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Three-Year Follow-up of Survivors of a Mass Shooting Episode

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ABSTRACT *This report describes a 3-year follow-up study of survivors of a mass shooting incident. Acute-phase and 1-year follow-up data from this incident have been previously reported. The Diagnostic Interview Schedule/Disaster Supplement was used to assess 116 survivors at 1–2 months and again 1 and 3 years later, with an 85% reinterview rate. Examining the course of postdisaster posttraumatic stress disorder (PTSD) and major depression in individuals allowed detailed consideration of remissions and delayed detection of disorders not possible from data presenting overall rates across different time frames. Only about one half of the PTSD cases identified at any time over 3 years were in remission at the 3-year follow-up. Those who did not recover from PTSD diverged from those who recovered at 3 years by reporting increased numbers of symptoms over time, especially avoidance and numbing symptoms. Although women and people with preexisting disorders were at greater risk for the development of PTSD, these variables did not predict chronicity. Chronicity of PTSD was predicted by functional impairment and seeking mental health treatment at baseline. Chronicity of major depression was predicted by report of family history of depression and treatment for paternal alcohol problems. No delayed cases of PTSD were identified. Studies are needed to compare these characteristics of the course of PTSD with other populations, using consistent methodology to allow valid comparison.*

INTRODUCTION

Policy planners and disaster intervention workers need information about the course of psychological recovery after disasters to develop programs matching the long-term needs of the affected population. Although a number of studies have provided data on the prevalence of posttraumatic stress disorder (PTSD) at various times after disasters, few have followed PTSD over time using repeated measures. Studies comparing the prevalence of PTSD in the acute disaster period with the rates after the passage of months to years suggest that the disorder appears to diminish over time.[1–4] Simply comparing the prevalence of PTSD at different points in time, however, is insufficient to document the true course of the disorder with its active forces of onset and remission—events easily submerged in global reporting of rates, with the newly detected cases obscuring those experiencing remission and vice versa.

Cumulative rates of PTSD from multiple assessment points in several stud-

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ies[2,3,5–8] found the combined prevalence of PTSD across time to be much greater than at any single assessment point. This suggests that some cases identified early may not be detectable later, and individuals without the disorder early may demonstrate it later. Four studies[5–8] charting individual PTSD cases over time described early cases that later remitted as well as "delayed" onset cases not identifiable in the early postdisaster period.

A 14-year follow-up study of PTSD following the Buffalo Creek dam break and flooding[9] found that only 30% of the active PTSD cases identified were consistently present at both the early and follow-up interviews. In this study, 17% were determined to have current PTSD at both interviews; 28% received an acute diagnosis at index but not at follow-up; and 11% had no diagnosis at index, but were identified with delayed PTSD at follow-up. Inconsistent methods of assessment (forensic evaluations at index and structured research interview at follow-up) may account for an unknown portion of the apparent discrepancies in diagnosis over time, and the setting of litigation in this study may have further affected reporting. A study of PTSD following a Norwegian paint factory explosion[8] found that symptoms decreased over time, except for irritability/aggression, which increased. PTSD with several weeks delay in onset was identified in 2 of the 125 most exposed individuals. A longitudinal study of Australian firefighters following a bush fire found delayed PTSD in 5% at 11 months and 11% at 29 months after the disaster.[7] It is unclear what the delayed PTSD in these studies represents because specifics of the structure of the symptom patterns over time are not available.

A 3-year longitudinal study of a courthouse shooting rampage in the St. Louis suburb of Clayton, Missouri,[10] using the Diagnostic Interview Schedule (DIS)[11] identified low rates of PTSD: 5% at 6–8 weeks and 3% at both 1- and 3-year follow-up. Examination of PTSD symptom groups found that intrusion (group B) and hyperarousal (group D) symptoms were prevalent initially and decreased with time, but avoidance and arousal (group C) symptoms were uncommon at index and at both follow-up assessments. Rates of subjectively feeling "very upset" about the event were more prominent and persistent, endorsed by 65% at index and 64% and 66%, respectively, at 1 and 3 years.

