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ORIGINAL ARTICLE

Recovery from DSM-IV post-traumatic stress disorder in the WHO World Mental Health surveys

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Background. Research on post-traumatic stress disorder (PTSD) course finds a substantial proportion of cases remit within 6 months, a majority within 2 years, and a substantial minority persists for many years. Results are inconsistent about pre-trauma predictors.

Methods. The WHO World Mental Health surveys assessed lifetime DSM-IV PTSD presence-course after one randomly-selected trauma, allowing retrospective estimates of PTSD duration. Prior traumas, childhood adversities (CAs), and other lifetime DSM-IV mental disorders were examined as predictors using discrete-time person-month survival analysis among the 1575 respondents with lifetime PTSD.

Results. 20%, 27%, and 50% of cases recovered within 3, 6, and 24 months and 77% within 10 years (the longest duration allowing stable estimates). Time-related recall bias was found largely for recoveries after 24 months. Recovery was weakly related to most trauma types other than very low [odds-ratio (OR) 0.2–0.3] early-recovery (within 24 months) associated with purposefully injuring/torturing/killing and witnessing atrocities and very low later-recovery (25+ months) associated with being kidnapped. The significant ORs for prior traumas, CAs, and mental disorders were generally inconsistent between early- and later-recovery models. Cross-validated versions of final models nonetheless discriminated significantly between the 50% of respondents with highest and lowest predicted probabilities of both early-recovery (66–55% *v.* 43%) and later-recovery (75–68% *v.* 39%).

Conclusions. We found PTSD recovery trajectories similar to those in previous studies. The weak associations of pre-trauma factors with recovery, also consistent with previous studies, presumably are due to stronger influences of post-trauma factors.

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Introduction

Little research has been done on the predictors of the long-term course of post-traumatic stress disorder (PTSD) (reviewed by Steinert *et al.* 2015). Existing evidence suggests that even though a substantial proportion of cases recover within a few months, at least one-third of cases persist for many years (Kessler *et al.* 1995; Breslau *et al.* 1998; Pietrzak *et al.* 2011; Chapman *et al.* 2012), and that chronic PTSD can lead to secondary disorders (Perkonigg *et al.* 2005) and suicidality (Tarrier & Gregg, 2004). The predictors of PTSD recovery considered most often in retrospective research have been trauma type-characteristics, PTSD symptom severity, and history of comorbid mental disorders (Breslau *et al.* 1998; Pietrzak *et al.* 2011; Chapman *et al.* 2012), although systematic reviews of prospective naturalistic studies suggest that socio-demographic factors and childhood adversities might also be important predictors (Steinert *et al.* 2015).

Previous studies of PTSD recovery were limited in being based on relatively small samples, making it impossible to investigate fine-grained associations. We address this limitation in the current report by presenting data on patterns and predictors of PTSD recovery in a sample of 1575 respondents with a history of PTSD in the WHO World Mental Health (WMH) surveys, a coordinated series of community epidemiological surveys carried out in countries throughout the world (Kessler & Üstün, 2008).

Materials and methods

Samples

Data come from 22 WMH surveys that assessed PTSD due to *randomly-selected* traumas (defined below). Twelve of these surveys were conducted in countries classified by the World Bank as high-income [Belgium, France, Germany, Israel, Italy, Japan, Netherlands, New Zealand, Northern Ireland, Spain (separate national and regional surveys), the USA], seven in countries classified upper-middle-income (Brazil, Bulgaria, Colombia, Lebanon, Mexico, Romania, South Africa), and three in countries classified low- and lower-middle-income [Peru, Ukraine, Colombia (a national survey administered prior to the previously-mentioned Colombian survey, which was carried out in the Medellin region, when the country income rating was lower)]. Each survey was based on a multi-stage clustered area probability sample of adult household residents. The target population was the entire country in most surveys, all urbanized areas in three (the first Colombian survey in addition to the surveys in Mexico and Peru), and specific metropolitan areas in four (Sao Paulo, Brazil; Medellin, Colombia; Murcia, Spain; six cities in Japan). Response rates ranged from 45.9% (France) to 97.2% (Medellin) and averaged 71.3% across surveys. More details about surveys and sample designs are presented in online Supplementary Table S1.

The interview schedule was developed in English and translated into other languages using a standardized WHO translation, back-translation, and harmonization protocol (Harkness *et al.* 2008). Interviews were administered face-to-face in respondent homes after obtaining informed consent using procedures approved by local Institutional Review Boards. Interviews were in two parts. Part I was administered to all respondents and assessed core DSM-IV mental disorders ($n = 101\,454$ respondents across all surveys). Part II assessed additional disorders and correlates. Questions about traumas and PTSD were included in Part II, which was administered to 100% of respondents who met lifetime criteria for any Part I disorder and a probability subsample of other Part I respondents ($n = 54\,601$). Part II respondents were weighted to adjust for differential probabilities of selection into Part II, and deviations between the sample and population demographic-geographic distributions. This weight resulted in prevalence estimates of Part I disorders in the weighted Part II sample being identical to those in the Part I sample. More details about WMH weighting are presented elsewhere (Heeringa *et al.* 2008). The analysis sample in the current report was the 1575 respondents who developed DSM-IV PTSD after a *randomly-selected* trauma (defined below).

