S UICIDE ATTEMPTS are among the most serious complication of mood disorders. Although most completed and attempted suicides occur in the context of a mood disorder, most individuals with mood disorders never engage in suicidal behavior. Therefore, there must be factors other than the mood disorder that predispose an individual to suicidal behavior. For example, familial genetic or nongenetic factors increase the likelihood that a suicide attempt will occur in the context of an episode of mood disorder.2,3

Adoption, family, and twin studies have demonstrated the familial transmission of suicide and suicidal behavior. Biological, but not adoptive, relatives of adoptees who commit suicide show a 6-fold higher risk for suicide compared with the biological relatives of living control adoptees.4 A related adoption study showed a 15-fold greater risk of suicide in the biological relatives of probands with mood disorders, with the highest rate in the relatives of probands with affect reaction, a condition akin to borderline personality disorder.5 Family studies2-10 of probands who completed or attempted suicide report a 4- to 6-fold greater risk of suicide or suicidal behavior in their relatives compared with the relatives of community or patient controls. There is greater concordance for monozygotic compared with dizygotic twins for completed and attempted suicide.17-19 In a large, representative sample of Australian twins, the heritability of serious suicide attempts was 55%.19

The familial transmission of suicidal behavior may involve a common liability for both completed and attempted suicide insofar as the rates of attempted suicide are elevated in the relatives of completers and the rates of completed suicide are elevated in the relatives of attempters.11-13,16,20 Familial transmission of suicidal behavior is not explained by transmission of mental disorders alone, since increased risk for suicide or suicidal be-
behavior persists even after controlling for familial transmission of mental disorder. 2,6,7,10,12,19

Little is known about the factors responsible for familial transmission of suicidal behavior. Familial transmission of mood disorders is thought to be important but not sufficient for familial transmission of suicidal behavior. 8 Impulsive aggression and violent suicidal behavior in suicide attempters or completers are associated with much greater family loading for suicidal behavior. 6 Aggressive traits and mood disorders may be familial transmission by genetic or nongenetic factors. Likewise, familial factors predisposing an individual to suicidal behavior can be environmental or genetic. 11-13 Family discord increases the risk for suicide attempt and completion in young people. 2,3,21 Maltreatment, particularly sexual abuse, conveys a markedly increased risk for suicide and suicidal behavior. 22-26 Family discord and abuse may also be explained by increased rates of parental mental disorder, tendency to impulsive aggression, and suicide attempts in abusive parents. 25,27,28 Nevertheless, even after controlling for other family problems, sexual abuse accounts for almost 20% of the population-attributable risk for suicide attempt in young people. 25,24 Imitation is not a major mechanism in familial transmission, given the results of adoption and twin studies and prospective studies of exposure to suicide. 3,5,19,29,30

Few studies have examined the risk factors for familial transmission, which can provide insight into the causes of suicidal behavior and offer potential targets for intervention. We describe a high-risk prospective family study to examine the rate of and risk factors for suicidal behavior in the offspring of 2 groups of parents with mood disorders: those with and those without a history of suicide attempt. We tested 2 main hypotheses: (1) the offspring of attempters, compared with the offspring of nonattempters, will show a higher rate of suicide attempt, greater levels of impulsivity and aggression, and greater exposure to family environmental stressors; and (2) the familial transmission of suicide attempt will be explained by proband and offspring impulsivity and aggression and family environmental stressors, not just by the transmission of mood disorder.

SAMPLE AND METHODS

Two proband groups were recruited from inpatient units, namely, depressed suicide attempters and a comparison group of depressed nonattempters, and their biological offspring. All probands were classified as attempters or nonattempters based on their report of a suicide attempt defined as “self-injurious behavior with intent to die.” Attempters were required to have 802

The remainder of the samples (n=77, 57%) in Pittsburgh, Pa, and New York, NY, was recruited from inpatient units following the same inclusion and exclusion criteria as the original cohort, with an acceptance rate of 75%. Probands provided contact information for offspring and biological coparents of offspring. In total, 299 offspring were recruited, with an acceptance rate of 88%. For the 146 biological coparents, information was provided by direct interview for 47% and by the proband for 29%, and no information was available for 36%. Similar proportions of coparents of attempter and nonattempter probands were directly interviewed (36% vs 30%). Informed consent for all interviews was obtained as approved by the institutional review boards of the University of Pittsburgh, Pittsburgh, St Francis Medical Center, Pittsburgh, and the New York State Psychiatric Institute in New York City.

