

# Natural Course of Posttraumatic Stress Disorder: A 20-Month Prospective Study of Turkish Earthquake Survivors

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**Objective:** A 20-month prospective follow-up of survivors of the severe earthquake in Turkey in 1999 examined the natural course of posttraumatic stress disorder (PTSD) and the contribution of different symptom clusters to the emergence of PTSD.

**Method:** Subjects were randomly sampled in a suburb of Istanbul that was severely affected by the earthquake. A total of 464 adults were assessed with a self-report instrument for PTSD symptoms on 3 consecutive surveys that were administered 1 to 3, 6 to 10, and 18 to 20 months following the earthquake.

**Results:** The prevalence of PTSD was 30.2% on the first survey and decreased to 26.9% and 10.6% on the second and third surveys, respectively. Female subjects showed initially higher (34.8%) PTSD rates compared with male subjects (19.1%). However, gender differences disappeared by the time of the third survey due to high spontaneous remission rates in female subjects. Low levels of chronic and delayed-onset PTSD were observed. A major contribution of the avoidance symptoms to PTSD diagnosis was identified by statistical analysis.

**Conclusions:** Initial PTSD following an earthquake may be as prevalent as in other natural disasters, but high rates of spontaneous remission lead to low prevalence 1.5 years following the earthquake. Initial avoidance characteristics play a major role in the emergence of PTSD.

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On the morning of August 17, 1999, an earthquake with a magnitude of 7.4 on the Richter scale struck the Marmara region of northwestern Turkey. The earthquake lasted 45 seconds and was felt over thousands of square miles in Turkey's most densely populated region. According to official government estimates, the earthquake killed over 17,000, injured almost 44,000, and displaced more than 250,000 people. One consequence of a natural disaster of such a large scale is high rates of post-traumatic stress reactions in the surviving population.

Posttraumatic stress disorder (PTSD) is defined by re-experiencing, avoidance of stimuli associated with the trauma, and increased arousal that cause functional impairments as a consequence of exposure to an extreme event.<sup>1</sup> Initially, these responses to an extreme event could be normal and even adaptive.<sup>2</sup> Thus, the duration of the symptoms distinguishes between adaptive and maladaptive responses,<sup>3</sup> and indeed, the diagnosis of PTSD requires that symptoms last at least 1 month.<sup>1</sup>

Following symptom emergence, PTSD may have either an acute or a chronic course. The acute course, by DSM-IV definition, lasts for less than 3 months, while the chronic course lasts for 3 months or longer. In addition, when the symptoms subside with no treatment, it is considered a spontaneous remission. Although stress symptoms more often appear within hours or days following the trauma, sometimes the pathologic reaction may start months or even years after the event. Accordingly, PTSD is considered by the DSM-IV as having delayed onset when symptoms emerge 6 months or more after the traumatic event.<sup>1</sup>

Natural disasters are not common events, but when they do occur, they often affect a massive amount of people and hence provide an opportunity for an epidemiologic study. However, few longitudinal studies have specifically investigated the course of PTSD among adults after natural disasters. In a prospective study of 78 survivors of the 1988 earthquake in Armenia, Goenjian and colleagues<sup>4</sup> reported PTSD rates of 86.7% at 1.5 years and 73.3% at 4.5 years following the earthquake. Lower rates of 33.2% at about 9 months and 14.4% at 2 years follow-

ing exposure were reported in a study of 515 subjects exposed to an earthquake in Australia.<sup>5</sup> PTSD rates of up to 22.7% in a sample of 66 subjects evaluated at 3 and 9 months and 23% in 56 subjects at 1 month were reported following earthquakes in China<sup>6</sup> and India,<sup>7</sup> respectively.

These rates generally meet with reports of PTSD following other natural disasters. McFarlane<sup>8</sup> reported PTSD rates of 32%, 27%, and 30% among 350 firefighters in Australian bushfires who were studied 4, 11, and 29 months, respectively, after the trauma. Green et al.<sup>9</sup> reported PTSD rates of 44% at 2 years after the Buffalo Creek flood and 28% 12 years later. Duggan and Gunn<sup>10</sup> reported PTSD rates of 39% within the year after various natural disasters and 23% at 26 months after them. There is clear agreement that the disorder affects a significant proportion of those exposed to trauma and that it often follows a chronic course. However, the data differ between studies with regard to the initial, and to a larger extent the long-term, rate of PTSD following natural disasters. Reports on the initial rates range from 22.7%<sup>6</sup> to 32%<sup>8</sup> at 3 or 4 months after the trauma, respectively. The long-term rates suggest that chronic PTSD ranges from 23% at 2 years posttrauma<sup>10</sup> to 73% at 4.5 years posttrauma.<sup>4</sup>