Measures

Traumas

As detailed in a prior report in this journal (Benjet *et al.* 2016), 29 trauma types were assessed. Exploratory factor analysis showed that they can be organized into six broad empirically-related groups (Benjet *et al.* 2016): five representing *exposure to organized violence* (e.g., civilian in war zone, civilian in region of terror, relief worker in war zone, refugee), five representing *participation in organized violence* (e.g., combat experience, witnessed atrocities); three indicators of *physical violence victimization* (witnessed violence at home as child; beaten by caregiver as child; beaten by someone other than romantic partner); seven representing *exposure to sexual violence victimization* (e.g., raped, sexually assaulted, beaten by romantic partner); six involving various *accidents/injuries* (e.g., natural disaster, automobile accident); and three *other* traumas that did not load on any of the five factors (mugged/threatened with weapon, man-made disaster, unexpected death of loved one).

Positive responses to trauma questions were followed by probes to assess the number of lifetime exposures and age at first exposure to each trauma type. Respondents who reported only one occasion of only one trauma type were assessed for PTSD associated with that occasion. Respondents who reported multiple trauma types and/or occasions were assessed twice: once for the trauma they defined as the worst trauma they ever experienced in terms of persistence-severity of PTSD symptoms and the second time, if different from the worst trauma, for one random occurrence (selected using a random numbers table) of one of the trauma types they ever experienced. We limited the assessment to only one random trauma per respondent because it was a practical impossibility to carry out a separate assessment of PTSD for each of the many lifetime traumas reported by each respondent. As discussed in more detail elsewhere (Kessler, in press), we used the random trauma approach rather than the more common approach of assessing PTSD only for each respondent's self-reported worst trauma because the latter approach yields biased estimates of conditional PTSD prevalence and course. No respondents had PTSD in response to the randomly-selected trauma of being a relief worker in a war zone. This trauma type was consequently excluded from our analysis.

PTSD

PTSD was assessed with the Composite International Diagnostic Interview (CIDI) (Kessler & Üstün, 2004), a fully-structured lay interview that assesses a wide range of common mental disorders. Clinical reappraisal interviews with the Structured Clinical Interview for DSM-IV (SCID) (Haro *et al.* 2006) blinded to CIDI diagnoses of PTSD (but instructed to focus on the same trauma occurrence as the one assessed in the CIDI in order to guarantee valid diagnostic comparisons) documented moderate CIDI-SCID concordance (Landis & Koch, 1977) (AUC = 0.69) for PTSD. Sensitivity and specificity were 38.3% and 99.1%, respectively. Although only a minority of clinical cases were detected, likelihood ratio positive [Sensitivity/(1-Specificity)] was 42.0, which is well above the 10.0 typically considered definitive for a positive screen (Gardner & Altman, 2000), leading to a very high proportion of CIDI cases (86.1%) being confirmed by the SCID. Number of months with PTSD was defined as the minimum of the number of months or years the respondent reported continuing to have re-experiencing (criterion B), avoidance/numbing (criterion C), and hyper-arousal (criterion D) symptoms. If symptoms within all three clusters persisted as of the time of interview, the respondent was classified as not having experienced recovery.

Predictors

We considered three sets of predictors in addition to socio-demographics (sex, age at the time of the random trauma), random trauma type, and age of exposure. The first set included the respondent's prior (to the random trauma) lifetime history of exposure to other traumas. The second set included the respondent's exposure to each of 12 family childhood adversities (CAs). Consistent with prior WMH research on CAs (Kessler *et al.* 2010), we distinguished between those in a highly-correlated set of seven previously referred to as 'maladaptive family functioning' CAs (parental mental disorder, parental substance abuse, parental criminality, witnessed family violence, physical abuse by a family member, sexual abuse by a family member, neglect) and five 'other' CAs (parental divorce, parental death, other parental loss/separation, serious physical illness, family economic adversity). Details on CA measurement are presented elsewhere (Kessler *et al.* 2010). The third set included the respondent's history of the 14 DSM-IV mental disorders assessed in the WMH surveys prior to the age of occurrence of the random trauma. These included two mood disorders [major depressive disorder/dysthymic disorder, broadly-defined bipolar disorder (defined elsewhere (Kessler *et al*. 2006))], six anxiety disorders (panic disorder and/or agoraphobia, specific phobia, social phobia, generalized anxiety disorder, PTSD, and separation anxiety disorder), four disruptive behavior disorders (attention-deficit/hyperactivity disorder, oppositional-defiant disorder, conduct disorder, and intermittent explosive disorder), and two substance use disorders (alcohol abuse with or without dependence; drug abuse with or without dependence). As detailed elsewhere (Haro *et al*. 2006), generally good concordance was found between these CIDI diagnoses and blinded clinical diagnoses based on SCID clinical reappraisal interviews.

Analysis method

Reports about random traumas were weighted at the respondent level by the inverse of random trauma probability of selection multiplied by the respondent's Part II survey weight, thereby generating a sample

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representative of all lifetime traumas, and by extension all episodes of PTSD, experienced by all respondents. PTSD recovery was assessed using a discrete-time survival model framework (Willett & Singer, 1993) with person-month the unit of analysis and a logistic link function in SAS version 9.3 (SAS Institute Inc., 2010). Each month between the onset of PTSD and the reported duration of the PTSD episode (or date of interview if symptoms persisted as of that time) was treated as a separate observational record. The outcome was coded 0 for each person-month until the retrospectively-reported month of recovery. Respondents were censored after the month of recovery. The actuarial method (Halli & Rao, 1992) was used to generate descriptive information about the distribution of speed of recovery.

All models included dummy variables for person-month and survey location so that coefficients for other predictors could be interpreted as pooled within-survey coefficients. This approach implicitly assumed that within-survey slopes were constant across surveys, a decision made because we wanted to focus on central tendencies in the data rather than to analyze between-survey differences in associations that would inevitably be difficult to interpret because of the small number of countries represented in the series.

