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A Population-Based Longitudinal Study of Risk Factors for Suicide Attempts in Major Depressive Disorder

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Abstract

No longitudinal study has examined risk factors for future suicide attempts in major depressive disorder in a nationally representative sample. The objective of this study was to investigate baseline sociodemographic characteristics, comorbid mental disorders, specific depressive symptoms, and previous suicidal behavior as potential risk factors for suicide attempts at 3 years follow-up. Data came from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), a large nationally representative longitudinal survey of mental illness in adults [Wave 1 (2001–2002); Wave 2 (2004–2005) n=34,653]. Logistic regression examined associations between risk factors present at Wave 1 and suicide attempts at Wave 2 (n=169) among individuals with major depressive disorder at baseline assessment (n=6004). Risk factors for incident suicide attempts at Wave 2 (n=63) were identified among those with major depressive disorder at Wave 1 and no lifetime history of suicide attempts (n=5170). Results revealed specific comorbid anxiety, personality, and substance use disorders to be associated with incident suicide attempts at Wave 2. Comorbid borderline personality disorder was strongly associated with suicide attempts in all models. Several comorbid disorders were strongly associated with suicide attempts at Wave 2 even after adjusting for previous suicidal behavior, notably posttraumatic stress disorder [Adjusted Odds Ratio (AOR) = 2.20; 95% confidence interval (95% CI) 1.27–3.83] and dependent personality disorder (AOR = 4.43; 95% CI 1.93–10.18). These findings suggest that mental illness comorbidity confers an increased risk of future suicide attempts in major depressive disorder that is not solely accounted for by past suicidal behavior.

Keywords

major depressive disorder; suicide attempt; epidemiology; anxiety disorder; personality disorder

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INTRODUCTION

Major depressive disorder (MDD) carries a significant risk of suicidal behavior (Kessler et al., 1999). Epidemiologic studies suggest that 15% of individuals with MDD have attempted suicide at some point in their life (Chen et al., 1996) and rates of 40% have been observed in clinical populations (Malone et al., 1996). Studies of suicide completers reveal that depression is present in approximately 60% of suicide deaths (Lesage et al., 1994; Cavanagh et al., 2003), and that depression is associated with a 20-fold increased risk of suicide (Osby et al., 2001). Studying suicide attempts is an important method to identify those at risk of future completion, since they are more common in the general population and strong risk factors for suicide (Suokas et al., 2001; Suominen et al., 2004). Suicide attempts frequently bring at-risk individuals to the attention of care providers, thus emphasizing their role as intervention points in suicide prevention strategies (Mann et al., 2005).

To date, much information has been gleaned from studies examining correlates of suicide attempts in MDD. Depression severity (Roy, 1993), comorbid personality (Corbitt et al., 1996; Soloff et al., 2000), anxiety (Bolton et al., 2008; Stein et al., 2001), and alcohol use disorders (Bulik et al., 1990; Claassen et al., 2007) have all been associated with an elevated risk of suicide attempt. Longitudinal studies have consistently demonstrated the importance of past suicide attempts (Oquendo et al., 2005; Oquendo et al., 2007; Sokero et al., 2005), cigarette smoking (Oquendo et al., 2005; Oquendo et al., 2007), alcohol use disorders (Maser et al., 2002), and comorbid personality disorder (Hansen et al., 2003; Oquendo et al., 2007) as predictors of future suicide attempts in depressed populations.

While these studies have considerably furthered our understanding of risk factors for suicide attempts in depression, there remain areas requiring further clarification. The vast majority of our knowledge is drawn from clinical samples of depressed individuals. To our knowledge, there have been no longitudinal studies examining predictors of suicidal behavior among individuals with MDD in a nationally representative epidemiologic sample. The existing literature on suicide attempts in depression reveals varying assessments of potential risk factors between studies. A recent review of prospective studies stressed the need to study a more comprehensive range of factors such as anxiety disorders (Oquendo et al., 2006). Many studies have established borderline personality disorder as a risk factor for suicidal behavior (Friedman et al., 1983; Soloff et al., 2000), whereas cluster A and C personality disorders have received less attention. Another important limitation in the existing literature relates to previous suicide attempts. Most studies examining suicide risk factors in MDD have included subjects with histories of suicidal ideation or attempts. While it is important to understand the contribution of previous suicide attempts to the risk of future attempts, it is also of interest to examine risk factors for incident suicide attempts in individuals with no history of suicidal behavior.

In this study we sought to examine an extensive range of correlates as possible risk factors for future suicide attempts among individuals with MDD in the general population. Using the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC; Grant et al., 2004a; Grant et al., 2008), we examined correlates including sociodemographic factors, comorbid Axis I and II mental illnesses, specific depressive symptoms, and past suicidal behavior. Predictors of incident suicide attempts were analyzed among depressed people with no previous history of suicidal behavior. Previous suicide attempts and suicidal ideation were also compared with comorbid psychiatric disorders as independent risk factors for future suicide attempts. The NESARC is a large, nationally representative survey of mental illness in community-dwelling adults. Its comprehensive assessment of Axis I disorders and all ten DSM-IV personality disorders, coupled with its longitudinal design and large sample size provided a unique ability to assess risk factors for subsequent suicide attempts in MDD.

