# Original Research

# Long-Term Trajectories of Posttraumatic Stress Disorder in Veterans: The Role of Social Resources

Karen-Inge Karstoft, MSc; Cherie Armour, PhD; Ask Elklit, MSc; and Zahava Solomon, PhD

### ABSTRACT

**Objective:** To (1) identify long-term trajectories of combat-induced posttraumatic stress disorder (PTSD) symptoms over a 20-year period from 1983 to 2002 in veterans with and without combat stress reaction (CSR) and (2) identify social predictors of these trajectories.

**Method:** A latent growth mixture modeling analysis on PTSD symptoms was conducted to identify PTSD trajectories and predictors. PTSD was defined according to *DSM-III* and assessed through the PTSD Inventory. Israeli male veterans with (n = 369) and without (n = 306) CSR were queried at 1, 2, and 20 years after war about combat exposure, military unit support, family environment, and social reintegration.

**Results:** For both study groups, we identified 4 distinct trajectories with varying prevalence across groups: resilience (CSR = 34.4%, non-CSR = 76.5%), recovery (CSR = 36.3%, non-CSR = 10.5%), delayed onset (CSR = 8.4%, non-CSR = 6.9%), and chronicity (CSR = 20.9%, non-CSR = 6.2%). Predictors of trajectories in both groups included perception of war threat (ORs = 1.59–2.47, *P* values  $\leq$  .30), and negative social reintegration (ORs = 0.24–0.51, *P* values  $\leq$  .047). Social support was associated with symptomatology only in the CSR group (ORs = 0.40–0.61, *P* values  $\leq$  .045), while family coherence was predictive of symptomatology in the non-CSR group (OR = 0.76, *P* = .015) but not in the CSR group.

**Conclusions:** Findings confirmed heterogeneity of long-term sequelae of combat, revealing 4 trajectories of resilience, recovery, delay, and chronicity in veterans with and without CSR. Symptomatic trajectories were more prevalent for the CSR group, suggesting that acute functional impairment predicts pathological outcomes. Predictors of symptomatic trajectories included perceived threat and social resources at the family, network, and societal levels.

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Corresponding author: Karen-Inge Karstoft, MSc, The National Centre for Psychotraumatology, University of Southern Denmark, Campusvej 55, Odense, Funen, Denmark (kikarstoft@health.sdu.dk). While recent decades have seen a plethora of research on the adverse psychiatric effects of military combat, little is known about long-term trajectories of posttraumatic stress disorder (PTSD) symptoms after combat, and their predictors.<sup>1</sup> Identifying long-term trajectories is important, as they outline prototypical, heterogeneous patterns of resilience and distress and may enable the prediction of psychological outcomes after combat. While recent research has identified heterogeneous PTSD trajectories, most often those of resilience, recovery, and chronicity,<sup>2–5</sup> the time span of these studies has been relatively short. This study aims to identify and explore PTSD trajectories over 20 years postdeployment.

Identifying predictors of these trajectories is also pertinent. In studies on predictors of the genesis, course, and outcome of traumatic stress sequelae, lack of social support has been consistently implicated.<sup>6,7</sup> Although social support is a multifaceted construct operating across many different levels,<sup>8</sup> most research has conceptualized it as a unitary construct. This study takes a multifaceted approach to the role of social support during and after deployment, investigating social support at the military unit, family, social network, and societal level as predictors for long-term PTSD trajectories. We expected that social resources at various levels would discriminate between long-term trajectories and thus aid the early identification of long-term symptomatic outcomes.

This study utilizes data from a 20-year prospective longitudinal study of veterans. Through latent growth mixture modeling,<sup>9</sup> we aim to (1) identify long-term PTSD symptom trajectories and their prevalence in veterans with and without combat stress reaction (CSR) and (2) investigate the role of social support in the following domains in relation to long-term PTSD trajectories: military unit, family, social network, and wider society.

