elliott and colleagues also did not find any differences in alcohol or substance abuse or dependency between medically serious and non-medically serious suicide attempters. Previous research has suggested that alcoholism reduces the risk of suicide at younger ages but then increases the risk of suicide later in life after longer duration of alcohol problems (Ballenger, Goodwin, Major, & Brown, 1979), which may help explain why we found no differences.

None of the suicide attempt characteristics that we examined that occurred prior to the suicide attempt (telling someone about the suicide plan, expecting to die, making a suicide attempt where the likelihood of discovery was high, or making an impulsive attempt)

were associated with the medical severity of the suicide attempt. If a less lethal suicide attempt was a “cry for help” we would perhaps expect that those who made such an attempt would be more likely to tell somebody about their suicide plans, call someone after the attempt, pick a place where discovery would be high, and be less likely to expect to die as a result of the attempt than those who made a medically serious suicide attempt. On the contrary, we found no distinct differences in terms of these suicide attempt characteristics. Moreover, there were no differences between less lethal and nearly lethal suicide attempters in terms of making an impulsive suicide attempt.

There are at least four limitations to this investigation. First, the findings only pertain to suicide attempters who present to the ED's. Many suicide attempters who sustain less serious injuries may not present to EDs. Research has estimated that only about one in four suicide attempters are admitted to a hospital or other facility (Crosby et al., 1999); therefore, the injuries observed in our sample are likely to be more severe than what would be observed among the entire population of suicide attempters. As a result of this truncated range in injury severity, we might have reduced our ability to detect significant associations, and therefore our analyses represent a conservative test of the associations studied. Also, the results may not generalize beyond the subpopulation of suicide attempters who are seen in EDs. Second, the recruitment and assessment of the less lethal suicide attempts were not part of the initial study protocol. Thus our small sample of less lethal suicide attempters represents the large and potentially heterogeneous group of suicide attempters who did not meet the criteria for a nearly lethal suicide attempt, but we are unable to determine the extent of the variability within this group and how this may have impacted our findings. Third, we obtained a low participation rate for the less lethal suicide attempters. Although the interviewed and non-interviewed less lethal attempters did not differ in terms of age, gender, or race/ethnicity, it is possible that the low participation rate may have introduced other biases to the study.

Fourth, because of the small sample size, we limited the analyses in this paper to bivariate comparisons, although we did adjust for age (the only significant demographic factor) when testing whether mental health indicators and the circumstances of the attempt were associated with the medical severity of the suicide attempts. There may be other potential confounders or modifiers that might affect the associations observed. To make sure our observations were not a result of differences in basic demographic characteristics between the near lethal and less lethal attempters we conducted the same analyses as described in this report while adjusting for age, gender, marital status, and education (analyses not shown). The results from these analyses were nearly identical and resulted in the same significant associations, interpretations, and conclusions as those reported in this article. Finally, due to the sampling strategy, the low participation rate, and the relatively small sample size, the findings should be considered tentative until further replications are performed.

Despite these limitations the study clearly showed that attempters who had made less lethal suicide attempts had a higher prevalence of all the mental health indicators examined compared to those who had made nearly lethal suicide attempts. Our findings also indicate that the expectation of dying, the planning of the suicide in terms of informing others, impulsivity, and choice of location are not associated with the medical severity of a suicide attempt. Therefore, the choice and availability of suicide methods may be the most important factors determining the outcome of the suicidal behavior. Since the nearly lethal and less lethal suicide attempters in our study were categorized based on their injury and their suicide attempt method, this investigation was unable to examine the factors that were associated with the choice of suicide method. Future research investigating the factors associated with the choice and availability of suicide methods may be particularly useful in understanding variations in morbidly associated with suicide attempts.

Our findings support a previous study which suggests that non-medically serious sui-

cide attempters have greater psychiatric problems than medically serious suicide attempters (Elliott et al., 1996). However, there are few explanations or theoretical frameworks for these findings. More importantly, it is unclear how these findings fit in with a large literature that has consistently demonstrated that these mental health problems are also associated with, and predictive of, completed suicides.

Therefore, our findings suggest the need for researchers to explore the issues we have raised in more detail and with larger samples, and to determine the extent to which findings from studies based on suicide attempters can be extrapolated to completed suicides.

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Alcohol Consumption and Nearly Lethal Suicide Attempts

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We conducted a case-control study of the association between nearly lethal suicide attempts and facets of alcohol consumption; namely, drinking frequency, drinking quantity, binge drinking, alcoholism, drinking within 3 hours of suicide attempt, and age began drinking. Subjects were 13-34 years of age. In bivariable analyses, all measures were associated with nearly lethal suicide attempts. Odds ratios ranged from 2.4 for alcoholism to 7.0 for drinking within 3 hours of attempt. All exposure variables except age began drinking exhibited a J-shaped relationship between alcohol exposure and nearly lethal suicide attempt. After controlling for potential confounders and other measures of alcohol exposure, drinking within 3 hours of attempt remained most strongly (odds ratios > 6) associated. Alcoholism remained significantly associated in most models, but at lower strength.

Alcohol ingestion has long been considered an important and probably causal factor in suicide attempts. Although Durkheim (1966), in his seminal treatise on suicide, discounted a causal relationship, current research generally supports a causal association between individual measures of alcohol consumption and suicide (Allbeck & Allgulander, 1990; Beautrais et al., 1996; Murphy & Wetzel, 1990; Petronis, Samuels, Moscicki, & Anthony,

1990). The mechanism for the association, however, is unclear.

Alcohol consumption and suicide may be linked via at least three different pathways. First, the risk of suicide may be related to the frequency or quantity of alcohol consumption (Caces & Harford, 1998; Cartwright & Shaw, 1978). Second, suicide may be related to alcohol dependence (Grant et al., 1994). Third, suicide may be related to the context or situation

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This study was funded in part through an interagency agreement, number 2Y02-AA30017, with the National Institute for Alcohol Abuse and Alcoholism.

We wish to thank the members of the Houston Case-Control Study of Nearly Lethal Suicide Attempts team for their contributions to the conceptualization, design and collection of these data.

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in which alcohol is drunk (Fagan, 1989). With up to 50% of suicide victims having evidence of recent ingestion of alcohol (Hlady & Middaugh, 1987; Peterson, Peterson, O'Shanick, & Swann, 1985), and 25% having evidence of intoxication (blood alcohol \geq 100 mg/dl) (Smith, Branas, & Miller, 1999), the exposure to alcohol itself may be a factor regardless of usual drinking practices or dependency. A primary purpose of our research was to examine these various pathways to determine which appeared to be more important, and which might be used to identify persons at higher risk of suicide. To do so, we developed six measures of alcohol exposure (drinking frequency, drinking quantity, binge drinking, alcoholism, drinking within 3 hours of the suicide attempt, and age began drinking) and evaluated each as a possible cause of suicide.

Another reason the relationship between alcohol consumption and suicide is difficult to unravel is that the relationships between alcohol and other potential causal factors are complex and vary from person to person. For example, in some persons, alcohol consumption may cause depression and precede depression in the causal chain to suicide (Figure 1, Option 1). In others, depression may cause alcohol consumption and precede alcohol in the causal chain (Figure 1, Option 2). In still others, depression may be a confounder in the relationship between alcohol and suicide (Figure 1, Option 3). Finally, alcohol and depression may be unrelated yet both contribute to suicide (Figure 1, Option 4.). These different pathways require different analyses. For example, if depression follows alcohol consumption in the causal chain then it is inappropriate to control for depression in the analysis. On the other hand, if depression precedes alcohol consumption in the causal chain one should control for depression to assess the independent contribution of alcohol. We have analyzed our data in several ways to allow various models to be considered.

