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A randomized controlled study of single-session behavioural treatment of earthquake-related post-traumatic stress disorder using an earthquake simulator

METİN BAŞOĞLU[1,2]*, EBRU ŞALCIOĞLU[1,2] AND MARIA LIVANOU[1]

[1] *Section of Trauma Studies, Division of Psychological Medicine, Institute of Psychiatry, King's College London, University of London, UK*; [2] *Istanbul Centre for Behaviour Research and Therapy, Istanbul, Turkey*

ABSTRACT

Background. Brief interventions are needed in dealing with traumatic stress problems in large survivor populations after devastating earthquakes. The present study examined the effectiveness of a single session of exposure to simulated tremors in an earthquake simulator and self-exposure instructions in reducing post-traumatic stress disorder (PTSD).

Method. Participants were consecutively recruited from among survivors screened during field surveys in the disaster region in Turkey. Thirty-one earthquake survivors with PTSD were assigned either to a single session of behavioural treatment ($n=16$) or to repeated assessments (RA; $n=15$). Assessments in the treatment group were at 4, 8, 12, 24 weeks and 1–2 years post-treatment. The RA cases were assessed at baseline and 4 and 8 weeks after trial entry, after which they received the same treatment and were followed up at 4, 12, 24 weeks and 1–2 years.

Results. Between-group treatment effects at week 8 were significant on measures of fear, PTSD and self- and assessor-rated global improvement. Improvement rates were 40% at week 4, 72% at week 12, 80% at week 24, and 80% at 1–2-years' follow-up, with large effect sizes on fear and PTSD measures. Post-session reduction in fear of earthquakes and increased sense of control over fear at follow-up related to improvement in PTSD.

Conclusion. The study provided further evidence of the effectiveness of a single session of behavioural treatment in reducing fear and PTSD in earthquake survivors. Future research needs to examine the usefulness of earthquake simulators in increasing psychological preparedness for earthquakes.

INTRODUCTION

Earthquakes affect large numbers of people and lead to high rates of post-traumatic stress disorder (PTSD) (Başoğlu *et al.* 2004), particularly in developing countries that suffer extensive devastation and casualties. Considering the numbers of people affected by some of the major disasters of the past decade, such as the earthquakes in Turkey, Taiwan, Iran and Pakistan, and the tsunami in Asia, there is a need for brief interventions that can be cost-effectively disseminated to survivors. Unfortunately, the currently available treatments for PTSD are neither sufficiently brief nor suitable for cost-effective dissemination in post-disaster circumstances.

Studies (Başoğlu *et al.* 2002; Şalcıoğlu *et al.* 2003, in press) after the 1999 earthquakes in

* Address for correspondence: Dr Metin Başoğlu, The Istanbul Centre for Behaviour Research and Therapy (ICBRT/DABATEM), Meşelik Sok. 36/5, Sıraselviler, Beyoğlu, Istanbul 80060, Turkey.
(Email: spjumeb@iop.kcl.ac.uk; mbasoglu@dabatem.org)

Turkey showed that pervasive conditioned fears and avoidance responses induced by repeated exposures to earthquake tremors and associated helplessness responses (Şalcıoğlu, 2004) played an important role in the development of PTSD. Fear-related stress symptoms were a prominent feature of PTSD in survivors, suggesting that an intervention designed to reduce fear might also reduce PTSD. Accordingly, we developed a modified version of cognitive-behavioural treatment (CBT) that involved mainly instructions for self-exposure to distressing or fear-evoking trauma cues with a focus on enhancement of sense of control and no systematic cognitive restructuring. This intervention was found to be effective in an open trial (Başoğlu *et al.* 2003*a*), reducing PTSD by 61% and achieving global improvement in 88% of the cases after two sessions. A subsequent randomized controlled study (Başoğlu *et al.* 2005) showed that a single session of modified BT led to global improvement in 85%, with 59% reduction in PTSD. Thus, although both studies achieved high rates of overall recovery, the survivors still had some residual PTSD symptoms. Furthermore, in the latter study participants with more severe fear, PTSD, depression and social disability improved less, mainly because of their difficulty in conducting self-exposure.

We conducted a further (uncontrolled) study (Başoğlu *et al.* 2003*b*) to examine whether exposure to simulated tremors in an earthquake simulator (without further self-exposure instructions) would achieve more improvement in PTSD. A finding of 71% improvement in PTSD suggested that this intervention might enhance the effectiveness of self-exposure, particularly in more severely ill cases, when used in combination. The next logical step would have been to compare each intervention with combined treatment but this was not feasible because we hypothesized 80% improvement with combined treatment and a large sample would have been required to demonstrate between-group differences of 10–20%. Instead, we examined the effectiveness of the combined treatment using a controlled design, hypothesizing an improvement of 80% in PTSD, independent of illness severity. We also tested the hypothesis that greater post-session reduction in fear of earthquakes and increased sense of control at follow-up would relate to greater improvement. We also conducted some direct and meta-analytic comparisons among our studies to examine differences in outcome.

