

Risk of Post-Traumatic Stress Disorder in 111 survivors the 2009 Viareggio (Italy) Rail Crash: the role of mood spectrum comorbidity

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Summary

Objectives

To explore the presence of PTSD and the potential correlations between the risk of developing PTSD and the lifetime mood spectrum signs and symptoms, as assessed with the Mood Spectrum Questionnaire Lifetime Version (MOODS-SR), in a sample of survivors of a liquid gas train crash in Italy, in 2009.

Methods

One hundred eleven subjects were assessed with the Structured Clinical Interview for Axis I Disorder (SCID-I), the Mood Spectrum Questionnaire (MOODS-SR) Lifetime version, the Impact of Event Scale-Revised (IES-R), and the Trauma and Loss Spectrum Questionnaire (TALS-SR).

Results

Sixty-six subjects, of the 111 who completed the SCID-I (59.5%), met criteria for PTSD. PTSD patients showed higher comorbidity rates for Generalized Anxiety Disorder (GAD) ($p < 0.001$), and lifetime and current Major Depressive Disorder (MDD) ($p < 0.001$) than subjects who did not develop PTSD. Lifetime MOODS-SR 'Sociability/Extraversion' factor and the prevalence of lifetime MDD differentiated subjects with from those without PTSD, when a multiple logistic regression analysis was performed.

Conclusions

Although further research is needed, our results show a significant correlation between the risk of developing PTSD and the mood spectrum comorbidity.

Key words

PTSD • Lifetime comorbidity • Mood spectrum • Mood disorders • Rail crash

Introduction

Disaster survivors may experience a number of responses in the aftermath of the event, such as feelings of sadness, anger, guilt, numbness, and sleep disturbances. These responses can belong to a normal stress reaction to abnormal situations. However, survivors may be more affected than general population by such signs and symptoms and may develop a Post-Traumatic Stress Disorder (PTSD) ¹⁻³. The DSM-5 ⁴ has highlighted the increased relevance of this disorder, and included PTSD in a separate session, namely the 'Trauma and Stress Related Disorders', that specifically addressed post-traumatic stress reactions. In the DSM-5, the PTSD structure has been shuffled into 4 clusters: re-experiencing, persistent avoidance of stimuli, negative alterations in cognition and mood, and arousal ⁴.

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Several studies investigated PTSD prevalence rates in general population exposed to different kind of traumatic events. Percentages ranging from 7.5% to 40% have been reported in survivors to terroristic attacks, natural disasters, bomb explosions, fire or accidents⁵⁻⁸. These differences have been accounted to inhomogeneity in the studies methodology, such as the recruitment procedure, the assessment methodology, the time from exposure to the traumatic event. Nevertheless, there is agreement across studies in reporting high comorbidity rates between PTSD and mood disorders⁹⁻¹³.

The link between mood disorders and PTSD is intriguing and increasing literature has pointed out the strong relationship between the two psychopathological areas. Patients with PTSD are at increased risk for the onset of mood disorders, if compared with individuals who experienced the same traumatic event without developing a PTSD¹⁴. Moreover, there is evidence that patients with mood disorders exposed to a traumatic event tend to develop more frequently PTSD than subjects without¹⁵⁻¹⁶. The percentages of both cross-sectional and lifetime comorbidity between depressive disorders and PTSD are constantly high in epidemiological and in clinical studies, ranging from 49.6% to 59.6% for current, and from 3.7% to 10.1% for lifetime comorbidity¹⁻¹⁸⁻²⁰. Further, the large majority of studies on patients with bipolar disorder documented rates of PTSD double than in general population with a mean prevalence of 16%²¹. When bipolar disorder co-occurs with PTSD, it is associated to an increased morbidity and mortality, a poorer outcome, a more severe course of illness, and a higher risk of self-injuring behaviors²²⁻²³.

Recently, clinical studies have shown the impact of sub-threshold mood dysregulations on PTSD onset on its symptoms and complications, including suicide⁹⁻²⁴⁻²⁶.

Aim of this study was to explore mood spectrum features potentially related to the occurrence of PTSD in a civil population exposed 7 to 8 months before a railway explosion in Italy, in 2009.