METHOD

Sample

The NESARC is a nationally representative longitudinal survey of the adult non-institutionalized, civilian population of the 50 United States conducted by the United States Census Bureau under the direction of the National Institute on Alcohol Abuse and Alcoholism (NIAAA). Wave 1 was conducted in 2001–2002 with a sample of 43,093 respondents age 18 and over (Grant et al., 2003). Wave 2 was a 3-year prospective follow-up comprising 34,653 of the Wave 1 respondents, representing a response rate of 86.7% of eligible respondents (Grant et al., 2005). In combination with the Wave 1 response rate of 81%, the cumulative response rate for Wave 2 is 70.2%. Trained lay interviewers conducted face-to-face assessments using computer-assisted software. Informed consent was obtained from all participants before beginning the interviews. Interviewers retested a random sample of both the Wave 1 and Wave 2 samples in order to assess the reliability of the survey (Grant et al., 2003; Grant et al., 2005). Detailed descriptions of methodology, sampling, and weighting procedures can be found elsewhere (Grant et al., 2003; Ruan et al., 2008).

Measures

Suicide Ideation and Attempts—In the Wave 1 NESARC, suicidal ideation and suicide attempts were assessed only among Wave 1 respondents who endorsed one of the following two MDD symptoms: “In your entire life, have you ever had a time, lasting at least 2 weeks, when you felt sad, blue, depressed, or down most of the time for at least 2 weeks?” or “In your entire life, have you ever had a time, lasting at least 2 weeks, when you didn’t care about the things that you usually cared about, or when you didn’t enjoy the things you usually enjoyed?” In order to assess suicide ideation and attempts, respondents were then asked whether they thought about committing suicide or attempted suicide, respectively, during that time when their mood was at its lowest or they enjoyed or cared the least about things. The exact question assessing suicide attempts was, “During that time when (your mood was at it’s lowest/you enjoyed or cared the least about things), did you attempt suicide?” The exact question assessing suicidal ideation was, “During that time when (your mood was at it’s lowest/you enjoyed or cared the least about things), did you think about committing suicide?”

Suicide attempts that occurred between the Wave 1 and 2 interviews were assessed at Wave 2 among individuals who endorsed depressed mood or anhedonia symptoms of MDD, and also in the general survey among all respondents. Therefore not all suicide attempts at Wave 2 necessarily occurred in the context of a major depressive episode. The exact question assessing suicide attempts was, “During the time since your LAST interview when (your mood was at it’s lowest/you enjoyed or cared the least about things), did you attempt suicide?” The exact question assessing suicidal ideation was, “During the time since your LAST interview when (your mood was at it’s lowest/you enjoyed or cared the least about things), did you think about committing suicide?” The question in the general survey assessing suicide attempts was, “In your ENTIRE life did you EVER attempt suicide?”

Sociodemographic Factors—Sociodemographic factors of sex, race/ethnicity, age, marital status, education, income, urbanicity and region of residence assessed at Wave 1 were examined as predictors of suicide attempts in the current study. Sex and urbanicity (urban vs. rural) were dichotomous variables while all other sociodemographic factors were categorical (See Table 1 for categories).

Psychiatric Disorders—Axis I and II psychiatric disorders were assessed at Waves 1 and 2 according to the *Diagnostic and Statistical Manual of Mental Disorders 4th Edition* (DSM-IV; American Psychiatric Association, 2000) criteria using the Alcohol Use Disorders and

Associated Disabilities Interview (AUDADIS-IV; Grant et al., 2001). This is a fully-structured diagnostic interview that is appropriate for use by trained lay interviewers. At Wave 1, Axis I disorders of major depression, dysthymia, mania, hypomania, panic disorder with or without agoraphobia, agoraphobia without panic disorder, social phobia, specific phobia, generalized anxiety disorder, alcohol abuse and dependence, and drug abuse and dependence were assessed. All Axis II diagnoses, excluding schizotypal, narcissistic and borderline personality disorders, were also assessed at Wave 1. The Wave 2 interview assessed all Axis I diagnoses included in Wave 1 and additionally assessed posttraumatic stress disorder (PTSD). The Wave 2 interview did not reassess the seven personality disorders assessed in Wave 1, but rather assessed the personality disorders excluded from the Wave 1 interview. Fair to excellent test-retest and inter-rater reliability have been demonstrated for diagnoses generated in both Waves 1 and 2 (Grant et al., 2003; Ruan et al., 2008). The validity of drug and alcohol diagnoses have been well-documented (Canino et al., 1999; Hasin et al., 1997) and validity of mood, anxiety and personality diagnoses assessed by the AUDADIS-IV has also been established statistically, using the NESARC data (Grant et al., 2004a; Grant et al., 2004b; Grant et al., 2004c).

For the purposes of the current study all diagnoses were lifetime and occurred previous to the Wave 1 interview. The three personality disorders assessed at Wave 2 were assumed to fit this time frame since personality disorder symptoms, by definition, begin before the age of 18. PTSD with onset after Wave 1 was excluded from the analyses.

Symptoms of Major Depressive Disorder—Seventeen depressive symptoms were assessed in the Wave 1 interview in order to generate a DSM-IV diagnosis of MDD. Many of the DSM-IV major depressive episode A-criteria are composed of more than one of these symptoms, but they were kept separate in analyses in order to present a more accurate characterization of relationships between depressive symptoms and suicide attempts. Depressive symptoms were also combined into a variable reflecting the number of depressive symptoms endorsed, as a proxy measure of depression severity.

Analytic Strategy

Two parallel sets of analyses were conducted in this study (Figure 1). The first examined associations between the above-mentioned correlates and incident suicide attempts during the 3-year follow-up period (Figure 1a). The second examined correlates of all suicide attempts (incident and recurrent) during the same period (Figure 1b). All analyses were conducted in the SUDAAN program (Shah et al., 1995) using Taylor Series Linearization, a variance estimation procedure that accounts for the complex survey methodology employed in the NESARC. Statistical weights and stratification variables are available specifically for this purpose.