Model 1 examined associations of recovery with sex, age at trauma exposure, and number of years between age at exposure and age at interview. These variables were also controlled for in all subsequent models. Model 2 then added dummy variables for the random trauma type. Supplementary Model 3 added information about history of prior (to the random trauma) trauma exposure. Supplementary Model 4 added information about history of CAs and Model 5 added information about prior DSM-IV/CIDI mental disorders. Significant predictors were carried forward across models. Logistic regression coefficients and standard errors were exponentiated and are reported as odds-ratios (ORs) with 95% confidence intervals (CIs). In Model 2, the logistic regression coefficients were scaled to have a sum of 0 across the 28 trauma types, resulting in the ORs for these trauma types having a product of 1.0. This means that ORs significantly different from 1.0 can be interpreted as meaning that PTSD due to the associated trauma types have significantly more rapid (ORs >1.0) or slower (ORs <1.0) odds of recovery than the average trauma, noting that the 'average' is defined by giving each trauma type equal weight (i.e., ignoring relative prevalence of the different trauma types). Statistical significance was consistently evaluated using 0.05-level two-sided tests. The design-based Taylor series linearization method (Wolter, 1985) implemented in the SAS software system (SAS Institute Inc., 2008) was used to adjust for the weighting and clustering of observations. Design-based Wald χ^2 tests were used to evaluate statistical significance of predictor sets.

In order to examine overall final model performance, we generated individual-level predicted probabilities of recovery and examined observed recovery curves separately within the first two quartiles and the latter half of the distribution of predicted probability-of-recovery. The method of replicated 10-fold cross-validation with 20 replicates (i.e., 200 separate estimates of model coefficients) was used to correct for the over-estimation of prediction accuracy when, as in this analysis, model coefficients are both estimated and evaluated in the same sample (Smith *et al.* 2014).

Results

Observed speed-of-recovery distributions by age of onset

A total of 1404 respondents out of 1575 eventually recovered. The slope of the recovery curve was steepest in the first 6 months (20% recovering within 3 months, 27% within 6 months) (Fig. 1). Fifty percent of cases recovered by 24 months and 77% by 10 years (120 months; the longest follow-up period for which a sufficient number of cases were observed for stable estimation of conditional probability of remission). The lowest projected recovery rate was among cases with onsets at ages 60+ (48%) and the highest among cases with onsets at ages 25–44 (89%).

Predictors of recovery

Socio-demographics and length-of-recall

Online Supplementary Table S2 reports distributions of all predictors. Sex was not associated with recovery overall ($\chi^2_1 = 1.0$, $p = 0.31$) and age at trauma exposure was significant along the lines seen in Fig. 1 ($\chi^2_4 = 34.3$, $p < 0.001$) (Table 1, Model 1). Length-of-recall between respondent age at trauma exposure and age at interview was also significant; an association most plausibly interpreted as evidence of time-related recall bias. Length-of-recall was divided into quartiles (low = 0–7, low-average = 8–16, high-average = 17–30, and high = 31+ years) and its association with recovery was found to differ by time-to-recovery, where the latter was collapsed to capture meaningful interactions. Length-of-recall did not predict recovery in the first 12 months after onset ($\chi^2_3 = 4.3$, $p = 0.23$), by which time Fig. 1 shows that roughly one-fourth of cases had recovered. Length-of-recall was significant in months 13–24 ($\chi^2_3 = 10.8$, $p = 0.013$), by which time roughly half of cases had recovered, due to a single significantly reduced OR associated with low-average length of recall (OR 0.5), but odds of recovery were

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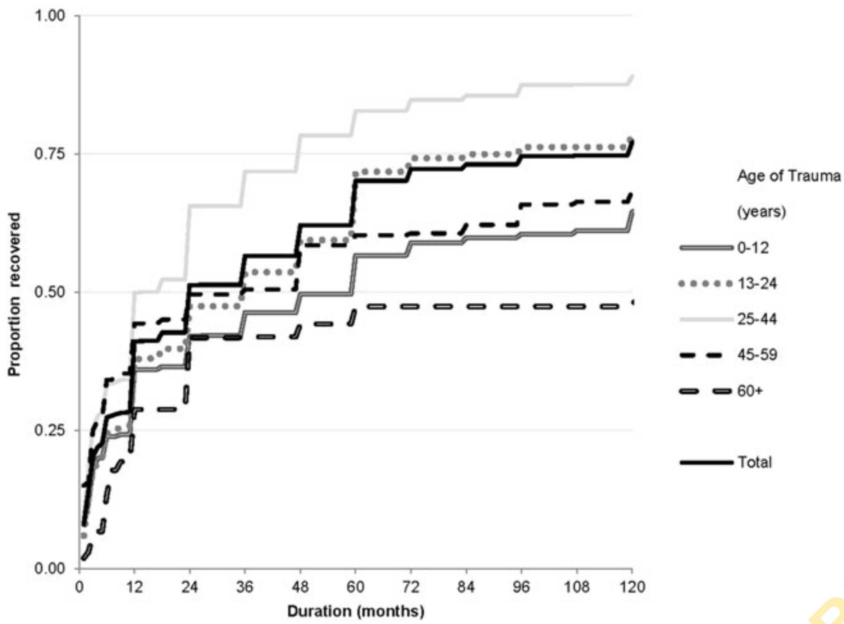

Fig. 1. Speed of recovery from random trauma PTSD, in the total sample and age of trauma exposure subgroups.

equivalent for cases with both lower and higher length-of-recall. It was only in months 25+ that a consistently strong monotonic inverse association emerged between length-of-recall and odds of recovery (ORs in the range 0.5–0.2 for low-average to high length-of-recall; $\chi^2_3 = 95.5$, $p < 0.001$).