ASSESSMENT

Axis I Disorder

All subjects older than 18 years were assessed for the presence of lifetime and current DSM-IV psychiatric disorders using the Structured Clinical Interview for DSM-IV (SCID-I). 33 Biological coparents not directly interviewed were assessed with regard to diagnosis and history of suicidal and assaultive behavior using the Family History Research Diagnostic Criteria 34 (with criteria modified to DSM-IV) reported by either the proband or a biological relative. Offspring between the ages of 10 and 17 years were assessed with regard to Axis I disorders using the School Aged Schedule for Affective Disorders and Schizophrenia, Present and Lifetime Version (K-SADS-PL). 33 For offspring aged 2 to 9 years (n=67, 22%), subjects were assessed solely with the parent-report questionnaire, the Child Behavior Checklist (CBCL). 36 History of suicidal behavior was assessed using the Columbia University Suicide History Form, the Medical Damage Lethality Rating Scale, and the Beck Suicidal Intent Scale for the current and most severe attempts in probands and all offspring 10 years and older. 33,37 Personality disorders were diagnosed using the Structured Clinical Interview for the DSM-IV Diagnosis of Personality Disorders (SCID-II) in all subjects older than 14 years. 38 Aggression was rated using the 11-item Brown-Goodwin Lifetime History of Aggression (BGLHA) in all subjects. 39 Tendency to impulsive aggression was assessed by the Buss-Durkee Hostility Inventory (BDHI) in all subjects older than 14 years. 40 In children aged 10 to 13 years, the downward extension of the BDHI, the Children’s Hostility Inventory (CHI), was used. 40 In subjects older than 18 years, impulsivity was assessed using the Barratt Impulsivity Scale (BIS). 41 In subjects aged 10 to 17 years, the 5-item impulsivity subscale of the Iowa Conners Parent Physical Report was used. 41 In subjects older than 18 years, a history of physical and sexual abuse was assessed from a series of screening questions in our demographic questionnaire. As part of a 1-year follow-up, a subset of subjects older than 18 years (n=201) were reassessed with a self-report measure of child trauma, the Child Experiences Questionnaire. 42 Reliability with the initial assessment was moderate for physical abuse (κ=0.41, SE=0.11) and high for sexual abuse (κ=0.74, SE=0.11). For children aged 10 to 17 years, a history of physical and sexual abuse was assessed using the Psychosocial Schedule, an interview with the parent and child about home and family environment. 43 Patterns of maladaptive parenting were assessed using the child report of the Conflict Tactics Scale (CTS). 44 This scale assesses the degree of 3 response patterns: reasoning, verbal aggression, and physical violence following family conflicts. Family adaptability and cohesion were assessed by the 20-item questionnaire Family Adaptability and Cohesion Evaluation Scales (Version II), which were filled out by the child. 45

Diagnostic Procedure

All interviewers were at least master’s degree–level clinicians or psychiatric nurses who received extensive training in the ad-

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ministration of semistructured interviews. Assessments of offspring and probands were conducted blind to each other. Best-estimate diagnoses were made by consensus and used all available sources in diagnostic consensus conferences. Within-site and cross-site reliability on the SCID-I and SCID-II, K-SADS-PL, suicide history, and the BGLHA were high (intraclass correlation coefficient = 0.82-0.98, k = 0.86-0.95).

DATA ANALYSIS

Data for the 2 sites were combined after ascertaining that differences between sites were not contributing to any risk factor-by-site interactions with regard to familial transmission. The morbid risks of a suicide attempt history in the offspring of attempters and nonattempters were compared using the Kaplan-Meier estimate. Characteristics of offspring who attempted and those who did not, as well as the characteristics of their parents, were compared using the \( \chi^2 \) test for dichotomous variables and \( t \) tests for continuous variables. The variables that discriminated between offspring of probands who did and did not attempt suicide were entered into a mixed-effects nominal logistic regression model along with site (Pittsburgh vs New York) and recruitment source (old vs new sample). A mixed-effects model was used to account for clustering of offspring within families, with covariates included as fixed effects. Because the data had previously been examined for a midpoint analysis, \( \alpha \) was set at 0.025 for hypothesis-testing analyses. As a further check, we conducted a separate set of analyses that treated the family as the analytic unit.