This article describes a 3-year follow-up study of a shooting massacre at a Luby's Cafeteria in Killeen, Texas, that also used the DIS. PTSD was identified in 28% of the survivors within 2 months of the incident,[12] but by 1 year later, the current prevalence of PTSD had dropped to 17%.[5] At follow-up, 12 cases not observed at index were newly detected. Closer inspection of these cases, however, found that the onset of symptoms had occurred within 6 months of the incident for all, thus representing not delayed onset PTSD, but rather subthreshold PTSD at index. At index, these cases nearly fulfilled diagnostic criteria, mostly lacking only one or two avoidance and numbing (group C) symptoms. Gaining those few symptoms over the next year edged these individuals over the diagnostic threshold to establish the diagnosis of PTSD. Patterns of recovery from PTSD over the year of follow-up did not show such consistent relationships, and number of symptoms of any PTSD symptom subgroup at index did not predict likelihood of recovery at 1 year. No predictors of recovery were identified.

In the era of terrorism ushered in by the September 11th events, data from previous incidents of terrorism such as this Texas shooting spree are of particular relevance to establishing the course of PTSD over time after terrorist acts.

As to the event, on Boss's Day (October 16) in 1991 in Killeen, Texas (population nearly 50,000), a gunman drove his pickup truck through the front window of Luby's

Cafeteria and held 150 people captive while he mounted a firearm assault for almost a quarter of an hour, killing one of every six individuals and wounding many others. The incident was billed as the deadliest mass shooting in American history.

METHODS

Sample

Subjects were recruited by study personnel from a comprehensive list of survivors provided by the local police department. Of 165 eligible persons, 5 could not be located, and 24 declined participation, yielding an index sample of 136 individuals (18% nonparticipation rate). Exploration of potential for bias due to this nonparticipation is not possible because reasons for nonparticipation such as a high degree of emotional upset or lack of interest among those with lower levels of exposure could not be determined from the data available.

By the 3-year follow-up, 116 remained in the study, for an 85% retention and reinterview rate. These 116 individuals constituted the study sample for the analyses for this report, and included 56 who were in the dining room during the event, 34 who were at the site during the shooting rampage but not in the dining room (such as kitchen workers), 15 who arrived on the scene in the immediate aftermath, and 11 who were off site at the time. At index, 11 described having been injured in the event. All study participants were adults, ranging in age from 18 to 83 years. The 20 index participants not reassessed at 3 years did not differ from the 116 who were retained in the study over that period on prevalence of pre- or postdisaster psychiatric disorders, sex, age, or marital status, although they had slightly less education (12.0 [SD = 1.0] vs. 13.6 [SD = 2.1] years, $t = 5.26$, $df = 51.7$, $P \leq .001$), indicating the attrition appeared to bias the sample little with regard to baseline psychopathology or demographics.

Interviews

Index interviews were completed within 6 to 8 weeks after the event, and the 1-year follow-up interviews were conducted at 13–14 months after the event. Approximately three fourths of the 3-year follow-up interviews were completed 1–2 months after the third 1-year anniversary of the event, and the remainder were completed during the next 5 months. Study participants were interviewed about their psychiatric and social status with the Diagnostic Interview Schedule for *DSM-III-R* (*Diagnostic and Statistical Manual for Mental Disorders, Revised Third Edition*)/Disaster Supplement (DIS/DS) at all three interviews, eliciting information about subjects' disaster experience and pre- and postdisaster prevalence of 10 *DSM-III-R* diagnoses.[13] At follow-up, the drug and alcohol abuse sections of the DIS were abbreviated by entering the index diagnosis as the follow-up diagnosis for individuals reporting no change in their use patterns since the last interview.

More details of the methods are provided in previous publications.[5,12] Prior to the inception of the study, approval was obtained from the Washington University School of Medicine Human Studies Committee, and all respondents provided written informed consent before participating.

Data Analysis

Rates are reported as raw numbers and percentages. Means are reported with standard deviations. For comparison of categorical variables, χ^2 tests were used, and

when expected rates in cells were less than 5, Fisher exact tests were substituted. We used *t* tests for comparing continuous and dichotomous variables, with paired *t* tests in comparisons of repeated measures. Statistical significance was set at the level of $P \leq .05$.

RESULTS

The sample of 116 subjects was 52% female with a mean age of 39.5 (SD = 14.2) years. The sample was 80% Caucasian, 10% African American, 8% Hispanic, and 2% other races. Subjects had completed a mean of 13.6 (SD = 2.1) years of education. Two thirds (67%) were currently married.

