

Childhood Abuse, Household Dysfunction, and the Risk of Attempted Suicide Throughout the Life Span

Findings From the Adverse Childhood Experiences Study

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SUICIDE WAS THE EIGHTH LEADING cause of death in the United States in 1998.¹ Particularly high rates have been reported among young persons and older adults.¹⁻⁷ Each year, more than 30 000 people in the United States commit suicide, but recognition of persons who are at high risk for suicide is difficult, making efforts to prevent its occurrence problematic.^{1,8-10} The US surgeon general brought attention to this complex public health issue by recommending that the investigation and prevention of suicide be a national priority.¹¹

An expanding body of research suggests that childhood trauma and adverse experiences can lead to a variety of negative health outcomes, including substance abuse, depressive disorders, and attempted suicide among adolescents and adults.¹²⁻¹⁴ Childhood sexual and physical abuse have been strongly associated with suicide attempts.¹⁵⁻²¹ A recent study of Norwegian drug addicts showed that a high proportion of them attempted suicide, and an even higher proportion of drug

Context Suicide is a leading cause of death in the United States, but identifying persons at risk is difficult. Thus, the US surgeon general has made suicide prevention a national priority. An expanding body of research suggests that childhood trauma and adverse experiences can lead to a variety of negative health outcomes, including attempted suicide among adolescents and adults.

Objective To examine the relationship between the risk of suicide attempts and adverse childhood experiences and the number of such experiences (adverse childhood experiences [ACE] score).

Design, Setting, and Participants A retrospective cohort study of 17 337 adult health maintenance organization members (54% female; mean [SD] age, 57 [15.3] years) who attended a primary care clinic in San Diego, Calif, within a 3-year period (1995-1997) and completed a survey about childhood abuse and household dysfunction, suicide attempts (including age at first attempt), and multiple other health-related issues.

Main Outcome Measure Self-reported suicide attempts, compared by number of adverse childhood experiences, including emotional, physical, and sexual abuse; household substance abuse, mental illness, and incarceration; and parental domestic violence, separation, or divorce.

Results The lifetime prevalence of having at least 1 suicide attempt was 3.8%. Adverse childhood experiences in any category increased the risk of attempted suicide 2- to 5-fold. The ACE score had a strong, graded relationship to attempted suicide during childhood/adolescence and adulthood ($P < .001$). Compared with persons with no such experiences (prevalence of attempted suicide, 1.1%), the adjusted odds ratio of ever attempting suicide among persons with 7 or more experiences (35.2%) was 31.1 (95% confidence interval, 20.6-47.1). Adjustment for illicit drug use, depressed affect, and self-reported alcoholism reduced the strength of the relationship between the ACE score and suicide attempts, suggesting partial mediation of the adverse childhood experience-suicide attempt relationship by these factors. The population-attributable risk fractions for 1 or more experiences were 67%, 64%, and 80% for lifetime, adult, and childhood/adolescent suicide attempts, respectively.

Conclusions A powerful graded relationship exists between adverse childhood experiences and risk of attempted suicide throughout the life span. Alcoholism, depressed affect, and illicit drug use, which are strongly associated with such experiences, appear to partially mediate this relationship. Because estimates of the attributable risk fraction caused by these experiences were large, prevention of these experiences and the treatment of persons affected by them may lead to progress in suicide prevention.

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addicts who had experienced childhood adversity had attempted suicide.²² In another study, low-income women who had a history of alcohol problems and had experienced childhood abuse and neglect were at increased risk for suicide attempts.¹³

There is little information about the relationship between multiple childhood traumas and the risk of suicide attempts. In fact, childhood stressors such as abuse, witnessing domestic violence, and other forms of household dysfunction are highly interrelated^{23,24} and have a graded relationship to numerous health and social problems.²³⁻²⁸ We examined the relationship of 8 adverse childhood experiences (childhood abuse [emotional, physical, and sexual], witnessing domestic violence, parental separation or divorce, and living with substance-abusing, mentally ill, or criminal household members) to the lifetime risk of suicide attempts. We then determined whether the relationship between the total number of such experiences (the adverse childhood experiences [ACE] score) and risk of suicide attempts was cumulative and graded. We tested for evidence that self-reported alcoholism, depressed affect, and illicit drug use mediate this relationship and examined the relationship between the number of adverse childhood experiences and suicide attempts during childhood/adolescence and adulthood. Finally, we estimated the attributable risk fraction for suicide attempts that may result from these experiences.