METHODS AND DATA

We conducted a population-based, case-control study of nearly lethal suicide attempts among

persons 13-34 years old from November 1992 through September 1995 in a defined geographic region in Houston, Texas. The sample was 153 case-subjects and 513 control-subjects. Nearly lethal suicide attempts met one of the following two conditions, which have a high case-fatality ratio (1) the attempter might have died had he or she not received medical or surgical intervention, or (2) the attempter sustained an injury of any severity from a suicide attempt with a firearm or by hanging. The institutional review boards of the Centers for Disease Control and Prevention; University of Texas Medical School, Houston; and Baylor College of Medicine approved the study.

Identification of Cases and Controls

The enrollment of subjects, interviewing procedures, and other methodological aspects of the study are described in detail elsewhere in this issue (see Kresnow, et al.). Briefly, the 153 case-subjects were persons treated for a nearly lethal suicide attempt at the emergency departments of three major hospitals in central Houston. The 513 control-subjects from the same geographic area were enrolled during the same time period using a random-digit-dialed telephone survey. Among the 153 interviewed case-subjects, 103 (67%) attempted suicide by drug ingestion, inhalation, or injection; 17 (11%) by firearm; 13 (8%) by cutting or piercing; 8 (5%) by hanging; 5 (3%) by other single methods; and 7 (5%) by two methods, always a combination of ingestion, cutting, and hanging.

Measures

The primary study outcome was whether or not the subject had made a nearly lethal suicide attempt. A single dichotomous outcome variable was created to differentiate between case-subjects and control-subjects.

Alcohol Exposure Variables. All subjects were asked if they had drunk at least 12 drinks in their lifetime and, if so, if they had drunk at least 12 drinks in the past 12 months. Subjects who reported drinking less than 12 drinks in the past year were classified as nondrinkers.

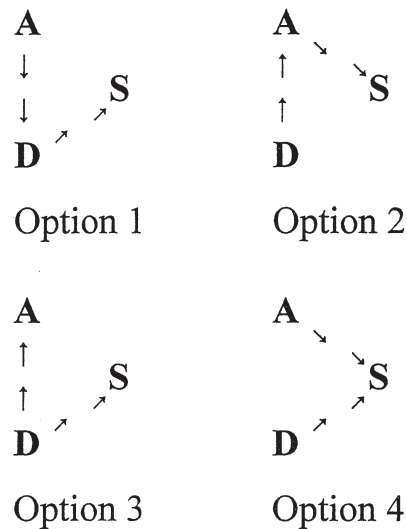


FIGURE 1. Possible relationships among Alcohol (A), Depression (D), and Suicide (S).

Subjects reporting 12 or more drinks in the past year were asked a series of questions about their usual drinking patterns and they were administered the Veterans Alcoholism Screening Test (VAST). All case-subjects, regardless of drinking history, were asked about drinking in the 24 hours before the suicide attempt. Similarly, all control-subjects were asked about drinking during the 24-hour period beginning with the time they awoke the day before the interview.

Age Began Drinking Regularly. Subjects were asked, "Not counting small tastes, how old were you when you started drinking alcoholic beverages?" Age in years was recorded and categorized as 5-12 years, 13-17 years, or 18-24 years. No one reported starting to drink after age 24.

Drinking Frequency. Subjects were asked, "On the average, how often do you drink any alcoholic beverage?" Responses were recorded as days per week, month, or year. All responses were converted into days per week and categorized as 7 days/wk, 3-6 days/wk, 1-2 days/wk, or <1 day/wk. Categories were

chosen to assure adequate sample size in each category and to satisfy *a priori* assumptions; for example, we thought it likely that those who drink every day differ from those who do not; and those who drink less than once per week differ from those who drink at least weekly.

Drinking Quantity. Subjects were asked, "On the average, on the days you drink alcohol, how many drinks do you have a day?" Responses, in drinks per day, were multiplied by the number of days per week of drinking, then divided by 7 to estimate the average drinks per day. For example, a person reporting drinking 3 days per week and averaging 6 drinks on each day of drinking was assigned a drinking quantity score of 2.6 drinks per day ($3 \times 6 \div 7$). Scores were categorized as ≥ 3 drinks/day, 1-<3 drinks/day, and <1 drink/day.

Binge drinking. Subjects were asked, "During the past 12 months, on how many days did you have 5 or more drinks (all kinds of alcoholic beverages combined)?" Responses were recorded as number of days and categorized as

≥ 16 days/yr, 4-15 days/yr, 1-3 days/yr, and 0 days/yr.

Alcoholism. A modified version of the VAST was used to detect alcoholism within the past year. The original 24-item VAST differs from the Michigan Alcoholism Screening Test (MAST) by distinguishing between past and current alcoholism. In addition to asking whether a specific problem has ever happened, the VAST inquires whether the problem has occurred within the past year, within 1-5 years, and more than 5 years ago (Magruder-Habib, Harris, & Fraker, 1982). We included only the query about the past year. Among patients at a Veterans Administration Hospitals the VAST had a sensitivity of 83% and specificity of 89% compared with DSM-III-R criteria (Magruder-Habib, Stevens, & Alling, 1993). Subjects were categorized as alcoholic if they scored ≥ 5 points on the VAST.

Alcohol Use Before the Suicide Attempt

Case-subjects were asked, "In the 24 hours before your suicide attempt, did you drink any alcoholic beverage?" If "yes," they were asked how many glasses of wine, bottles or cans of beer, or drinks of whiskey or liquor that had been they consumed "in the 24 hours before your suicide attempt," and "in the three hours before your suicide attempt." Responses were recorded in number of drinks. Case-subjects were categorized according to whether they had consumed any alcohol in the 3 hours before the attempt.

Control-subjects were asked, "In the 24 hours beginning when you woke up yesterday, did you drink any alcoholic beverage?" Those responding "yes" completed a 24-hour drinking history form which indicated the number of glasses of beer, wine, and hard liquor consumed in each 1-hour period beginning with the hour of awakening the day before the interview. Control-subjects were randomly assigned a 3-hour period based on the distribution of attempt-times for the case-subjects who attempted on that day of the week. The control-subjects' drinking status (yes/no) was based on whether they reported drinking

during that 3-hour period (Kresnow et al., 2001).

Selected Potentially Confounding Variables. Symptoms of depression, migration, exposure to suicidal behavior, sex, age group, race/ethnicity, marital status, years of education completed, employment, and total household income are defined elsewhere in this issue (see Kresnow et al.). In addition, subjects were categorized as having an "upsetting end to a relationship" if they reported being "very upset" about the breakup of a romantic relationship within the past 12 months. Subjects were categorized as having a "nonsuicide death exposure" if a relative, close friend, or spouse had died within the past 12 months. Based on sex-specific distributions of body mass index of control-subjects, participants were divided into three groups (high [upper 25%], medium [middle 50%], low [lower 25%]).