Based on these results, all subsequent analyses were carried out separately for months 1–24 and 25+, with a recognition that results in the latter subsample might be biased due to recall error. Women had a significantly elevated odds of early-recovery (OR 1.4) and a significantly decreased odds of later-recovery (OR 0.8) compared with men (Models 1a–1b). Both models found a significantly elevated odds of recovery among respondents whose traumas occurred in middle age (OR 1.4) whereas odds of early-recovery were significantly decreased among respondents whose traumas occurred at ages 60+ (OR 0.6).

Trauma type

Distribution of random trauma types ranged from a high of 19.8% for unexpected death of a loved one to 0.2% for natural disasters (online Supplementary Table S2). This wide variation was a joint function of differences in population prevalence (Benjet *et al.* 2016) and PTSD risk (Liu *et al.* 2017). Controlling for the predictors in Models 1a–1b, random trauma type significantly predicted both early- ($\chi^2_{26} = 87.8$, $p < 0.001$) and later- ($\chi^2_{26} = 201.3$, $p < 0.001$) recovery (Table 2, Models 2a–2b). As none of the respondents whose random trauma was purposefully injuring/torturing/killing someone recovered within 24 months of onset, we removed those respondents from the early-recovery sample. Other traumas in five of the six trauma groups were significant as sets in both the early-recovery and later-recovery models, sexual violence victimization being the exception in both cases. Two of five within-group OR differences were non-significant in the early-recovery model, leading us to collapse traumas in these groups in that model. We retained individually significant traumas otherwise. Neither collapsed group (exposure to organized violence, accidents/injuries) had early-recovery odds significantly different from the omitted category (OR 1.0–1.5). Being beaten up by someone other than a caregiver or romantic partner was the only trauma that had significantly elevated odds of recovery in the early-recovery (OR 2.3) model, and two other traumas had significantly reduced odds (witnessed atrocities, mugged/threatened with a weapon; OR 0.2–0.5). The reduced later-recovery model, in comparison, had four traumas with elevated odds of recovery (accidentally caused serious injury/death, witnessed physical fights at home in childhood, other life-threatening accident, man-made disaster; OR 1.7–5.0) and an additional two traumas with significantly reduced odds (kidnapped, automobile accident; OR 0.3–0.6).

Prior traumas

Controlling for the predictors in Models 2c–2d, prior (to age of random trauma exposure) lifetime trauma exposure significantly predicted both early- ($\chi^2_{28} = 114.1$, $p < 0.001$) and later- ($\chi^2_{28} = 348.2$, $p < 0.001$) recovery (online Supplementary Table S3). Three of the six

Table 1. *Associations (odds-ratios) of sex, age at trauma exposure, and length of recall with recovery from DSM-IV/CIDI PTSD in the WMH surveys (n = 1575)*[a]

	Model 1		Model 1a		Model 1b	
	Total sample		Early-recovery (months 1–24)		Later-recovery (months 25+)	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Sex (Female)	1.1	(0.9–1.3)	1.4*	(1.0–2.0)	0.8*	(0.7–1.0)
Age of trauma						
0–12	0.8	(0.7–1.1)	0.8	(0.6–1.2)	0.9	(0.7–1.1)
13–24	1.0	(–)	1.0	(–)	1.0	(–)
25–44	1.4*	(1.1–1.6)	1.4*	(1.1–1.8)	1.4*	(1.1–1.9)
45–59	0.9	(0.7–1.2)	1.1	(0.7–1.5)	0.8	(0.6–1.1)
60+	0.7	(0.5–1.0)	0.6*	(0.4–1.0)	1.0	(0.6–1.6)
χ^2_4	34.3*		24.1*		33.4*	
Years from trauma onset by person-months						
Person-months 1–12						
Low	1.0	(–)	1.0	(–)	–	
Low-average	1.1	(0.8–1.5)	1.1	(0.8–1.5)	–	
High-average	1.1	(0.8–1.5)	1.1	(0.8–1.6)	–	
High	0.6	(0.4–1.0)	0.7	(0.4–1.1)	–	
χ^2_3	4.3		5.6		–	
Person-months 13–24						
Low	1.0	(–)	1.0	(–)	–	
Low-average	0.5*	(0.3–0.7)	0.5*	(0.3–0.8)	–	
High-average	0.9	(0.5–1.5)	0.9	(0.5–1.5)	–	
High	0.8	(0.4–1.5)	0.9	(0.5–1.5)	–	
χ^2_3	10.8*		9.0*		–	
Person-months 25+						
Low	1.0	(–)	–		1.0	(–)
Low-average	0.5*	(0.4–0.7)	–		0.6*	(0.5–0.7)
High-average	0.3*	(0.2–0.3)	–		0.3*	(0.2–0.5)
High	0.2*	(0.1–0.4)	–		0.2*	(0.1–0.4)
χ^2_3	95.5*		–		42.9*	

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Revised; CIDI, Composite International Diagnostic Interview; PTSD, post-traumatic stress disorder; WMH, World Mental Health; OR, odds-ratio; 95% CI, 95% confidence interval.

* Significant at the 0.05 level, two-sided test.

[a] Coefficients in the first pair of columns are based on a multivariate discrete-time person-month survival model controlling for number of follow-up person-months and survey location among the 1575 respondents with PTSD associated with random traumas (a total of *n* = 111 355 person-months). The coefficients in the next columns are based on separate subgroups in multivariate discrete-time person-month survival models for early-recovery (months 1–24) and later-recovery (months 25–120) among the same 1575 respondents.

prior trauma sets were significant in the early-recovery model, in each case with ORs differing significantly within the group, whereas five trauma sets were significant in the later-recovery model (the exception being exposure to organized violence). In one of the latter groups (sexual assault victimization), within-group ORs did not differ significantly from each other and we consequently entered a count variable of all prior lifetime traumas in that group in the reduced model.