METHOD

The study was conducted between December 2003 and August 2005 as part of an outreach treatment delivery programme that we had launched after the 1999 earthquakes in Turkey. The sample was obtained from among the participants of an epidemiological study and two field surveys conducted at three sites, using the Traumatic Stress Symptom Checklist (TSSC; Başoğlu *et al.* 2001) as a screening instrument for PTSD. The survivors who scored higher than 20 on the TSSC (cut-off = 25 for possible diagnosis of PTSD), were literate, and aged 18–65 years, were invited for an assessment of their eligibility for the study. Inclusion criteria were a DSM-IV diagnosis of PTSD and availability for follow-up. Exclusion criteria were predominant depression with suicidal ideas or grief, psychotic illness, history of cardiovascular problems, pregnancy, history of conversional fainting, use of benzodiazepines, use of antidepressants for less than 2 months at assessment, and previous CBT for earthquake-related PTSD.

The three field studies served a dual purpose: to study the prevalence of PTSD among survivors and to provide treatment for those in need. The survivors were informed that they would be contacted again if they needed (or requested) treatment. Help was sometimes offered as part of a treatment study but mostly on a routine basis. In 5 years about 12 000 survivors were screened and 5000 were provided with treatment.

Study design

Thirty-one participants were randomized either to exposure to simulated earthquake tremors and self-exposure instructions ($n = 16$) or to repeated assessment conditions (RA; $n = 15$). A computer-generated sequence of random numbers that ensured equal cell sizes and did not lead to allocation of more than two consecutive cases to the same experimental condition was used in the randomization. Participants who did not have treatment or at least one follow-up after treatment were replaced so that the random sequence could be preserved. Participants were enrolled by two independent assessors (psychologists) and randomization was conducted by the second author (E.Ş.), who did not participate in baseline assessments. Based on expected improvement rates of 70% in the treatment group and 15% in the RA group, a cell size of 12 was required to detect a between-groups difference significant at the 0·05 level with a degree of certainty of 0·90.

The assessments in the treatment group were at baseline and 4, 8, 12 and 24 weeks post-treatment. The RA cases were assessed at baseline and at weeks 4 and 8, after which they received the same treatment and were assessed at weeks 4, 12 and 24. Although not part of the original design, trial completers were also followed-up at least 1 year after treatment (mean 1·3 years, S.D. = 0·22, range 1·0–1·7). The assessors were blind as to the participants' experimental condition at the week 4 and week 8 assessments.

Measures

The assessor-rated measures included a semi-structured interview for earthquake survivors (Şalcıoğlu, 2004), the Turkish version (Aker *et al.* 1999) of the Clinician-Administered PTSD Scale (CAPS; Blake *et al.* 1996), the Structured Clinical Interview for DSM-IV (First *et al.* 1996), the Work and Social Adjustment Scale (WSA; Marks *et al.* 1998), and a Global Improvement Scale–Assessor (GIS-A). The latter was modified from the Clinician's Global Impression–Improvement rating (Marks *et al.* 1998), and included an item assessing overall improvement [0 = no improvement, 1 = minimal (<20%), 2 = moderate (20–60%), 3 = much (60–80%), 4 = very much (>80%)]. A Blindness Integrity Assessment Form was used at week 8 to obtain information about whether blindness was maintained and the assessors' guess as to the participants' experimental condition.

The self-rated measures included the Fear and Avoidance Questionnaire (FAQ; Başoğlu *et al.* 2005), which consisted of 35 items measuring avoidance of situations that evoked earthquake-related fears (0 = no avoidance, 3 = extreme avoidance), the Turkish version (Hisli, 1987) of the Beck Depression Inventory (BDI; Beck *et al.* 1974), and the Global Improvement Scale–Self (GIS-S; the self-rated version of the GIS-A). Treatment effect on sense of control was measured by a Sense of Control Scale (SCS; five items measuring change in fears, sense of control over feared situations, and courage, self-confidence, and belief about ability to cope in feared situations, each rated on a 0–3 scale; 0 = no change or worsening, 3 = much increased/decreased). Cronbach's α values for the SCS ranged from 0·91 to 0·94 at different assessment points. Finally, post-session change in fear of future earthquakes was measured on a 1–7 scale (1 = very much reduced, 4 = no change, 7 = very much increased).