1. Incident Suicide Attempts at Wave 2—Incident suicide attempts were defined as suicide attempts occurring in the 3-year period between Wave 1 and Wave 2, only among the sub-sample of respondents with a lifetime diagnosis of MDD at Wave 1 who had not made a lifetime suicide attempt prior to Wave 1 (n=5261). By excluding individuals with MDD who had made a suicide attempt prior to Wave 1, only new (or incident) suicide attempts were captured. In this part of the analysis, the risk group consisted of people with an incident suicide attempt (n=63). They were compared to the reference group consisting of the remainder of the depressed persons who had never made a suicide attempt at any point in their lives (n=5170).

The incidence rate of suicide attempts over the 3 years between Waves 1 and 2 is reported as percentage of the at-risk group (i.e., individuals with major depression at Wave 1 without suicide attempts) and per 100 person-years. These incidence rates were calculated in an identical manner as previous studies with the prospective NESARC data (Grant et al., 2008).

Specifically, the incidence rate is expressed as a percentage $(I/T) \times 100$ where I is the weighted number of individuals with a first onset of suicide attempt and T is the population at risk (weighted n), or all individuals without a previous suicide attempt. Incidence rates per 100 person-years are calculated using the equation $(I/(T - (1.5)I)) \times 100$, which takes into account the population's total period of exposure. The period of exposure is estimated at 1.5 years (the midpoint of the 3 year follow-up) as the assumption is typically made that the average point when a new case emerges lies halfway through the exposure period (Grant et al., 2008; Shah et al., 1995).

Predictors of incident suicide attempts at Wave 2 included sociodemographic factors, depressive features and lifetime psychiatric disorders occurring before the Wave 1 interview. Predictors were examined in cross-tabulations with the dependent variables and multiple logistic regression models. Sociodemographic factors were first examined in bivariate logistic regression models. Each psychiatric disorder and depressive feature was then examined in a regression model adjusting for sociodemographic factors significantly associated with incident suicide attempts. Each psychiatric disorder was also examined in regression models adjusting for sociodemographic factors and depressive features significantly associated with incident suicide attempts. A final regression model was examined wherein all sociodemographic factors, depressive symptoms and psychiatric diagnoses that were significant in previous models were entered simultaneously to predict incident suicide attempts.

Positive predictive values (PPVs) were calculated for each psychiatric diagnosis, depressive symptom and previous suicidal behavior. The PPV represents the probability that an individual will make a suicide attempt given the presence of one of these variables and is used to evaluate the effectiveness of each variable in predicting suicide attempts. The formula used for these calculations is based on the following:

$$\text{Positive Predictive Value} = a/(a+b) = \text{true positive} / (\text{true positive} + \text{false positive})$$

The way that the formula was utilized in our calculations is the following:

$$\text{Positive Predictive Value} = X + SA / [(X + SA) + (X + \text{no SA})]$$

wherein X refers to the presence of a specific variable and SA refers to a suicide attempt.

2. All Suicide Attempts at Wave 2—This part of the analysis examined risk factors for all suicide attempts (both incident and recurrent) during the 3-year period between Wave 1 and Wave 2. Because this analysis did not focus solely on incident suicide attempts, all individuals with a lifetime diagnosis of MDD at Wave 1 were included (n=6004). The risk group in this part of the study consisted of all people who had made a suicide attempt during the 3-year follow-up period (n=169). The reference group consisted of all individuals with lifetime MDD at Wave 1 who did not attempt suicide during the follow-up period (n=5803).

Predictors of all suicide attempts included sociodemographic factors, depressive features (including a history of suicide ideation or suicide attempts) and lifetime psychiatric disorders occurring before the Wave 1 interview. Predictors were examined in cross-tabulations with the dependent variables and multiple logistic regression models. The same pattern of regression models as described in the analyses of incident suicide attempts was employed to examine all suicide attempts.

RESULTS

Demographic characteristics of the sample as well as the incidence of suicide attempts at Wave 2 and the prevalence of suicide attempts at Wave 2 are presented in Table 1. The incidence of a suicide attempt among individuals with major depression was 1.2% for the 3-year period between interviews (1.3 per 100 person-years). The prevalence of suicide attempts in the follow-up period was 2.7%.

1. Incident Suicide Attempts at Wave 2

The only significant sociodemographic predictor of an incident suicide attempt was age (results not shown in tables but available upon request). Respondents age 45 and over were significantly less likely than those age 18–29 to have made an incident suicide attempt between Waves 1 and 2 (OR = 0.30, 95% CI = 0.10–0.87).

After adjusting for age, no depressive symptoms were significantly associated with incident suicide attempts. PPVs for depressive symptoms ranged from 0.8% to 1.5%, with the highest PPV associated with feeling worthless and excessive guilt (results not shown in tables but available upon request).

Psychiatric correlates of incident suicide attempts are presented in Table 2. Among anxiety disorders, panic disorder, specific phobia, posttraumatic stress disorder and any anxiety disorder were significantly associated with incident suicide attempts after adjusting for age. Paranoid, avoidant, borderline, schizotypal and any personality disorder were also predictive of an incident suicide attempt after adjusting for age. Finally, any drug use disorder, any alcohol use disorder, nicotine dependence and any substance use disorder were all significant predictors of an incident suicide attempt between Waves 1 and 2 after adjusting for age. PPVs for psychiatric correlates ranged from 1.3% to 5.0%.