Figure 1 shows predisaster prevalence and postdisaster current prevalence rates for diagnoses of PTSD, major depression, and any diagnosis for all who were reassessed at 3 years. PTSD prevalence rates were highest in the acute postdisaster period. The 26% (n = 30) postdisaster prevalence rate of disaster-related PTSD dropped to a 1-year current prevalence rate of 14% (n = 16; McNemar $\chi^2 = 8.91$, $df = 1$, $P \leq .003$) and a 3-year current prevalence rate of 18% (n = 21; McNemar $\chi^2 = 4.29$, $df = 1$, $P \leq .513$). The prevalence of major depression at index was 10% (n = 12) and did not change significantly at 1 and 3 years. The prevalence of any diagnosis at index was 36% (n = 42), which dropped to a 1-year current prevalence of 24% (n = 37; McNemar $\chi^2 = 4.54$, $df = 1$, $P \leq .033$) but did not change significantly thereafter.

Of the PTSD cases identified at index, 43% (12 of the 28) had recovered when they were reassessed at the 3-year follow-up. Of 23 index PTSD cases who would recover at some point, 18 (78%) were found to be in remission by the 1-year interview, although 6 of those cases subsequently relapsed and presented as active PTSD cases at 3 years. There were 12 new PTSD cases diagnosed for the first time at the 1-year follow-up, and 8 (67%) of these had recovered by 3 years. Four new PTSD

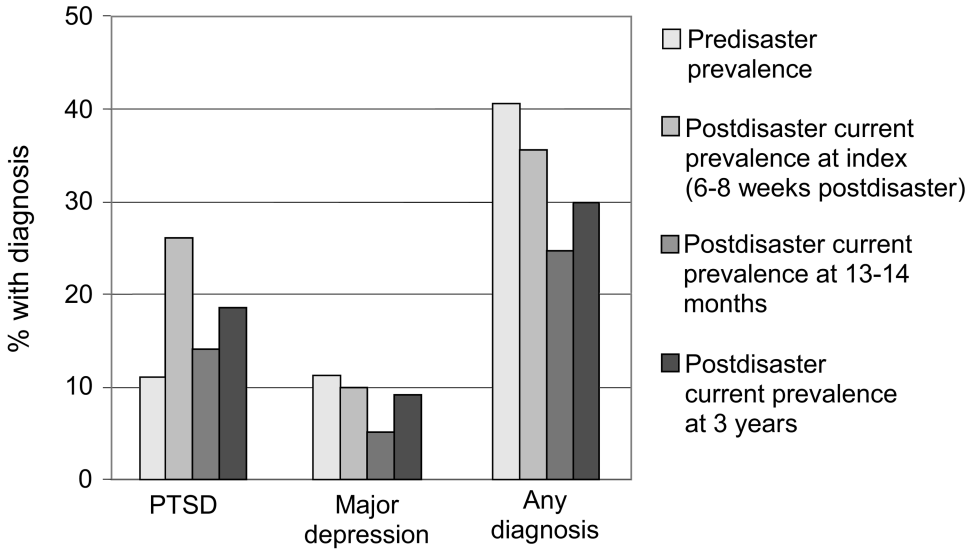

FIGURE 1. Predisaster and current rates of PTSD, major depression, and any diagnosis among survivors of the 1991 Killeen, Texas, massacre (N = 116).

cases were identified at the 3-year follow-up. Overall, of all 46 cases of PTSD identified by any of the three assessments, 25 (54%) were in remission at the 3-year mark.

Most of the 16 cases of PTSD not observed at index but identified at one of the follow-up interviews reported their symptoms had begun within 1 day (n = 8), 1 week (n = 6), or 1 month (n = 1) of the episode, with the 1 remaining individual reporting onset less than 6 months after the incident. Thus, no delayed onset PTSD was detected during 3 years of follow-up. The 16 cases undetected at index all represented subthreshold cases meeting criteria for symptom groups B and D and the 1-month duration requirement, only subsequently accumulating sufficient group C symptoms to cross the diagnostic threshold. This was accomplished by gaining at least one (n = 8), two (n = 5), or three (n = 2) C symptoms, except for 1 individual, who achieved the diagnosis by crossing the group B threshold after gaining two group B symptoms.

Of the three individuals who were positive for PTSD at index, recovered by 1 year, and then once again had active PTSD at the 3-year follow-up, all reported one less group C symptom at 1 year than at index, which dropped them below threshold for meeting group C criteria and hence PTSD criteria. Two of them gained back the one lost group C symptom at the 3-year follow-up, with the third gaining three group C symptoms.