METHODS

The Adverse Childhood Experiences (ACE) Study is a collaboration between Kaiser Permanente's Health Appraisal Center (HAC) in San Diego, Calif, the Centers for Disease Control and Prevention, and Emory University, Atlanta, Ga. The overall objective is to assess the impact of numerous adverse childhood experiences on a variety of health behaviors and outcomes and health care use.²³ The ACE Study was approved by the institutional review boards of Kaiser Permanente, Emory University, and the Office of Protection from Research Risks,

National Institutes of Health. Potential participants were sent letters that accompanied the ACE Study questionnaire and told them that their participation was voluntary and that their answers would be held in strictest confidence, never becoming a part of their medical record.

Recent publications from the ACE Study have shown a strong, graded relationship between the number of adverse childhood experiences, multiple risk factors for leading causes of death in the United States,²³ and priority health and social problems such as smoking,²⁴ sexually transmitted diseases,²⁵ unintended pregnancies,²⁶ male involvement in teen pregnancy,²⁷ and alcohol problems.²⁸

Study Population

The study population was drawn from the HAC, which provides complete and standardized medical, psychosocial, and preventive health evaluations to adult members of Kaiser Health Plan in San Diego County. In any 4-year period, 81% of the adult membership obtains this service, and more than 50 000 members are evaluated yearly; thus, data from the HAC represent the experiences and health status of a majority of adult Kaiser members in San Diego. Their visit to the HAC is primarily for complete health assessments rather than symptom-based or illness-based care.

Persons evaluated at the HAC complete a standardized questionnaire, which includes detailed health histories and health-related behaviors, a medical review of systems, and psychosocial evaluations. This information was abstracted and is included in the ACE Study database.

ACE Study Design and Questionnaire

The baseline data collection was divided into 2 survey waves according to the method we described earlier.²³ Two weeks after the HAC evaluation, each person was mailed an ACE Study questionnaire, which included detailed information about adverse childhood experiences (eg, abuse and neglect) and family and household dysfunction (eg, domestic violence and substance abuse

by parents or other household members) and questions about health-related behaviors from adolescence to adulthood. Prior publications from the ACE Study included respondents to wave 1 (9508 of 13 494; 70% response), conducted between August 1995 and March 1996.^{23,24,26,29} Wave 2 was conducted between June and October 1997; 8667 of 13 330 persons (65%) responded. Wave 2 added detailed questions about health topics that analysis of wave 1 had shown to be important.^{23,26} The response rate for both survey waves combined was 68% (18 175 of 26 824).

Assessment of Representativeness, and Response or Reporting Bias

In wave 1, the HAC questionnaire data were abstracted for respondents and nonrespondents to the ACE Study questionnaire, enabling a detailed assessment of the representativeness of respondents in terms of demographic characteristics and health-related issues. Results of this analysis have been published elsewhere.²⁹ Briefly, nonrespondents tended to be younger, less educated, or from racial or ethnic minority groups. After demographic differences were controlled for, health behaviors such as smoking and alcohol or drug abuse and health conditions such as heart disease, hypertension, obesity, and chronic lung disease did not differ between respondents and nonrespondents. Thus, there was no evidence that the general health of respondents and nonrespondents differed.

In addition, questions from the HAC allowed assessment of the strength of the relationship between childhood sexual abuse and health behaviors, diseases, and psychosocial problems; the strength of these relationships was virtually identical for respondents and nonrespondents.²⁹ Thus, there was no evidence that respondents to the ACE Study questionnaire were biased toward attributing their health problems to childhood experiences such as sexual abuse.

Exclusions From the Study Cohort

We excluded 754 respondents who coincidentally underwent examinations

during both survey waves. The unduplicated total number of respondents was 17421. After exclusion of 17 respondents with missing information about race and 67 with missing information about educational level, the final study sample included 95% of the respondents (17337 of 18175; wave 1=8708, wave 2=8629).

Definitions of Adverse Childhood Experiences

All questions about adverse childhood experiences pertained to the respondents' first 18 years of life. For questions adapted from the Conflict Tactics Scale (CTS),³⁰ the response categories were as follows: never, once or twice, sometimes, often, or very often.