In the final model predicting incident suicide attempts, age, any anxiety disorder, any personality disorder and any substance use disorder were entered simultaneously (Table 3). These psychiatric disorder categories were entered instead of each disorder separately due to sample size concerns. In this model, any personality disorder and any substance use disorder were the only variables that remained significant predictors of incident suicide attempts.

2. All Suicide Attempts at Wave 2

Age, marital status and income emerged as significant predictors of suicide attempts during the follow-up period (results not shown in tables but available upon request). Respondents age 45 and over were significantly less likely than those age 18–29 to have made a suicide attempt between Waves 1 and 2 (OR = 0.30, 95% CI = 0.17–0.53). Respondents who were never married were significantly more likely than respondents who were married or common-law to have made a suicide attempt between Waves 1 and 2 (OR = 1.81, 95% CI = 1.08–3.03). Respondents in all three higher income categories were significantly less likely to have made a suicide attempt between Waves 1 and 2 compared to those in the lowest income category.

Specific features of MDD were associated with suicide attempts occurring between Wave 1 and 2 (results not shown in tables). After adjusting for significant sociodemographic factors (age, marital status, and income), the strongest associations were observed with Wave 1 lifetime suicidal ideation (AOR = 6.04, 95% CI = 3.63–10.05) and a Wave 1 lifetime suicide attempt (AOR = 11.28, 95% CI = 7.19–17.70). Depressive symptoms of anhedonia, feeling worthless and excessive guilt as well as the number of depressive symptoms endorsed were also significantly associated with all suicide attempts at Wave 2 in the adjusted model. PPV's for depressive symptoms were in the range of 2.7% to 3.7%, with feeling worthless having the

highest PPV. PPV's for suicidal behaviors were slightly higher (5.5% for suicidal ideation and 14.1% for suicide attempts).

After adjusting for sociodemographic factors as well as depressive features, many psychiatric disorders remained significantly associated with all suicide attempts during the follow-up period (Table 4). Panic disorder, generalized anxiety disorder, posttraumatic stress disorder and any anxiety disorder were significantly associated with all suicide attempts at Wave 2. Dependent, paranoid, schizoid, avoidant, borderline, schizotypal and any personality disorder were also significantly associated with all suicide attempts. Finally, any drug use disorder, nicotine dependence and any substance disorder were also significantly associated with all suicide attempts during the 3-year follow-up period.

In the final model predicting all suicide attempts at Wave 2, age, marital status, income, anhedonia, feeling worthless, excessive guilt, Wave 1 lifetime suicidal ideation, a Wave 1 lifetime suicide attempt, number of depressive symptoms, any anxiety disorder, any personality disorder and any substance use disorder were entered simultaneously (Table 5). In this model, age, income, Wave 1 lifetime suicide attempt, any anxiety disorder, any personality disorder and any substance disorder remained significant predictors of future suicide attempts.

DISCUSSION

For the first time, a longitudinal nationally representative sample was used to examine risk factors for suicide attempts among individuals with MDD. This study was able to explore a more comprehensive range of mental disorders and depressive symptoms than has been previously possible in large epidemiologic samples. It extends our understanding of the spectrum of suicidal behavior by examining correlates of incident suicide attempts among people who have never attempted suicide. This study also confers important information regarding the independent risk associated with mental illness comorbidity when compared to previous suicidal behavior and other features specific to MDD. It overcomes limitations inherent in clinical studies and thus provides new insight into risk factors for suicidal behavior in depressed people who have not necessarily presented to treatment providers. These advantages provide a novel context that increases the importance of the findings from this study and in so doing extends our knowledge on risk factors for suicidal behavior in MDD.

Panic disorder comorbidity in MDD increases the odds of incident suicide attempts threefold when compared to MDD without panic disorder. Previous studies have yielded contradictory results as to the role of panic disorder in suicidal behavior when comorbid with MDD (Bolton et al., 2008a; Placidi et al., 2000). One study found panic disorder to be protective against more lethal suicide attempts (Nakagawa et al., 2009). The current study is the first longitudinal study of depressed individuals to demonstrate an association between panic disorder and future suicide attempts. Posttraumatic stress disorder was also strongly associated with a risk of new-onset suicide attempts. This finding corroborates previous studies demonstrating heightened risk of suicide attempts when PTSD is comorbid with MDD (Oquendo et al., 2003; Oquendo et al., 2005). Although longitudinal epidemiologic studies have found that anxiety disorders independently increase the risk of incident suicide attempts (Boden et al., 2007; Bolton et al., 2008b; Sareen et al., 2005b), longitudinal studies of suicidal behavior specific to depressed cohorts have not identified anxiety disorder comorbidity as a predictor of suicidal behavior (Oquendo et al., 2006). These discrepant findings may be due to methodological differences in study design, including sampling and assessment of comorbidity. Our findings emphasize the role of anxiety disorders in suicidal behavior, and should alert care providers to the presence of panic disorder and PTSD as potential risk factors for future suicidal behavior in individuals presenting with MDD.