On 29 June 2009, at 11.48 p.m., in the railway station of Viareggio, Italy, a freight train carrying Liquefied Petroleum gas, derailed with a subsequent fire. The wagon hit the platform of the station and the derailed wagons overturned to the ground, with two of them exploding and coughing a fire. A whole street alongside the railway was destroyed in the explosion. Thirty-two people died (8 immediately at the time of explosion; 24 after being hospitalized for physical trauma and burns); 26 people were severely injured. A large area of the town was damaged in the subsequent fires caused by the wagons exploding. Local authorities declared the state of emergency: around 1,000 residents of Viareggio were evacuated from their homes; the accident left around 100 people homeless.

Methods

Study Participants

The study sample consisted of 111 subjects exposed 7 to 8 months before to the explosion of a train containing liquid gas near to the Central Station of Viareggio (Italy)²⁷. Subjects referred to a psychiatric service dedicated to the survivors of the traumatic event. Eligible subjects provided written informed consent after receiving a complete description of the assessment procedures approved by the Ethical Committee of the Azienda USL 12 of Viareggio (Italy).

Instruments

Axis I disorders were assessed with the Semi-structured Clinical Interview from the DSM-IV (SCID-I)²⁸. Participants completed the following self-report measures: the Impact of Event Scale-Revised (IES-R)²⁹; the Trauma and Loss Spectrum-Self Report (TALS-SR)³⁰; the Lifetime Mood Spectrum Self-Report (MOODS-SR-LT)³¹⁻³³. The Impact of Event Scale-Revised version (IES-R)²⁹ is a 22 items scale measuring subjective stress following a traumatic event. It represents the revised version of IES, a 15-item scale measuring intrusive, avoidant, and hyper-arousal symptoms³⁴. Participants were asked to rate the different statements on a scale ranging from '0' (not at all) to '4' (completely true). Psychometric properties of the IES, its reliability and validity are described in detail elsewhere³⁵.

The TALS-SR includes 116 items exploring a range of loss and/or traumatic events that the subjects may have experienced and the symptoms, behaviors and personal characteristics that might represent manifestations and/or risk factors for the development of a stress response syndrome. The instrument is organized into 9 domains (loss events, grief reactions, potentially traumatic events, reaction to losses or upsetting events, re-experiencing, avoidance and numbing, maladaptive coping, arousal, personal characteristics/risk factors). Each item response is coded in a dichotomous way (yes/no) and domain scores are obtained by counting the number of positive answers.

The MOODS-SR explores the overall spectrum of lifetime mood signs and symptoms, including manic and depressive features, rhythmicity and vegetative functions³⁶. In the present study we utilized the factors structure of mood spectrum, identified by an exploratory factor analysis approach as described by Cassano et al.³²⁻³³. This includes 6 factors for the lifetime depressive side, namely: '*Depressive Mood*', '*Psychomotor Retardation*', '*Suicidality*', '*Drug/Illness related depression*', '*Psychotic Features*' and '*Neurovegetative Symptoms*'. The manic side accounts 9 factors: '*Psychomotor activation*', '*Creativity*', '*Mixed instability*', '*Sociability/extraversion*', '*Spirituality/mysticism*', '*Mixed irritability*',

'Inflated self-esteem', 'Euphoria', 'Wastefulness/recklessness'.

Statistical Methods

Mann-Whitney U-test and Chi-square test were used to test differences between patients with or without PTSD. A multiple logistic analysis was performed to investigate potential significant associations between the presence/absence of PTSD as dependent variable, and the mood spectrum features (including lifetime Axis I mood comorbidity and MOODS-SR factor scores) as independent variables. All statistical analyses were carried out with SPSS, version 15.0³⁷.

Results

A total sample of 111 subjects was recruited, 60 females (54.0%) and 51 males (46.0%). The mean age of the overall sample was 52.9 ± 15.8 years. Sixty-six subjects (59.5%) met Axis I criteria for PTSD. Demographic characteristics of the sample are summarized in Table I. Subjects who developed PTSD reported statistically significant lower ($p = .04$) educational levels, when compared to subjects who did not develop PTSD.

Among survivors with PTSD, 49 (74.2%) fulfilled SCID-I criteria for at least one Axis I disorder comorbidity in their lifetime, with respect to 20 of survivors without PTSD (44.4%) (chi-square = 10.10, $p = 0.001$). The lifetime prevalence of major depressive disorder (MDD) was significantly higher in patients with PTSD than in

patients without PTSD (65.2% vs 28.9%, respectively; chi-square = 14.07, $p < 0.001$).