Emotional Abuse. Emotional abuse was determined from answers to 2 questions from the CTS: (1) "How often did a parent, stepparent, or adult living in your home swear at you, insult you, or put you down?" and (2) "How often did a parent, stepparent, or adult living in your home act in a way that made you afraid that you might be physically hurt?" Responses of "often" or "very often" to either item defined emotional abuse during childhood.

Physical Abuse. A 2-part question from the CTS was used to describe childhood physical abuse: "Sometimes parents or other adults hurt children. How often did a parent, stepparent, or adult living in your home (1) push, grab, slap, or throw something at you or (2) hit you so hard that you had marks or were injured?" A respondent was defined as being physically abused if the response was "often" or "very often" to the first part or "sometimes," "often," or "very often" to the second part.

Sexual Abuse. Four questions from Wyatt³¹ were adapted to define contact sexual abuse during childhood: "Some people, while they are growing up in their first 18 years of life, had a sexual experience with an adult or someone at least 5 years older than themselves. These experiences may have involved a relative, family friend, or stranger. During the first 18 years of life, did an adult, relative, family friend, or stranger ever (1) touch or fondle your body in a sexual way, (2)

have you touch their body in a sexual way, (3) attempt to have any type of sexual intercourse with you (oral, anal, or vaginal), or (4) actually have any type of sexual intercourse with you (oral, anal, or vaginal)?" A "yes" response to any of the 4 questions classified a respondent as having experienced contact sexual abuse during childhood.

Battered Mother. We used 4 questions from the CTS to define childhood exposure to a battered mother. "Sometimes physical blows occur between parents. How often did your father (or stepfather) or mother's boyfriend do any of these things to your mother (or stepmother)? (1) Push, grab, slap, or throw something at her, (2) kick, bite, hit her with a fist, or hit her with something hard, (3) repeatedly hit her over at least a few minutes, or (4) threaten her with a knife or gun, or use a knife or gun to hurt her." A response of "sometimes," "often," or "very often" to either the first or second question or any response other than "never" to either the third or the fourth question defined a respondent as having had a battered mother.

Household Substance Abuse. Two questions asked whether respondents, during their childhood, lived with a problem drinker or alcoholic³² or with anyone who used street drugs. An affirmative response to either of these questions indicated childhood exposure to substance abuse in the household.

Mental Illness in Household. A "yes" response to the question "Was anyone in your household mentally ill or depressed?" defined this adverse childhood experience.

Parental Separation or Divorce. This experience was defined as a "yes" response to the question "Were your parents ever separated or divorced?"

Incarcerated Household Members. This experience was defined as having had childhood exposure to a household member who was incarcerated.

Definition of Reported Risk Factors for Suicide Attempts

Depressed Affect. Depressed affect was defined as a "yes" response to this question, which was included in both ACE

Study survey waves: "Have you had or do you now have depression or feel down in the dumps?" We compared the measure of depressed affect to a validated screening tool developed by the Rand Corporation for lifetime prevalence of major depression or dysthymia.³³ The tool was available for the ACE Study survey wave 1 only. In this comparison (2 × 2 table), lifetime depressed affect was significantly associated with the validated measure³³ ($\chi^2_1=1476$; $P<.001$); the sensitivity, specificity, and positive predictive value for lifetime depressed affect were 83%, 60%, and 87%, respectively.

Self-reported Alcoholic. A "yes" response to the question "Have you ever considered yourself to be an alcoholic?" defined self-reported alcoholism.³² Assessment of the methodological studies indicates that for the general population, self-reports of alcohol use are fairly accurate.³⁴ Furthermore, assuring respondents of the confidentiality of their responses, which was part of the ACE Study protocol, and providing responses in a private setting (mail survey in the home for the ACE Study) also enhance the accuracy of self-reported alcohol abuse.^{34,35}

Ever Used Illicit Drugs. A "yes" response to the question "Have you ever used street drugs?" defined illicit drug use.

Definition of a Lifetime Suicide Attempt

Attempted suicide was defined as a "yes" response to the question "Have you ever attempted to commit suicide?" According to data available from wave 2 only, for persons who had attempted suicide, the mean number of suicide attempts was 1.6 (SD, 0.91); the range was 1 to 4 times, and 75th and 95th percentiles were 2 and 4, respectively. For persons who had attempted suicide, the mean number of attempts did not differ between men and women or according to the ACE score.