RESULTS

PROBANDS

Table 1 gives the demographic and clinical characteristics of the probands. Probands were middle-aged, mostly female, and had mood disorders. Proband attempters made their first attempt around the age of 30 years (mean ± SD, 31.5 ± 14.1 years). More than half had made multiple attempts (56%), with high maximum intent (mean ± SD, 16.4 ± 5.6) and lethality (43.6 ± 1.8). Attempters compared with nonattempters were more likely to be nonwhite and non-Catholic and have diagnoses of posttraumatic stress disorder and cluster B disorder. Probands recruited from Pittsburgh were younger (40.7 ± 9.7 vs 51.6 ± 12.7 years, Mann-Whitney \( U \) test = 1092.0, \( P < .001 \)), less likely to be college educated (49% vs 85%, \( \chi^2 = 17.57, P < .001 \)), had higher rates of posttraumatic stress disorder (35% vs 15%, \( \chi^2 = 6.15, P = .01 \)), and had higher rates of any alcohol or substance abuse (56% vs 31%, \( \chi^2 = 8.19, P = .004 \)) than the probands from New York. However, these 4 variables conveyed similar risks for offspring attempt in Pittsburgh and New York. Therefore, for subsequent analyses the samples were combined. Coparents of attempters were younger (45.8 ± 10.6 vs 50.5 ± 12.5 years, \( t_92 = 1.98, P = .05 \)) and more likely to be nonwhite (34% vs 12%, \( \chi^2 = 5.64, P = .02 \)), but were otherwise similar.

OFFSPRING

Offspring were on average in early adulthood, with age distribution depicted in Table 2. Offspring of attempters and nonattempters showed similar rates of Axis I and II disorders, both lifetime (Table 2) and current disorders. There was a higher rate of suicide attempt in the offspring of probands than in the offspring of nonattempters (12% vs 2%, \( \chi^2 = 6.96, P = .008 \)). Per family analyses also revealed a higher rate of offspring attempt in at-
RISK FACTORS FOR FAMILIAL TRANSMISSION OF SUICIDAL BEHAVIOR

Nineteen of the offspring attempted suicide, of whom 6 were pairs of siblings. Offspring who themselves attempted suicide were much more likely to have a parent who had attempted suicide and who reported a history of sexual abuse (Table 3). Offspring characteristics associated with an attempt were female sex; lifetime diagnoses of mood, anxiety, alcohol or other substance abuse, and cluster B disorder; a history of sexual abuse; exposure to more psychological aggression; and higher impulsive aggression. Parent sexual abuse was associated with offspring sexual abuse (OR, 6.4; 97.5% CI, 1.8-27.5).

A mixed-effects logistic regression was conducted, including site (New York vs Pittsburgh), recruitment source (old vs new sample), and all the significant variables noted herein, except for offspring cluster B personality disorder and continuous measures, for which sample sizes were reduced. Neither site nor recruitment source contributed significantly to the models. Proband sexual abuse (adjusted OR [AOR], 23.8; 97.5% CI, 2.0-289.5), offspring sex (AOR, 17.1; 97.5% CI, 1.6-183.6), and offspring alcohol and/or other substance abuse (AOR, 8.7; 97.5% CI, 1.2-64.6) were significant risk factors. Analysis of these data using Cox regression yielded nearly identical results. Of the 19 offspring who attempted suicide, 17 (90%) were the offspring of suicide attempters, and so risk factors for offspring attempt were examined just within the offspring of attempters, with very similar results. A logistic regression conducted with offspring of attempters also identified parental history of sexual abuse, offspring substance abuse, and offspring female sex as predictors of familial transmission of suicidal behavior.

Additional text and analysis are provided in the document, including tables and diagrams to support the findings.
TIMING OF PROBAND AND OFFSPRING ATTEMPT

The relationship between the timing of the most recent parent attempt and earliest offspring attempt was examined and did not show any evidence of time clustering. In 4 parent-child pairs, the offspring attempt actually preceded the parent attempt by 1.8 to 9.4 years. In 4 parent-child pairs, the offspring attempts occurred more than 20 years after the last parent attempt. In only 2 parent-offspring pairs did the attempts occur within 12 months of one another. In addition, there were 3 sibling pairs of attempters whose first attempts occurred within 10 months, 18 months, and 14 years of one another.