The risk of new-onset suicide attempts in MDD is also heightened by personality disorder and substance use disorder comorbidity. Borderline personality disorder increased the odds of incident suicide attempts by a factor of seven. Borderline personality disorder is a well-recognized risk factor for suicidal behavior both independently and when comorbid with MDD (Soloff et al., 2000; Yen et al., 2003). The current results extend these previous findings to a general population sample. The NESARC also allowed an investigation of suicidal behavior in the less-studied Cluster A and C personality disorders, with intriguing results. Baseline avoidant, paranoid, and schizotypal personality disorders comorbid with MDD were all associated with higher rates of suicide attempts at follow-up. This is consistent with our previous cross-sectional analysis of personality disorder comorbidity in MDD, which revealed that avoidant and paranoid personality disorders, among others, were associated with a lifetime history of suicide attempts (Bolton et al., 2008a). All substance use disorders were significantly associated with incident suicide attempts, with nicotine dependence having the strongest association. Longitudinal studies have demonstrated cigarette smoking to be associated with the development of depression (Fergusson et al., 2003), and among depressed people it has emerged as an important independent predictor of future suicidal acts (Oquendo et al., 2004). This mechanism may be partially explained by aggression and impulsivity.

Depressed smokers have higher rates of aggressive and impulsive personality traits (Angst et al., 1998), and these same traits have been identified as risk factors for suicide attempts (Mann et al., 1999). Our finding of an elevated risk of incident suicide attempts in alcohol use disorders is also consistent with previous studies (Maser et al., 2002; Sokero et al., 2003). The disinhibition effect of alcohol and drugs likely contributes to the heightened risk of suicidality associated with these disorders. Clinicians should be aware that comorbid alcohol or drug disorders and nicotine dependence are worrisome signs suggestive of future suicidal acts.

Many interesting findings emerged from analyses examining the entire cohort of people with MDD at Wave 1. As expected, a history of past suicidal ideation and previous suicide attempts at baseline assessment were strong risk factors for suicide attempts within three years follow-up. Previous suicide attempts are one of the most consistently identified risk factors for future suicide attempts in depression (Harrington et al., 1990; Oquendo et al., 2004; Sokero et al., 2005). The effect of previous suicide attempts is strong and often renders associations with other risk factors nonsignificant (Sokero et al., 2005). Surprisingly, after adjusting for the effects of past suicidal ideation, previous suicide attempts, and significant depressive symptoms, many comorbid Axis I and II disorders remained significantly associated with a higher likelihood of suicide attempts at follow-up. Panic disorder, generalized anxiety disorder, and PTSD were anxiety disorders positively correlated with new-onset suicide attempts. Several personality disorders, nicotine dependence, and drug use disorders were also associated with future suicide attempts. Some disorders, such as antisocial personality disorder, fell from significance after controlling for a history of suicide attempts, indicating that the latter may account for a significant portion of the variance in the relationship with suicidal behavior and mental disorders. A multivariable regression model of significant correlates revealed past suicide attempts, anxiety, personality, and substance use disorders to be independently associated with subsequent suicide attempts, whereas higher income and age over 45 were protective. Therefore, while past attempts remain a strong predictor of repeat suicide attempts, comorbid mental illnesses should alert clinicians as independent risk factors.

While there are many correlates significantly associated with suicidal behavior, it is important to consider the predictive ability of these factors. The PPV for many of the associations were low. Most disorders carried a PPV of less than 10%, indicating that individual comorbid disorders have low specificity in predicting future suicide attempts within 3 years. Even a history of suicide attempt, although strongly associated with subsequent suicide attempts in regression models, predicted a future attempt at a rate of only 14%. These PPV findings

emphasize the difficulty in accurately identifying people who will later engage in suicidal behavior, despite growing knowledge of correlates that make up the profile of suicidal individuals. It is likely that multiple comorbid disorders would result in higher PPV values; future studies examining specific combinations of risk factors could produce a refined risk assessment for a person's total burden of mental illness.

The results of this study need to be interpreted in the context of specific limitations. The first pertains to the assessment of suicidal behavior. We were unable to assess the severity or intended lethality of suicide attempts, and could not address indirect severity markers such as health service contacts related to suicide attempts. Highly lethal suicide attempts may differentiate individuals that are closer in profile to suicide completers than their counterparts who choose less lethal means (Linehan, 1986; Mann, 2002). It would be important in future studies to determine whether the subgroup of individuals with MDD with more lethal suicide attempts had a different pattern of correlates when compared to those with less severe suicide attempts. Another limitation of this study was the inability to examine correlates of completed suicide, since information on completed suicide is not available in the NESARC survey. Our study was limited to an examination of non-fatal suicidal behavior, and as a result the potential risk factors identified in our study may not apply to completed suicide. Some evidence suggests that suicide attempters and suicide completers are different populations (Beautrais, 2001) whereas other studies implicate suicide attempts as important risk factors in the trajectory to suicide (Harris et al., 1997; Suominen et al., 2004). Future prospective studies including suicide completers are necessary to elucidate specific risk factors for completion as well as to understand the relationship between suicide attempts and suicide. Specific elements of MDD were not examined as factors influencing the risk of suicide attempts, such as the chronicity or recurrence of depressive episodes. It would also be of interest to further examine the role of suicidal ideation in future suicidal behavior given recent findings showing that suicidal ideation influences the relationship between mental disorders and future suicidal behavior (Borges et al., 2008). Another limitation of the current study is that we did not differentiate people who made multiple suicide attempts from those who attempted only once. Lastly, it is possible that the wording of the specific questions asking about suicidal behavior may have been misinterpreted by respondents, resulting in inaccurate prevalence rates of suicide attempts.