Assessing the Relationship of Adverse Childhood Experiences to Child, Adolescent, and Adult Suicide Attempts

Questions about age at suicide attempt were added to the wave 2 questionnaire

Table 1. Prevalence of Each Category of Adverse Childhood Experiences and ACE Score by Sex*

| | No. (%) | | |
|--------------------------------|---------------------|-------------------|-----------------------|
| | Women (n = 9367) | Men (n = 7970) | Total (N = 17 337) |
| Adverse childhood experiences | | | |
| Emotional abuse | 1227 (13.1) | 602 (7.6) | 1829 (10.5) |
| Physical abuse | 2530 (27.0) | 2382 (29.9) | 4912 (28.3) |
| Sexual abuse | 2310 (24.7) | 1276 (16.0) | 3586 (20.7) |
| Battered mother | 1281 (13.7) | 920 (11.5) | 2201 (12.7) |
| Household alcohol/drug abuse | 2759 (29.5) | 1896 (23.8) | 4655 (26.9) |
| Mental illness in household | 1937 (20.7) | 1058 (13.3) | 2995 (17.3) |
| Parental separation or divorce | 2293 (24.5) | 1738 (21.8) | 4031 (23.3) |
| Incarcerated household member | 485 (5.2) | 324 (4.1) | 809 (4.7) |
| ACE score | | | |
| 0 | 3271 (34.9) | 3044 (38.2) | 6315 (36.4) |
| 1 | 2299 (24.5) | 2237 (28.1) | 4536 (26.2) |
| 2 | 1443 (15.4) | 1297 (16.3) | 2740 (15.8) |
| 3 | 969 (10.3) | 685 (8.6) | 1654 (9.5) |
| 4 | 665 (7.1) | 382 (4.8) | 1047 (6.0) |
| 5 | 390 (4.2) | 212 (2.7) | 602 (3.5) |
| 6 | 210 (2.2) | 74 (0.9) | 284 (1.6) |
| ≥7 | 120 (1.3) | 39 (0.5) | 159 (0.9) |

*For ACE Study waves 1 and 2 combined. ACE indicates adverse childhood experiences. See "Methods" for definitions of each type of adverse event.

(n=8629). Childhood/adolescent suicide attempts were defined as the subject's being 18 years or younger at the time of the attempt. Adult suicide attempts were defined as those that occurred when the subject was 19 years or older. These outcomes were assessed from wave 2 only. The mean ages for childhood/adolescent and adult suicide attempts were 15.1 (SD, 2.1) and 28.4 (SD, 10.6) years, respectively.

Statistical Analysis

All analyses were conducted with the SAS System, Version 6.12 (SAS Institute Inc, Cary, NC). Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were obtained from logistic regression models that estimated the likelihood of ever attempting suicide by each of the 8 categories of adverse childhood experiences. The number of experiences was summed for each respondent (ACE score range, 0-8). Because of small sample sizes, ACE scores of 7 or 8 were combined into 1 category (≥7). Thus, analyses were conducted with the summed score as 7 dichotomous variables (yes/no), with 0 experiences as the referent.

Covariates in all models were included on a priori reasoning rather than by using stepwise selection and included age (continuous variable), sex, race, and education (high school diploma, some college education, or college graduate vs less than high school education). We had no a priori hypotheses about interaction between demographic variables and the adverse childhood experiences to examine. Using SAS regression diagnostics, we found no evidence of collinearity. Persons with incomplete information about an adverse childhood experience were considered not to have had that experience. To assess the potential effect of this assumption, we repeated our analysis after excluding any respondent who had missing information on any adverse childhood experience and found no substantial difference in the results.

Because we have previously reported the graded relationship of adverse childhood experiences to 3 known risk factors for suicide, ie, self-reported alcoholism, illicit drug use, and depressed affect,^{23,28} we used logistic models with and without controlling for these variables to assess their

potential mediating role in the relationship between the ACE score and suicide attempts.

