

# The Course of Posttraumatic Stress Disorder in a Follow-up Study of Survivors of the Oklahoma City Bombing

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**Background.** *The course of posttraumatic stress disorder (PTSD) in populations directly exposed to terrorist attacks is of major importance in the post-9/11 era. Because no systematic diagnostic studies of the most highly exposed individuals of the 9/11 terrorist attacks have yet been done, the Oklahoma City bombing remains a unique opportunity to examine PTSD over time in high-exposure terrorist victims.*

**Methods.** *This study assessed 137 survivors in the direct path of the explosion at approximately 6 and 17 months postdisaster, using the Diagnostic Interview Schedule.*

**Results.** *Combined index and follow-up data yielded a higher (41%) incidence of PTSD than detected at index (32%) or follow-up (31%). All PTSD was chronic (89% unremitted at 17 months) with no delayed-onset cases. The avoidance and numbing symptom group C, unlike groups B and D alone, was pivotal to current PTSD status and was associated with indicators of functioning at index and follow-up. The findings at index were sustainable.*

**Conclusions.** *This follow-up study confirmed the immediacy of onset of PTSD and its persistence over time, pointing to the need for early interventions that continue over the long term. Group C avoidance and numbing symptoms may aid in early recognition of PTSD and in predicting long-term functioning.*

**Keywords** Posttraumatic stress disorder; Oklahoma City bombing; Onset; Persistence.

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## INTRODUCTION

The incidence and time course of posttraumatic stress disorder (PTSD) in populations directly exposed to terrorist attacks is of great interest to mental health and community service planners, because large-scale terrorism is relatively new in the United States and its mental health consequences may differ compared to other kinds of disaster (1,2). Research to date on the September 11th terrorist attacks has provided important information on posttraumatic symptoms experienced by the general Manhattan population (3) and remotely affected population groups nationally (4–6), but groups with the most severe exposure, who would be expected to demonstrate the greatest psychiatric consequences, have not been specifically studied. Thus, the opportunity for longitudinal study of the most highly exposed group from this most severe terrorist attack on American soil has been lost forever. Until September 11, 2001, the Oklahoma City bombing marked the most severe act of terrorism in American history. Research on the Oklahoma City bombing provides a template for understanding the course of PTSD and other psychopathology among the most vulnerable, highly exposed members of disaster-stricken communities and helped inform disaster mental health planning after the September 11 terrorist attacks (7).

Studies of other populations directly exposed to terrorism have been few, and the longitudinal course of such populations is not known (8). Access to populations highly exposed to terrorist acts of national and international proportion is limited because of the highly sensitive nature of the situation, making systematic studies difficult if not impossible. The world's literature on directly exposed victims of terrorist attacks contains six published studies addressing PTSD following exposure to terrorism in the form of bombings, bus attacks, and shooting episodes. The incidence of PTSD, examined up to 8 months postdisaster in these studies, ranged from 27% to 50% (9–14), and one later study 4 to 5 years post-event found a lower PTSD incidence of 18% (9). The only event in the United States represented in this review was the Oklahoma City bombing (12).

Following serial PTSD prevalence rates starting acutely postdisaster is a way to track PTSD in the population over time but does not reflect individual differences in diagnostic status longitudinally. In serial prevalence rates, newly identified PTSD cases may cancel out recovery from PTSD in others, and aggregate statistics may fail to find remitted cases obscured by shifts toward diagnosis in other individuals over time.

The current report describes a follow-up study conducted nearly one and one-half years after the Oklahoma City bombing, approximately one year after an index study approximately 6 months post-bombing. To observe the development of new cases over time and determine remission rates for

index cases, consistent and systematic data collection continued in the next year.

## METHODS

The index study of the Oklahoma City bombing was completed at approximately 6 months postdisaster. This study assessed 182 survivors in the direct path of the explosion who were randomly sampled from the Oklahoma State Department of Health's registry of 1,092 survivors collected as a public record of directly affected individuals. The overall participation rate of those invited to participate was 71%; 13% could not be contacted and 16% declined to be interviewed. Approximately one-third of the sample was in the Murrah Building and the remaining two-thirds were either in nearby buildings where fatalities occurred or were unprotected on the street. The severe exposure level of the sample is reflected in its 87% rate of injury in the bombing.