A further limitation potentially influencing our findings is the lack of assessment of other known risk factors for suicide attempts. We were unable to assess personality traits such as impulsivity and aggression which have been shown to be important factors in suicide attempts (Oquendo et al., 2004) and completion (Dumais et al., 2005). Hopelessness is a worrisome cognition that has been implicated in future suicide attempts (Malone et al., 2000), but was not assessed specifically in this survey. Furthermore, we could not assess the temporal relationship between correlates and suicide attempts at a greater level of detail than the two assessment points 3 years apart. Therefore the individual's mental state at time of attempt could not be determined. This prospective design identified correlates of MDD that increase future risk of suicide attempt, but it does not permit an examination of more proximal factors that lead a person to attempt suicide. Psychological autopsy studies are better suited to capture this level of detail and have shown, for example, that specific stressors and a lack of mental health resource coordination are temporally associated with suicide (Lesage et al., 2008; Seguin et al., 2006). Despite these specific limitations, the NESARC's longitudinal design and more comprehensive assessment of mental disorders compared to other large mental health surveys allow it to overcome many of the limitations in previous studies addressing risk factors at the population level. The complete assessment of all 10 personality disorders in particular is a major advancement in epidemiologic studies of suicidal behavior, and strengthens the findings of this study.

In summary, this study identifies specific anxiety, personality, and substance use disorders as risk factors for future suicide attempts in MDD. It furthers our understanding by examining depressed individuals with no prior suicidal behavior, a population understudied to date. By examining a nationally representative sample, it overcomes biases inherent in clinical studies and extends findings to a population level. The findings from this study along with its methodological advantages will likely contribute to the ongoing development of suicide prevention strategies. Future large-scale prospective studies including completed suicide as an outcome are necessary to enhance the predictive ability of risk factors in this challenging area of study.

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Figure 1a. Flowchart depicting the sample, risk and reference groups used in the analysis examining incident suicide attempts at Wave 2. Note: MDD = major depressive disorder.

Figure 1b. Flowchart depicting the sample, risk and reference groups used in the analysis examining incident and recurrent suicide attempts at Wave 2. Note: MDD = major depressive disorder.

Figure 1.
Analytic models

Table 1

Demographic Characteristics of the Sample

Characteristics	Wave I Lifetime MDD (N=6004) N ^a	Prevalence % (95% CI) ^a
Sex		
Male	1798	34.3 (32.8–35.8)
Female	4206	65.7 (64.2–67.2)
Race/ethnicity		
White	3983	77.7 (75.2–80.0)
Hispanic/Latino	946	8.6 (6.9–10.6)
Other	1075	13.8 (12.4–15.3)
Age		
18–29	1257	23.1 (21.6–24.7)
30–44	2073	33.7 (32.2–35.2)
45+	2674	43.2 (41.6–44.9)
Marital Status		
Married/Common-law	2706	55.8 (54.2–57.4)
Widowed/Separated/Divorced	1914	23.2 (21.9–24.5)
Never Married	1384	21.0 (19.7–22.4)
Education		
Less than high school	889	13.7 (12.5–15.0)
High school graduate	1605	26.7 (25.2–28.4)
Some college or higher	3510	59.6 (57.8–61.4)
Income		
\$0–\$19,999	1664	21.8 (20.3–23.4)
\$20,000–\$34,999	1302	20.3 (18.9–21.7)
\$35,000–\$59,999	1515	25.8 (24.3–27.4)
\$60,000 or greater	1523	32.2 (30.1–34.3)
Urbanicity		
Urban	2010	28.3 (25.0–31.8)
Rural	3994	71.7 (68.2–75.0)
Region		
Northeast	1076	17.8 (12.9–24.2)
Midwest	1441	25.2 (19.7–31.5)
South	2029	32.7 (27.4–38.5)
West	1458	24.3 (18.5–31.2)
Since Wave I Incident Suicide Attempt	63	1.2 (0.9–1.7) ^b
Since Wave I Suicide Attempt	169	2.7 (2.2–3.3) ^c

^a Ns are unweighted values; percentages are weighted values.

^b 3-year incidence of suicide attempts assessed at Wave 2 among people with MDD at Wave 1 without a history of previous suicide attempt.

^c 3-year prevalence of suicide attempts assessed at Wave 2 among all people with MDD at Wave 1

*
p < .05,

**
p < .01,

***
p < .001.

Table 2

Mental Disorder Correlates of Incident Suicide Attempts in Major Depressive Disorder^a