In the reduced early-recovery model, three traumas had significantly elevated odds (witnessed death/dead body/serious injury, combat experience, and the residual 'other' trauma category; OR 1.4–2.9) and four others had significantly reduced odds (refugee, witnessed atrocities, raped, trauma to loved one; OR 0.3–0.7). In the reduced later-recovery model (Supplementary Model 3d), five traumas had significantly elevated odds (witnessed death/dead body/serious injury, beaten up by someone other than a caregiver or romantic partner, automobile

Table 2. *Associations (odds-ratios) between randomly-selected trauma type with recovery from DSM-IV/CIDI PTSD in the WMH surveys (n = 1575)*[a]

	Model 2a		Model 2b		Model 2c		Model 2d	
	Months 1–24		Months 25+		Months 1–24		Months 25+	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
I. Exposure to organized violence					1.5	(0.9–2.3)		
Civilian in war zone	2.9	(0.7–11.3)	1.6	(0.8–3.0)				
Civilian in region of terror	2.2*	(1.1–4.6)	1.4	(0.9–2.2)				
Refugee	2.2*	(1.1–4.4)	0.5	(0.2–1.0)				
Kidnapped	0.9	(0.5–1.9)	0.3*	(0.2–0.4)			0.3*	(0.2–0.5)
χ^{2b}_4		12.5*		58.3*				
χ^2_3		4.0		27.5*				
II. Participation in organized violence								
Witnessed death/dead body/serious injury	1.2	(0.8–1.9)	0.7	(0.5–1.0)				
Accidentally caused serious injury/death	1.4	(0.6–2.8)	2.7*	(1.3–5.7)			3.4*	(1.9–6.3)
Combat experience	0.2*	(0.1–1.0)	1.6	(0.9–2.7)	0.2	(0.1–1.0)		
Purposefully injured/tortured/killed someone		–	0.6*	(0.4–0.9)			0.6	(0.3–1.0)
Witnessed atrocities	0.2*	(0.0–0.8)	1.2	(0.6–2.3)	0.2*	(0.0–0.9)		
χ^{2b}_5		10.9*		12.5*		8.2*		21.5*
χ^2_4		10.9*		12.3*		0.1		19.4*
III. Physical violence victimization								
Beaten up by someone else	2.4*	(1.6–3.6)	1.8*	(1.0–3.3)	2.3*	(1.6–3.5)	1.9	(1.0–3.8)
Witnessed physical fight at home	0.6	(0.4–1.0)	1.7*	(1.2–2.4)			1.7*	(1.2–2.4)
Beaten up by caregiver	0.8	(0.3–2.1)	0.9	(0.7–1.3)				
χ^{2b}_3		22.2*		14.0*				10.8*
χ^2_2		18.0*		11.8*				0.1
IV. Sexual violence victimization								
Raped	1.0	(0.6–1.6)	1.1	(0.8–1.6)				
Sexually assaulted	1.0	(0.5–1.9)	0.9	(0.6–1.3)				
Stalked	1.0	(0.5–1.7)	1.4	(0.8–2.2)				
Beaten up by spouse/romantic partner	0.7	(0.5–1.0)	0.7	(0.5–1.0)				
Trauma to loved one	0.8	(0.4–1.5)	0.8	(0.6–1.1)				
Some other trauma	1.3	(0.9–1.9)	0.6*	(0.3–1.0)				
Private trauma[c]	1.1	(0.7–1.6)	1.0	(0.6–1.6)				
χ^{2b}_7		7.5		13.3				
χ^2_6		7.3		12.0				
V. Accidents/injuries					1.0	(0.7–1.3)		
Natural disaster	2.6*	(1.3–5.3)		–				
Toxic chemical exposure	0.7	(0.2–2.3)	0.6*	(0.5–0.9)			0.6	(0.4–1.0)
Automobile accident	1.6*	(1.0–2.6)	0.5*	(0.4–0.7)			0.6*	(0.4–0.9)
Life-threatening illness	0.9	(0.5–1.6)	0.7	(0.4–1.1)				
Child with serious illness	1.4	(1.0–2.0)	0.7*	(0.5–1.0)			0.8	(0.5–1.2)
Other life-threatening accident	0.6	(0.2–1.9)	1.8*	(1.4–2.3)			1.9*	(1.3–2.7)
χ^{2b}_6		14.5*		76.1*				60.0*
χ^2_5		9.4		76.1*				59.9*
VI. Other								
Mugged/threatened with a weapon	0.5*	(0.3–0.9)	0.7*	(0.6–1.0)	0.5*	(0.3–0.9)	0.8	(0.6–1.1)
Man-made disaster	0.9	(0.2–3.0)	5.1*	(3.1–8.4)			5.0*	(3.1–8.1)
Unexpected death of a loved one	1.3	(1.0–1.7)		–				
χ^{2b}_3		9.6*		49.5*				51.7*
χ^2_2		9.5*		48.8*				48.7*

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Table 2 (*cont.*)

	Model 2a		Model 2b		Model 2c		Model 2d	
	Months 1–24		Months 25+		Months 1–24		Months 25+	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
$\chi^2_{27/5}$	87.8*		201.3*		37.3*		265.0*	

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Revised; CIDI, Composite International Diagnostic Interview; PTSD, post-traumatic stress disorder; WMH, World Mental Health; OR, odds-ratio; 95% CI, 95% confidence interval.