Attributable risk fractions (ARFs) were calculated by using adjusted ORs from logistic regression models based upon having had at least 1 adverse childhood experience, with 0 as the referent. This analysis was done because a substantial increase in the risk of attempted suicide was seen for persons reporting at least 1 experience. We used Levin's formula for these calculations: $ARF = P_1 (RR - 1) / 1 + P_1 (RR - 1)$,³⁶ where P_1 is the prevalence of an ACE score of at least 1 and RR is the OR of attempted suicide for an ACE score of at least 1.³⁶ The ARF is an estimate of the proportion of the health problem (eg, attempted suicide) that would not have occurred if no persons had been exposed to the risk factor being assessed.³⁶

RESULTS

Characteristics of the Study Population

The study population included 9367 (54%) women and 7970 (46%) men. The mean age was 56 (SD, 15.2) years. Seventy-five percent of participants were white, 39% were college graduates, 36% had some college education, and 18% were high school graduates. Only 7% had not graduated from high school.

Adverse Childhood Experiences

The prevalence of each experience and of the ACE scores is shown in TABLE 1. Sixty-four percent of respondents reported at least 1 of the 8 categories. We found no substantial difference in prevalence of adverse childhood experiences between waves 1 and 2, with the adjusted mean ACE score for both waves equaling 1.5.

Known Risk Factors for Suicide

The prevalence of self-reported alcoholism, illicit drug use, and depressed affect was 6.5%, 16.5%, and 28.4%, respectively. Self-reported alcoholism and illicit drug use were higher among men than women (8.9% vs 4.1% and 17.9% vs 15.3%, respectively), while de-

pressed affect was higher among women than men (35.2% vs 20.4%). The prevalence we obtained for self-reported alcoholism (6.5%) and depressed affect (28.4%) is similar to previously reported data on alcohol dependence and depressive symptoms.³⁷⁻³⁹ Because illicit drug use is inversely associated with age (a secular trend), we adjusted the prevalence of ever using illicit drugs to the age distribution of the US population by using 2000 census population figures (using the direct method).⁴⁰ The adjusted prevalence is substantially higher, 25.5%. Thus, the apparent low estimate (16.5%) of illicit drug use may largely be an artifact of the age structure of the study population.

Demographic Characteristics of Suicide Attempts

The lifetime prevalence of having at least 1 suicide attempt was 3.8% and was approximately 3 times higher for women than for men (5.4% vs 1.9%). The age-adjusted prevalence of attempted suicide decreased with increasing educational level: no high school (5.5%), high school graduate (4.7%), some college (4.2%), and college graduate (2.8%).

The risk of suicide attempt was increased 2- to 5-fold ($P<.001$) by any adverse childhood experience, regardless of the category (TABLE 2). Because we found no substantial differences in these risk estimates between men and women, we present the data for men and women combined (Table 2). Estimates of the OR for each of the 8 adverse childhood experiences were statistically significant ($P<.01$) and ranged from 1.9 (95% CI, 1.6-2.2) for parental separation or divorce to 5.0 (95% CI, 4.2-5.9) for emotional abuse (Table 2).

We used separate logistic regression models to assess the association of the ACE score, self-reported alcoholism, depressed affect, and illicit drug use to attempting suicide, with each of these exposures treated as an individual dependent variable (TABLE 3). In these individual models, we found a significant graded relationship between the ACE score and ever attempting suicide. Self-reported alcoholism, de-

Table 2. Prevalence and Risk of a Lifetime History of Attempted Suicide by Category of Adverse Childhood Experience*

| Adverse Experience Category | Ever Attempted Suicide | |
|-------------------------------|------------------------|---------------------|
| | Prevalence, % | Odds Ratio (95% CI) |
| Emotional abuse | | |
| No | 2.5 | 1.0 |
| Yes | 14.3 | 5.0 (4.2-5.9) |
| Physical abuse | | |
| No | 2.2 | 1.0 |
| Yes | 7.8 | 3.4 (2.9-4.0) |
| Sexual abuse | | |
| No | 2.4 | 1.0 |
| Yes | 9.1 | 3.4 (2.9-4.0) |
| Battered mother | | |
| No | 3.1 | 1.0 |
| Yes | 9.0 | 2.6 (2.2-3.1) |
| Substance abuse in home | | |
| No | 2.6 | 1.0 |
| Yes | 7.0 | 2.1 (1.8-2.5) |
| Mentally ill household member | | |
| No | 2.6 | 1.0 |
| Yes | 9.6 | 3.3 (2.8-3.9) |
| Parents separated/divorced | | |
| No | 3.0 | 1.0 |
| Yes | 6.6 | 1.9 (1.6-2.2) |
| Incarcerated family member | | |
| No | 3.5 | 1.0 |
| Yes | 10.8 | 2.5 (2.0-3.2) |