Studies on the course of PTSD in the general population also indicate the long-term persistence of this illness. In 2 prospective studies on a sample of 64 rape victims, Rothbaum and Foa<sup>11</sup> found that 65% of them had PTSD symptoms after 1 month and 47%, after 3 months or longer. Rothbaum and Foa also reported lower PTSD rates among nonsexual crime victims: 36.7% after 1 month, 25% after 2 months, and 11.5% after 6 months. In that study, none of the victims showed PTSD 9 months after the traumatic event. In a prospective study of survivors of the Oklahoma City bombing, 36% met PTSD criteria 6 months after the trauma.<sup>12</sup> Interestingly, that study reported a significant contribution of the avoidance criterion to PTSD, as 94% of the subjects who met the avoidance criterion were diagnosed as having PTSD. Based on data from the National Comorbidity Survey,<sup>13</sup> Breslau<sup>14</sup> reported that among subjects who showed PTSD, a steep decline of symptoms occurred in about 40% of the subjects within 12 months following the trauma and thereafter the decline became less prominent.

PTSD rates appeared to be lower among victims of traumas of a nonassaultive nature. For example, among traffic accident victims, PTSD was observed in 36% after the first 4 months, and this prevalence decreased to 18% over another 6-month period.<sup>15</sup> In other studies, PTSD rates of 32% after 1 year,<sup>16</sup> 25% following an 18-month period,<sup>17</sup> and 11% after 3 years<sup>18</sup> were reported in traffic accident victims.

The current study prospectively examines the course of PTSD among 464 adult survivors of the 1999 earthquake in Turkey. They were repeatedly evaluated for PTSD symptoms in 3 consecutive surveys within 20

months following the earthquake, thus representing the specific postdisaster prevalence at each of the 3 time points. The aim of the study was 2-fold: first, to examine the natural course of PTSD, and, second, to clarify the relative contribution of the different diagnostic criteria (reexperiencing, avoidance, and arousal) to the development of PTSD. The importance of the study is that it includes the biggest sample ever studied and followed up for nearly 2 years after an earthquake. Moreover, this study examines rate of and gender differences in spontaneous remission over the course of the study, for which data are not established in the literature.

## METHOD

### Sample

Following the August 17, 1999, earthquake in the Marmara region of Turkey, 3 surveys were carried out. The first cohort consisted of 9422 subjects who filled in the checklist 1 to 3 months following the tremor. The second survey included 15,453 subjects tested 6 to 10 months after the quake, and the third survey covered 15,597 subjects 18 to 20 months after the quake. The present study consisted of the 464 adult subjects whose data were obtained on all 3 surveys.

### Procedure

The surveys were performed in Avcilar, a suburb of Istanbul that was severely affected by the earthquake with more than 500 people killed. Avcilar was chosen because it was the only place in the Istanbul province where the earthquake caused death and damage to property. The survey administrators were primary care nurses who worked in the survey district. The study was approved by the institutional review board of Sisli Eftal Teaching and Research Hospital in Istanbul, Turkey. Oral assent to participate in the study was given. The aim of the study was explained to the participants, and they were informed that there would be no form of compensation available for participation. The forms were distributed to all of the houses in the district and collected the next day. The data collected in the survey were used initially for the detection of subjects in need of further follow-up. All residents over the age of 16 years were asked to fill out the questionnaire. The response rate was about 85%, as the nurses who administered the questionnaires were well known to the people from ongoing health care contacts.

### Measures

**Demographic.** Demographic data included gender, age, marital status, number of children, education level, and occupation.

**Traumatic experience.** The subjects were asked about the level of exposure to the earthquake, the type of loss they experienced, the part they took in rescue missions,

and the need to evacuate their homes. They were also asked about their expectation and preparation for future recurrence of an earthquake.

**PTSD.** On each of the 3 surveys, a Turkish translation of the PTSD self-test of the Anxiety Disorders Association of America<sup>19</sup> was filled out by the subjects. The PTSD self-test is a checklist consisting of 17 items to which the subject replies “yes” or “no.” The items were categorized into the 3 diagnostic dimensions of the DSM-IV—reexperiencing (3 items), avoidance (7 items), and arousal (5 items)—and 2 general questions: (1) “Have you experienced or witnessed a life-threatening event that caused intense fear, helplessness, or horror?” and (2) “Do your symptoms interfere with your daily life?”