This high-risk family study found a strong and specific familial transmission of early-onset suicidal behavior from parent to child. Offspring of attempters had a 6-fold increased risk for a suicide attempt, relative to offspring of nonattempters, comparable to rates reported in adoption, twin, and family studies of suicide and suicidal behavior. An essential but not sufficient component of familial transmission of suicidal behavior was the transmission of a mood disorder because 82% of familial offspring suicide attempts occurred in the context of an offspring mood disorder. In addition to the transmission of a mood disorder, the familial transmission of suicidal behavior was related to the familial transmission of sexual abuse and to increased impulsivity aggression in offspring.

Sexual abuse in both parent and child played an important role in transmission of suicidal behavior. A history of reported parental sexual abuse increased the risk of attempt in offspring, regardless of the offspring’s reported abuse status. In addition, a history of sexual abuse in the proband increased the likelihood that their offspring would be sexually abused, which in turn was also associated with increased likelihood of offspring attempt. The intrafamilial transmission of sexual abuse has been described previously, but to our knowledge, this is the first report linking the familial transmission of reported sexual abuse with the familial transmission of suicide attempt. At present, we cannot determine how parent and child sexual abuse were related in this sample, although other studies suggest that abused parents may be less vigilant and more likely to choose an abusive partner. Other family environmental correlates of suicide attempt in offspring, namely, increased parental psychological aggression directed toward the child and decreased family cohesion, are consistent with previous reports and are often important family correlates of sexual abuse.

Difficulties with regulation of mood and behavior in parent and offspring were associated with offspring attempt. Offspring of probands with suicide attempts showed a greater likelihood to respond to frustration or provocation with aggression on the BDHI or its down-ward extension, the CHI, and also showed a higher prevalence of cluster B personality disorder. Impulsive aggression, measured dimensionally, and cluster B personality disorder were also associated with offspring suicide attempt. However, measures of impulsivity alone were not associated with offspring attempt. These data are consistent with a growing literature that associates liability to hostility or aggression in the face of stress, rather than impulsivity, with suicidal behavior.

Our data are not consistent with imitation as an explanation for parent-to-child transmission. The time difference between parent and child attempt was highly variable, with the child attempt preceding the parent attempt in some cases. Other studies of familial transmission of suicidal behavior are also inconsistent with imitation. Studies of youth exposed to suicide, including siblings, did not find imitation of suicidal behavior. Twin concordance for suicide attempt show great variability in the timing of their attempts. Adoption studies do not support a strong role for modeling of suicide within families.