The Diagnostic Interview Schedule (DIS)/Disaster Supplement for *DSM-III-R*, a structured interview to assess psychiatric diagnoses, disaster exposure, and other relevant variables, was used at both index and follow-up (with slight modifications to reflect the time passed since the bombing), averaging hours at index and 2 hours at follow-up. More extensive detail of the index study methods is provided in an earlier publication (12). Currently active PTSD is defined as bombing-related PTSD cases with any PTSD symptoms in the last month, and remission from PTSD signifies bombing-related PTSD cases with no symptoms in the last month. While the DIS provided the postdisaster PTSD symptom *prevalence*, it did not provide a *current* symptom count. Thus, reports of all PTSD symptoms experienced after the bombing could be compared between index and follow-up, but current symptoms could not be differentiated from remitted symptoms.

Follow-up interviews were completed an average of one year after the index study (range, 8–15 months), an average of 17 months postbombing (range, 14 to 20 months). At follow-up, 137 index participants were reinterviewed (75% of the index sample). In-person interviews were requested, but 52 of the interviews were completed by telephone for those who had moved away or could not schedule an in-person meeting. The follow-up sample was 49% male, 91% Caucasian, and 8% African-American, 68% married, with a mean age of 44.1 (SD=10.8) years, and having two years of college on average. No differences with respect to gender, age, income, psychiatric diagnoses, rate of injuries, or other post-disaster life events were identifiable between those who did and did not participate in the follow-up interview. Index participants not reinterviewed, however, had significantly fewer years of education (13.6 [SD=2.0] vs. 14.6 [SD=2.1];  $t=2.92$ ,  $df=180$ ,  $p=.004$ ) and were less likely to be married (49% vs.

68%;  $\chi^2=5.25$ ,  $df=1$ ,  $p=.022$ ). The group reinterviewed at follow-up was highly exposed to the bomb blast: 88% were injured; nearly one-half (47%) had thought they were going to die during the event, and most (84%) had witnessed others being injured or killed at the bombing scene. Two-thirds (68%) had lost a family member or friend in the bombing, and most (93%) personally knew someone injured or killed.

Approval for both the index and follow-up studies was obtained from the Washington University School of Medicine Institutional Review Board. All participants provided written informed consent prior to the assessments at both time points.

### Data Analysis

Data are displayed as numbers and percentages for categorical variables and means with standard deviations for numerical variables. Categorical variables were compared using  $\chi^2$  analyses, substituting Fisher's exact tests when expected numbers in cells were less than five. T-tests were performed for comparisons of dichotomous with numerical variables.

### RESULTS

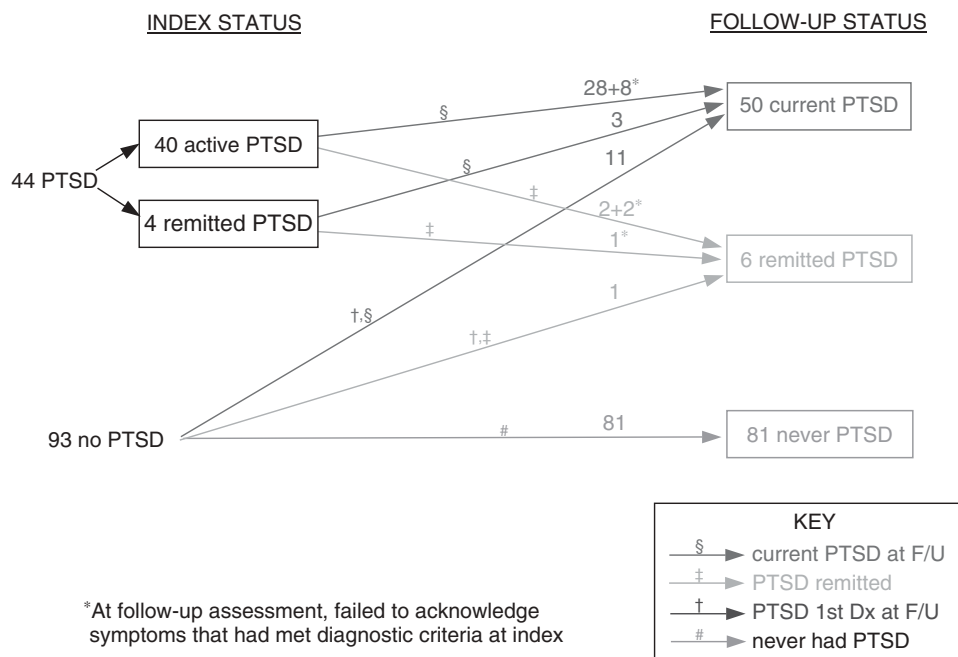
At index, the proportion of the follow-up sample found to meet criteria for bombing-related PTSD was 32% (44/137). At follow-up, 31% (42/137) had active PTSD. Combining