The scale’s validity was calculated using the Cronbach  $\alpha$  coefficient. The validity of the entire questionnaire was  $\alpha = .89$ . Validities of the subscales were as follows: re-experiencing,  $\alpha = .73$ ; avoidance,  $\alpha = .79$ ; and arousal,  $\alpha = .76$ . The construct validity of the scale was tested on 90 of the earthquake survivors who were also evaluated by the Clinician-Administered PTSD Scale (CAPS)<sup>20</sup> for DSM-IV. The concordance between the 2 scales was 86%. False-positive diagnoses were observed in 3% and false-negative diagnoses were observed in 11% of the cases.

The diagnostic criteria for PTSD were based on the DSM-IV definition.<sup>1</sup> According to responses on the 3 surveys, 4 groups of subjects were defined:

- No PTSD: subjects who did not meet PTSD criteria on any survey.
- Spontaneous remission: subjects who met PTSD criteria on the first but no longer met the diagnostic criteria on the second and third surveys, or met PTSD criteria on the first and second but no longer met the diagnostic criteria on the third survey. As the participants in this study received no treatment during the survey, all these remissions were considered spontaneous.
- Delayed onset: subjects who met PTSD criteria on the second and third surveys or on the third only, but not on the first survey.
- Chronic: subjects who met the PTSD criteria on all 3 surveys.

**Data analysis.** Most of the data are presented in terms of percentage of subjects. We used the term *PTSD population* for prevalences that were calculated as a ratio of the entire sample and the term *PTSD patients* for prevalences that were calculated among the subjects who showed PTSD on 1 or more of the 3 surveys. Chi-square models were used to test associations between variables. When using continuous measures as dependant variables, *t* tests, 2 × 2 factorial analyses of variance (ANOVAs),

**Table 1. Demographic Characteristics of 464 Turkish Earthquake Survivors**

Characteristic	Value
Age, mean (SD), y	34.4 (12.5)
Gender, N (%) <sup>a</sup>	
Male	131 (28.4)
Female	331 (71.6)
Married, N (%)	283 (61.0)
No. of children, mean (SD)	2.5 (1.25)
Education, N (%)	
Illiterate	17 (3.7)
Elementary	130 (28.0)
Junior high	58 (12.5)
Senior high	100 (21.6)
University	32 (6.9)
Did not answer	127 (27.4)
Occupation, N (%)	
Labor	32 (6.9)
Private business	47 (10.1)
Governmental	22 (4.7)
Household	200 (43.1)
Student	14 (3.0)
Unemployed	23 (5.0)
Did not answer	126 (27.2)

<sup>a</sup>Data missing for 2 subjects.

and Mann-Whitney tests were applied. All tests used 2-tailed significance levels.

Logistic regression models were applied for the prediction of PTSD diagnosis by the 3 diagnostic criteria (re-experiencing, avoidance, and arousal). First, odds ratios were calculated based on univariate logistic regression models. Second, the variables were introduced into a multivariate equation in a stepwise method, using the reduction of likelihood ratio as a criterion. Model fit at each stage was evaluated by the log likelihood value (−2LL); a well-fitting model is represented by a small −2LL value. Based on the decrease in the −2LL value, a “pseudo-R<sup>2</sup>” measure, compatible to the R<sup>2</sup> of multiple regression, was calculated. The statistical significance of each coefficient was calculated using the Wald statistic.

## RESULTS

The demographic characteristics of the subjects, including gender, age, marital status, number of children, education, and occupation, are presented in Table 1.

Most of the subjects (70.9%) were in the affected area during the earthquake. For 19.4%, a close person was harmed, but only 2 subjects (0.4%) were caught under the ruins themselves. The percentage of the subjects who participated in the rescue operation was 5.2%. The majority of the subjects (66.6%) had to evacuate their homes following the earthquake.

Expectation of a future tremor was reported by 67.7% of the subjects. Preparation for a future earthquake included instructions to the family (14%), geological checks (8.6%), preparing an emergency bag (4.7%), change of house (4.3%), and intention to leave the area (1.1%).

## General Prevalence

The prevalence of subjects who met PTSD criteria on 1 survey or more was 45.7% (54.3% did not develop PTSD) (Table 2); we refer to this group heretofore as the PTSD patients. In the entire sample, the PTSD prevalence at each of the 3 surveys was as follows: 30.2% after 1 to 3 months, 26.9% after 6 to 10 months, and 10.6% after 18 to 20 months following the trauma. Subjects who met the criteria at all 3 surveys were 5.2% of the entire sample (24/464). Thus, the prevalence of a chronic course among the PTSD patients was 11.3% (24/212).