*Data from waves 1 and 2 combined, N = 17,337. Odds ratios adjusted for sex, race, educational level, and age at survey. CI indicates confidence interval.

pressed affect, and illicit drug use were associated with ever attempting suicide, with a 3- to 5-fold increased risk ($P<.001$). When we simultaneously entered the ACE score, self-reported alcoholism, depressed affect, and illicit drug use in a single (full) logistic model (Table 3), the graded relationship between the ACE score and the lifetime risk of attempted suicide remained. However, there was a slight reduction in the strength of the OR for each ACE score in the full model, suggesting a mediating role for these factors. Adding alcoholism, depressed affect, and illicit drug use to the model with the ACE score improved the fit of the model significantly ($\chi^2_3=225.83$; $P<.001$).

The associations of the ACE score to childhood/adolescent or adult suicide attempts are presented in TABLE 4. The likelihood of childhood/adolescent and adult suicide attempts increased as ACE score increased. An ACE score of at least 7 increased the likelihood of childhood/adolescent suicide attempts 51-fold and

adult suicide attempts 30-fold ($P<.001$). For childhood/adolescent and adult suicide attempts, the addition of the known risk factors (potential mediators) improved the fit of the models ($\chi^2_3=235.0$, $P<.001$ and $\chi^2_3=90.8$, $P<.001$, respectively; data not shown).

To test for a trend (graded relationship) between the ACE score and the risk of suicide attempts, we entered ACE score as an ordinal variable into logistic models, with adjustment for the demographic covariates, for the 3 outcomes: suicide attempts during childhood/adolescence, attempts during adulthood, and lifetime suicide attempts. The 3 ordinal ORs are, respectively, 1.7 (95% CI, 1.5-1.8), 1.5 (95% CI, 1.4-1.6), and 1.6 (95% CI, 1.5-1.6). These results suggest that for every increase in the ACE score, the risk of suicide attempts increases by about 60%. Thus, we found strong statistical evidence of a trend; the precision in the estimate of the trend for increasing OR as the ACE score increases is high.

Attributable Risk Fraction

Because the risks for attempted suicide increased substantially beginning with an ACE score of 1, we used an ACE score of at least 1 (prevalence = 64%) to calculate ARFs. The estimated ARFs for lifetime, childhood/adolescent, and adult suicide attempts were 67%, 80%, and 64%, respectively.

COMMENT

We found that each of the 8 adverse childhood experiences increased the risk of ever attempting suicide from 2- to 5-fold. Because these experiences are strongly interrelated and rarely occur in isolation,^{23,24,41} it is important to simultaneously consider the impact of multiple experiences. As the number of such

experiences increased, the risk of ever attempting suicide, as well as attempted suicide during either childhood/adolescence or adulthood, increased dramatically. Moreover, because adverse childhood experiences were common and strongly associated with attempted suicide, the estimated population attributable fractions were large—ranging from 64% to 80%.

To assess adverse childhood experiences as risk factors for suicide attempts during different life stages, we examined the association between the ACE score and suicide attempts separately for childhood/adolescence and adulthood. The extraordinarily strong and graded association we report between the burden of adverse childhood experiences and the likelihood of childhood/adolescent suicide attempts may be due to the temporal proximity of these experiences to the attempts and a more limited capacity of young people to cope with these stressors. These findings are supported by studies on abused children and adolescents at high risk for suicidal behaviors.^{16,42} The immediacy of the stress and the pain of physical, emotional, or sexual abuse or witnessing domestic violence are experiences not easily escaped by children and adolescents, which may make suicide appear to be the only solution.

In our analysis of suicide attempts during adulthood, we can establish a temporal relationship between the exposure (adverse childhood experiences) and outcome, which is important because some reports suggested that determining the temporal sequence of events makes causal inferences about putative risk factors for suicide difficult.⁴³ Furthermore, the relationship between adverse childhood experiences and suicide attempts among adults demonstrates how these childhood exposures have a long-term impact on the risk for suicide attempt.