* Significant at the 0.05 level, two-sided test.

[a] Coefficients are based on multivariate discrete-time person-month survival models for early-recovery (months 1–24) and later-recovery (months 25–120) among the 1575 respondents with PTSD associated with random traumas (a total of n = 111 355 person-months) controlling for number of follow-up person-months, survey location, and all significant variables in Models 1a–1b.

[b] The first χ^2 for each trauma group assesses the significance of the full set of ORs for traumas in the group using *all other traumas* as the reference. The second χ^2 assesses the significance of differences among the ORs within the group.

[c] A *private* trauma is a trauma that some individuals reported in response to a question at the very end of the trauma section that asked if they ever had some other very upsetting experience they did not tell us about already because they were too embarrassed or upset to talk about it. Respondents were told, before they answered, that if they reported such a trauma we would not ask them anything about what it was, only about their age when the trauma happened.

accident, life-threatening illness, unexpected death of loved one; OR 1.4–1.9) and two others significantly reduced odds (accidentally caused serious injury/death, number of sexual violence victimizations; OR 0.3–0.9).

Childhood adversities (CAs)

Controlling for the earlier predictors, CAs significantly predicted both early- ($\chi^2_{12} = 44.9$, $p < 0.001$) and later- ($\chi^2_{12} = 50.8$, $p < 0.001$) recovery (online Supplementary Table S4). In both cases this was due to maladaptive family functioning (MFF) CAs ($\chi^2_7 = 36.9$–39.3, $p < 0.001$) rather than other CAs ($\chi^2_5 = 5.2$–5.6, $p = 0.35$–0.40). One MFF CA, witnessing family violence, was associated with significantly elevated odds of recovery in both early-recovery and later-recovery models (OR 1.4–1.9) and three others with significantly reduced odds in either the early-recovery (neglect; OR 0.6) or later-recovery (physical and sexual abuse; OR 0.6) models.

Mental disorders

Controlling for earlier predictors, prior (to age of random trauma exposure) lifetime DSM-IV/CIDI disorders significantly predicted both early- ($\chi^2_{14} = 66.3$, $p < 0.001$) and later- ($\chi^2_{14} = 78.4$, $p < 0.001$) recovery. Mood and anxiety disorders were significant as sets in both models, although ORs did not vary within either group in the early-recovery model but did in the later-recovery model (Table 3, Models 5a–5b). Disruptive behavior disorders were also significant as a set (with significant within-group differences in ORs) in the early-recovery model but not the later-recovery model. Substance use disorders were not significant as a set in either model. In the reduced early-recovery model (Model 5c), number of mood disorders and ADHD were associated with significantly elevated odds of recovery (OR 1.4–1.9) and number of anxiety disorders with significantly reduced odds (OR 0.8). In the reduced later-recovery model (Model 5d), prior separation anxiety disorder was associated with significantly elevated odds of recovery (OR 1.5), whereas major depression-dysthymia, PTSD, and social phobia had significantly reduced odds (OR 0.4–0.8).

Overall model performance

Each respondent was assigned 20 predicted probabilities of recovery in each person-month based on the coefficients in 20 replicates of 10-fold cross-validated versions of models with the predictors in Models 5c and 5d (i.e., the final models) but with coefficients allowed to vary across these replicates. The observations in these two sets of 20 replicates were then divided into three groups consisting of the cases in the top 25%, next 25%, and lowest 50% of predicted probabilities of recovery. Speed-of-recovery curves based on observed time-to-recovery in these subgroups were then generated to simulate the likely performance of the models in an independent dataset (Fig. 2).

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Table 3. *Associations (odds-ratios) between mental disorders prior to randomly-selected trauma and recovery from DSM-IV/CIDI PTSD in the WMH surveys (n = 1575)*[a]

	Model 5a		Model 5b		Model 5c		Model 5d	
	Months 1–24		Months 25+		Months 1–24		Months 25+	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
I. Mood disorders								
MDD or dysthymic disorder	1.6*	(1.2–2.0)	0.6*	(0.4–0.7)			0.6*	(0.5–0.8)
Bipolar disorder (broad definition)	1.2	(0.6–2.2)	1.3	(0.9–1.9)				
Number					1.4*	(1.1–1.7)		
χ^{2b}_{2}	18.7*		21.9*					
χ^2_1	0.7		12.0*					
II. Anxiety disorders								
Panic disorder or agoraphobia	1.0	(0.7–1.5)	0.9	(0.6–1.2)				
Generalized anxiety disorder	1.0	(0.7–1.4)	1.4*	(1.0–1.9)			1.3	(1.0–1.7)
PTSD	0.8	(0.6–1.1)	0.4*	(0.3–0.6)			0.4*	(0.3–0.6)
Social phobia	0.7*	(0.6–0.9)	0.7*	(0.6–0.9)			0.8*	(0.6–0.9)
Specific phobia	1.1	(0.8–1.4)	1.2	(1.0–1.6)				
Separation anxiety disorder	0.5*	(0.3–0.7)	1.3*	(1.1–1.7)			1.5*	(1.2–1.8)
Number					0.8*	(0.8–0.9)		
$\chi^2_{6/2}$ [b]	21.5*		50.1*				39.1*	
$\chi^2_{5/1}$	10.4		50.1*				38.9*	
III. Disruptive behavior disorders								
Attention-deficit/hyperactivity disorder	2.3*	(1.4–3.7)	1.6	(0.6–4.0)	1.9*	(1.2–3.0)		
Conduct disorder	0.6	(0.3–1.2)	1.1	(0.7–1.9)				
Intermittent explosive disorder	1.3	(0.6–2.6)	0.8	(0.5–1.3)				
Oppositional-defiant disorder	0.9	(0.5–1.4)	0.8	(0.5–1.3)				
χ^{2b}_{4}	25.8*		2.2					
χ^2_3	15.2*		2.2					
IV. Substance use disorders								
Alcohol abuse or dependence	0.7	(0.5–1.1)	0.9	(0.6–1.4)				
Drug abuse or dependence	1.6*	(1.0–2.5)	1.1	(0.7–1.9)				
χ^{2b}_{2}	4.6		0.3					
χ^2_1	4.0*		0.2					
$\chi^2_{14/3}$	66.3*		78.4*		26.9*		52.9*	