PTSD prevalence among female subjects was higher than in males. PTSD criteria were met at least once by 49.8% of female subjects but by only 35.9% of the male subjects ( $\chi^2 = 7.38$ ,  $df = 1$ ,  $p < .01$ ). The difference in prevalence between male and female subjects was most pronounced on the first survey ( $\chi^2 = 11.02$ ,  $df = 1$ ,  $p < .01$ ) and attenuated with time (second survey:  $\chi^2 = 1.60$ ,  $df = 1$ ,  $p = .21$ ; third survey:  $\chi^2 = 0.43$ ,  $df = 1$ ,  $p = .51$ ) (Figure 1).

Associations were found between PTSD diagnosis and both demographic characteristics and traumatic experience. PTSD prevalence was significantly higher among subjects with an education level lower than junior high (48.3%) compared to subjects educated to junior high and above (34.8%) ( $\chi^2 = 5.92$ ,  $df = 1$ ,  $p < .05$ ). No age differences were observed between subjects without PTSD and PTSD patients ( $t = 0.46$ ,  $df = 462$ ,  $p = .65$ ).

Harm to people in close acquaintance was associated with a PTSD rate of 64.4%, whereas among subjects whose close acquaintances were not harmed, a PTSD rate of only 39.6% was seen ( $\chi^2 = 17.58$ ,  $df = 1$ ,  $p < .001$ ). Evacuation from home for periods longer than 1 week was associated with a PTSD rate of 58.7%, whereas evacuation periods of 1 week or less resulted in a PTSD rate of only 33.1% ( $\chi^2 = 20.17$ ,  $df = 1$ ,  $p < .001$ ). Lastly, subjects participating in rescue missions showed a higher PTSD rate (66.7%) compared with those who did not participate (43.1%) ( $\chi^2 = 5.06$ ,  $df = 1$ ,  $p < .05$ ).

## Spontaneous Remission

The prevalence of subjects who showed spontaneous remission (i.e., ceased to meet diagnostic criteria for PTSD despite having met them on previous survey[s]) within the first year was 15.9% of the entire population ( $N = 464$ ), and during the second year, an additional 7.8% showed remission (Table 2). Importantly, spontaneous remission was observed in 51.9% of the 212 PTSD patients.

The proportion of subjects showing spontaneous remission differed between female and male subjects. As can be seen in Figure 1, there was a constant decline in the percentage of female subjects across the 3 surveys. In the entire sample, more female than male subjects showed spontaneous remission within the 20-month pe-

**Table 2. Frequency and Percentage of Subjects in PTSD Diagnosis Combinations as Determined by Presence or Absence of PTSD Diagnosis on the 3 Surveys (N = 464)**

PTSD Category	PTSD Diagnosis			N (%)	Prevalence, %
	Survey 1	Survey 2	Survey 3		
No PTSD	No	No	No	252 (54.3)	54.3
Spontaneous remission					23.7
Combination 1	Yes	No	No	74 (15.9)	
Combination 2	Yes	Yes	No	36 (7.8)	
Delayed onset					4.1
Combination 1	No	Yes	Yes	12 (2.6)	
Combination 2	No	No	Yes	7 (1.5)	
Chronic	Yes	Yes	Yes	24 (5.2)	5.2
Other <sup>a</sup>				59 (12.7)	12.7

<sup>a</sup>“Other” subjects met PTSD diagnosis in the first and third surveys or met PTSD diagnosis in the second survey only and thus did not match any category defined.

Abbreviation: PTSD = posttraumatic stress disorder.

riod ( $\chi^2 = 8.73$ ,  $df = 1$ ,  $p < .01$ ). Among PTSD patients, 40.4% of male and 55.2% of female subjects showed spontaneous remission ( $\chi^2 = 3.18$ ,  $df = 1$ ,  $p = .075$ ).

The age of the subjects who showed spontaneous remission tended to be lower compared with the age of other subjects who met PTSD criteria at least once, indicating marginal significance (spontaneous remission: mean age = 37.4 years,  $SD = 10.2$  years; no spontaneous remission: mean age = 40.2 years,  $SD = 13.0$  years;  $t = 1.75$ ,  $df = 210$ ,  $p = .08$ ). The association between spontaneous remission and age did not differ between female and male subjects.

Demographic variables and traumatic experience were not associated with spontaneous remission.

## Delayed Onset

The population prevalence of subjects who showed delayed onset within the first year was 2.6%, and an additional 1.5% showed delayed onset during the second year following the trauma (Table 2). Among PTSD patients, the prevalence of delayed onset was 9%.