### Table 3. Risk Factors for Offspring Suicide Attempt

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Attempters (n = 19)</th>
<th>Nonattempters (n = 213)</th>
<th>Statistical Test</th>
<th>P Value</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proband characteristics, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proband attempt</td>
<td>90</td>
<td>59</td>
<td>$\chi^2 = 6.96$</td>
<td>.008</td>
<td>6.0 (1.3-26.6)</td>
</tr>
<tr>
<td>Proband sexual abuse</td>
<td>79</td>
<td>24</td>
<td>$\chi^2 = 25.19$</td>
<td>&lt;.001</td>
<td>11.6 (3.7-36.6)</td>
</tr>
<tr>
<td>Offspring characteristics, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>90</td>
<td>45</td>
<td>$\chi^2 = 14.07$</td>
<td>&lt;.001</td>
<td>10.6 (2.5-45.4)</td>
</tr>
<tr>
<td>White</td>
<td>47</td>
<td>72</td>
<td>$\chi^2 = 5.19$</td>
<td>.02</td>
<td>2.9 (1.1-7.5)</td>
</tr>
<tr>
<td>Any mood disorder (lifetime), %</td>
<td>84</td>
<td>32</td>
<td>$\chi^2 = 20.95$</td>
<td>&lt;.001</td>
<td>11.6 (3.3-41.0)</td>
</tr>
<tr>
<td>Any alcohol or substance abuse (lifetime), %</td>
<td>58</td>
<td>24</td>
<td>$\chi^2 = 9.87$</td>
<td>.002</td>
<td>4.3 (1.6-11.2)</td>
</tr>
<tr>
<td>Cluster B, %</td>
<td>31</td>
<td>7</td>
<td>Fisher exact test</td>
<td>.007</td>
<td>6.4 (1.9-21.7)</td>
</tr>
<tr>
<td>Offspring sexual abuse, %</td>
<td>42</td>
<td>4</td>
<td>Fisher exact test</td>
<td>&lt;.001</td>
<td>18.5 (5.9-58.7)</td>
</tr>
<tr>
<td>Psychological aggression, mean ± SD, %</td>
<td>18.4 ± 9.1</td>
<td>6.4 ± 6.2</td>
<td>$t_{213} = 4.76$</td>
<td>&lt;.001</td>
<td>1.2 (1.1-1.4)</td>
</tr>
<tr>
<td>Cohesion, mean ± SD, %</td>
<td>42.1 ± 11.3</td>
<td>55.8 ± 11.7</td>
<td>$t_{213} = 2.97$</td>
<td>.004</td>
<td>0.9 (0.8-0.98)</td>
</tr>
<tr>
<td>Impulsivity or aggression</td>
<td>Buss-Durkee Hostility Inventory and Child Hostility Inventory, mean ± SD</td>
<td>0.55 ± 0.81</td>
<td>-0.25 ± 0.92</td>
<td>$t_{213} = 3.46$</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*OR indicates odds ratio; CI, confidence interval. Sample sizes were reduced for offspring cluster B (n = 16 attempters, n = 166 nonattempters); psychological aggression (n = 7 attempters, n = 86 nonattempters); cohesion (n = 7 attempters, n = 84 nonattempters); and Buss-Durkee Hostility Inventory and Child Hostility Inventory (n = 17 attempters, n = 198 nonattempters).
The strengths of this study include a high-risk family design, allowing assessment of mechanisms of transmission from parent to child, assessment of key domains likely to be involved in the transmission of suicidal behavior, and control for mood disorder in both proband groups, so that risk factors for transmission of suicidal behavior other than mood disorder could be examined. Our assessment of sexual abuse showed high reliability with few false-negative results. In this 2-site study, the same risk factors for familial transmission of suicide attempt were observed at both sites, thereby bolstering the validity and generalization of these findings.

This study has some limitations. The proband sample, recruited from inpatient facilities, was clinically severe, so it remains to be determined whether the findings can be generalized to those with less severe mood disorders. Therefore, this sample is informative, because of its severity, rather than representative. However, other family studies that used representative samples of suicide completers and attempters, although not of a high-risk design, have also found transmission of suicidal behavior. Because all the probands had mood disorders, we cannot draw conclusions about the familial transmission of suicidal behavior in those with other mental disorders, although other studies suggest that familial transmission of suicidal behavior occurs in patients with alcoholism and schizophrenia. Our sample of probands contains very few male attempters, because male attempters who were inpatients often did not have access to their children. Consequently, our results are informative about familial transmission of suicidal behavior from mother to child only. However, our findings are consistent with family studies of mostly male suicide completers. In this article, we only report on the presence or absence of physical or sexual abuse. More detailed assessment of abuse and exposure histories are being obtained on follow-up and will be the subject of future communications. The reliability of our assessment of physical abuse was only moderate, in keeping with the literature, and this may have obscured finding a relationship between physical abuse and suicidal behavior. Finally, although the design of the study is prospective, in this report, we describe solely the cross-sectional relationships observed.

In conclusion, we have demonstrated familial transmission of suicidal behavior in a sample of hospitalized adults with mood disorders and their offspring using a high-risk design. These findings are consistent with previous adoption, twin, and family studies. In a clinically referred sample, parents with mood disorders who have made suicide attempts and have been sexually abused are highly likely to have children who attempt suicide. Conversely, children with mood disorders are at greater risk for an attempt if they also show evidence of impulsive aggression, have been sexually abused, and have parents with the aforementioned risk indicators. These findings provide a framework for potential targets for treatment and prevention. Future studies will attempt to validate and extend these observations through the further prospective follow-up of this cohort.

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