Lifetime Psychiatric Disorders at Wave 1 (N)	No Suicide Attempt ^b (N=5170) N (%) ^d	Suicide Attempt ^c (N=63) N (%) ^d	AOR ^e (95% CI)	Positive Predictive Value ^f % (95% CI)
Anxiety disorders				
Panic disorder (N=761)	744 (14.4)	17 (32.6)	3.01 (1.39–6.50) **	2.8 (1.4–5.4)
Agoraphobia (N=26)	25 (0.6)	1 (1.1)	---	---
Social phobia (N=712)	699 (14.4)	13 (20.8)	1.51 (0.63–3.61)	1.8 (0.8–3.8)
Specific phobia (N=1048)	1032 (20.7)	16 (38.2)	2.29 (1.01–5.23) *	2.3 (1.2–4.3)
Generalized anxiety disorder (N=832)	818 (16.6)	14 (25.3)	1.85 (0.77–4.47)	1.9 (0.9–3.8)
Posttraumatic stress disorder (N=682)	663 (13.0)	19 (28.7)	2.86 (1.32–6.23) **	2.3 (1.2–4.1)
Any anxiety disorder (N=2494)	2450 (50.0)	44 (72.8)	2.76 (1.29–5.91) **	1.8 (1.2–2.7)
Personality disorders				
Antisocial (N=343)	331 (7.2)	12 (11.8)	1.44 (0.61–3.42)	2.0 (0.9–4.5)
Dependent (N=48)	46 (0.8)	2 (7.0)	---	---
Obsessive-compulsive (N=934)	917 (18.8)	17 (19.9)	1.03 (0.41–2.58)	1.3 (0.6–3.0)
Paranoid (N=666)	643 (12.0)	23 (27.4)	2.44 (1.21–4.94) *	2.8 (1.6–4.8)
Schizoid (N=428)	419 (7.8)	9 (14.4)	1.91 (0.62–5.84)	2.3 (0.8–6.2)
Histrionic (N=247)	241 (4.4)	6 (8.3)	1.57 (0.42–5.90)	2.3 (0.7–8.0)
Avoidant (N=383)	369 (7.2)	14 (22.0)	3.32 (1.53–7.18) **	3.7 (1.9–7.0)
Narcissistic (N=552)	540 (9.1)	12 (10.5)	1.04 (0.46–2.34)	1.4 (0.7–2.9)
Borderline (N=704)	670 (12.6)	34 (53.4)	7.23 (3.69–14.17) ***	5.0 (3.3–7.7)
Schizotypal (N=431)	418 (7.8)	13 (22.0)	3.11 (1.35–7.18) **	3.4 (1.6–7.1)
Any personality disorder (N=2190)	2142 (41.5)	48 (71.3)	3.12 (1.46–6.69) **	2.1 (1.4–3.1)
Substance use disorders				
Any drug use disorder (N=937)	915 (18.7)	22 (41.0)	2.57 (1.21–5.47) *	2.7 (1.6–4.5)
Any alcohol use disorder (N=2139)	2103 (42.5)	36 (66.8)	2.57 (1.36–4.86) **	1.9 (1.2–3.0)
Nicotine dependence (N=1516)	1481 (30.5)	35 (59.5)	3.17 (1.69–5.95) ***	2.4 (1.6–3.5)
Any substance use disorder (N=2778)	2730 (55.0)	48 (83.6)	3.85 (1.87–7.90) ***	1.9 (1.3–2.7)

^a Among people with lifetime major depression assessed at Wave 1 with no history of suicide attempt (N=5261)

^b Reference group is individuals without a suicide attempt between Wave 1 and Wave 2. Individuals with suicidal ideation at Wave 1 were excluded from this group.

^c Risk group is individuals with a suicide attempt between Wave 1 and Wave 2

^d Ns are unweighted values; percentages are weighted values

^e AOR: Adjusted Odds Ratio: adjusted for age.

^f Positive predictive values are based on weighted N's. Note: boldface type indicates significance;

* p < .05,

** p < .01,

*** p < .001

^g Dashed lines signify statistics not presented due to cell sizes less than 5.

Table 3 Final Model of Incident Suicide Attempts In Major Depressive Disorder^a

	Incident Suicide Attempts (N=63) AOR ^b (95% CI)
Sociodemographics	
Age	
18–29	1.00
30–44	0.71 (0.32–1.57)
45+	0.35 (0.12–1.01)
Comorbid Psychiatric Disorders	
Any Anxiety Disorder	2.25 (0.95–4.64)
Any Personality Disorder	2.44 (1.04–5.71) *
Any Substance Use Disorder	4.10 (1.82–9.23) ***

^a Among people with lifetime major depression assessed at Wave 1 with no history of suicide attempt (N=5261)^b AOR: Adjusted Odds Ratio: all variables in table were entered simultaneously*
p < .05,**
p < .01,***
p < .001;

Note: boldface type indicates significance.

Table 4

Mental Disorder Correlates of All Suicide Attempts in Major Depressive Disorder^a