data from both assessments, 41% (56/137) had PTSD related to the bombing at one or both interviews. A few of the index-identified PTSD cases ( $n=11$ ) were no longer detectable at follow-up. A similar number of PTSD cases ( $n=12$ ) were first identified at follow-up.

Figure 1 illustrates the course of individual PTSD cases over the study period. At the index assessment, 4 of the 44 (9%) PTSD cases were already in remission. At follow-up, three of these four remitted index cases had relapsed; the other remitted case remained in remission. Of the 40 individuals with currently active PTSD at index, 4 (10%) were in remission at 6 months. A year later, reassessment of the 44 original index PTSD cases found 5 (11%) to be in remission. At follow-up, 3 of these 5 remitted cases failed to acknowledge all the symptoms that had qualified them for a diagnosis at index, although they did report symptoms in the last month.

Of 93 individuals not meeting PTSD criteria at index, 12 (13%) were diagnosed with PTSD for the first time at follow-up. Only 1 of these 12 (8%) had remitted from their PTSD at the time of the follow-up assessment. Therefore, combined data for follow-up of 44 index PTSD cases and the 12 additional cases identified at follow-up found a total remission rate of 11% (6/56).

None of the 12 cases first identified at follow-up described delayed onset as defined by *DSM-III-R* (symptoms starting more than six months after the event), but all were subthreshold at index, lacking sufficient symptoms at index to reach diagnostic criteria at that time. At index, 6 of these 12 indicated that their PTSD symptoms had begun the



**Figure 1** Flow chart of PTSD course from index (6 months) to follow-up (17 months).

same day as the bombing, 4 said their symptoms had begun within the first week, and the other 2 said their symptoms had begun within the first month. These 12 cases described a mean of 6.9 ( $SD=2.7$ ) and a median of 6 PTSD symptoms at the index assessment, ranging from 3 to 10. Between index and follow-up, they all developed enough additional symptoms to cross the diagnostic threshold (one symptom in group B, three in group C, and two in group D). At follow-up, similar proportions with PTSD reported problems functioning due to PTSD symptoms (76% of those diagnosed with PTSD at both assessments and 58% of those first diagnosed at follow-up, Fisher's exact  $p=.285$ ). Compared to those retaining their PTSD status from index to follow-up, the PTSD cases first identified at follow-up reported significantly more group B symptoms at follow-up than at index (3.0 [ $SD=1.6$ ] symptoms at follow-up vs. 1.8 [ $SD=1.3$ ] at index, compared to 3.7 [ $SD=1.2$ ] symptoms at follow-up vs. 4.1 [ $SD=1.0$ ] at index ( $t=3.09$ ,  $df=43$ ,  $p=.003$ ) in those retaining PTSD status) and more group C symptoms (3.8 [ $SD=0.9$ ] at follow-up vs. 1.6 [ $SD=0.7$ ] at index, compared to 4.7 [ $SD=1.4$ ] at follow-up vs. 4.4 [ $SD=1.1$ ] at index ( $t=5.57$ ,  $df=39$ ,  $p<.001$ )), but no difference in the number of group D symptoms reported. All 12 of the PTSD cases first identified at follow-up had failed to meet group C criteria at index.