Of the entire sample ( $N = 464$ ), 3.9% of the female and 4.6% of the male subjects showed delayed onset, indicating no sex differences ( $\chi^2 = 0.10$ ,  $df = 1$ ,  $p = .75$ ). Among the PTSD patients ( $N = 212$ ), delayed onset was shown by 7.9% of the female and 12.8% of the male subjects ( $\chi^2 = 1.0$ ,  $df = 1$ ,  $p = .30$ ).

Age did not differ between those who showed delayed onset and other PTSD patients ( $t = 1.08$ ,  $df = 210$ ,  $p = .28$ ) or subjects who did not develop PTSD ( $t = 1.09$ ,  $df = 462$ ,  $p = .28$ ). An association between delayed onset and sex was found with regard to the age of the subjects. Among the subjects who showed delayed onset, the age of male subjects was higher than that of female subjects (Figure 2), whereas no difference in age was found between male and female subjects who did not show delayed onset. This finding was supported by a  $2 \times 2$  ANOVA with main factors of gender (male, female) and course



Figure 1. Percentage of Male and Female Subjects With Posttraumatic Stress Disorder at Each Survey

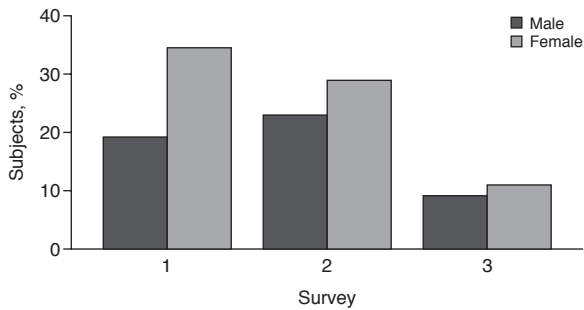
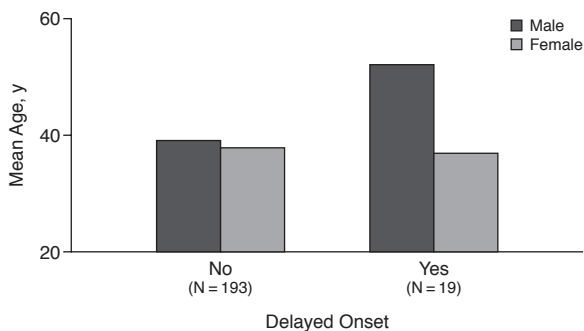


Figure 2. Age of Male and Female Posttraumatic Stress Disorder Subjects Showing or Not Showing a Delayed Onset



(no delayed onset, delayed onset), which yielded a significant gender-by-course interaction ( $F = 4.73$ ,  $df = 1,461$ ;  $p < .001$ ).

### Differential Contribution of the Diagnostic Criteria

**PTSD diagnosis.** In order to test the specific contribution of each diagnostic criterion to the diagnosis of PTSD, the associations between the intensity of each diagnostic aspect and the diagnosis were calculated. First, in each survey the associations between the 3 diagnostic criteria were calculated using Pearson correlations. Second, logistic regression models were performed to predict PTSD diagnosis in each survey.

The associations between the 3 diagnostic criteria were relatively high in each survey, indicating a high level of overlap between them. In addition, the correlations showed a high level of consistency between surveys with a maximal range of 0.09 between coefficients. The associations between reexperiencing and avoidance in the 3 surveys ranged from  $r = .52$  to  $.61$ ; between reexperiencing and arousal,  $r = .60$  to  $.69$ ; and between avoidance and arousal,  $r = .62$  to  $.69$  ( $df = 462$ ,  $p < .001$  for all).

Logistic regression models using the scores of the 3 diagnostic criteria as predictors of the PTSD diagnosis (no,

yes) were performed. As the results were very similar between the 3 surveys, we present herein the outcomes of the first survey only. Univariate models using avoidance, arousal, and reexperiencing showed odds ratios of 67.46, 16.96, and 9.15, respectively. A multivariate logistic regression model showed significant contribution of all 3 predicting variables (avoidance: Wald = 61.48,  $p < .001$ ; arousal: Wald = 21.26,  $p < .001$ ; reexperiencing: Wald = 11.84,  $p < .001$ ). Based on the improvement of the  $-2LL$  value, the model explained 64% of the diagnosis variance, as indicated by the "pseudo- $R^2$ " measure. Avoidance alone contributed to 89.85% correct predictions. Thus, the model suggests that as the level of avoidance responses increases, there is a higher chance that the subjects will be diagnosed with PTSD.