Analysis

Interview data were used for all statistical analyses. A p value <0.05 was considered statistically significant. We used Pearson's chi-square test to assess the association between our selected potentially confounding variables and nearly lethal suicide attempt. Bivariable and multivariable analyses were conducted using logistic regression to estimate the effects of our measures of alcohol exposure on the risk of nearly lethal suicide attempts. In multivariable analysis, we identified potentially confounding variables on theoretical grounds and controlled for them by including each in the full main effects model (alcohol exposure variable plus potential confounders). We then constructed six logistic regression models, one for each of our alcohol-related main exposure variables, which consisted of all main effects and all two-way interactions between the alcohol exposure variables of interest and sex, age, and depressive symptoms. We compared each full main effects model to its corresponding interaction model. Within each pair of models, the interaction terms were assessed as a group and found to be unnecessary ($p \geq 0.05$; likelihood ratio test); therefore, we focused on models

TABLE 1. Distribution of Case- and Control-Subjects by Demographic and Selected Potentially Confounding Variables, and by Measures of Alcohol Exposure

Variable	Case-Subjects (N = 153)		Control-Subjects (N = 513)	
	n ¹	(%)	n ¹	(%)
Sex²				
Male	83	(54.2)	221	(43.1)
Female	70	(45.8)	292	(56.9)
Age Group				
13–17 years	37	(24.2)	126	(24.6)
18–24 years	45	(29.4)	147	(28.7)
25–34 years	71	(46.4)	240	(46.8)
Race/Ethnicity³				
Black non-Hispanic	55	(35.9)	118	(23.1)
Hispanic	44	(28.8)	101	(19.8)
White non-Hispanic	50	(32.7)	277	(54.2)
Other	4	(2.6)	15	(2.9)
Marital Status²				
Never married	104	(68.0)	344	(67.1)
Sep/Div/Wid ⁴	24	(15.7)	47	(9.2)
Married	25	(16.3)	122	(23.8)
Years of Education Completed³				
< HS ⁵ , current student	33	(21.9)	136	(26.5)
< HS, not current student	62	(41.1)	43	(8.4)
HS, not current student	30	(19.9)	68	(13.3)
HS, current student	26	(17.2)	266	(51.9)
Employment Status³				
Student	37	(24.2)	207	(40.4)
Homemaker	18	(11.8)	29	(5.7)
Employed/Self Employed	62	(40.5)	259	(50.5)
Other ⁶	36	(23.5)	18	(3.5)
Household Income³				
\$0–\$20,000	67	(43.8)	105	(20.5)
\$20,001–\$30,000	24	(15.7)	103	(20.1)
> \$30,000	22	(14.4)	211	(41.1)
Unknown	40	(26.1)	94	(18.3)
Body Mass Index				
High	31	(20.5)	128	(25.2)
Medium	77	(51.0)	255	(50.2)
Low	43	(28.5)	125	(24.6)
Depressive Symptoms³ (CES-D ≥ 16)				
Yes	131	(85.6)	163	(31.9)
No	22	(14.4)	348	(68.1)
Moved in the Past Year³				
Yes	90	(58.8)	161	(31.4)
No	63	(41.2)	352	(68.6)

containing only main effects. We present crude and adjusted (first for demographics, then for all potential confounders) odds ratios and 95% confidence limits for each measure

of alcohol use/abuse. The referent group for each alcohol exposure measure was the group of nondrinkers. The significance of each measure of alcohol exposure was assessed using

TABLE 1. Continued

Variable	Case-Subjects (N = 153)		Control-Subjects (N = 513)	
	n ¹	(%)	n ¹	(%)
Exposure to the Suicidal Behavior of Another²				
Yes	95	(62.1)	368	(71.7)
No	58	(37.9)	145	(28.3)
Upsetting End to a Relationship within the past 12 Months³				
Yes	54	(35.3)	69	(13.5)
No	99	(64.7)	444	(86.5)
Exposure to Nonsuicide Death within the past 12 Months				
Yes	46	(30.1)	172	(33.5)
No	107	(69.9)	341	(66.5)
Drinking Frequency³				
7 days per week	14	(9.3)	12	(2.4)
3–6 days per week	13	(8.6)	27	(5.3)
1–2 days per week	29	(19.2)	102	(20.1)
< 1 day per week	19	(12.6)	123	(24.3)
Nondrinker	76	(50.3)	243	(47.9)
Drinking Quantity³				
≥ 3 drinks per day	23	(15.2)	20	(3.9)
1– < 3 drinks per day	18	(11.9)	39	(7.7)
< 1 drink per day	34	(22.5)	205	(40.4)
Nondrinker	76	(50.3)	243	(47.9)
Binge Drinking^{7,3}				
>15 days/yr	41	(27.0)	61	(11.9)
4–15 days/yr	16	(10.5)	65	(12.7)
1–3 days/yr	11	(7.2)	70	(13.7)
0 days/yr	8	(5.3)	72	(14.1)
Nondrinker	76	(50.0)	243	(47.6)
Alcoholism (VAST score ≥ 5)³				
Yes	52	(34.7)	69	(13.5)
No	22	(14.7)	198	(38.8)
Nondrinker	76	(50.7)	243	(47.6)
Drinking within 3 Hours of Event³				
Yes	40	(26.5)	20	(3.9)
No	44	(29.1)	255	(49.9)
Nondrinker ⁸	67	(44.4)	236	(46.2)
Age Began Drinking³				
5–12 years	20	(13.2)	25	(4.9)
18–24 years	15	(9.9)	67	(13.1)

¹ Numbers may not add to 153 case- and 513 control-subjects due to missing values. ² 0.01 ≤ p ≤ 0.05, Pearson's χ^2 test. ³ p < 0.01, Pearson's χ^2 test. ⁴ Separated, divorced, or widowed. ⁵ High school education. ⁶ Other = looking for work (26), sick/disabled (18), doing nothing (5), miscellaneous (5). ⁷ Binge drinking = number of days in the past 12 months with ≥ 5 drinks at single setting. ⁸ Among all who reported drinking less than 12 drinks in the past year, 4 case-subjects reported drinking within the 3 hours before the suicide attempt; no control-subjects reported drinking within the 3 hour index period.

the Wald chi-square test. In addition, to assess the strength of the pattern of risk according to increasing level of exposure, we performed tests for linear trend in the full model for the

ordinal alcohol-related exposure variables, both with and without nondrinkers.

The common referent group across alcohol exposure variables prevented calculating an

odds ratio for one alcohol exposure variable while controlling for the other alcohol exposure variables because of the high degree of multicollinearity. We circumvented the multicollinearity problem by collapsing exposure groups within each variable. Each type of exposure (e.g., drinking quantity) was converted to a single exposure category by combining all levels of exposure that were not positively and significantly associated with nearly lethal suicide attempts. For example, those who had 1 to <3 drinks per day, those who had <1 drink per day, and nondrinkers were combined and served as the referent group for those who consumed ≥ 3 drinks per day. Even with this adjustment, drinking frequency and drinking quantity were too highly correlated to include both; we chose to include drinking quantity. Odds ratios and 95% confidence limits were computed for each measure of alcohol exposure, first adjusted only for other measures of alcohol exposure, and then for both other measures of alcohol exposure and potential confounders. This analysis was repeated excluding drinking in the 3 hours before the attempt. As before, the significance of each alcohol exposure measure was assessed using the Wald chi-square test.

To examine whether our findings were influenced by telephone access we excluded from the analysis the 30 case-subjects who had no telephone. The findings did not change.