The CAPS, FAQ, GIS-A and GIS-S were designated as the primary outcome measures. The assessors were standardized in their ratings through an inter-rater reliability exercise based on five videotaped and five live interviews (concordance rate of 90%). Written informed consent was obtained after the procedures were fully explained. The study was approved by the Research Ethics Committee of the Institute of Psychiatry, King's College London.

Treatment

Treatment was delivered in two steps. The first step (60 min) involved explanation of the treatment rationale, treatment target setting, and self-exposure instructions. The treatment targets involved four most functionally disabling problems, such as avoidance of safe buildings, staying home alone, going near sights of devastation or rubble. Unlike in a traditional behavioural approach, where treatment focus is on habituation to anxiety cues (e.g. stay in the situation until your anxiety subsides), the participants were asked to confront their fear until they felt in control. No systematic cognitive restructuring was undertaken.

The second step involved exposure to simulated earthquake tremors. The participants were told that this process was designed to enhance their sense of control over earthquake tremors and also to demonstrate how they could overcome their fears by confronting them. The earthquake simulator consisted of a small furnished house based on a shake table that could simulate earthquake tremors on nine intensity levels. The participants controlled the tremors (using a mobile control switch), stopping or starting it whenever they wanted to, and increasing the intensity whenever they felt ready for it. If the participant's anxiety related more to the tremors, they were asked to focus on this sensation and the sight and sound of the moving objects. If their distress related more to re-experiencing trauma events, they were encouraged to talk about these events to facilitate imaginal exposure. The session was terminated when the survivors felt in complete control of their distress or fear. Mean session duration was 33 min (S.D. = 18, range 9–70 min).

The treatment was conducted by E.Ş. in accordance with a protocol. The therapist had extensive experience in treatment delivery from previous studies. Treatment integrity checks were not conducted because the treatment protocol closely reflected the way treatment was delivered in routine fieldwork. Audiotaping of the entire session was not possible because of the loud noise generated by the earthquake simulator.

Data analyses

Data analyses were conducted using SPSS version 12 (SPSS Inc., Chicago, IL, USA). Between-group treatment effects were examined using repeated measures analyses of variance (ANOVAs). Other comparisons involved χ^2 tests for categorical variables and t tests for continuous variables. The groups were pooled after the RA cases received treatment at week 8 to examine longer-term outcome using repeated measures ANOVAs. The week 8 assessment for the RA group was taken as their pretreatment baseline. As completers and intent-to-treat analyses yielded similar results (due to only four non-completer cases), only the results of the latter (more conservative) analyses were reported. Effect sizes were based on Cohen's d (Cohen, 1992). In pooled analyses effect sizes were also based on 'change score divided by standard deviation of change' (Marks *et al.* 1998) to allow comparison with our previous studies.

A direct comparison of outcome between our previous study of self-exposure (Başoğlu *et al.* 2005) and the present study was possible because both studies used the same methodology and the samples did not significantly differ on pretreatment characteristics. We used an analyses of covariance (ANCOVA) to compare the two samples in change in total CAPS and item scores from baseline to 1–2 years' follow-up. As baseline scores correlated significantly with change scores in the present study, they were used as a covariate in each analysis to control for this 'ceiling' effect.

RESULTS

Flow of participants

Fig. 1 shows the flow of participants through the study. Compared with the 192 assessment-eligible survivors, those who were inaccessible for further contact or refused assessment ($n = 220$) were more likely to be male [14% *v.* 36%, $\chi^2 = 23{\cdot}8$, df = 1, $p < 0{\cdot}001$, odds ratio (OR) 3·35, 95% confidence interval (CI) 2·1–5·5] and have lower TSSC scores (mean 41, S.D. = 10 *versus* mean 38, S.D. = 10, $t = 2{\cdot}9$, df = 448, $p < 0{\cdot}01$, 95% CI 0·9–4·7). Thus, the survivors who underwent full assessment had slightly more severe post-traumatic stress. Men were less likely to be at home during work hours when house visits were made. The 68 survivors who had PTSD at assessment but were otherwise ineligible for study were similar to the 33 trial entrants on pretreatment characteristics. Of the 15 treatment refusers, 13 were women. Seven survivors did not want treatment, either because of fear or because they did not find the treatment credible. Three women wanted treatment but their husbands did not allow them (possibly for cultural reasons). Five survivors were not motivated for any kind of treatment. The treatment refusers were similar to the trial participants on all pretreatment characteristics.