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Revised; CIDI, Composite International Diagnostic Interview; PTSD, post-traumatic stress disorder; WMH, World Mental Health; OR, odds-ratio; 95% CI, 95% confidence interval; MDD, major depressive disorder.

* Significant at the 0.05 level, two-sided test.

[a] Coefficients are based on multivariate discrete-time person-month survival models for early-recovery (months 1–24) and later-recovery (months 25–120) among the 1575 respondents with PTSD associated with random traumas (a total of n = 111 355 person-months) controlling for number of follow-up person-months, survey location, and all significant variables in earlier models.

[b] The first χ^2 for each trauma group assesses the significance of the full set of ORs for traumas in the group using *all other traumas* as the reference group, while the second χ^2 assesses the significance of differences among these traumas within the group.

The model distinguished well the two groups predicted to have highest probabilities of recovery (i.e., top 25% and next 25%) from the 50% with lowest predicted probability of recovery and less well between the top two groups. It took 3–4 months for 25% of respondents in the top two groups to recover compared with 12 months in the group predicted to have lowest probability of recovery (Fig. 2*a*). It took 12 months for 50% of respondents in the top group to recover, and 66% recovered by 24 months compared with 55% in the middle group and 42% in the group with lowest predicted probability of recovery. Seventy-five percent of respondents with highest predicted probability of later-recovery did, in fact, recover

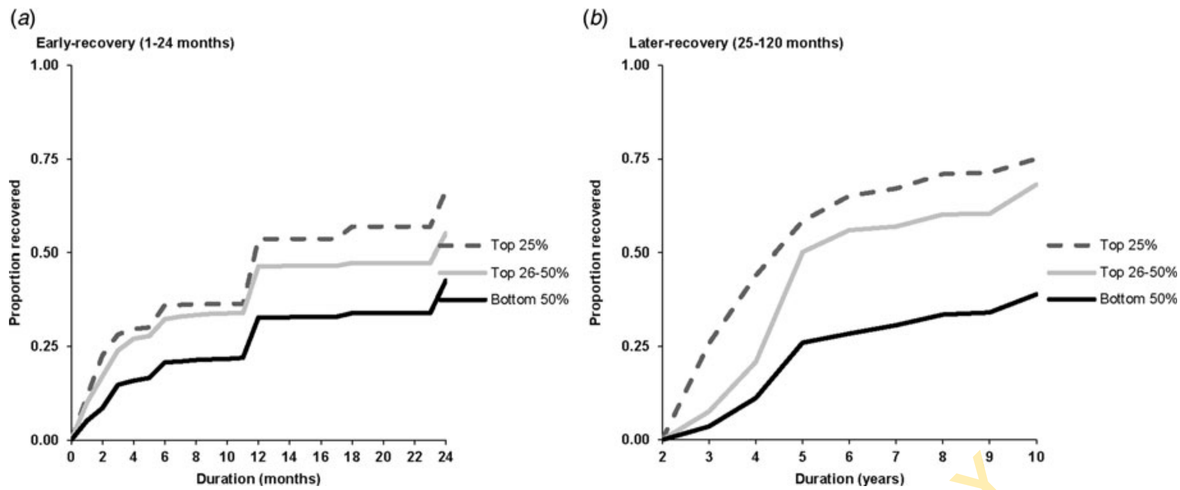

Fig. 2. Speed of recovery from random trauma PTSD within subgroups defined by cross-validated final model predicted probability of recovery separately for early-recovery (1–24 months; Fig. 1*a*) and later-recovery (25–120 months; Fig. 1*b*) models. (*a*) Early-recovery (1–24 months). (*b*) Later-recovery (25–120 months).

within 10 years of onset (25% within 3 years, 50% within 5 years) compared with 68% of those with intermediate predicted probabilities (25–50% within 5 years) and 39% of those with lowest predicted probabilities (25% within 5 years) (Fig. 2*b*).

Discussion

Despite substantial variation in the definitions of PTSD 'recovery' in prior studies of PTSD course (Morina *et al.* 2014; Steinert *et al.* 2015), our findings that 50% of WMH respondents with PTSD recovered within 2 years and roughly 25% had not recovered within 10 years are broadly consistent with previous epidemiological estimates of PTSD recovery after random traumas (Breslau *et al.* 1998). Somewhat lower and slower rates of recovery have been reported in epidemiological studies of PTSD associated with 'worst' traumas (Kessler *et al.* 1995; Chapman *et al.* 2012).

Our failure to find a sex difference in overall PTSD recovery is consistent with the results of a meta-analysis of predictors of PTSD recovery carried out by Morina *et al.* (2014). Our finding of opposite-sign sex differences in early-recovery (women higher recovery than men) and later-recovery (women lower recovery than men) is not comparable with prior studies as none have examined interactions between predictors and timing of recovery. Nor are we aware of any previous research that speaks to the significant association we found between length-of-recall and retrospective reports about PTSD recovery. As noted above, this association is most plausibly interpreted as due to recall bias related to length of the recall period. Because of this association, which was largely confined to later-recovery, our results regarding the predictors of early-recovery are likely to be less influenced by recall bias than those regarding later-recovery.