#### METHOD

#### Sample

The sample consisted of 675 male Israeli combat veterans who were in active duty during the 1982 Lebanon War. The sample included a clinical group of 369 veterans who were diagnosed with CSR by Israel Defense Forces' mental health personnel. Combat stress reaction refers to psychological breakdown on the battlefield, expressed in cognitive, affective, and behavioral symptoms. A CSR diagnosis is focused on the soldier's inability to continue to function as a combatant.<sup>10</sup> A control group of 306 combat veterans without CSR from the same combat units were matched on age, education, military rank, and assignment. The veterans were assessed at 3 time points: 1 year (T1), 2 years (T2), and 20 (T3) years after war. Participants' age at the first measurement ranged between 18 and 37 years (mean = 25.81, SD = 4.72, median = 26). Of the total sample at T1, 68.4% also participated at T2, and 64.1% participated

- While the majority of soldiers are resilient or will recover from symptoms of psychological distress after combat, a significant minority will develop chronic posttraumatic stress disorder.
- Assessment of functional impairment during combat and social resources after deployment is important for predicting chronic outcomes of combat exposure.

at T3. Importantly, military records and data collected at T1 revealed no significant differences in sociodemographic and military background, premilitary adjustment, intelligence, or mental and somatic health 1 year after the war between those who participated at all 3 time points and those who did not. While the rate of attrition was significantly higher for the CSR group (27.3%) than for the non-CSR group (19.2%) at T2 ( $\chi^2_{2,666}$  = 14.04, P<.001), there was no difference between the 2 groups at T3 (CSR = 24.4%missing, non-CSR = 29.9%;  $\chi^{2}_{2,666}$  = 0.21, *P* = .644). To deal with the effects of attrition, all missing data were handled using the multiple imputation technique, in which the missing value is replaced by a set of plausible values.<sup>11</sup> We tested the accuracy of the multiple imputation procedure by comparing correlations between outcome measures before and after imputation and found no differences. Finally, we ran the latent growth mixture model on the nonimputed data set including only participants with at least 2 time points. This model was very similar to the model based on imputed data in trajectory profiles as well as in trajectory prevalence. Thus satisfied with the imputation procedure, we based the main analyses on the imputed data set to maximize group sizes for the post hoc analysis.

### Measures

The PTSD Inventory<sup>10</sup> consists of 13 statements describing symptoms of PTSD according to *DSM-III*, the standard criteria used when the study commenced. Participants are asked to report whether they experienced each symptom in the last month. The overall score reflects the total number of endorsed symptoms. The inventory was employed at all 3 measurements. It has demonstrated good psychometric properties,<sup>12</sup> with high test-retest reliability (82.3% agreement)<sup>13</sup> and Cronbach  $\alpha$  ranging from 0.89 to 0.92.

Subjective combat exposure was assessed by 2 statements on perceived life threat and severity of the battles. The first statement was assessed on a 5-point scale ranging from "not at all" to "very much." The second question assessed the severity of battles on a 4-point scale, with answers ranging from 1 (did not participate in battles) to 4 (difficult).

Unit support was assessed at T1 via the Military Company Environment Inventory,<sup>14</sup> adapted to the characteristics of the Israeli Army. It consists of 39 yes/no questions about the military company and comprises 4 factors: emotional support, officer support, involvement in unit activities, and order and coherence. The  $\alpha$  coefficients ranged between 0.71 and 0.83, indicating adequate internal consistency. For this study, we used the total score.

The Family Environment Scale<sup>15</sup> was applied at T1. We utilized 3 subscales of family relations; namely, family cohesiveness (eg, family member's support of each other), family expressiveness (eg, open emotional communication), and family conflict (eg, anger, violence, and disputes within the family). These subscales have good reliability in the current study (Cronbach  $\alpha$  = 0.78–0.89).

Social support from the social network was assessed at T2 through 7 questions based on Mueller's social network interview<sup>16</sup> about the level of received support from their social network of family and friends on a 4-point scale ranging from "not at all" to "very much." Scale reliability in the current study was good (Cronbach  $\alpha$ =0.86).

The Social Reintegration Scale<sup>17</sup> measures exclusion and support following homecoming in 8 statements. Following Laufer et al,<sup>17</sup> 2 scores were computed: (1) alienation at homecoming and (2) belief that people and government support veterans. Both scales displayed high reliability (Cronbach  $\alpha$  = 0.88–0.92).