Subjects with PTSD had a higher percentage of comorbidity for multiple Axis I disorders, than subjects without (81.0% vs 27.6%, respectively, chi-square = 20.22, $p < 0.001$). Subjects with PTSD scored significantly higher percentages of current Major Depression (53.0% vs 15.6%, respectively, chi-square=15.98, $p < 0.001$), and Generalized Anxiety Disorder (GAD) (57.6% vs 24.4%, respectively, chi-square=11.91, $p = 0.001$) than subjects without PTSD. Only one patient with PTSD met diagnostic criteria for Bipolar Disorder (Table II).

As expected, the IES total scores and the TALS-SR scores were significantly higher in subjects with PTSD than in those without (Table III). The only exception was the TALS-SR domain regarding the 'lifetime exposure to traumatic events', infrequent in the overall sample.

Survivors with PTSD reported statistically significant higher scores in all the factors of the lifetime MOODS-SR depressive component (*Depressive Mood, Psychomotor Retardation, Suicidality, Drug-Illness Related Depression, Psychotic Features, Neurovegetative Symptoms*) as well as in the following factors of the manic component: *Psychomotor Activation, Creativity, sociability/extraversion, Mixed Irritability, Inflated Self-Esteem, and Wastefulness/Recklessness* (see Table IV for details). A multiple logistic regression, including lifetime MOODS-SR factors and lifetime Major Depression prevalence as independent variables, was performed. The 'sociability/extraversion' factor (OR = 1.89, 95% CI 1.25-2.86), and the prevalence of lifetime Major Depression (OR = 5.21, 95% CI 1.61-16.91) differentiated subjects with and without PTSD.

TABLE I. Demographic characteristics ($n = 111$).

	No PTSD ($n = 45$)	PTSD ($n = 66$)	p
Age (years)	Mean/SD 51.5 (16.6)	Mean/SD 53.9 (15.2)	ns
Female gender	n (%) 22 (48.9)	n (%) 38 (57.6)	ns
Single	n (%) 8 (17.8)	n (%) 9 (13.8)	ns
Married	32 (71.1)	41 (63.1)	ns
Separated/divorced	2 (4.4)	10 (15.4)	ns
Widowed	3 (6.7)	5 (7.7)	ns
Low Educational Level	21 (46.7)	43 (53.3)	.04
High Educational Level	24 (66.2)	22 (33.8)	ns
Family History for Psychiatric Disorders	n (%) 15 (44.1)	n (%) 19 (55.9)	ns

Discussion

Our study aimed at exploring mood spectrum features potentially related to the risk of PTSD in a civil population exposed 7 to 8 months before a railway explosion. Our results showed PTSD prevalence rates in almost two thirds of exposed subjects (59.5%), much higher than those reported in other similar studies. Galea et al.⁵, in fact, reported PTSD rates of 7.5 % in a sample of adults living south of 110th Street in Manhattan after the terroristic attack of September 11, 2001. Farhood et al.⁶, reported prevalence rates of PTSD of 17.2 % in a sample of Lebanese civilians exposed to a church explosion, and in their comparison groups (33 victims, 30 family members, and 30 neighbors), 1 year after exposure. Methodological differences across these studies, particularly the subjects' recruitment, could account for the discrepancies in results. In our study, the sample was obtained from subjects who spontaneously referred to a psychiatric service dedicated to the rail crash witnesses or survivors.

TABLE II. Lifetime and Current Axis I Comorbidity* (SCID-I) in the Overall Sample (n = 111).

	No PTSD (n = 45)	PTSD (n = 66)	Chi-square Or Fisher Exact test	p value
Lifetime Comorbidity	n (%)	n (%)		
Major Depressive Episode (MDE)	13 (28.9)	43 (65.2)	14.07	< .001
Panic Disorder	17 (37.7)	9 (13.6)	0.36	.547
Agoraphobia without PD	-	1(1.5)	-	.595
OCD	1 (2.2)	-	-	.405
Social Phobia	1 (2.2)	-	-	.405
Specific Phobia	-	4 (6.0)	-	.120
Anxiety Disorders NOS	2 (4.4)	1 (1.5)	-	.162
At least 1 comorbid Axis I Lifetime Disorder	20 (44.4)	49 (74.2)	10.10	< .001
Current Comorbidity	n (%)	n (%)		
Major Depressive Episode (MDE)	7 (15.6)	35 (53.0)	15.98	< .001
Panic Disorder	5 (11.1)	14(21.2)	3.01	.083
Bipolar I Disorder	-	1 (1.5)	-	.595
Dysthymia	1 (2.2)	-	-	.405
GAD	11 (24.4)	38 (57.5)	11.91	< .001
Social Phobia	1 (2.2)	-	-	.405
Specific Phobia	-	4 (6.0)	-	.120
Anxiety Disorder NOS	1 (2.2)	-	-	.405
At least 1 comorbid Axis I Current Disorder	17 (37.8)	52 (78.8)	19.13	< .001

* Lifetime and Current Axis I Diagnoses are calculated as mutually exclusive

TABLE III. IES and TALS-SR Scores in subjects with and without PTSD.