Multiple factors reportedly increase the risk of suicide.⁴⁴⁻⁴⁹ Substance abuse has repeatedly been associated with suicidal behaviors, and depression has as well.^{1,50-62} Moreover, previous reports from the ACE Study have demon-

Table 3. Relationship of the Adverse Childhood Experiences (ACE) Score to a Lifetime History of Attempted Suicide With and Without Adjusting for 3 Known Risk Factors for Attempted Suicide*

| ACE Score† | No. (%) | Odds Ratio (95% CI)† | |
|--------------------------|------------|----------------------|------------------|
| | | Individual Models§ | Full Model |
| 0 (n = 6315) | 70 (1.1) | 1.0 | 1.0 |
| 1 (n = 4536) | 101 (2.2) | 1.9 (1.4-2.6) | 1.7 (1.2-2.3) |
| 2 (n = 2740) | 109 (4.0) | 3.3 (2.4-4.5) | 2.5 (1.8-3.4) |
| 3 (n = 1654) | 92 (5.6) | 4.3 (3.1-5.9) | 3.0 (2.2-4.2) |
| 4 (n = 1047) | 88 (8.4) | 6.2 (4.5-8.6) | 3.9 (2.8-5.4) |
| 5 (n = 602) | 83 (13.8) | 10.6 (7.6-14.9) | 6.3 (4.4-8.9) |
| 6 (n = 284) | 62 (21.8) | 16.5 (11.3-24.1) | 9.7 (6.5-14.3) |
| ≥7 (n = 159) | 56 (35.2) | 31.1 (20.6-47.1) | 17.0 (11.0-26.3) |
| Known risk factors | | | |
| Self-reported alcoholism | | | |
| No (16 241) | 524 (3.2) | 1.0 | 1.0 |
| Yes (1096) | 137 (12.5) | 5.0 (4.1-6.2) | 2.6 (2.0-3.2) |
| Depressed affect | | | |
| No (12 411) | 249 (2.0) | 1.0 | 1.0 |
| Yes (4926) | 412 (8.4) | 3.6 (3.1-4.3) | 2.5 (2.1-3.0) |
| Illicit drug use | | | |
| No (14 481) | 393 (2.7) | 1.0 | 1.0 |
| Yes (2856) | 268 (9.4) | 3.0 (2.5-3.6) | 1.7 (1.3-2.0) |
| Total (17 337) | 661 (3.8) | | |

*From waves 1 and 2 combined, N = 17 337. CI indicates confidence interval.

†All odds ratios adjusted for sex, race, education, and age at survey.

‡The trend for increasing risk of attempted suicide at all levels of the ACE score is significant ($P < .001$) for the individual models and full model.

§Odds ratios for ACE score, self-reported alcoholism, depressed affect, and drug use were obtained from separate models.

||Adjusted simultaneously for the ACE score, self-reported alcoholism, depressed affect, and drug use.

Table 4. Relationship of the Adverse Childhood Experiences (ACE) Score to Having Attempted Suicide During Childhood/Adolescence or Adulthood*

| ACE Score† | Child/Adolescent | | Adult | |
|------------------|------------------|---------------------|-----------|---------------------|
| | No. (%)‡ | Odds Ratio (95% CI) | No. (%) | Odds Ratio (95% CI) |
| 0 (3100) | 5 (0.2) | 1.0 | 24 (0.8) | 1.0 |
| 1 (2280) | 6 (0.3) | 1.4 (0.4-4.6) | 40 (1.8) | 2.3 (1.4-3.8) |
| 2 (1358) | 17 (1.3) | 6.3 (2.3-17.3) | 33 (2.4) | 3.1 (1.8-5.2) |
| 3 (n = 821) | 16 (1.9) | 8.5 (3.1-23.5) | 23 (2.8) | 3.4 (1.9-6.0) |
| 4 (n = 521) | 15 (2.9) | 11.9 (4.3-33.3) | 17 (3.3) | 3.8 (2.0-7.1) |
| 5 (n = 313) | 12 (3.8) | 15.7 (5.4-45.3) | 29 (9.3) | 11.2 (6.4-19.8) |
| 6 (n = 149) | 12 (8.1) | 28.9 (9.8-85.1) | 17 (11.4) | 13.2 (6.8-25.7) |
| ≥7 (n = 87) | 12 (13.8) | 50.7 (17.0-151.4) | 20 (23.0) | 29.8 (15.3-57.9) |
| Total (n = 8629) | 95 (1.1) | | 203 (2.4) | |

*Odds ratio adjusted for sex, race, educational level, and age at survey. CI indicates confidence interval.