The six control group participants who did not receive treatment had significantly lower baseline total CAPS scores than did the treated RA cases (mean 53·2, S.D. = 12·1 *versus* mean 68·4, S.D. = 13·1, $t = -2{\cdot}3$, df = 13, $p = 0{\cdot}04$). Three of these cases were not given treatment because they had improved as a result of self-instigated exposure during the RA period. Two participants, when asked questions about their avoidance behaviours, concluded that avoidance was a problem that needed to be overcome and started conducting systematic exposure. The third participant, a previous survivor camp resident who had just been relocated to a flat in a block of apartments prior to trial entry, realized that 'there was no escape from fear' and started conducting exposure.

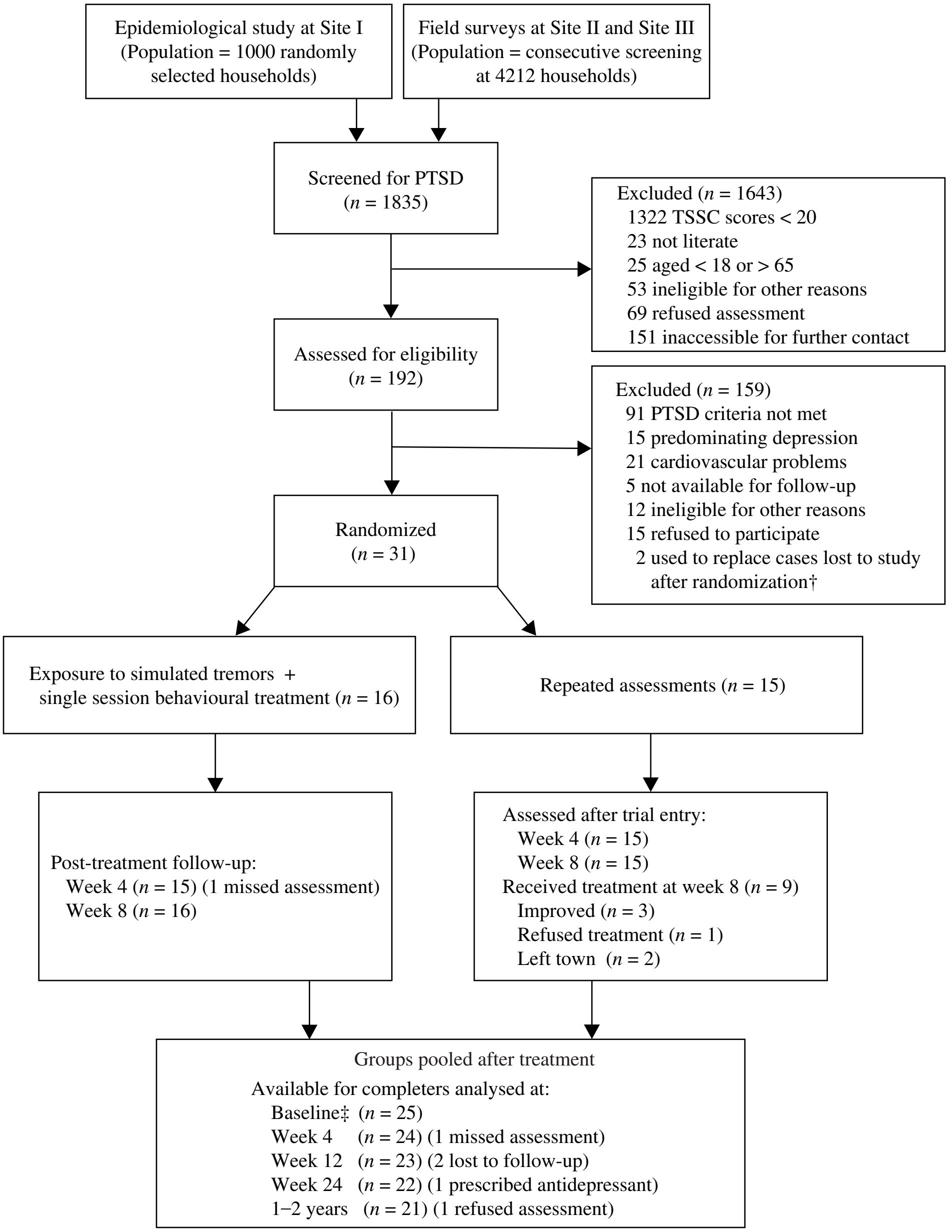

Fig. 1. Flow of participants through each stage of the study. PTSD, Post-traumatic stress disorder; TSSC, Traumatic Stress Symptom Checklist. † One participant lost to study after randomization and another lost to follow-up after treatment. ‡ Week 8 assessment taken as pretreatment baseline for the control group.