RESULTS

Characteristics of the Study Population

Demographic Characteristics. Case- and control-subjects were similar in age distribution and body mass index, but differed in other ways (Table 1). Case-subjects were more likely to be male; of minority race or ethnicity; poorer; and separated, divorced, or widowed; they were less likely to have completed high school or to be employed.

Selected Potentially Confounding Variables. Case-subjects were more likely than control-subjects to have depressive symp-

toms, to have moved within the past 12 months, and to report being very upset over the end of a relationship in the past 12 months. They were less likely to report being exposed to the suicidal behavior of another, and equally likely to be exposed to a nonsuicide death in the past year (Table 1).

Alcohol Exposure Variables. Case-subjects were more likely than control-subjects to drink frequently, drink more, binge drink, be alcoholic (VAST score ≥ 5), and to have begun drinking at a young age (Table 1). Case subjects also were more likely to have drunk within 3 hours of the suicide attempt than control-subjects were to have drunk during the 3-hour index period.

Bivariable Analyses

Crude odds ratios comparing case-subjects with control-subjects indicated that drinking more frequently, drinking greater quantities, bingeing more often, being an alcoholic, drinking within 3 hours of the suicide attempt, and beginning to drink at a younger age were all associated with an increased risk for nearly lethal suicide attempt (Table 2). Except for age at onset of regular drinking, each comparison exhibited a J-shaped pattern. That is, the lightest drinkers were less likely than nondrinkers to attempt suicide whereas the heaviest drinkers were more likely than nondrinkers to attempt. Omitting nondrinkers, the *p*-values for trend from light to heavy drinkers were <0.01 for all six alcohol exposure variables.

Controlling for Demographic Characteristics (Demographic Adjustment)

Controlling for sex, age group, race/ethnicity, marital status, education, employment, household income, and body mass index did not change the J-shape of the relationships between the alcohol exposures and nearly lethal suicide attempt but it reduced the strength of all the associations except for drinking within 3 hours of the attempt (Table 2). Omitting nondrinkers, the *p*-values for trend from light to heavy drinkers were <0.05

TABLE 2. Crude and Adjusted Odds Ratios (ORs), 95% Confidence Intervals (CIs), and Test for Linear Trend¹ for Risk of Nearly Lethal Suicide Attempt by Six Measures of Alcohol Exposure

Variable	Crude		Demographic Adjustment ²		Full Adjustment ³	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Drinking Frequency	[<i>p</i> < 0.01] ¹		[<i>p</i> = 0.02]		[<i>p</i> = 0.12]	
7 days per week	3.7	(1.7–8.4)	2.2	(0.9–5.7)	1.6	(0.5–4.7)
3–6 days per week	1.5	(0.8–3.1)	1.6	(0.6–4.0)	1.5	(0.6–3.8)
1–2 days per week	0.9	(0.6–1.5)	1.1	(0.6–2.2)	1.3	(0.6–2.9)
< 1 day per week	0.5	(0.3–0.9)	0.7	(0.4–1.3)	0.6	(0.3–1.3)
Nondrinkers	1.0		1.0		1.0	
Drinking Quantity	[<i>p</i> < 0.01]		[<i>p</i> = 0.01]		[<i>p</i> = 0.11]	
≥ 3 drinks per day	3.7	(1.9–7.1)	2.5	(1.1–5.9)	1.6	(0.7–4.1)
1–<3 drinks per day	1.5	(0.8–2.7)	1.3	(0.5–3.4)	1.6	(0.6–4.3)
< 1 drink per day	0.5	(0.3–0.8)	0.8	(0.4–1.3)	0.8	(0.4–1.4)
Nondrinker	1.0		1.0		1.0	
Binge Drinking⁴	[<i>p</i> < 0.01]		[<i>p</i> = 0.02]		[<i>p</i> = 0.04]	
>15 days/yr	2.1	(1.3–3.5)	1.7	(0.9–3.4)	1.4	(0.7–2.9)
4–15 days/yr	0.8	(0.4–1.4)	1.0	(0.5–2.3)	1.3	(0.5–3.1)
1–3 days/yr	0.5	(0.3–1.0)	0.8	(0.3–1.8)	0.7	(0.3–2.1)
0 days/yr	0.4	(0.2–0.8)	0.6	(0.2–1.3)	0.5	(0.2–1.4)
Nondrinker ⁵	1.0		1.0		1.0	
Alcoholism (VAST score ≥5)	[<i>p</i> < 0.01]		[<i>p</i> < 0.01]		[<i>p</i> = 0.02]	
Yes	2.4	(1.5–3.8)	1.9	(1.0–3.5)	1.5	(0.8–2.8)
No	0.4	(0.2–0.6)	0.5	(0.3–0.9)	0.6	(0.3–1.2)
Nondrinker	1.0		1.0		1.0	
Drinking within 3 Hours of the Event	[<i>p</i> < 0.01]		[<i>p</i> < 0.01]		[<i>p</i> < 0.01]	
Yes	7.0	(3.9–12.9)	10.2	(4.3–24.3)	8.0	(3.1–20.7)
No	0.6	(0.4–0.9)	0.8	(0.4–1.3)	0.7	(0.4–1.3)
Nondrinker ⁵	1.0		1.0		1.0	
Age Began Drinking	[<i>p</i> < 0.01]		[<i>p</i> = 0.38]		[<i>p</i> = 0.98]	
5–12 years	2.6	(1.3–4.9)	1.5	(0.7–3.4)	1.3	(0.5–3.4)
13–17 years	0.7	(0.5–1.1)	0.9	(0.5–1.5)	0.9	(0.5–1.6)
18–24 years	0.7	(0.4–1.3)	1.0	(0.5–2.1)	1.3	(0.5–3.2)
Nondrinker	1.0		1.0		1.0	

¹*p*-value, Wald chi-square test for linear trend, SUDAAN, excludes nondrinkers. ²Adjusted for sex, age, race/ethnicity, marital status, years of education/student status, employment status, household income, and body mass index. ³Adjusted for the above listed demographic characteristics plus symptoms of depression, migration, exposure to suicide, upsetting end to a relationship, and exposure to nonsuicide death. ⁴Binge drinking = number of days in the past 12 months with ≥5 drinks at a single setting. ⁵Among all who reported drinking less than 12 drinks in the past year, ⁴ case-subjects reported drinking within the 3 hours before the suicide attempt; no control-subjects reported drinking within the 3-hour index period.

for all alcohol exposure variables except age began drinking.