# Analysis

All analyses were conducted in Mplus version 7.<sup>18</sup> We used latent growth mixture modeling to identify trajectories over time. Whereas investigations of growth or decline over time have often assumed a single population with 1 growth trajectory, latent growth mixture modeling expects different subpopulations with unique trajectories.<sup>9</sup> Slope variance was fixed to aid convergence of our model. To sustain the original sampling division between CSR and non-CSR participants, we utilized a multiple group analysis approach to identify trajectories separately in the 2 groups. By using the *KNOWNCLASS* option in Mplus, the latent growth mixture modeling trajectories were estimated in 1 model, while all parameters were allowed to vary freely across the 2 groups.

Initially, we examined a series of unconditional models (ie, with no covariates) ranging from 1 to 6 classes. The optimal model was selected based on fit indices, including the Akaike information criterion (AIC), the Bayesian information criterion (BIC), and the sample size–adjusted BIC (adj BIC). The most favorable model has low fit indices and high classification accuracy with an entropy value approaching 1. Simulation studies have found that the BIC and adj BIC perform best among these information criteria and should thus be favored when deciding on the number of classes.<sup>19</sup>

Subsequently, we used the most likely class membership variable to test the association of social support covariates outside of the model. Simulation studies have suggested that, for models with high entropy (>0.80), covariate estimation based on most likely class membership is a viable alternative to including covariates in the model.<sup>20</sup> Since our model had very high entropy (0.93), we used the most likely class membership as the outcome variable in a multinomial logistic regression to assess the relation of the latent classes to a number of covariates.

Table 1. Fit Indices for the 1 Through 6 Class Models <sup>a</sup>								
Model	AIC	BIC	Adj BIC	Entropy				
1 class	11,078.84	11,119.47	11,090.89					
2 classes	10,878.34	10,946.06	10,898.44	0.92				
3 classes	10,827.72	10,922.52	10,855.85	0.91				
4 classes	10,708.58	10,830.48	10,744.75	0.93				
5 classes	10,675.84	10,824.82	10,720.05	0.89				
6 classes	10,648.58	10,824.65	10,700.83	0.90				

<sup>a</sup>Fit indices of the selected model are shown in bold.

Abbreviations: adj BIC = sample size-adjusted Bayesian information criterion,

AIC = Akaike information criterion, BIC = Bayesian information criterion.

Figure 1. Four Class Trajectory Models for the CSR Group and the Non-CSR Group<sup>a</sup>



"The figures display the sample mean values for each trajectory at each time poin Abbreviations: CSR = combat stress reaction, PTSD = posttraumatic stress disorder.

# RESULTS

Table 1 shows fit indices of the 1- to 6-class unconditional models. Addition of each class revealed improvements of fit; however, reductions were small with the addition of the fifth class (AIC difference = 32.74, BIC difference = 5.66, adj BIC difference = 24.7), suggesting that little was added by the fifth class. Also, the 4-class model was most clearly classified (entropy = 0.93), while the fifth class was a split of an already existing class. Hence, on the basis of fit indices, parsimony, and theoretical soundness, the 4-class solution was chosen.

For both the CSR and non-CSR groups, 4 trajectories emerged: resilience, recovery, delayed onset, and chronicity

(Figure 1). Trajectories were similar across groups, albeit with differences in intercepts (ie, initial symptom level) and prevalence. Of the CSR veterans, 34.4% belonged to the resilient trajectory, compared to 76.5% of the non-CSR group. Furthermore, the initial mean number of symptoms reported by the CSR-group (3.0) was higher than that reported by the non-CSR group (1.5). Prevalence of delayed onset was 8.4% in the CSR group and 6.9% in the non-CSR group, with the CSR group reporting higher initial symptom level (3.3) than the non-CSR group (1.9). Of the CSR group, 36.3% had a recovering trajectory, compared to only 10.5% of the non-CSR group. Again, the CSR group showed initial higher symptom level (9.2) than the non-CSR group (7.8). Finally, 20.9% of the CSR group and only 6.2% of the non-CSR group belonged to the chronic trajectory. Initial symptom level was higher for the CSR group (9.4) than for the non-CSR group (7.2). These results clearly suggest that CSR is predictive of chronic outcomes and initial pathology with recovery over time as well as for generally higher levels of symptoms.