Lifetime Psychiatric Disorders at Wave 1 (N)	No Suicide Attempt ^b (N=5803) N (%) ^d	Suicide Attempt ^c (N=169) N (%) ^d	AOR ^e (95% CI)	AOR-2 ^f (95% CI)	Positive Predictive Values ^g % (95% CI)
Anxiety disorders					
Panic disorder (N=982)	919 (15.8)	63 (39.1)	3.25 (2.12–4.98) ***	1.91 (1.14–3.21) *	6.4 (4.6–8.9)
Agoraphobia (N=29)	28 (0.6)	1 (0.5)	---	---	---
Social phobia (N=867)	824 (15.1)	43 (27.8)	1.96 (1.21–3.19) **	1.41 (0.86–2.33)	4.9 (3.2–7.3)
Specific phobia (N=1272)	1218 (21.8)	54 (40.0)	2.24 (1.37–3.66) **	1.58 (0.91–2.73)	4.9 (3.3–7.0)
Generalized anxiety disorder (N=1019)	965 (17.2)	54 (35.5)	2.78 (1.76–4.38) ***	1.96 (1.17–3.26) *	5.4 (3.8–7.6)
Posttraumatic stress disorder (N=851)	800 (14.1)	51 (33.1)	3.09 (1.92–4.98) ***	2.20 (1.27–3.83) **	5.5 (3.8–7.8)
Any anxiety disorder (N=2971)	2846 (51.5)	125 (80.6)	3.82 (2.21–6.60) ***	3.05 (1.63–5.72) ***	4.1 (3.2–5.2)
Personality disorders					
Antisocial (N=486)	444 (8.6)	42 (21.3)	2.17 (1.34–3.52) **	1.05 (0.61–1.80)	6.5 (4.4–9.5)
Dependent (N=99)	81 (1.4)	18 (15.8)	9.87 (5.17–18.85) ***	4.43 (1.93–10.18) ***	24.6 (15.0–37.7)
Obsessive-compulsive (N=1132)	1080 (19.7)	52 (30.1)	1.64 (0.97–2.77)	1.13 (0.63–2.01)	4.1 (2.6–6.3)
Paranoid (N=887)	816 (13.3)	71 (39.5)	3.31 (2.10–5.21) ***	2.13 (1.29–3.51) **	7.7 (5.6–10.4)
Schizoid (N=569)	527 (8.6)	42 (31.1)	4.10 (2.53–6.63) ***	2.22 (1.31–3.76) **	9.1 (6.1–13.4)
Histrionic (N=341)	315 (5.2)	26 (18.1)	2.93 (1.62–5.29) ***	1.43 (0.77–2.64)	8.8 (5.4–14.1)
Avoidant (N=537)	485 (8.3)	52 (32.6)	4.27 (2.72–6.70) ***	2.46 (1.47–4.12) ***	9.8 (6.9–13.7)
Narcissistic (N=679)	639 (9.7)	40 (16.7)	1.48 (0.89–2.44)	1.16 (0.67–2.01)	4.6 (3.0–6.9)
Borderline (N=999)	888 (14.7)	111 (67.8)	10.27 (6.65–15.86) ***	6.61 (4.07–10.72) ***	11.4 (9.1–14.3)
Schizotypal (N=595)	535 (8.7)	60 (36.5)	4.91 (3.01–8.00) ***	3.12 (1.85–5.26) ***	10.5 (7.2–14.9)
Any personality disorder (N=2714)	2569 (44.2)	145 (85.5)	6.25 (3.35–11.67) ***	4.00 (1.95–8.22) ***	5.1 (4.1–6.4)
Substance use disorders					
Any drug use disorder (N=1178)	1110 (20.3)	68 (44.3)	2.59 (1.66–4.06) ***	1.69 (1.05–2.71) *	5.7 (4.3–7.6)
Any alcohol use disorder (N=2516)	2419 (43.6)	97 (58.2)	1.80 (1.19–2.72) **	1.43 (0.92–2.21)	3.6 (2.8–4.7)
Nicotine dependence (N=1827)	1733 (31.9)	94 (54.6)	2.36 (1.58–3.52) ***	1.80 (1.18–2.75) **	4.6 (3.5–5.9)

Lifetime Psychiatric Disorders at Wave 1 (N)	No Suicide Attempt ^b (N=5803) N (%) ^d	Suicide Attempt ^c (N=169) (%) ^d	AOR ^e (95% CI)	AOR-2 ^f (95% CI)	Positive Predictive Values ^g % (95% CI)
Any substance use disorder (N=3261)	3131 (56.2)	130 (80.0)	2.99 (1.88–4.74) ***	2.51 (1.56–4.04) ***	3.8 (3.1–4.7)

^a Among people with lifetime major depression assessed at Wave 1 (N=6004)

^b Reference group is individuals without a suicide attempt between Wave 1 and Wave 2.

^c Risk group is individuals with a suicide attempt between Wave 1 and Wave 2

^d Ns are unweighted values; percentages are weighted values

^e AOR: Adjusted Odds Ratio: adjusted for age, marital status, and income.

^f AOR-2: Adjusted Odds Ratio: adjusted for age, marital status, income and depression features significantly related to a suicide attempt between Wave 1 and Wave 2 after adjusting for sociodemographics (Anhedonia, Feeling worthless, Excessive Guilt, Wave I Lifetime suicidal ideation, Wave I Lifetime suicide attempt, and Number of depressive symptoms).

^g Positive predictive values are based on weighted N's; Note: boldface type indicates significance;

* p < .05,

** p < .01,

*** p < .001

^h Dashed lines signify statistics not presented due to cell sizes less than 5.

Table 5 Final Model of All Suicide Attempts In Major Depressive Disorder^a

All Suicide Attempts (N=169) AOR ^b (95% CI)	
Sociodemographics	
Age	
18–29	1.00
30–44	1.12 (0.64–1.96)
45+	0.49 (0.26–0.96)*
Marital Status	
Married/Common-law	1.00
Widowed/Separated/Divorced	0.76 (0.40–1.46)
Never Married	0.97 (0.51–1.84)
Income	
\$0–\$19,999	1.00
\$20,000–\$34,999	0.51 (0.27–0.98)*
\$35,000–\$59,999	0.54 (0.24–1.19)
\$60,000 or greater	0.44 (0.20–0.99)*
Depression Features	
Anhedonia	1.60 (0.56–4.57)
Feeling Worthless	1.40 (0.64–3.04)
Excessive Guilt	1.53 (0.84–2.77)
Wave I Lifetime Suicidal Ideation	1.57 (0.81–3.08)
Wave I Lifetime Suicide Attempt	5.57 (3.16–10.17)***
Number of depressive symptoms	0.96 (0.87–1.05)
Comorbid Psychiatric Disorders	
Any Anxiety Disorder	2.31 (1.19–4.47)*
Any Personality Disorder	3.23 (1.47–7.10)**
Any Substance Use Disorder	2.26 (1.32–3.85)**

^a Among people with lifetime major depression assessed at Wave 1 (N=6004)^b AOR: Adjusted Odds Ratio: all variables in table were entered simultaneously*
p < .05,**
p < .01,***
p < .001;

Note: boldface type indicates significance.