**Spontaneous remission.** We compared the 3 PTSD diagnostic criteria on the first survey between subjects who showed spontaneous remission and subjects with chronic PTSD. It is important to note that, at the first survey, subjects of both groups met PTSD diagnostic criteria, i.e., responded positively to at least 1 reexperiencing, 3 avoidance, and 2 arousal items. As the 3 diagnostic criteria did not show normal distribution, Mann-Whitney nonparametric tests were applied. The median scores for avoidance and arousal were significantly lower for spontaneous remission subjects compared with subjects with chronic PTSD (Table 3). No difference in reexperiencing was yielded. Among subjects who showed spontaneous remission, no sex differences were observed for any of the diagnostic criteria.

We examined the percentage of subjects showing spontaneous remission who met each diagnostic criterion in the third survey. It is important to note that, at the time of the third survey, these subjects no longer met the diagnostic criteria for PTSD. However, it is possible that some of the subjects met 1 or even 2 diagnostic criteria. Thus, showing the percentage of subjects meeting each diagnostic criterion could clarify which aspect contributed more to the definition of spontaneous remission. Among the subjects who showed spontaneous remission, 50.5% met the reexperiencing and 50.4% met the arousal criterion, while only 11.0% met the avoidance criterion. In addition, 35.3% of these subjects met both the reexperiencing and the arousal criteria, while only 7.3% met the combination of avoidance and reexperiencing and 8.1% avoidance and arousal. This finding implies that the reduction in avoidance behavior was an important factor that differentiated subjects who showed spontaneous remission from subjects with chronic PTSD.

**Delayed onset.** The 3 diagnostic criteria at the first survey were compared between subjects with no PTSD and subjects who showed delayed onset. Subjects of both groups did not meet the diagnostic criteria for PTSD at the time of the first survey. Mann-Whitney nonparametric tests were applied. The mean ranks of reexperiencing,

**Table 3. Scores (median and interquartile range) and Mann-Whitney Comparisons for the 3 PTSD Diagnostic Criteria on the First Survey for Subjects Who Later Showed Spontaneous Remission and Subjects With Chronic PTSD**

Diagnostic Criterion	Spontaneous Remission		Chronic		Z
	Median	Interquartile Range	Median	Interquartile Range	
Reexperiencing	3.0	1.0	3.0	0	1.16
Avoidance	4.0	2.0	5.0	2.0	3.40**
Arousal	4.0	2.0	5.0	1.0	2.04*

\*p < .05.  
\*\*p < .01.  
Abbreviation: PTSD = posttraumatic stress disorder.

**Table 4. Scores (median and interquartile range) and Mann-Whitney Comparisons for the 3 PTSD Diagnostic Criteria on the First Survey for Subjects Who Showed Delayed PTSD Onset or Did Not Develop PTSD**

Diagnostic Criterion	Delayed Onset		No PTSD		Z
	Median	Interquartile Range	Median	Interquartile Range	
Reexperiencing	2.0	2.0	1.0	2.0	10.34*
Avoidance	1.0	2.0	1.0	2.0	14.88*
Arousal	3.0	2.0	2.0	3.0	12.15*

\*p < .01.  
Abbreviation: PTSD = posttraumatic stress disorder.

avoidance, and arousal were significantly higher for subjects who later showed delayed onset compared to subjects with no PTSD (Table 4). These results indicate that higher scores on any of the diagnostic criteria could be predictive of a greater chance of developing delayed-onset PTSD.

We examined the percentage of subjects showing delayed onset who met each diagnostic criterion at the first survey. By definition, at this survey none of these subjects met PTSD diagnosis. However, it is possible that some of the subjects met 1 or even 2 diagnostic criteria. Thus, showing the percentage of subjects meeting each diagnostic criterion could clarify which aspect contributed more to the appearance of delayed onset. Among subjects who later showed delayed onset, the reexperiencing criterion was initially met by 89.5% and the arousal criterion was met by 57.8%, while the avoidance criterion was met only by 15.9%. In addition, in the first survey, 52.6% of these subjects met both the reexperiencing and the arousal criteria, while only 10.5% and 15.8% met avoidance in combination with either reexperiencing or arousal, respectively. These results indicate that, at the time of the first survey, most of the subjects who later showed delayed onset met the diagnostic criteria of reexperiencing and arousal, while only few met the avoidance criterion. Thus, the change in avoidance behavior seems to be the most critical aspect that contributed to the delayed onset of PTSD in these subjects. Among subjects who showed delayed

onset, no association was found between gender and the diagnostic criteria.