Controlling for Demographic and Selected Potential Confounders (Full Adjustment)

Adding depressive symptoms, migration, suicide exposure, upsetting end to a relationship, and nonsuicide death exposure to the model further attenuated the pattern (Table 2)

for all alcohol exposure variables except drinking within 3 hours of attempt. The changes induced by the addition of these nondemographic variables to the model were caused by the depression and migration variables. Adding suicide exposure, upsetting end to a relationship, and nonsuicide death exposure did not affect the strength of the associations between nearly lethal suicide attempts

TABLE 3. Crude and Adjusted Odds Ratios (ORs), 95% Confidence Intervals (CIs), and Tests of Significance¹ for Risk of Nearly Lethal Suicide by Dichotomous Measures of Alcohol Exposure

Variable	Crude Odds Ratio		Alcohol Measures Adjustment		Alcohol and Demographic Adjustment		Full Adjustment ²	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Drinking Frequency	[<i>p</i> < 0.01] ¹							
7 days per week	4.2	(1.9–9.3)	Not included ³		Not included ³		Not included ³	
All others	1.0							
Drinking Quantity	[<i>p</i> < 0.01]		[<i>p</i> = 0.17]		[<i>p</i> = 0.48]		[<i>p</i> = 0.89]	
≥ 3 drinks per day	4.4	(2.3–8.2)	1.8	(0.8–4.1)	1.4	(0.5–3.9)	1.1	(0.4–3.3)
All others	1.0		1.0		1.0		1.0	
Binge Drinking ⁴	[<i>p</i> < 0.01]		[<i>p</i> = 0.51]		[<i>p</i> = 0.79]		[<i>p</i> = 0.76]	
≥ 3 days per year	2.7	(1.7–4.3)	1.2	(0.7–2.4)	1.1	(0.5–2.5)	1.1	(0.5–2.8)
All others	1.0		1.0		1.0		1.0	
Alcoholism								
(VAST score ≥ 5)	[<i>p</i> < 0.01]		[<i>p</i> = 0.01]		[<i>p</i> = 0.03]		[<i>p</i> = 0.25]	
Yes	3.4	(2.2–5.2)	2.2	(1.2–3.8)	2.2	(1.1–4.2)	1.6	(0.7–3.3)
All others	1.0		1.0		1.0		1.0	
Drinking within 3 Hours of the Event ⁵	[<i>p</i> < 0.01]		Withdrawn from model		Withdrawn from model		Withdrawn from model	
Yes	8.8	(5.0–15.7)						
All others	1.0							
Age Began Drinking	[<i>p</i> < 0.01]		[<i>p</i> = 0.15]		[<i>p</i> = 0.99]		[<i>p</i> = 0.89]	
5–12 years	3.0	(1.6–5.5)	1.7	(0.8–3.4)	1.0	(0.4–2.3)	1.1	(0.4–2.8)
All others	1.0		1.0		1.0		1.0	

¹*p*-value, Wald χ^2 test. ²Adjusted for sex, age, race/ethnicity, marital status, years of education/student status, employment status, household income, body mass index, symptoms of depression, migration, exposure to suicide, upsetting end to a relationship, exposure to nonsuicide death, other measures of alcohol exposure except drinking frequency and drinking within 3 hours of the attempt. ³Drinking frequency not included in the model because of multicollinearity with drinking quantity. ⁴Binge drinking = number of days in the past 12 months with ≥ 5 drinks at a single setting. ⁵Among all who reported drinking less than 12 drinks in the past year, 4 case-subjects reported drinking within the 3 hours before the suicide attempt; no control-subjects reported drinking within the 3-hour index period.

and the various measures of alcohol-related exposure. Omitting nondrinkers, the *p* values for trend from light to heavy drinkers were <0.05 for binge drinking, alcoholism, and drinking within 3 hours of the attempt; they were 0.12 and 0.11, respectively, for drinking frequency and quantity.

Controlling for Alcohol-Related Exposures

After collapsing each of the alcohol exposure variables into two categories to reduce multicollinearity (see methods), the crude odds ratios for each remained associated with nearly lethal suicide attempts (Table 3). Controlling for all other alcohol variables, only drinking within 3 hours of the attempt remained significantly associated with suicide attempt (OR = 6.2, 95% CI, 3.2–11.8). After omitting drinking within 3

hours of the attempt because it is so closely tied to the event itself, controlling for all other alcohol variables (but none of the demographic or potentially confounding variables) reduced the point estimate of the odds ratio for every exposure variable, and eliminated statistical significance for all except alcoholism (Table 3). A sensitivity analysis (data not shown) comparing, one by one, the effects of each alcohol variable upon the others indicated that no single variable, not even drinking 3 hours before the attempt, dominated the decline in significance of the other variables. Adjusting for other alcohol measures and demographic variables, alcoholism remained statistically significant. After adjusting for other alcohol measures, demographic variables, and potentially confounding variables, none of the associations remained statistically significant.

DISCUSSION

Our findings are consistent with previous research indicating a causal role for alcohol consumption in suicidal behavior. In models adjusting for demographic characteristics including employment and household income, drinking frequency, drinking quantity, binge drinking, alcoholism, and drinking within 3 hours of suicide attempt were all directly and significantly associated with nearly lethal suicide attempts (Table 2, Column 2). When other alcohol exposure variables were added to the model, only alcoholism and drinking within 3 hours of suicide attempt remained significantly associated (Table 3, Column 3). This suggests that these two variables are most important in the alcohol suicide relationship. In all analyses, drinking within 3 hours of the event stood apart in strength and persistence of association.

In case-series reports, alcohol consumption before suicide attempt has been reported in as many as half of patients (Hlady & Middaugh, 1987; Peterson et al., 1985) and intoxication in a quarter (Smith et al., 1999). Twenty-six percent of our case-subjects reported drinking within 3 hours of their attempt. Our case-control study indicates that case-subjects were more likely than control-subjects to be drinking at the time of day when the attempts took place. Time of day, however, probably is less important than the context or other characteristics of the suicide event itself. We cannot say, for example, that case-subjects were more likely to be drinking within 3 hours of their attempt than control-subjects were before an event in their lives, such as an argument with a friend. Also important, our data provide no information about whether the alcohol use was a purposeful component to a predetermined plan or an unintentional facilitator of an impetuous act. The strength and persistence of the association, however, indicates that further exploration of this relationship is in order.

In addition to suggesting a causal role for alcohol in the hours preceding the nearly lethal suicide attempt, our findings also are consistent with a causal role for other aspects of drinking behavior, with alcoholism seem-

ingly more important than frequency, quantity, or binge drinking. When controlling for demographic characteristics, the dose-response relationship met standard criteria for statistical significance for all measures except age began drinking (Table 2, column 2). Controlling only for demographic characteristics is the most appropriate model when other factors related to suicide, such as depression and migration, follow alcohol in the causal chain (Figure 1, Option 1) (Victora, Huttly, Fuchs, & Olinta, 1997). We believe this model provides the most accurate estimate of the causal effect of alcohol drinking patterns on nearly lethal suicide attempts in our population. When controlling for demographic and potentially confounding variables the relationships remained significant for binge drinking, alcoholism, and drinking within 3 hours of the attempt (Table 2, column 3). The *p*-values (test for trend) for drinking frequency ($p = 0.12$) and quantity ($p = 0.11$) were small but not significant. This analysis is most appropriate when other factors precede alcohol in the causal chain (Figure 1, Option 2) or are confounders (Figure 1, Option 3). If one knew for each subject the causal or at least the temporal relationship between the alcohol variable and the potential confounder, the analytic models relating alcohol and suicide could be refined.

We also sought to determine the relative strength and importance of each alcohol exposure variable independent of the other alcohol exposure variables. Again, drinking within 3 hours of the event stood apart with a strong and significant association with the nearly lethal suicide attempt even after controlling for all other alcohol exposure variables. Alcoholism maintained strength and significance of the relationship with a nearly lethal suicide attempt better than did drinking quantity, binge drinking, and age began drinking. No variable stood out as responsible for the decline in strength of the associations of the other variables, suggesting that each contributes to the overall process.

Thus, among the alcohol exposures we examined, the time of consumption (drinking within 3 hours of attempt) has the strongest relationship with nearly lethal suicide at-

tempts. Alcoholism also stands out as an important thread in suicide's causal web.