The fluctuation over time of PTSD symptoms around the diagnostic threshold is a phenomenon also observed with other diagnoses in other settings. While some concern might arise that this diagnostic fluctuation could indicate problems of validity of the diagnostic criteria, other aspects of the diagnostic validation process of this diagnosis are of more concern, especially the Robins and Guze[14] validation criterion requiring demonstration of exclusion of other psychiatric diagnoses. Meeting exclusion criteria may represent a problematic area for PTSD, which usually travels in the company of other psychiatric disorders rather than solo. The dominance of the avoidance and numbing symptom cluster in determination of PTSD is another troubling area of its validation process.[15,16] Further exploration of the complex topic of validation of this diagnosis, however, is beyond the scope of this article.

People who were recovered from PTSD at 3 years were indistinguishable at index in terms of number of group B, C, or D symptoms of PTSD they had reported at index and at 1 year (Fig. 2). At the 3-year follow-up assessment, however, difference in numbers of group B, C, and D symptoms was evident, with those not recovered reporting significantly higher numbers of symptoms in all three symptom groups. Those who recovered showed decreases in numbers of group B, C, and D symptoms between the 1- and 3-year follow-ups. The group that did not recover had a significant increase in group C symptoms between 1 and 3 years postdisaster. Significant divergences were seen between those who did and who did not recover in changes in group C and D symptoms reported at 1 and 3 years.

Of 12 (10%) cases of major depression identified at index, 11 were recovered by 1 year, and 1 case persisted at the 3-year follow-up. Eight more cases of major depression were first identified at the 1-year follow-up, and 2 of these had already recovered. Two additional cases were first identified at 3 years, and 1 of these had already recovered. At 3 years, 18 of the 30 (60%) individuals diagnosed with major depression at any of the assessments were no longer actively experiencing the disorder.

Bivariate analyses found few predictors of nonrecovery from PTSD and major depression at the time of the 3-year assessment. No demographic and diagnosis