## DISCUSSION

### Natural Course

This report describes a 20-month follow-up of 464 survivors of the 1999 earthquake in Turkey. During those 20 months, 45.7% of the participants met, at least at one point, DSM-IV diagnostic criteria for PTSD. A total of 30.2% of the subjects exhibited PTSD on the first survey (1–3 months after the quake). The prevalence of PTSD decreased to 26.9% within 10 months, and to 10.6% at 20 months following the trauma. In this sample, only 11.3% of the subjects who met PTSD criteria in at least one of the 3 surveys were characterized by a chronic course of illness (i.e., showing PTSD on all 3 surveys). The notable decrease of prevalence of PTSD with the passage of time was due to a high level of spontaneous remission; 51.9% of the subjects who met PTSD criteria showed spontaneous remission within the 20-month period. Female subjects initially showed higher PTSD levels compared with male subjects, but as female subjects had higher levels of spontaneous remission, there were no gender differences at the third survey (18–20 months after the trauma), suggesting a less severe course in female subjects. The rates of delayed onset were relatively low (4.1%), indicating that delayed PTSD (in our sample) was not very prevalent. We define delayed onset as not meeting PTSD criteria at the first survey, but meeting those criteria at either the second and third or only the third survey. However, it is possible that some of those individuals actually had subthreshold PTSD initially, and “delayed onset” might in fact be related not to the appearance of the symptoms de novo but rather to exacerbation of existing symptoms that crossed the diagnostic threshold after several months. No difference in the prevalence of delayed onset was found between male and female subjects, but male subjects who showed this course were older compared with female subjects.

The prevalence of PTSD reported in the current study is in line with most of the existing reports of PTSD following a natural disaster.<sup>5,6,8,10</sup> Reports on PTSD rates following natural disasters indicated PTSD rates of 32% after 4 months,<sup>8</sup> 33.4% after 9 months,<sup>5</sup> 22.7% within 9 months,<sup>6</sup> and 39% within the first year.<sup>10</sup> However, our study differs from some of those studies in demonstrating higher rates of spontaneous remission, even in spite of the pending threat of a future earthquake. The PTSD rate in the current study is significantly lower than reports indicating a decrease from 87% after 1.5 years to 73% after 4.5 years following an earthquake in Armenia,<sup>4</sup> a relatively stable rate of 30% within a 29-month period,<sup>8</sup> and a rate of 28% after 2<sup>10</sup> or 12 years.<sup>9</sup> A possible explanation of the higher rate observed in Armenia might be related

to external conditions that made it harder for the victims. The earthquake took place in December (therefore, the population also had to fight with the harshness of a cold winter), and it occurred in remote places where no immediate help and support could be provided. This is in contrast to the earthquake that is the subject of this paper, which took place in summer and in a place that was easily accessible to major emergency services. A more general explanation of the lower rates observed in the present study could be the changes in diagnostic criteria of DSM-IV from the former DSM-III-R, since the new diagnostic criteria are harder to meet. Indeed, a direct comparison between the 2 sets of criteria has shown up to 50% decrease of PTSD rates when DSM-IV criteria were applied.<sup>6</sup>

A high remission rate of 56%, similar to that in the current study, was reported by Lewin and colleagues<sup>5</sup> in a study following an earthquake in Australia. Interestingly, the time frame of the occurrence of PTSD symptoms was similar, with substantial decrease of symptoms at the period between 12 to 20 months. In the current study, the spontaneous remission rate could be explained by the lack of secondary gains for symptom perseverance, as no compensation schedule for PTSD subjects was offered by Turkish authorities. This might have forced them to resume functionality. It has been shown that compensation-seeking veterans with PTSD report exaggerated symptoms compared with non-compensation-seeking veterans with PTSD.<sup>21,22</sup>

Important implications of the spontaneous remission rate could relate to the time frame of PTSD diagnosis. Firstly, the definition of chronic PTSD might be considered to be longer than 3 months, since according to our data about two thirds of the subjects showing PTSD at 3 months subsequently ceased to meet the diagnostic criteria. Secondly, it is possible that the minimal period of 1 month between the trauma and PTSD diagnosis is too short, yielding an overestimation of diagnosed subjects. When individuals are exposed to a stressful environment, activation of the sympathetic nervous system, leading to increased vigilance, might be related to survival. Accordingly, most of the exposed population will react with PTSD-like symptoms, if only for a limited period. In this perspective, PTSD could be viewed as impairment in the recovery or coping process. Thus, it could be argued that a substantial percentage of the subjects who were initially diagnosed as having PTSD showed a slower coping process compared with the nondiagnosed subjects. To compensate for the possibility that a high rate of the diagnosed subjects are in fact slow in recovery, a longer period between trauma and diagnosis could be requested as a diagnostic criterion.