Results of the multinomial logistic regression can be seen in Table 2. The severity of battles did not significantly distinguish between trajectories in either the CSR or the non-CSR group. Perception of war as life threatening did significantly predict membership of all trajectories compared to the resilient trajectory for the CSR group (chronic, OR = 1.59, P = .030; recovering, OR = 1.88, P < .001; delayed onset, OR = 1.90, P = .026) and for the chronic (OR = 2.43, P = .003) and recovering (OR = 2.47, P = .001) trajectories for the non-CSR group. Unit atmosphere did not significantly predict trajectory membership for either group. More social support after the war was associated with lower probability of belonging to the chronic (OR = 0.40, P = .002) and the recovering (OR = 0.61, P = .045) trajectories in the CSR group, but it was not significantly associated with membership of trajectories in the non-CSR group. Less family support decreased the probability of belonging to the trajectory of recovery in the non-CSR group only (OR = 0.76, P = .015). Finally, less exclusion from society at homecoming decreased the probability of belonging to the chronic (OR = 0.43, P = .044) and the recovering (OR = 0.36, P = .006) trajectories in the non-CSR group and to all the symptomatic trajectories in the CSR group (chronic, OR = 0.24, *P* < .001; recovering, OR = 0.50, *P* = .001; delayed onset, OR = 0.51, P = .047).

To investigate whether the chronic trajectory could be differentiated from the other trajectories, we repeated the multinomial regression with the chronic trajectory as the reference class. For the non-CSR group, no variables differentiated the chronic trajectory from the recovering trajectory, while only the perception of war threat (OR = 0.39, P=.008) differentiated the chronic trajectory from the delayed trajectory. For the CSR group, exclusion at homecoming differentiated the chronic trajectory from those of recovery (OR=2.13, P=.003) and delayed onset (OR=2.16, P=.042).

Table 2. Odds Ratios (ORs) and 95% CIs for the Latent Trajectories of the CSR and the Non-CSR Group									
	Chronic OR (95% CI) <sup>a</sup>		Recovering OR (95% CI) <sup>a</sup>		Delayed OR (95% CI) <sup>a</sup>				
Social Resources	CSR	Non-CSR	CSR	Non-CSR	CSR	Non-CSR			
Severity of battles	1.26 (0.92 - 1.74)	0.94 (0.59 - 1.50)	1.05 (0.81 - 1.36)	1.07 (0.73 - 1.57)	0.96 (0.63 - 1.48)	0.87 (0.55 - 1.36)			
	P = 152	P = 803	P = 707	P = 737	P = 863	P = 534			
Life threatening war	1.59 (1.05-2.42)	2.43 (1.34-4.41)	1.88 (1.33 - 2.66)	2.47 (1.46 - 4.21)	1.90 (1.08 - 3.35)	0.95 (0.64 - 1.43)			
	P = .030	P = 0.03	P < 001	P = .001	P = 0.26	P = .809			
Unit atmosphere	1.00 (0.96 - 1.04)	0.95 (0.89 - 1.02)	0.98 (0.95 - 1.01)	1.00 (0.94 - 1.06)	1.08 (1.00-1.17)	1.02 (0.96 - 1.09)			
	P = .945	P = .161	P = .205	P = .978	P = 0.51	P = 529			
Social support <sup>b</sup>	0.40 (0.22 - 0.72)	0.86 (0.34 - 2.18)	0.61 (0.37 - 0.99)	1.22 (0.53-2.81)	0.58 (0.25 - 1.31)	0.66 (0.29 - 1.53)			
	P = .002	P = .747	P = .045	P=.648	P = .186	P = .332			
Family cohesiveness <sup>c</sup>	1.00 (0.84 - 1.19)	0.95 (0.69 - 1.30)	1.05 (0.90-1.27)	0.76 (0.60–0.95)	1.17 (0.86–1.58)	1.07 (0.77–1.48)			
	P = .970	P = .732	P=.541	<i>P</i> =.015	<i>P</i> =.316	P=.685			
Family expressiveness	0.91 (0.72 - 1.09)	0.71 (0.50-1.01)	0.92 (0.75-1.12)	0.88 (0.65 - 1.20)	0.99 (0.72 - 1.37)	0.94 (0.69–1.28)			
	P = .430	P=.058	P=.382	P = .418	P = .972	<i>P</i> =.692			
Family conflict	0.93 (0.79–1.09)	1.06 (0.82–1.37)	0.97 (0.85–1.12)	0.92 (0.73–1.15)	1.04 (0.82–1.30)	1.00 (0.78–1.28)			
	<i>P</i> =.381	<i>P</i> =.655	P=.674	<i>P</i> =.471	<i>P</i> =.771	<i>P</i> =.993			
Homecoming exclusion <sup>c</sup>	0.24 (0.14–0.40)	0.43 (0.19–0.98)	0.50 (0.33-0.76)	0.36 (0.18–0.75)	0.51 (0.26–0.99)	0.55 (0.25–1.20)			
	<i>P</i> <.001	<i>P</i> =.044	P=.001	<i>P</i> =.006	<i>P</i> =.047	<i>P</i> =.135			
Homecoming support	1.01 (0.64–0.159)	1.46 (0.64–3.36)	1.17 (0.80–1.72)	1.76 (0.86–3.60)	0.61 (0.31–1.22)	1.45 (0.67–3.17)			
	<i>P</i> =.983	<i>P</i> =.372	<i>P</i> =.412	<i>P</i> =.120	<i>P</i> =.161	<i>P</i> =.349			