The dose-response curve was J-shaped for all of the alcohol exposure variables except age began drinking. That is, in bivariable analyses the risk of nearly lethal suicide attempt among the lightest drinkers was less than that among nondrinkers, and the risk rose progressively across categories of increasing consumption. J-shaped curves by level of alcohol consumption occur for overall and cardiovascular disease mortality (Poikolainen, 1995). It has been argued that the "elevated" rate among nondrinkers derives from contamination of the group by former drinkers or persons with pre-existing disease (Shaper, Wannamethee, & Walker, 1988). Repeating our analyses using only those individuals who reported drinking <12 drinks in their lifetime as the referent group did not appreciably alter our findings. To our knowledge, this is the first report suggesting that individuals with low levels of alcohol consumption are at lower risk of suicide than nondrinkers. We note it with interest but do not recommend light drinking for suicide prophylaxis.

Our findings must be interpreted in light of our study design and its inherent strengths and weaknesses. The selection of case-subjects with nearly lethal suicide attempt is unique. The case-definition limited the number of subjects thereby reducing the power of the study to detect differences among the various alcohol-related exposures. On the other hand, we expected the case definition to provide two advantages. First, we expected to approximate more closely the characteristics of persons who die from suicide by selecting subjects who nearly died. Second, we expected to obtain more accurate information by interviewing the attemptees rather than surrogates. The stringent case definition did shift the characteristics of case-subjects from all suicide attempters toward suicide completers but the shift was incomplete. For example, males composed 54% of our sample but made up 80% of completed suicides in Harris County for this age group and time period. In addition, firearm injuries accounted for 11% of our sample but were used in

two-thirds of fatal events in Harris County. Thus, our sample had fewer males and fewer firearm injuries than did actual suicides. Given that males drink more often and consume greater quantities than females (Midanik & Room, 1992), and that males are more likely to own firearms than women (Maguire & Pastore, 1998), our sample probably underestimates the relative importance of alcohol in actual suicides.

Whereas direct interview of case-subjects provides more accurate collection of information known only to the subject, and self-reported data are generally valid, validity varies by topic. Focusing on the alcohol questions, we probed three areas of alcohol consumption: use within 3 hours of the attempt, alcohol dependency (alcoholism), and usual drinking practices. Of the 153 case-subjects, 82 (54%) were tested for blood alcohol level as part of their initial hospital evaluation. The limited number tested for alcohol reduces precision and raises the specter of bias. Nevertheless, data from these 82 subjects suggest that self-reported drinking within 3 hours of the attempt is reasonably accurate. Thirty-one tested positive for alcohol, 25 (81%) of whom reported drinking alcohol in the previous 24 hours. Among the 51 with negative tests, 13 (25%) reported that they had consumed alcohol in the 24 hours prior to attempt, 5 (10%) of them within 3 hours of the attempt. Thus, self-reported alcohol consumption within 3 hours of the attempt excludes some patients who either forgot, didn't know, or lied about their alcohol consumption; but it also includes some for whom the laboratory test was negative. Our measure of alcoholism, the VAST, provides an adequate assessment of alcohol dependency in veterans (Magruder-Habib, Stevens, & Alling, 1993), but has not been validated in a younger population. The questions about drinking frequency and quantity were drawn from existing instruments but are not duplicated precisely in any other survey. Self-reported alcohol consumption has been shown to provide satisfactory rankings of individuals according to intake (Feunekes, vant Veer, van Staveren, & Kok, 1999). Our analyses of drinking frequency, quantity, and

binge drinking which are based on rankings of self-reported alcohol consumption should be valid. Bias will be present if case-subjects and control-subjects vary in their accuracy or truthfulness of response. We have no evidence or experience during this study to suggest such variation exists.

In summary, our findings are consistent with a causal role for alcohol consumption and dependence in suicide. In our study, alco-

holism was superior to drinking frequency, drinking quantity, and binge drinking as a measure of risk for suicide but only slightly so. The strong independent association between drinking within 3 hours of the attempt and nearly lethal suicide attempt indicates that the role of alcohol consumption in the context of the suicide event may be a particularly fruitful area of future research.

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The Influence of Geographic Mobility on Nearly Lethal Suicide Attempts

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Teenagers and young adults are very mobile and mobility has been identified as a potential risk factor for suicidal behavior. We conducted a population-based, case-control study of nearly lethal suicide attempts with 153 cases and 513 controls. Study participants were asked about changing residence over the past 12 months. Results indicate that moving in the past 12 months is positively associated with a nearly lethal suicide attempt (adjusted odds ratio of 2.1, with 95% confidence interval of 1.4-3.3), as are specific characteristics of the move (e.g., frequency, recency, distance, and difficulty staying in touch). These findings confirm and extend prior ecologic research by demonstrating a relationship, at the individual level, between the geographic mobility of adolescents and young adults and nearly lethal suicide attempts.

Persons between the ages of 15 and 34 years are very mobile and mobility has been identified as a potential risk factor for suicidal behavior (Breed, 1966; Sorenson & Shen, 1996). Moving from one social environment to another frequently results in an individual experiencing a lack of social integration and increases the likelihood of experiencing novel situations without the structure of social regulation. Persons who move are more likely than those who do not to experience social isolation and stress. In one of the classic studies of suicide, Emile Durkheim (1951) describes

both egoistic and anomic suicide. Egoistic suicide results from the lack of integration of the individual into society. Durkheim believed that the stronger the forces leading an individual to rely on his or her own resources, the greater the suicide rate would be. Anomic suicide results from the lack of regulation of the individual by society and occurs when individuals cannot cope with life situations while experiencing a void of social regulation. Migratory behavior may influence the potential for both egoistic and anomic suicide (Lantz & Harper, 1990).

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We wish to thank the members of the Houston Case-Control Study of Nearly Lethal Suicide Attempts team for their contributions to the conceptualization, design and collection of these data.

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Research on suicide rates of migrants and descendents from countries with high suicide rates suggest they tend to maintain their high suicide rates in their new host countries (Shiang et al., 1997). Kushner (1991) suggests that it is not so much country of origin but rather migration that increases risk of suicide. Kushner contends that immigration may be a "strategy of risk-taking" and may cause loss of kin support in times of crisis.

Ecological studies have found associations between geographic mobility and suicide rates. In a study of state-to-state migration and suicide rates, a 1% increase in interstate migration was associated with a 0.27% increase in the rate of suicide (Stack, 1980). This finding held when controlling for income level and percentage Black population. While a study of suicide and migration in Canadian provinces found strong support for an effect of migration on suicide (Trovato, 1986), an international study of suicide rates and migration found only a mild association between immigration and suicide rates (Stack, 1981), and an ecological study of suicide rates and net migration in Texas found no association between rates of net migration and suicide (Saenz, 1989).

In a study of eighth and eleventh grade students it was found that those with plans to settle elsewhere after graduation were more likely to have elevated feelings of depression and unhappiness about life (Elder, King & Conger, 1996). A review of the literature on involuntary relocation (institutional transfers, job transfers, and urban renewal projects) found that characteristics such as poor health, old age, low income, neurosis, and depression are most often related to stressful reactions to relocation (Heller, 1982). A matched case-control study of a cluster of suicides found that cases had moved more often than control subjects, attended more schools, and lived with more parent figures (Davidson, Rosenberg, Mercy, Franklin, & Simmons, 1989).