Sample characteristics

The study groups were similar in all baseline variables. Mean age was 34 (s.d. = 11). Twenty-seven (87 %) participants were women and 26 (84 %) married. The preponderance of women in the sample reflected in part the threefold higher prevalence of PTSD in women than in men (Başoğlu *et al.* 2004). Fifteen participants (48 %) had primary school education while five (16 %) had secondary school, eight (26 %) high school, and three (10 %) university education.

Table 1. *Comparison of clinical outcome in active treatment (n = 16) and control groups (n = 15)*

	Baseline		Week 4		Week 8		Between-group effect		Cohen's d[a]	
Measures	Mean	S.D.	Mean	S.D.	Mean	S.D.	Week 4 F/t[b]	Week 8 F/t[b]	Week 4	Week 8
Clinician-Administered PTSD Scale (0–136)										
Treatment	63·1	10·1	38·7	18·7	30·2	20·3	12·3**	9·2**	0·9	0·9
Control	62·3	14·5	54·5	16·9	49·1	20·3				
Fear and Avoidance Questionnaire (0–105)										
Treatment	55·4	18·2	30·3	14·5	24·6	15·1	25·7***	9·9**	1·1	0·9
Control	53·1	21·4	51·0	22·5	43·5	25·0				
Beck Depression Inventory (0–63)										
Treatment	23·4	5·9	13·1	6·2	13·3	9·2	10·5**	3·6*	1·1	0·5
Control	21·9	3·5	20·5	7·4	18·4	11·0				
Work and Social Adjustment (0–8)										
Treatment	4·1	0·8	2·2	1·4	1·7	1·9	8·1**	3·7*	0·8	0·6
Control	4·1	0·9	3·3	1·4	2·7	1·6				
Global Improvement Scale–Self										
Treatment	—		2·3	1·0	2·8	1·0	4·8***	3·2**	1·7	1·2
Control	—		0·8	0·8	1·7	0·8				
Global Improvement Scale–Assessor[c]										
Treatment	—		—		2·6	1·2	—	3·1**	—	1·1
Control	—		—		1·4	1·0	—			

[a] Cohen's $d = (\text{Mean}_{\text{control}} - \text{Mean}_{\text{treatment}})/[\sqrt{(\text{S.D.}^2_{\text{control}} - \text{S.D.}^2_{\text{treatment}})/2}]$.
[b] t value applies only to analyses involving Global Improvement Scale–Self (GIS-S) and Global Improvement Scale–Assessor (GIS-A).
[c] Not administered at week 4.
* $p = 0{\cdot}07$, ** $p < 0{\cdot}01$, *** $p < 0{\cdot}001$.

Three (10%) survivors had been trapped under rubble, nine (29%) had physical injury, and 21 (68%) had lost second-degree relatives or friends. The mean time since the earthquake was 4·5 years (S.D. = 0·2). Eleven participants (36%) had major depression, three (10%) panic disorder, and six (19%) panic disorder with agoraphobia.

Treatment effects

Table 1 shows a comparison of the two groups in treatment outcome. The treatment effects were significant on all primary outcome measures. The effect sizes were large on all primary outcome measures (0·20 = small, 0·50 = medium, 0·80 = large effect size; Cohen, 1992). Some improvement was noted in the control group, as indicated by a 21% reduction in CAPS scores at week 8. The three participants who conducted self-exposure during the control period accounted for 20% of the improvement in CAPS scores. Based on the criterion of much/very much improved according to GIS-S, the Number Needed to Treat (NNT = 1/proportion benefiting from treatment minus the proportion benefiting from control intervention) was 2·04 (95% CI 1·29–2·79), suggesting effective treatment (Laupacis *et al.* 1988).

Analysis of treatment outcome in pooled groups

Table 2 shows treatment outcome in pooled groups. The groups were similar in their pre-treatment and improvement scores. Of the four trial non-completers, only one had not improved according to GIS-S at their last assessment. Change in all measures was significant at all time points. Improvement continued beyond week 12, reaching a maximum at week 24. Much/very much improvement rates according to GIS-S were 40% at week 4, 72% at week 12, 80% at week 24, and 80% at 1–2 years' follow-up. Improvement rates according to GIS-A (not

Table 2. *Intent-to-treat analyses in pooled groups* ($n = 25$)