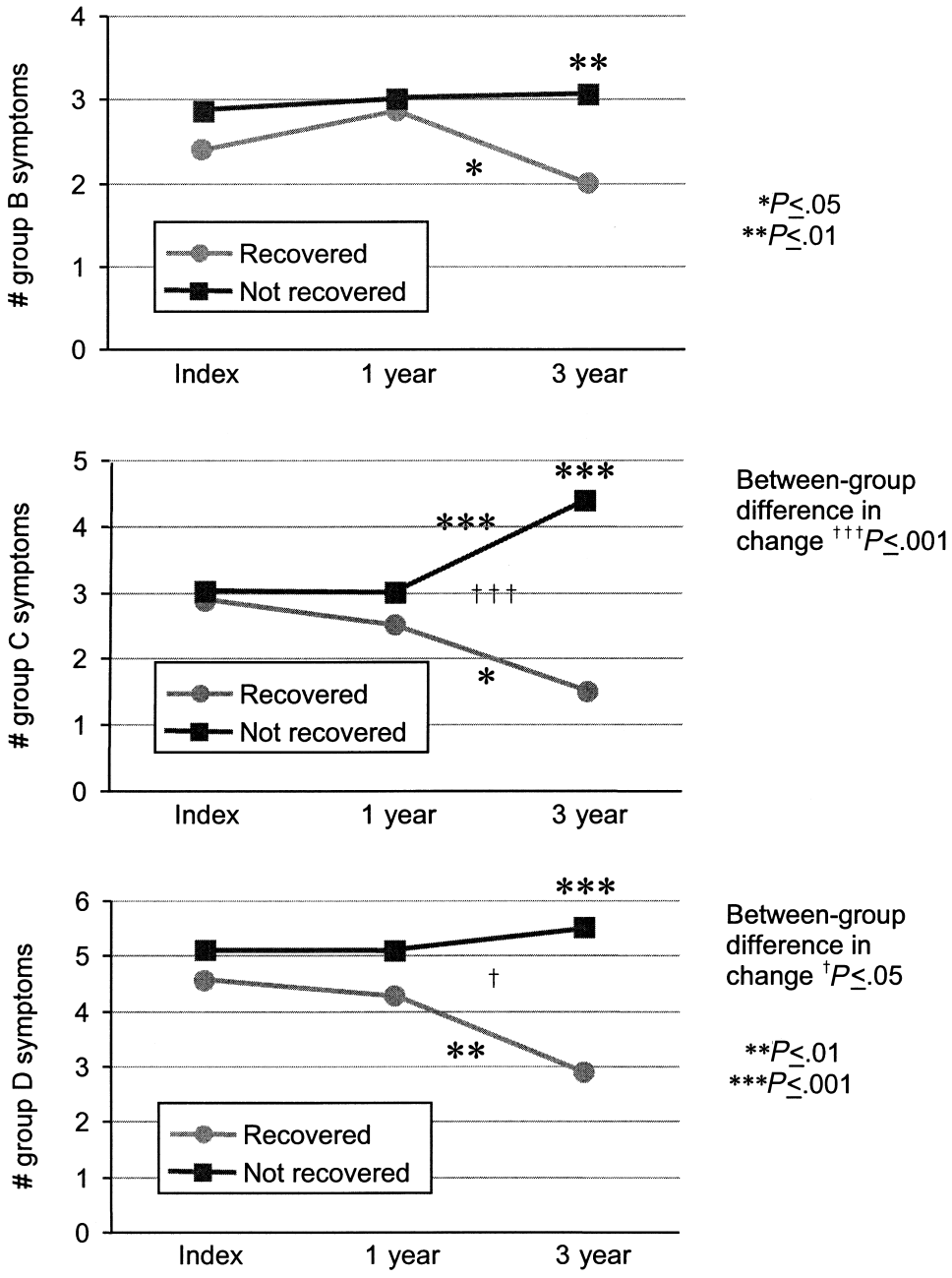

FIGURE 2. Mean number of PTSD groups B, C, and D symptoms at index (6–8 weeks postdisaster), 1 year later, and at 3-year follow-up assessment by 3-year recovery status among the survivors of the 1991 Killeen, Texas, mass shooting episode with PTSD identified at any assessment point (N = 116).

(predisaster or comorbid) variables predicted recovery from PTSD or depression. Among those with PTSD identified at any assessment, nonrecovery was associated with report of functional interference due to PTSD symptoms (recovery in 21% of impaired and 79% of nonimpaired at index; $\chi^2 = 12.46$, $df = 1$, $P \leq .001$). Those who reported at index that they had seen a mental health professional after the disaster were significantly less likely than others to have recovered from PTSD at 3 years (38% vs. 68%; $\chi^2 = 4.11$, $df = 1$, $P \leq .043$).

The 3-year nonrecovery status from major depression identified at any time after the disaster was not associated with any demographic variables. Nonremission from depression at 3 years was predicted by index reports by those reporting a family history of depression (remission from depression in 14% reporting and 82% of those not reporting a family history of depression; Fisher exact $P \leq .003$) and paternal history of treatment for drinking problems (remission from depression in 17% reporting and 75% not reporting paternal alcohol treatment history; Fisher exact $P \leq .016$).

DISCUSSION

In this study, PTSD and major depression were most prevalent early after the disaster and dropped off over time. However, considerable chronicity of psychopathology was observed after this shooting massacre: Only about half of psychiatric disorders had recovered after 3 years. No delayed onset PTSD was observed, although a number of cases were slow to reach full fruition. The PTSD cases not identified at index did not represent delayed onset cases, but rather cases that were subthreshold, barely lacking the required avoidance and numbing symptoms for the diagnosis at index. These symptoms accrued over time to meet the diagnostic threshold.

The development of PTSD appears to be more readily predicted than its recovery. Few predictors of recovery were apparent. While previous psychopathology and gender were robust predictors of the original development of PTSD in the Killeen sample, these variables did not predict recovery over time. Other studies, in contrast, have found preexisting psychopathology and personality characteristics to predict PTSD chronicity, although degree of disaster exposure and losses sustained were not predictive.[7,8]

Risk for chronicity of major depression in this study was identifiable in reported family history variables of depression and paternal alcoholism. The findings suggest that risk for chronicity of PTSD may be better indicated by problems functioning and seeking early treatment than by symptoms in the early postdisaster period. The association of PTSD chronicity with seeking mental health treatment early does not necessarily imply that treatment worsened the PTSD, but more likely that early treatment was sought by those with more severe and nonremitting illness.

Predictors of recovery from PTSD in the current study were consistent with predictors in a study of firefighters involved in a bush fire, in which losses, exposure, injury, and perceived threat did not predict persistence or resolution of PTSD over time.[7] The findings of the current study differed from the Buffalo Creek study,[6] in which female gender was found to be associated with recovery. The current study did not find index symptoms of any symptom group to predict outcome, even though other studies have observed early PTSD symptoms to be predictive of the course of PTSD.[7,8,17] Statistical power may have limited the ability of the Killeen data to address such potential associations. Regardless, prediction of later symptoms from early symptoms may simply reflect symptom reporting characteristics of

individuals repeating themselves over time. In the current study, those who recovered from PTSD reported fewer symptoms over time in all three symptom groups, but those who did not demonstrated increasing numbers of avoidance and numbing symptoms over time.