Existing studies addressing the relationship between mobility and suicidal behavior suffer from several important limitations. The ecological research in this area is unable to directly measure whether the actual suicide victims had moved and, consequently, their results could potentially inaccurately reflect a

true association between mobility and suicide (i.e., the ecological fallacy). Other studies have examined the impact of mobility only on correlates of suicide or have been based on very small samples. This study significantly advances efforts to understand the relationship between mobility and suicidal behavior by studying the association at the individual level of analysis, in a large sample, and using a rigorous measure of suicidal behavior.

In an effort to approximate completed suicide we interviewed persons presenting at emergency departments with near lethal suicide attempts (see earlier article by Kresnow et al. in this issue). We also interviewed community controls. We sought to test two hypotheses concerning the risk of a nearly lethal suicide attempt in relation to migration. First, we hypothesized that persons who moved at least once in the past 12 months would be at elevated risk for attempted suicide compared to those who did not move. Second, we hypothesized that a number of characteristics of moving in the past 12 months (e.g., frequency of moving, distance moved, recency of move, and difficulty staying in touch) would be associated with elevated risk for attempted suicide.

METHODS

We conducted a population-based, case-control study of nearly lethal suicide attempts among persons 13-34 years old from November 1992 through September 1995 in a defined geographic region in Houston, Texas (Potter et al., 1998). The sample was 153 case-subjects and 513 control-subjects. Nearly lethal suicide attempts met one of the following two conditions: (1) the attempter might have died had he or she not received medical or surgical intervention, or (2) the attempter sustained a self-inflicted injury from a highly lethal method, such as a firearm or by hanging, two methods with a high case-fatality ratio. The institutional review boards of the Centers for Disease Control and Prevention, University of Texas Health Science Center at Houston, and Baylor College of Medicine approved the study.

The enrollment of subjects, interviewing procedures, and other methodological aspects of the study are described earlier in this issue

(see Kresnow et al.). Briefly, the 153 case-subjects were persons treated for a nearly lethal suicide attempt at the emergency departments of three major hospitals in central Houston. The 513 control-subjects from the same geographic area were enrolled during the same time period using a random-digit-dialed telephone survey.

MEASURES

Exposures—Geographic Mobility/Migration

A dichotomous variable describing respondents' geographic mobility in the past 12 months was created. Persons who answered yes to either "Have you moved from one place to another in the past 12 months?" or "Have you moved from your parent's home to college/technical school or back to your parent's house from college/technical school in the past 12 months" were coded as experiencing migration or having moved in the past 12 months. Migration (yes/no) was considered our primary exposure variable of interest. Those who indicated they had moved in the past 12 months were further classified by frequency or number of moves (once, twice, 3+ moves), time since most recent move (0-3 months, 4-6 months, 7-12 months), distance moved (<60 miles, 60+ miles—which corresponds to more than 1 hour in driving distance), and difficulty staying in touch with friends/family (*very difficult*, *somewhat difficult*, or *not difficult*). The referent group for the primary exposure variable, as well as each of the more refined exposure variables, consisted of those who did not move.

Potential Confounders

We examined measures of alcoholism and depression as potential confounders of the relationship between migration and nearly lethal suicide attempts. Persons experiencing alcoholism or depression may be more likely to have unstable living conditions and they may also be at greater risk for suicide. These two variables were associated with both nearly lethal suicide and migration, and did not exhibit characteris-

tics of collinearity in the presence of the other potential confounders. Based on these criteria, depression and alcoholism emerge as potential confounders and we included them in our analyses. We also elected to include age and sex in our analyses. Our coding of these potential confounders is described below.

Demographic Variables. Study participants were grouped into three separate age categories: 13-17 years, 18-24 years, and 25-34 years. Respondent sex (male/female) was also included in analyses.

Alcoholism. A modified version of the 24-item (yes/no) Veterans' Alcoholism Screening Test (VAST) was used to identify respondents exhibiting symptoms of alcoholism in the past year (Magruder-Habib, Harris, & Fraker, 1982). Subjects were categorized as alcoholic if they scored 5 or more points out of 24 on the VAST.

Depression. The Center for Epidemiologic Studies Depression (CES-D) 20-item scale (Radloff, 1977) was used to assess depressive symptoms during the week before the suicide attempt (cases) or the interview (controls). Based on responses to these items, study participants were categorized as either depressed (those scoring 16 or higher out of 20 on the scale components) or not depressed (those scoring 1-15).

ANALYSIS

Data were analyzed using both SAS computer software and SUDAAN computer software, with the simple random sample design specification. Pearson's chi-square test was used to assess the association between each of the migration exposure variables or potential confounders and case-control status. Crude and adjusted odds ratios and 95% confidence limits were generated using logistic regression. The primary exposure of interest—moved in the past 12 months (yes/no)—and potentially confounding variables were included in a multivariable model along with all two-way interactions between the primary exposure variable and each potential confounder. Effect

TABLE 1. Distribution of Migration and Potential Confounders, by Case–Control Status

Characteristic	Cases <i>n</i> (%)	Controls <i>n</i> (%)
Moved, Past 12 Months*		
Yes	90 (58.5)	161 (31.4)
No	63 (41.2)	352 (68.6)
Age Group		
13–17 years	37 (24.2)	126 (24.6)
18–24 years	45 (29.4)	147 (28.7)
25–34 years	71 (46.4)	240 (46.8)
Sex*		
Male	83 (54.2)	221 (43.1)
Female	70 (45.8)	292 (56.9)
Depression*		
Yes	131 (85.6)	163 (31.9)
No	22 (14.4)	348 (68.1)
Alcoholism*		
Yes	52 (34.7)	69 (13.5)
No	98 (65.3)	441 (86.5)

**p*-value <0.05, Pearson's χ^2 test.

modification was assessed using the likelihood ratio test. Once the final model was determined, the migration variable was replaced with other more refined measures of exposure (frequency, recency, distance, and difficulty staying in touch) and the model rerun. The importance of each variable in the model was assessed using the Wald chi-square test, with tests for linear trend conducted where appropriate.

Controls were all contacted by phone whereas cases were identified in hospital emergency departments. Some cases did not have telephones. Having a telephone in the home could in some way be tied to migration and the ability to stay in touch. Thus, we reran the final model excluding case subjects with no telephone in the home to test whether our results were sensitive to presence of a telephone.

Finally, we developed a single model containing all refined exposure variables and potential confounders, which allowed us to assess the association between each refined exposure variable and nearly lethal suicide attempt, while taking into account the other migration exposures of interest. For this analysis, the reference group has non-movers combined with what was considered the lowest risk migration category for each variable in

order to circumvent issues of multicollinearity. For “Number of Moves,” we combined no move with 1 move; for “Distance Moved,” we combined no move with less than 60 miles; for “Recency of Move,” we combined no move with 7–12 months; and for “Staying in Touch,” we combined no move with somewhat/not hard. Thus, the number and recency of moves became 3-level variables while distance and staying in touch became 2-level variables.

RESULTS

Bivariable Analysis

In Table 1 we compare the distribution of potential confounders and having moved in the past 12 months (yes/no) by case-control status. With the exception of age, case-control status was significantly associated with all potential confounders. Cases were more likely to be male, depressed, and alcoholic than were controls ($p < 0.05$, Pearson's chi-square test). In addition, cases were significantly more likely than controls to have moved in the past 12 months (crude odds ratio 3.1; 95% confidence interval 2.2–4.5) (Table 2).