†The trend for increasing risk of attempted suicide at all levels of the ACE score is significant ($P < .002$) for both groups.

‡From wave 2 only, n = 8629.

strated strong, graded relationships between the number of adverse childhood experiences and the risk of alcohol or illicit substance abuse and depressive disorders.^{23,24,28} Although a temporal relationship between the onset of substance abuse or depressive disorders and lifetime suicide attempts in the ACE Study cohort is uncertain, our analysis of the potential mediating effects of these known risk factors provides evidence that for some persons, adverse childhood experiences play a role in the development of substance abuse or depression. In turn, these problems may partially mediate the relationship between these experiences and suicide attempts.

Our estimates of the ARFs are of an order of magnitude that is rarely observed in epidemiology and public health data. The current analysis suggests that approximately two thirds (67%) of suicide attempts are attributable to the types of abusive or traumatic childhood experiences that we studied. Although preventing, treating, and understanding the effects of adverse childhood experiences is difficult, progress in this area may substantially reduce the burden of suicide attempts.

Information from the neurosciences supports the biological plausibility of our findings. Children who experienced traumatic events are more likely to have problems with emotional and behavioral self-regulation later in life and more likely to mutilate themselves and attempt to commit or commit suicide.¹⁴ Furthermore, the biological processes that occur when children are exposed to stressful events such as recurrent abuse or witnessing domestic violence can disrupt early development of the central nervous system, which may adversely affect brain functioning later in life.⁶³

A potential weakness of studies with retrospective reporting of childhood experiences is that respondents may have difficulty recalling certain events. For example, longitudinal follow-up of adults whose childhood abuse was documented has shown that their retrospective reports of childhood abuse are likely to underestimate actual occurrence.^{64,65}

Difficulty recalling childhood events likely results in misclassification (classifying persons truly exposed to adverse childhood experiences as unexposed) that would bias our results toward the null. Thus, this potential weakness probably resulted in underestimates of the true relationships between these experiences and suicide attempts.⁶⁶ It is also possible that persons who report suicide attempts may have a more negative view of themselves and their past than persons not reporting suicide attempts, thus increasing the likelihood that the former may report a history of adverse childhood experiences. Furthermore, it is possible that other unmeasured or unknown factors could have affected the strength of our estimates (either upward or downward) of association between adverse childhood experiences and suicide attempts.

We did not examine the relationship between childhood exposure to suicidal behaviors among household members and personal suicide attempts because it was impossible to separate genetic vs environmental (experiential) contributions to the risk of suicide attempts. Additionally, the ACE survey could not include subjects who completed suicides, so our results reflect solely suicide attempts.

Our data cannot provide certainty about the temporal relationship between adverse childhood experiences and lifetime or childhood/adolescent suicide attempts, because both the exposure and outcome were reported as occurring when subjects were 18 years or younger. Nonetheless, the powerful association observed between the ACE score and attempted suicide during childhood/adolescence merits serious consideration.

Other population-based studies have found prevalences of attempted suicide similar to those we report. The prevalence of lifetime suicide attempts in the present study was 3.8%, which is within the range reported by Moscicki et al⁶⁷ (1.1%-4.3%) and the National Comorbidity Survey (4.6%).^{67,68} In our cohort, women were 3 times as likely as men to report attempted suicide (5.4%

vs 1.9%), which is consistent with known gender differences in suicide attempts.⁶⁹

The prevalence of childhood exposures we report is nearly identical to that reported in surveys of the general population. We found that 16% of the men and 25% of the women met the case definition for contact sexual abuse; a national telephone survey of adults in 1990 conducted by Finkelhor et al⁷⁰ and using similar criteria estimated that 16% of men and 27% of women had been sexually abused. As for physical abuse, 30% of the men from our study had experienced it as boys, which closely parallels the finding (31%) in a population-based study of Ontario men that used questions from the same scales.⁷¹ The similarity of the estimates from the ACE Study to those of population-based studies suggests that our findings would be applicable in other settings.

In conclusion, we found that adverse childhood experiences dramatically increase the risk of attempting suicide. The unusually high estimates we obtained for the ARFs suggest that such experiences largely influence suicide attempts throughout the life span. Thus, recognition that adverse childhood experiences are common and frequently take place as multiple events may be the first step in preventing their occurrence; identifying and treating persons who have been affected by such experiences may have substantial value in our evolving efforts to prevent suicide.

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