Measures and assessment points	Mean	S.D.	F^{a}	PI	Effect size[b]	Effect size[c]
CAPS (0–136)						
Baseline	61·3	13·4				
Week 4	34·9	22·6	61·1***	46	1·6	1·4
Week 12	19·8	16·7	116·4***	67	2·2	2·7
Week 24	13·7	12·5	190·0***	78	2·8	3·7
1–2-year follow-up	12·7	14·3	168·4***	79	2·6	3·5
FAQ (0–105)						
Baseline	54·1	19·4				
Week 4	29·6	16·7	84·6***	44	1·8	1·4
Week 12	20·6	18·9	65·5***	61	1·6	1·8
Week 24	14·2	13·7	82·7***	71	1·8	2·4
1–2-year follow-up	14·0	15·4	84·1***	73	1·8	2·3
BDI (0–63)						
Baseline	23·5	7·6				
Week 4	13·1	10·7	36·3***	45	1·2	1·1
Week 12	9·1	7·5	64·1***	59	1·6	1·9
Week 24	7·6	7·1	56·2***	64	1·5	2·2
1–2-year follow-up	5·9	6·6	66·4***	72	1·6	2·5
WSA (0–8)						
Baseline	3·8	1·1				
Week 4	2·0	1·7	12·0**	57	1·6	1·3
Week 12	1·1	1·5	19·4***	76	1·9	2·1
Week 24	0·6	1·2	39·8***	86	2·2	2·8
1–2-year follow-up	0·6	1·1	41·8***	86	2·2	2·9

CAPS, Clinician-Administered Post-Traumatic Stress Disorder (PTSD) Scale; FAQ, Fear and Avoidance Questionnaire; BDI, Beck Depression Inventory; WSA, Work and Social Adjustment; PI, percentage improvement.

[a] Repeated-measures analysis of variance (ANOVA) within-subjects contrasts testing change from baseline (all df's = 1, 24).

[b] Calculated as mean change divided by standard deviation (S.D.) of that change.

[c] Cohen's $d = (\text{Mean}_{\text{baseline}} - \text{Mean}_{\text{follow-up}})/[\sqrt{(\text{S.D.}^2_{\text{baseline}} - \text{S.D.}^2_{\text{follow-up}})/2}]$.

** $p < 0{\cdot}01$, *** $p < 0{\cdot}001$.

obtained at week 8) were 76% at week 12, 88% at week 24, and 84% at final follow-up.

Using the criterion (Jacobson & Truax, 1991) of 2 S.D. or more improvement since baseline, the rates of improvement in CAPS were 52% at week 4, 72% at week 12, 92% at week 24, and 92% at 1–2-years' follow-up. At the latter assessment 18 (72%) cases achieved good end-state functioning, defined as a CAPS total score of 19 or less (indicating absence of PTSD; Weathers *et al.* 2001) and a BDI score of 10 or less (Kendall *et al.* 1987). Among the 17 much/very much improved cases at week 12, only one showed relapse (e.g. a subsequent rating of 0 or 1 on the GIS-S) during follow-up.

Following the treatment session, 18 (72%) participants reported marked to very much reduction in their fear of future earthquakes. This measure correlated significantly with change in CAPS at most assessments (week 4: $r = 0{\cdot}41$, $p < 0{\cdot}05$; week 12: $r = 0{\cdot}64$, $p < 0{\cdot}001$; week 24: $r = 0{\cdot}45$, $p = 0{\cdot}03$, 1–2-year follow-up: $r = 0{\cdot}38$, $p = 0{\cdot}06$). The mean SCS scores (range 0–15) ranged from 8·3 (S.D. = 3·6) at week 4 to 11·0 (S.D. = 4·1) at 1–2-year follow-up, indicating marked to much increase in sense of control over fears. The SCS correlated significantly with change in CAPS at all assessments (r's from 0·64 to 0·77, all p's $< 0{\cdot}001$).

In six cases follow-up assessments were conducted by the therapist because the assessors had to leave the study due to an unexpected shortage of funding. Four participants in the treatment group unintentionally revealed their experimental condition during assessment. These 10 cases did not differ significantly from the others in assessor-rated outcome measures, suggesting that unblinding did not affect the assessors' ratings. However, among the 21 cases whose assessment was blind, the assessors correctly guessed the treatment condition in 16 (nine RA, seven treatment). The rate of correct guessing was higher than expected by chance ($\chi^2 = 5{\cdot}8$, df $= 1$, $p = 0{\cdot}02$).