TABLE 2. Crude and Adjusted Odds Ratios (95% CIs) for Case-Control Status, by Level of the Main Exposure "Migration" Variable Listed

Migration Variable	Crude OR (95% CI)	Adjusted ¹ OR (95% CI)
Moved Past 12 Months²		
Yes	3.1 (2.2–4.5)	2.1 (1.4–3.3)
No	1.0	1.00
Number of Moves³		
3+ Moves	10.1 (5.5–18.5)	6.2 (3.0–13.1)
2 Moves	2.5 (1.4– 4.6)	1.7 (0.9– 3.3)
1 Move	2.0 (1.2– 3.2)	1.5 (0.9– 2.5)
No Move	1.0	1.0
Distance Moved³		
60+ Miles	2.6 (1.4–4.8)	2.2 (1.0–4.5)
< 60 Miles	3.0 (2.0–4.5)	1.9 (1.2–3.1)
No Move	1.0	1.0
Recency of Move³		
0–3 Mos	4.7 (2.95–7.52)	3.0 (1.7–5.3)
4–6 Mos	2.9 (1.62–5.05)	2.1 (1.1–4.1)
7–12 Mos	1.6 (0.88–2.94)	1.2 (0.6–2.4)
No Move	1.0	1.0
Staying in Touch³		
Very Hard	14.0 (4.3–45.9)	8.6 (2.2–33.6)
Somewhat, Not Hard	2.9 (2.0– 4.2)	1.9 (1.3– 3.0)
No Move	1.0	1.00

¹Includes the specified main exposure variable and sex, age group, depression, and alcoholism. ² p -value < 0.05, Wald χ^2 test, crude and adjusted models. ³ p -value < 0.05, Wald χ^2 test for linear trend, crude and adjusted models.

Multivariable Analysis

We initially constructed a model consisting of our primary exposure variable, the potential confounders (age, sex, depression, and alcoholism), and all two-way interactions between migration and the potential confounders. A simultaneous assessment of all 2-way interactions was nonsignificant ($p = 0.22$, likelihood ratio test) and these terms were removed from the model. The odds ratio for migration in the final model, although reduced, remained significant after adjusting for age, sex, depression, and alcoholism (odds ratio 2.1; 95% confidence interval 1.4–3.3). Sex, depression, and alcoholism, all significant predictors of case-control status in bivariable analysis, remained significant in the adjusted model. Excluding the 30 case subjects who reported not having a telephone in the home from the analysis had no effect on the adjusted odds ratio for migration (odds ratio 2.0; 95% confidence interval 1.2–3.1).

Refined Analysis

In an effort to determine which specific characteristics of a move might put one at increased risk of a nearly lethal suicide attempt, we conducted an analysis where the migration variable was replaced with each of the more refined exposure variables and rerun (Table 2). As was done with migration, the referent group for each of the refined variables consisted of those who did not move. Risk of nearly lethal suicide increased with increased number of moves, increased distance moved, and increased difficulty staying in touch, and became stronger as the time interval since the most recent move decreased ($p < 0.05$, test for linear trend), even after controlling for age, sex, depression, and alcoholism. Those moving 3 or more times in the past 12 months were at a particularly high risk (odds ratio 6.2; 95% confidence interval 3.0–13.1) of a nearly lethal suicide attempt relative to nonmovers, as were those experiencing difficulty staying in touch

with friends or family. Risk of a nearly lethal suicide attempt was almost 9 times higher among those who reported that it was “very hard” to stay in touch, relative to those who did not move. Even those who reported finding it “somewhat or not very hard” to stay in touch were at an increased risk of a nearly lethal suicide attempt. In the model controlling each migration exposure variable for the remaining 3 exposures plus the potential confounders, only number of moves remained as a significant predictor of nearly lethal suicide ($p = 0.015$, test for linear trend). Recency, distance moved, and difficulty staying in touch no longer predicted nearly lethal suicide attempts. While sex and depression remained as important predictors in the model, alcoholism was no longer significant.

DISCUSSION

Our findings suggest that moving in the past 12 months is associated with increased risk for a nearly lethal suicide attempt after adjusting for a number of potential confounders. This finding holds true even when controlling for indicators of alcoholism and depression. This finding is also consistent with our hypothesis and with findings of other studies.

When looking at more specific characteristics of moving we found that frequency of moving, distance moved, recency of move, and difficulty staying in touch were all factors that appear to be associated with increased odds of nearly lethal suicide attempts. When we adjusted for all migration variables and potential confounders simultaneously, the only migration characteristic that remained a significant predictor of nearly lethal suicide attempts was number of moves in the past 12 months. There are several possible interpretations of this finding. One is that higher frequency of moving may indicate more disruption of social support and social networks. Another possibility is that frequent moves may be a marker for some unmeasured characteristic (e.g., financial difficulties) that is causally associated with suicidal behavior. There are still many questions to be answered about geographic mobility and suicide. Our findings suggest direction for pursuit of ques-

tions about the causal nature of moving and suicidal behavior. These results really extend prior research by testing the association of mobility to suicidal behavior in a more rigorous study design. Thus they give us greater confidence that there is a true association between mobility and serious suicidal behavior at the individual level.

These findings should be considered in light of several limitations. First, we lack information about the reason for moving. The literature on migration suggests that when people move, it is either because they were pushed (as in getting away from something), pulled (they were going to something), or there was some combination of pushes and pulls. Whether or not the move was self-versus other-motivated would be expected to be an indicator of positive anticipation (which may be protective) versus negative force (which may increase risk). Knowing something about the reasons for moving and being able to associate specific reasons with suicidal behavior would shed light on the nature of possible causal associations.

Second, we had very limited information on the effects of the move on the mover. Asking more questions about difficulties in relationships, finances, and other disruptions frequently associated with moving would be useful in developing a better understanding of the etiological effects of moving on suicide attempts. Third, we have a sample that is geographically limited to the greater Houston area. It is possible that movers in other cities may have an easier or more difficult time adjusting, making the effects we found in this analysis difficult to replicate in other places or times. Also, because cases do not include suicide attempts with lower levels of potential lethality, we do not know if our findings would hold true in the full population of suicide attempters.

Despite these limitations, our analysis confirms the positive association between migration and suicide found in other studies. The analysis also highlights how certain characteristics of a move relate to suicide risk. Additional research is necessary to refine our understanding of which movers are at greatest risk, and to determine whether temporary

strategies to help high-risk movers make their transition can impact risk for suicidal behavior.

The association we found between mobility and suicidal behavior, after controlling for depression and alcoholism, suggests the possibility that interventions to prevent suicidal behavior could and should be targeted toward highly mobile individuals and families. One potential avenue for addressing this high-risk population may be to develop prevention programs for students who migrate among schools, as well as for businesses, corporations, and military organizations that tend to frequently move their employees. Suicidal be-

havior may impinge on the health and productivity of employees who move frequently and efforts to help smooth the transitions inherent in such moves may help to reduce these costs. Another potential avenue for prevention is for communities with high proportions of in-migrants to organize programs to better and more quickly integrate new arrivals into the community. Further research is needed to help us better understand why highly mobile individuals are at greater risk for suicide. In the meantime, the development and evaluation of programs to reduce suicidal behavior in this high-risk population should be promoted.

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