Consistency of group C criteria was the sole characteristic associated with the change in diagnostic status from index to follow-up. Neither group C avoidance nor numbing symptoms contributed disproportionately to development of PTSD at follow-up. At index, 4 of these 12 cases also lacked group B criteria and 2 lacked group D criteria. At follow-up, these 12 cases still reported significantly fewer PTSD symptoms than those whose PTSD was first identified at index (10.7,  $SD=1.8$  vs. 13.1,  $SD=2.1$ ;  $t=-2.83$ ,  $df=43$ ,  $p=.007$ ). These findings indicate that these 12 cases represent not late-onset but subthreshold index cases whose PTSD symptoms were already underway at index and proceeding toward full expression of the disorder before the follow-up interview. The 12 unidentified index cases later determined to have PTSD were far less likely (17%) to have a predisaster diagnosis compared to the 33 cases retaining the PTSD diagnosis from index to follow-up (61%) ( $\chi^2=6.80$ ,  $df=1$ ,  $p=.009$ ).

The 11 cases meeting PTSD criteria at index but not acknowledging enough of the same symptoms to meet diagnostic criteria at follow-up described significantly fewer group C symptoms at follow-up compared to index, providing a mean of 4.2 [ $SD=0.9$ ] symptoms at index compared to 1.5 [ $SD=0.7$ ] at follow-up, in contrast to those who retained their PTSD status from index to follow-up who reported a mean of 4.4 [ $SD=1.1$ ] symptoms at index and 4.7 [ $SD=1.4$ ] at follow-up (difference statistic,  $t=-5.97$ ,  $df=42$ ,  $p<.001$ ). Numbers of B and D symptoms were consistent, however. At follow-up, all 11 of these cases failed to meet

group C criteria and 2 also lacked B criteria, but all 11 still met D criteria. Thus, decreased reporting of group C avoidance and numbing symptoms determined most of the slip-page below threshold over time among these index-established PTSD cases.

Meeting index Group C criteria was the determining factor in the diagnosis of PTSD. Of those with three avoidance and numbing symptoms at index, thus by definition fulfilling group C criteria, 96% also met full criteria for PTSD. In contrast, only 40% of those meeting group B and 39% of those meeting group D criteria at index also met full criteria for PTSD. (By comparison, in the index group without PTSD, only 2% met group C criteria, but 70% met group B and 73% met group D criteria at index.) At follow-up, 72% of cases meeting group C criteria at index met criteria for active PTSD a year later. In contrast, 39% of those meeting group B criteria and 37% of those meeting group D criteria at index had active PTSD one year later. Of 81 individuals without PTSD at index or follow-up, only 2% met group C criteria, but 80% met group B criteria and 77% met group D criteria at either interview.

Meeting group C symptom criteria at index was highly associated with posttraumatic impairment of functioning at both index (impairment reported by 70% vs. 19% in those not meeting C criteria,  $\chi^2=32.79$ ,  $df=1$ ,  $p<.001$ ) and follow-up (impairment reported by 71% vs. 26% in those not meeting C criteria,  $\chi^2=21.88$ ,  $df=1$ ,  $p<.001$ ), self-reported work performance problems at index (58% vs. 37%,  $\chi^2=4.95$ ,  $df=1$ ,  $p=.026$ ) and follow-up (39% vs. 9%,  $\chi^2=15.60$ ,  $df=1$ ,  $p<.001$ ), self-reported problems functioning at home at both index (38% vs. 20%,  $\chi^2=4.07$ ,  $df=1$ ,  $p=.044$ ) and follow-up (50% vs. 25%,  $\chi^2=8.40$ ,  $df=1$ ,  $p=.004$ ), seeking treatment at index (78% vs. 41%,  $\chi^2=17.36$ ,  $df=1$ ,  $p<.001$ ), being in treatment at follow-up (70% vs. 34%,  $\chi^2=9.86$ ,  $df=1$ ,  $p=.002$ ), and taking medication for coping at index (58% vs. 22%,  $\chi^2=17.05$ ,  $df=1$ ,  $p<.001$ ). In contrast, meeting group D criteria without meeting C criteria was associated only with symptom-related impairment of functioning, and only at index (23% vs. 0%, Fisher's exact  $p=.021$ ). Meeting B without C criteria was not associated with any of the above variables. Therefore, group C criteria were associated with several indicators of functioning at index and predicted difficulties with functioning at follow-up, but groups B and D criteria in the absence of C criteria were virtually unassociated with functioning.