Very low relative-odds of early-recovery (OR 0.0–0.3) were found for two trauma types (purposefully injuring/torturing/killing someone and witnessing atrocities) and of later-recovery for another (being kidnapped). Very high odds of early-recovery (OR 3.0+) were found for no trauma types and of later-recovery for two trauma types (accidentally causing serious injury/death, man-made disaster). Other significant between-trauma differences in recovery were few in number and comparatively modest in magnitude. No trauma type was a significant predictor in both early-recovery and later-recovery models. These results are broadly consistent with the Morina *et al.* (2014) meta-analysis finding that between-trauma differences in recovery rates are for the most part insignificant, although the one exception to this general pattern in the meta-analysis, a significantly higher recovery rate from natural disasters than other traumas, was not replicated in the WMH data.

We are unaware of previous epidemiological research on the associations of PTSD recovery with prior traumas or childhood adversities even though both have consistently been found to predict increased risk of *onset* of PTSD (Liu *et al.* 2017; McLaughlin *et al.* in press). In the WMH data, history of being a refugee and of witnessing atrocities (early-recovery) and accidentally causing serious injury/death (later-recovery) were the only prior traumas associated with very low odds of recovery. No prior trauma type was associated with very high odds of recovery, and no childhood adversities were associated either with very low or with very high odds of recovery. No prior trauma type other than witnessing death/dead body/serious

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injury and no childhood adversity other than exposure to childhood family violence was a significant predictor in both the early-recovery and later-recovery models. However, the consistently significant ORs for these variables were not large (OR 1.4–1.9).

Our finding that prior history of anxiety disorders (i.e., number of disorders, PTSD, social phobia) was associated with decreased likelihood of PTSD recovery is broadly consistent with the results of both cohort (Pietrzak *et al.* 2014) and clinical (Zlotnick *et al.* 2004) studies that found comorbid prior anxiety disorders to be associated with a more chronic course of PTSD. It is noteworthy, though, that separation anxiety disorder was associated with decreased likelihood of early PTSD recovery but increased likelihood of later-recovery. Such divergent results may help explain why a summary measure of *any* pre-trauma anxiety disorder was not significantly associated with PTSD recovery in the one prior general population epidemiological study that examined associations of prior mental disorders with PTSD recovery using retrospective reports (Chapman *et al.* 2012). We are unaware of prior studies that examined the association of temporally primary ADHD with PTSD recovery.

Our finding that observed recovery curves differed substantially between the subgroups defined as having higher and lower predicted probabilities of recovery raises the possibility that models along the lines presented here could be developed at the time of trauma exposure to classify survivors into those with higher and lower probabilities of recovery. It is unclear how much value this would have, though, for targeting interventions based on the fact that much stronger models exist to predict PTSD onset (Kessler *et al.* 2014) and information about initial treatment response and other post-trauma factors that are not available at the time of trauma exposure have been found to predict recovery (Brackbill *et al.* 2009; North *et al.* 2011; Pietrzak *et al.* 2014). Receiving an evidence-based treatment for PTSD, which we did not evaluate here, is also an important determinant of PTSD recovery (Courtois *et al.* 2016). Nonetheless, it is useful to see based on our simulation results that the joint associations of the pre-trauma predictors considered here in addition to information about random trauma type are associated with striking difference in the shape of speed-of-recovery curves.

A number of limitations of the above analysis are noteworthy. First, the data were based on retrospective reports that are subject to recall bias. Second, PTSD was assessed with a fully-structured diagnostic interview with a low sensitivity rather than with a semi-structured clinical interview, while recovery was defined using a relatively coarse dichotomous measure. Third, the predictors were limited to those available in the survey, which consisted of measures of socio-demographics, childhood adversities, prior (to the index trauma) traumas, and prior psychopathology. Fourth, we did not take treatment or other factors that occurred after the occurrence of the trauma into consideration. Within the context of these limitations, we analyzed a unique cross-national epidemiological sample. We focused on representative PTSD cases associated with randomly-selected traumas. We replicated the findings in previous studies that a substantial minority of PTSD cases recover within a short period of time, that the majority recover within 2 years, and that a substantial minority of cases do not recover even after many years. We found weak evidence for associations of socio-demographics, trauma types, and prior trauma history with recovery. We found that prior anxiety disorders predict recovery, but again with fairly modest magnitudes of association. Although our composite risk model discriminated well between the recovery trajectories within the 50% of patients predicted to have the highest and lowest probabilities of recovery, this recovery model was much weaker than models using the same kinds of pre-trauma variables to predict PTSD onset, highlighting the importance of including information on post-trauma symptoms and experiences to develop powerful models of PTSD recovery.

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/S0033291717001817

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Declaration of Interest

In the past 3 years, Dr Kessler received support for his epidemiological studies from Sanofi Aventis, was a consultant for Johnson & Johnson Wellness and Prevention, Shire and Takeda, and served on an advisory board for the Johnson & Johnson Services Inc. Lake Nona Life Project. Kessler is a co-owner of DataStat, Inc., a market research firm that carries out healthcare research. In the past 3 years, Dr Stein has received research grants and/or consultancy honoraria from AMBRF, Biocodex, Cipla, Lundbeck, National Responsible Gambling Foundation, Novartis, Servier, and Sun. The remaining authors declare no conflicts of interest.

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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Disclaimer

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