Table 3. *Clinical trials of modified behavioural treatment in earthquake survivors – intent-to-treat analyses*[a]

	Study 1 ($n=143$)[b]		Study 2 ($n=10$)[c]		Study 3 ($n=51$)[d]		Present study ($n=25$)	
	PI	ES	PI	ES	PI	ES	PI	ES
Clinician-Administered PTSD Scale	—	—	71	2·5	59	1·7	79	2·6
Traumatic Stress Symptom Checklist	56	1·8	72	2·5	67	2·0	—	—
Fear and Avoidance Questionnaire	67	1·9	66	1·7	69	1·9	73	1·8
Beck Depression Inventory	53	1·2	66	1·2	59	1·2	72	1·6
Work and Social Adjustment–Self	69	1·5	—	—	—	—	86	2·2
Global Improvement–Self[e]	75	—	80	—	86	—	80	—
Global Improvement–Clinician[e]	83	—	—	—	90	—	88	—

PI, Percentage improvement; ES, effect size, based on mean change score divided by standard deviation (S.D.) of the change; PTSD, post-traumatic stress disorder.
[a] Outcome at mean 7·2 weeks post-treatment in study 1, 12 weeks in study 2, 12 months in study 3 and 13 months in present study.
[b] Self-exposure instructions (mean of five sessions). Based only on cases with PTSD (Başoğlu *et al.* 2003*a*).
[c] Single session of exposure to simulated earthquake tremors (Başoğlu *et al.* 2003*b*).
[d] Single session of self-exposure instructions (Başoğlu *et al.* 2005).
[e] Defined as much/very much improvement.

Because of too few cases for regression analysis, the pretreatment predictors of outcome (age, gender, education, past psychiatric illness, history of past trauma, time since the earthquake, and the pretreatment clinical ratings) at the last follow-up were examined by correlational analyses (p set to 0·001 after Bonferroni adjustment). No variable correlated significantly with change in the outcome measures.

Comparison with previous studies

Table 3 shows a comparison of findings across our studies in terms of percentage of improvement in clinical ratings, effect sizes, and global improvement. The effects sizes on the PTSD measures (TSSC in study 1) were larger in the studies involving exposure to simulated earthquake tremors than in studies of self-exposure alone. The between-group effect size on CAPS with combined treatment was 0·90, compared with 0·44 achieved by self-exposure in study 3 (not shown in Table 3). An improvement of 79% in CAPS with combined treatment, as opposed to 59% with self-exposure, was consistent with a hypothesized difference of 20% between the two treatments.

Compared to self-exposure at final follow-up, combined treatment achieved greater improvement in CAPS (mean 65, S.D. = 17 to mean 27, S.D. = 25 *versus* mean 61, S.D. = 13 to mean 13, S.D. = 14; $F=5{\cdot}7$, df = 1,73, $p=0{\cdot}02$) and symptoms of irritability ($p<0{\cdot}001$), loss of interest ($p<0{\cdot}001$), nightmares, distress related to trauma reminders, emotional numbing, sense of foreshortened future, sleeping difficulty, and memory/concentration difficulty (all p's $<0{\cdot}05$). Applying Cohen's d formula to compare within-group change in CAPS between the two studies, an effect size of 0·90 was found, indicating a strong between-samples effect size. More cases had good end-state functioning with combined treatment than with self-exposure, although the difference just failed to reach significance (72% *v.* 49%, $\chi^2=3{\cdot}6$, df = 1, $p=0{\cdot}058$).

DISCUSSION

The present study provided further evidence of the effectiveness of modified BT in earthquake-related PTSD. An effect size of 2·7 (2·2 based on mean change/S.D. of change) on the CAPS at the 3-month follow-up was substantially larger than the mean effect size of 1·27 reported in a meta-analysis (van Etten & Taylor, 1998) of studies of CBT in PTSD. Our study also compares favourably with more recent studies reporting an effect size of 0·9 with 10 sessions of imaginal exposure (Tarrier *et al.* 1999), 2·46 with 12 sessions of cognitive therapy (Ehlers *et al.* 2003), and 1·3 (based on mean change/S.D. of change) with 10 sessions of exposure treatment (Marks *et al.* 1998).

Could these comparisons reflect greater treatment responsiveness in our sample? A mean CAPS score of 63 in our study was similar to those in some studies (e.g. 58 in Ehlers *et al.* 2003 and 63 in the exposure group of Marks *et al.* 1998) but lower than in others (e.g. 69 in Bryant *et al.* 2003, 71 in Tarrier *et al.* 1999, 80 in Schnurr *et al.* 2003, and 98 in Paunovic & Öst, 2001). Our treatment was, however, effective in cases with CAPS scores up to 92. Nevertheless, a single session might not be sufficient in some cases complicated by various co-morbid illnesses. It is worth noting that a single-session intervention was not originally intended for the most severely ill cases, which constitute a relatively small proportion of survivors after major earthquakes. Rather, it was developed with a view to providing cost-effective help for the majority of survivors, while sparing longer and more costly treatments for non-responders to a single-session intervention.