<sup>a</sup>All odds ratios and confidence intervals are in comparison to the low stable class.

<sup>b</sup>Social support was assessed at 2 years after war.

<sup>c</sup>Reverse coded (higher score = feeling less excluded).

Abbreviation: CSR = combat stress reaction.

# DISCUSSION

Four similar PTSD trajectories were found in both groups: resilience, recovery, chronicity, and delayed onset. Trajectory prevalence differed, with the non-CSR group showing a high prevalence of resilience, and the CSR group showing a higher prevalence of symptomatic groups. Subjective perception of a life-threatening war was predictive of symptomatic trajectories in both groups, whereas social support at the family, social network, and societal levels were differentially associated to PTSD trajectories in the 2 groups.

Our finding of 4 distinct trajectories is in line with earlier research. The identified trajectories were similar in the CSR and the non-CSR groups, differing only in symptom level and prevalence and not in longitudinal course, suggesting that the nature of heterogeneous trajectories is prototypical and not dependent on acute functional impairment such as CSR.<sup>3</sup> However, the prevalence of symptomatic trajectories was much higher in those with initial CSR, suggesting that CSR is a strong predictor of pathological outcomes.<sup>13,21,22</sup> The strong predictive value of CSR, which is the equivalent of acute stress disorder in a military setting,<sup>23</sup> underlines the importance of assessing functional impairment during the acute phase. The prevalence of trajectories in the non-CSR group is in line with earlier studies of PTSD trajectories, suggesting that resilience is the modal outcome encompassing around 80% of participants, with a smaller rate of participants belonging to the chronic, recovering, and delayed-onset trajectories.<sup>2-4</sup>

Posttraumatic symptomatology has been associated with battle severity and perceived threat,<sup>24,25</sup> and we therefore expected these factors to differentiate between trajectories of PTSD. While perception of life threatening war was a significant predictor of membership in all symptomatic classes for the CSR group, as well as for the chronic and recovery trajectories of the non-CSR group, perceived severity of battles was not predictive of trajectory membership in either group. Hence, while exposure to more severe battles will not create or sustain symptomatology in veterans of war, the feeling of being exposed to threat appears to be a relatively strong predictor of symptomatology. This subjective perception of life threat is closely related to the A2 criterion of PTSD in previous versions of *DSM*: namely, that the traumatic experience is accompanied by intense fear, helplessness, or horror. While the A2 criterion is not part of the *DSM-5*, it has been suggested that intense fear should be included as a risk factor in studies of PTSD.<sup>26</sup> The role of intense fear is supported by our results.

Contrary to our expectations, military unit atmosphere did not differentiate between trajectories in either the CSR or the non-CSR group. While unit support has been found to buffer against acute combat stress reaction<sup>13</sup> and, to some extent, also PTSD postdeployment,<sup>27</sup> our results suggest that unit support is less salient in predicting long-term PTSD trajectories. Family support had no significant relationships with PTSD trajectories in the CSR group, but in the non-CSR group, family cohesion was significantly and exclusively predictive of the recovery trajectory. More specifically, for veterans without CSR, low access to family support decreased recovery trajectory membership, and hence seems to be a protective factor.