Timing of PTSD onset was compared between index and follow-up reports for each participant with PTSD. All but two of the 52 individuals reporting onset of PTSD within the first week at the index interview consistently reported that the onset of their symptoms had been within the first week. At follow-up, one of these 52 individuals subsequently reported that the onset had been within the first month and the other described the onset as within six months. Of two additional individuals reporting onset of

PTSD within one month at index, one was consistent at follow-up and the other reported PTSD onset between one and six months. Finally, the one individual who at index had reported PTSD onset between one and six months reported onset within one month at follow-up. Thus the agreement between index and follow-up reporting of onset was 93%. All 56 PTSD cases identified at index or follow-up had persisted more than three months. Thus, according to *DSM-III-R* criteria, all identified PTSD cases were classified as chronic (lasting  $\geq 3$  months).

## DISCUSSION

This study examined the course of PTSD in directly exposed survivors of the Oklahoma City bomb blast over one year following an index assessment. The time course of PTSD in highly exposed survivors of terrorism assessed has not been previously examined with the rigor of sequential structured diagnostic interviews. Previous studies examining posttraumatic syndromes over time in disaster-exposed populations have generally compared group prevalence at two different time points rather than tracking the outcomes of specific cases.

In the current study, comparison of group prevalence of PTSD between index and follow-up appeared to indicate stability of the disorder at the two time points (32% and 31%); however, a more complete picture of the course of PTSD was revealed by tracking individual cases from index to follow-up. The combined index and follow-up PTSD data yielded a total PTSD incidence of 41% in connection with bombing exposure, taking into account subthreshold cases at index and cases not identified at follow-up along with the majority of PTSD cases that were diagnosed at both assessment points. Thus, the index assessment by itself did not capture 16% (12/74) and the follow-up assessment by itself overlooked 15% (11/74) of the total cases of PTSD diagnosed at either assessment. The recovery rate of all PTSD cases was 11% considering all cases identified at index or follow-up—a very different figure than the apparent lack of change over time when summary rates of index-identified PTSD are presented along with rates of current PTSD observed with the follow-up assessment.

The 12 PTSD cases first identified at follow-up represented not delayed-onset PTSD but subthreshold PTSD at index. The full magnitude of these PTSD cases was not apparent at index; participants developed the few additional symptoms needed to meet PTSD criteria at follow-up. The fact that their PTSD symptoms (six on average at index) had begun quickly and merely slipped over the diagnostic threshold by the time of the follow-up assessment suggests that these cases were not delayed onset cases but were rather subthreshold cases all along. These subthreshold cases may represent milder PTSD to account for their greater time

meeting or exceeding diagnostic criteria, as they still reported significantly fewer PTSD symptoms than those whose PTSD was first identified at index. Regardless, the end result in terms of impairment of functioning was the same as for the group whose PTSD had reached full diagnostic manifestation at index. This suggests that a small but functionally significant proportion of PTSD may not be fully diagnosable until much later in the postdisaster period. There may be a few people who develop PTSD who are not identified in the early postdisaster period, and this small proportion of cases suggests potential for PTSD prevention programs that might benefit this select, already-symptomatic, group at index.