An improvement of 21% in PTSD in our control group is not substantially higher than that reported in other studies (e.g. 21% in Foa *et al.* 2005, 18% in Foa *et al.* 1999, and 18% in Ehlers *et al.* 2003). Excluding the three participants whose improvement was due to self-exposure, the improvement rate was 17%. Considering that the FAQ scores also reduced by 18%, improvement in controls might reflect in part the fear- and helplessness-reducing effects of various processes, such as contact with a therapist, anticipation of forthcoming help, and a strong element of imaginal exposure involved in a detailed assessment of trauma history. Detailed assessments also seemed to help survivors recognize their problems as treatable 'symptoms', thereby reducing their helplessness.

Although our results need to be confirmed by a comparative study, the exposure session seemed to confer additional benefits. Several explanations are possible. The treatment involved exposure to the primary causal agent (unconditioned stimuli) for fear, that is the earthquake tremors, which might have more powerful fear-reducing effects than exposure to trauma reminders (i.e. conditioned stimuli). Fear reduction predicted subsequent improvement in PTSD, suggesting that the session contributed to long-term improvement. In addition, a simulation of the original trauma evoked the full range of earthquake-related memories and associated emotions, thereby leading to more extensive imaginal exposure than would normally occur with self-exposure to conditioned stimuli. Furthermore, enhanced sense of control over earthquake tremors might have contributed to improvement, as suggested by the association between increased sense of control and improvement and the low relapse rate. Increased sense of control also seemed to enhance resilience, as suggested by the fact that 11 of the 13 survivors who experienced an earthquake some time after the treatment reported much less fear than usual during the tremors.

The characteristics of earthquake trauma also need to be taken into account in explaining the potency of the intervention. A fear-focused approach was designed specifically for earthquake trauma, based on findings showing that conditioned fears and helplessness induced by repeated exposures to unpredictable and uncontrollable earthquakes are both mediators and prominent features of earthquake-related PTSD (Başoğlu *et al.* 2004; Şalcıoğlu, 2004). The intervention was thus a good match for the problem. Other conditions with similar features, such as specific phobias, are also responsive to a single exposure session (Öst, 1996; Öst *et al.* 2001). Our intervention was different from phobia treatment, however, in that it involved exposure not only to fear cues but also to distressing trauma memories or reminders.

Improvement in cognitive symptoms of PTSD (e.g. sense of foreshortened future, detachment, guilt) suggests that exposure led to cognitive change, a finding also reported by other studies (Paunovic & Öst, 2001; Foa *et al.* 2004). These findings suggest that the treatment might also be useful in PTSD characterized by emotions other than fear, provided that adequate exposure to the cues that trigger such emotions takes place. In cases where fear is not the predominant feature, treatment could focus on cues that trigger re-experiencing symptoms. Our previous work (Başoğlu *et al.* 2002) shows that 85% of earthquake survivors have either behavioural/cognitive avoidance or at least one re-experiencing symptom, most commonly (61%) distress associated with trauma reminders. Such an alternative approach is worth testing in future research.

A limitation of our study concerns the relatively short control period. Given that the control group showed some improvement and treatment gains took six months to reach a maximum, a controlled comparison at week 24 would have allowed a more reliable study of treatment effects. This was not, however, feasible, because it would have been difficult to keep the participants in the study without treatment for such a long period. Furthermore, this might have raised ethical concerns, considering that not all participants were non-treatment-seeking. In fact, 36% had previously sought and received drug treatment with no improvement and 61% stated at first contact that they needed treatment.

Other limitations include a relatively small sample size, potential sampling biases not detected by our study measures, and the exclusion of survivors with grief problems. Small samples might yield unstable treatment effects that might not be replicable across studies. It is thus important to view all our studies together. The predominance of women in the sample might be a potential source of bias, although gender did not relate to treatment outcome in our previous studies. Although the present study involved a community sample, similar results were obtained in our previous studies of treatment-seeking survivors (Başoğlu *et al.* 2003*a*, *b*). Correct guessing of the participants' experimental condition by blind assessors, a common problem in clinical trials that involve a highly effective psychological treatment, need not necessarily invalidate assessor ratings, as the latter may reflect true treatment response (Başoğlu *et al.* 1997).

In conclusion, our studies viewed together suggest that self-exposure alone would meet the needs of the majority of earthquake survivors (i.e. those with relatively less severe traumatic stress), while exposure in an earthquake simulator could be reserved for non-responders to self-exposure. Considering that 5–10 people can be treated in a single session, the treatment is 50–100 times more cost-effective in terms of therapist time than 10-session CBT. Given the large numbers of survivors who need treatment after major earthquakes, the treatment is likely to be highly cost-effective in the long term, despite the initial cost of an earthquake simulator. Earthquake simulators might also have a potential use in increasing psychological preparedness for earthquakes in earthquake-prone countries, if further research can confirm their resilience-building potential.

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DECLARATION OF INTEREST

None.

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