Social support derived from the social network differentiated between resilient and symptomatic trajectories only for the CSR group. More precisely, higher levels of social support were significantly associated with lower probability of belonging to the chronic and the recovery trajectories. That low levels of social support were related to chronic PTSD is not surprising and very much in line with earlier research on predictors of PTSD.<sup>6,7</sup> It seems counterintuitive that more social support also decreased the probability of

belonging to the recovery group. However, we suggest that low levels of support are tightly related to the initially high level of PTSD in this group and that the decline in symptoms over time might be related to other factors. However, this remains speculative.

Another somewhat surprising finding is that social support was not significantly related to the delayed-onset trajectory in either group. Intuitively, social support would seem an obvious predictor of delayed-onset PTSD; however, other studies have also failed to find a connection between social support and delayed PTSD.<sup>28</sup> One possible explanation stems from Kaniasty and Norris's discussion of social selection and social causation.<sup>29-31</sup> Kaniasty and Norris<sup>30</sup> have shown that, whereas initial high levels of social support lead to fewer PTSD symptoms at 6-18 months after the traumatic event (social selection), this is not the case 18-24 months after the event. They found that, at 18-24 months after the event, high levels of PTSD lead to less social support (social causation). This might explain why we did not find any relationship between low social support 2 years after the war and the delayed-onset trajectory.

For both the CSR and the non-CSR group, support or lack thereof from the wider society at homecoming was a strong predictor of symptomatic PTSD trajectories: compared to the resilient group, respondents in the CSR group who felt less excluded had a lower probability of belonging to the delayed group, and an even lower probability of belonging to the recovery group, and the lowest probability of belonging to the chronic group. For the non-CSR group, homecoming exclusion most strongly reduced the probability of belonging to the recovery trajectory, followed by a smaller, but significant, reduced probability of belonging to the chronic trajectory. Yet it was not a significant predictor of delayed onset in this group. Interestingly, exclusion at homecoming was the only social support variable significantly differentiating the chronic from the recovery and delayed-onset trajectories. As such, social support from society at homecoming seems to be a buffer against chronic outcomes, which is supported in the literature.<sup>27</sup>

Overall, our findings suggest that social support at the family, network, and societal level is involved in the genesis and sustenance of PTSD symptomatology over 20 years following military combat. It is also clear that these social resources are involved differently in predicting long-term outcomes in soldiers with and without CSR. However, given that the same predictors are predicting chronic as well as recovering trajectories, predicting who will continue to suffer and who will recover remains a central challenge.

Certain limitations must be taken into account when interpreting the results of this study; it is based on selfreport questionnaires that rely on introspection, and 1 of the predictor variables (social support) was not measured until the second time point, therefore disqualifying it as an early predictor. The temporal proximity between the second and the third measurement was 18 years, so we cannot account for what happened in the participants' lives in those years. Finally, since we did not obtain detailed information on interventions that the participants might have received throughout the course of the study, we cannot account for the effect treatment might have had on the course of symptoms.

Nevertheless, this study adds important perspectives to the field of PTSD research. By exploiting sophisticated advances in latent growth mixture modeling, we were able to not only confirm earlier findings of 4 diverse trajectories of posttraumatic adaptation but also demonstrate that these 4 trajectories are the prototypical outcomes for soldiers with and without CSR, while noting drastic changes in prevalence of symptomatic and especially chronic outcomes and pinpointing specific predictors of these trajectories. Hence, we suggest that assessment of functional impairment in the acute phase and identification of social resources at the family, social network, and societal level will aid in identifying soldiers at risk for symptomatic outcomes at an early stage. Furthermore, treatment for those individuals could involve increased family and social network support. Finally, reducing soldiers' sense of social exclusion at homecoming might help reduce the number of soldiers belonging to the chronic trajectories.

Author affiliations: The National Centre for Psychotraumatology, University of Southern Denmark, Odense, Denmark (Dr Armour and Ms Karstoft and Mr Elklit); School of Psychology, University of Ulster at Coleraine Campus, Coleraine, Northern Ireland, United Kingdom (Dr Armour); and Bob Shapell School of Social Work, Tel Aviv University, Tel Aviv, Israel (Dr Solomon). Potential conflicts of interest: None reported. Funding/support: None reported.

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