The differential rate and course of PTSD among male and female subjects in the current study were notable considering that this was a natural disaster. It is important to note that the bias toward female subjects resulted from the

initial survey (1–3 months following the earthquake), and on the subsequent surveys, the percentages of female subjects were 54.5% and 53%. The main reason for the bias was that during the period following the earthquake, men were recruited to participate in organized work such as reconstruction and cleaning projects and were therefore difficult to reach. An alternative explanation for the difference could be that the more ill subjects would not work and stayed at home. Such bias would be expected to lead to inflated rates of PTSD. However, as our findings are very much in line with other reports of PTSD prevalence following an earthquake, this explanation is not in accord with the data.

Reports of gender differences in the prevalence of PTSD are common and relate mainly to violent traumatic events.<sup>23,24</sup> In the National Comorbidity Survey,<sup>13</sup> females were twice as likely as males to have lifetime PTSD, mainly due to violent events, but higher rates were reported also for natural disaster (fire) (males, 3.7%; females, 5.4%). In a retrospective study, Breslau and colleagues<sup>23</sup> reported that females show higher rate of PTSD for traumas of intentional violence but not for natural disasters and accidents. Our data do not conform to these findings and suggest that sex differences occur across types of traumas.

Some of the reports indicate a more severe<sup>24</sup> or longer<sup>25</sup> course in women compared to men. Our data conform with the higher prevalence of PTSD in females but not with reports of longer or more severe course. On the contrary, the rate of spontaneous remission in female subjects was higher compared to that in male subjects, and the prevalence of PTSD did not differ between female and male subjects 20 months after the earthquake.

Also, several variables, such as the occurrence of previous trauma or PTSD,<sup>26</sup> were not measured in this study and may have hampered the interpretation of the results.

### Diagnostic Criteria and Course

We evaluated the contribution of the different diagnostic criteria to the course of illness from 3 different perspectives: (1) the association with PTSD diagnosis, (2) the association with the course of illness, and (3) the association with remission. The most substantial associations of the 3 perspectives were with the avoidance symptom cluster. As determined using a logistic regression model, avoidance alone contributed to nearly 90% correct prediction of PTSD, with arousal and reexperiencing adding only 3.5% to the predictability. The low contribution of arousal and reexperiencing to the prediction could be explained by the relatively high associations between the 3 diagnostic categories, indicating that they are nonorthogonal (i.e., a high degree of overlap exists between avoidance, arousal, and reexperiencing).

The significance of avoidance in the diagnosis of PTSD was previously reported by some authors. Breslau

and colleagues<sup>23</sup> suggested that avoidance serves as a limiting criterion for PTSD diagnosis. That is, higher risk of PTSD is associated with higher level of avoidance symptoms. This was further stressed by findings that 94% of the subjects who met the avoidance criterion also met the other symptom criteria for PTSD,<sup>12</sup> while their absence in early stages effectively predicts who will not develop PTSD.<sup>27</sup> The possible significance of these findings was previously discussed by Davidson and Foa,<sup>28</sup> who suggested that the requirement for 3 avoidance symptoms might overshadow genuine PTSD that is otherwise manifested by the reexperiencing and arousal symptoms. They suggest that a better diagnosis could be achieved by lowering the avoidance threshold.

Lower avoidance and arousal scores were predictive of higher chance of spontaneous remission, suggesting that with less pathologic response and physiologic reactivity, the probability of a more benign course increases. Avoidance accounted for diagnostic fluctuations of 2 types: first, higher avoidance scores were associated with symptom exacerbations; second, reduction of avoidance symptoms was associated with remission of symptoms. Specifically, a lower chance to respond positively to some of the avoidance items on the first survey characterized subjects who later showed spontaneous remission, compared with subjects with chronic PTSD. Moreover, the predicting power of avoidance, more than the other aspects, was also shown in the prediction of delayed onset by the initial scores. High avoidance scores were predictive of a higher chance of developing PTSD at later stage. These findings suggest that proper treatment and focus on the avoidance aspect of PTSD could also ameliorate the other aspects of this illness and increase the rates of remission.

## SUMMARY

The prevalence of PTSD after an earthquake was 30.2% at 1 to 3 months after the earthquake, and due to substantial spontaneous remission it decreased to 10.6% at 1.5 years after the event. Another consequence of the high rate of spontaneous remission is low prevalence of chronic course, which was shown by 5.2% of the subjects. Female subjects initially appeared to be more affected, but as they tended to show more spontaneous remission, 1.5 years later the male and female prevalences were equal. Delayed onset was not common, appearing in 4.1% of the subjects, with high initial avoidance being a key factor in its development. Altogether, avoidance more than reexperiencing seems to play major role in the emergence of PTSD. As the follow-up continues, we will keep readers informed.

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