These findings that PTSD symptoms begin relatively quickly following disasters, including those that are initially subthreshold cases, have upheld and extended the results of the index study of the Oklahoma City bombing (12) and are consistent with other disaster studies (15) and with studies of other kinds of traumatic events (16,17). Bryant and Harvey assessed 103 motor vehicle accident victims for PTSD at six months and two years post-accident, of whom five were first diagnosed with PTSD two years post-trauma. Even in these initially subthreshold cases, however, elevated psychopathology and resting heart rates were evident at the six month assessment, indicating detectable levels of illness before full PTSD could be diagnosed. The authors stated that their findings “challenge the notion of PTSD developing after a period without symptoms” (p. 205) (16). The current study confirms their observation in a highly exposed sample of disaster victims.

In the current study, no PTSD cases had remitted by three months, the temporal demarcation of *DSM-III-R* criteria for PTSD as chronic. This also is consistent with findings of PTSD chronicity reported in other contexts (18,19,20). The implications of this study’s findings for disaster intervention work and policymaking are that disaster mental health relief efforts can begin immediately following these events and should continue for the long term as persistence of PTSD indicates the need for ongoing mental health services. Part of the activity during this period should be continued surveillance for additional symptoms qualifying a few additional individuals for diagnostic status with the passage of time, particularly among the subthreshold cases nearly meeting PTSD criteria.

In this study, the presence of the C symptom group of avoidance and numbing symptoms was pivotal to current PTSD status. The presence of group C criteria was also highly associated with PTSD and with indicators of functioning and illness at index and follow-up. No such associations were observed with group B and D symptoms outside the presence of group C criteria. Therefore, the importance of the group C symptoms was apparent not just at index but also over time, suggesting that the group C symptom profile might provide early indications of individuals likely to develop PTSD. Confirmation of this likelihood, however,

will require prospective collection of data in early postdisaster days and weeks to predict associations at later follow-up.

Strengths of this Oklahoma City bombing follow-up investigation include study of a high-magnitude terrorism incident, a representative highly exposed sample, use of a structured diagnostic interview, and application of the same instrument at both assessment points. Potential limitations of the study include biases related to participant selection, attrition, recall, and compensation. No diagnostic differences were found between follow-up and dropout subgroups, although other important differences may have been present. Nothing is known of the nonparticipants at index, and one cannot be certain the Health Department's list was necessarily universally inclusive of the directly exposed group. The 25% loss of participants at follow-up, characterized by lower educational attainment and greater marital disruption—variables generally known to be associated with psychopathology—might have biased the findings toward greater PTSD recovery among those who remained in the study. However, the lack of association of education and marital status with PTSD persistence in the sample makes these disparities unlikely contributors to outcomes. Consistency of PTSD onset, with 93% agreement between index and follow-up reports, argues against recall bias on this variable, although it is possible that bias on other retrospective variables could have occurred. Compensation bias is unlikely as no financial reward was contingent on the information they provided.

The lack of an unexposed comparison group reduced ability to draw associations of outcomes with exposures, although variation in injury rates and other exposure variables provided some within-sample comparisons. Because of the low PTSD remission rate, statistical power to find predictors of remission was limited. Another limitation of the study is the lack of data provided by the DIS on number of current PTSD symptoms, prohibiting analysis to determine which symptoms contributed most to PTSD persistence. Future use of this instrument would benefit from revisions to provide this information. Finally, the present study could not examine the effects of mental health treatment on outcome, because treatment was not randomized in this naturalistic, descriptive study.

No studies were conducted with the most severely exposed part of the population (i.e., individuals in the Twin Towers) early after the September 11 terrorist attacks on the World Trade Center. Therefore, the opportunity to examine longitudinal effects of posttraumatic psychopathology has been missed in this most severe act of terrorism ever on American soil. The Oklahoma City bombing cohort has yielded a unique investigation of the longitudinal course of PTSD in highly exposed survivors of terrorism. Given the likelihood of further major attacks, renewed emphasis on longitudinal study using structured diagnostic assessments is needed for determining accurate prognosis and formulating effective treatments for those most severely affected. Available fund-

ing for such studies should be prioritized and planning should be proceeding now to allow such research to commence in the narrow window of opportunity that follows such events.

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