Strengths of the current study include systematic and comprehensive assessment of the course of formally diagnosed PTSD over time through repeated application of the same structured diagnostic instrument. Additional strengths included examination of the course of specific cases rather than reporting overall rates over time, with investigation of the symptom-based mechanisms for apparent recovery and delay of meeting criteria for some cases of PTSD. The study was limited by the fact that, while current diagnosis could be followed over time, symptom counts could identify only the cumulative number of postdisaster symptoms and did not differentiate current symptoms from all postdisaster symptoms. The nonparticipation and non–follow-up rates, approaching 15%–20% of the sample, could have biased the sample toward individuals either more or less psychologically traumatized by the mass shooting episode.

Further research into disaster-affected populations will be needed to confirm these findings and identify other predictors of chronicity of PTSD and major depression. Considerably larger samples may be required to provide statistical power needed to discover additional predictors.

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REFERENCES

1. Steinglass P, Gerrity E. Natural disasters and posttraumatic stress disorder: short-term versus long-term recovery in two disaster-affected communities. *J Appl Soc Psychol.* 1990;20:1746–1765.
2. Epstein R, Fullerton C, Ursano R. Posttraumatic stress disorder following an air disaster: a prospective study. *Am J Psychiatry.* 1998;155:934–938.
3. Wang XW, Gao L, Shinfuku N, Zhang H, Zhao C, Shen Y. Longitudinal study of earthquake-related PTSD in a randomly selected community sample in North China. *Am J Psychiatry.* 2000;157:1260–1266.
4. Groenjian AK, Steinberg AM, Najarian LM, Fairbanks LA, Tashjian M, Pynoos RS. Prospective study of posttraumatic stress, anxiety, and depressive reactions after earthquake and political violence. *Am J Psychiatry.* 2000;157:911–916.
5. North CS, Smith EM, Spitznagel EL. One-year follow-up of survivors of a mass shooting. *Am J Psychiatry.* 1997;154:1696–1702.
6. Grace MC, Green BL, Lindy JL, Leonard AC. The Buffalo Creek Disaster: a 14-year follow-up. In: Wilson JP, Raphael B, eds. *International Handbook of Traumatic Stress Syndromes*. New York: Plenum Press; 1993:441–449.
7. McFarlane A. The longitudinal course of posttraumatic morbidity: the range of outcomes and their predictors. *J Nerv Ment Dis.* 1988;176:30–39.
8. Weisæth L. Post-traumatic stress disorder after an industrial disaster. In: Pichot P, Berner P, Wolf R, Thau K, eds. *Psychiatry—the State of the Art*. New York: Plenum Press; 1985:299–307.

9. Green BL, Lindy JD, Grace MC, et al. Buffalo Creek survivors in the second decade: stability of stress symptoms. *Am J Orthopsychiatr*. 1990;60:43–54.
10. Johnson SD, North CS, Smith EM. Psychiatric disorders among victims of a courthouse shooting spree: a three-year follow-up study. *Commun Ment Health J*. 2002;38:181–194.
11. Robins LN, Helzer JE, Cottler L, Goldring E. *NIMH Diagnostic Interview Schedule, Version 3–Revised*. St. Louis, MO: Washington University; 1989.
12. North CS, Smith EM, Spitznagel EL. Posttraumatic stress disorder in survivors of a mass shooting. *Am J Psychiatry*. 1994;151:82–88.
13. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders,* 3rd ed., revised. Washington, DC: APA; 1987.
14. Robins E, Guze SB. Establishment of diagnostic validity in psychiatric illness: its application to schizophrenia. *Am J Psychiatry*. 1970;126:983–987.
15. North CS, Nixon SJ, Shariat S, et al. Psychiatric disorders among survivors of the Oklahoma City bombing. *JAMA*. 1999;282:755–762.
16. McMillen JC, North CS, Smith EM. What parts of PTSD are normal: intrusion, avoidance, or arousal? Data from the Northridge, California earthquake. *J Trauma Stress*. 2000;13:57–75.
17. Ursano RJ, Fullerton CS, Kao T, Bhartiya VR. Longitudinal assessment of posttraumatic stress disorder and depression after exposure to traumatic death. *J Nerv Ment Dis*. 1995;183:36–42.