	No PTSD (n = 29)	PTSD (n = 42)	Mann-Whitney test	p value
Trauma and Loss Spectrum-Self Report (TALS-SR)	Mean/SD	Mean /SD		
Loss events	4.0 (2.0)	4.9 (1.9)	2.04	.041
Grief reactions	10.5 (5.8)	14.3 (5.8)	2.59	.009
Potentially traumatic events	3.7 (2.7)	5.0 (3.0)	1.81	.071
Reaction to losses or upsetting events	6.4 (4.9)	11.1 (3.4)	4.27	< .001
Re-experiencing	2.7 (2.2)	6.0 (2.9)	5.43	< .001
Avoidance and numbing	3.7 (3.7)	6.3 (2.9)	3.22	.001
Maladaptive coping	0.8 (1.0)	1.8 (1.4)	3.58	< .001
Arousal	2.0 (1.7)	3.7 (1.2)	4.26	< .001
Personal characteristics/risk factors	0.9 (1.4)	1.7 (1.1)	3.64	< .001
Impact of Event Scale (IES)	Mean/SD	Mean/SD		
Total score	18.4 (18.5)	43.5 (18.7)	4.62	< .001
Intrusion	8.4 (9.5)	23.9 (10.0)	5.09	< .001
Avoidance	10.0 (10.6)	19.6 (10.6)	3.51	< .001

TABLE IV. Lifetime MOODS-SR factors' scores in subjects with and without PTSD, according to TALS-SR Criteria.

	No PTSD (n = 35)	PTSD (n = 36)	p value
MOODS-SR Lifetime version Factors	Mean/SD	Mean/SD	
Depressive mood	3.5 (4.2)	9.6 (6.3)	.0001
Psychomotor retardation	1.4 (2.5)	5.4 (4.6)	.0001
Suicidality	0.1 (0.4)	0.8 (1.2)	.004
Drug-illness related depression	0.2 (0.6)	0.6 (0.8)	.016
Psychotic features	0.6 (1.3)	2.1 (1.9)	.001
Neurovegetative symptoms	2.4 (2.4)	4.5 (3.1)	.003
Psychomotor activation	2.2 (2.1)	4.4 (2.8)	.001
Creativity	2.4 (2.3)	3.7 (2.8)	.03
Mixed instability	0.4 (1.1)	0.8 (1.0)	.222
Sociability/extraversion	1.5 (1.3)	2.3 (1.9)	.06
Spirituality/mysticism	0.3 (0.6)	0.5 (0.9)	.330
Mixed irritability	0.8 (1.0)	1.9 (1.5)	.001
Inflated self-esteem	0.4 (1.0)	1.0 (1.1)	.029
Euphoria	2.2 (1.4)	2.7 (1.7)	.199
Wastefulness/recklessness	0.5 (0.8)	1.1 (1.2)	.015

Further, our results showed lower educational level in survivors who developed PTSD compared to those who did not, in line with the available literature^{8 38-40}. Despite a slight higher prevalence of women among survivors with PTSD, we found no statistically significant gender difference in the PTSD rates. Most literature on humans' made or natural disaster survivors suggested a higher vulnerability to PTSD in females⁴¹⁻⁴⁵. However non-univocal results are described in literature when the traumatic event is a severe crash, as occurred in our sample⁴⁶.

A higher prevalence of lifetime and current comorbidity for major depression (MDD) was found among survivors with PTSD, when compared to those who did not. Interestingly, exploring lifetime mood spectrum symptoms and features in survivors with PTSD, with respect to those without, we found significantly higher scores not only in all the depressive component factors as expected, but also on several factors belonging to the manic/hypomanic component, namely: 'psychomotor activation', 'mixed irritability', 'lifetime Spirituality/Mysticism', 'Sociability/Extraversion'. However, only one PTSD survivor reported Axis I Bipolar Disorder comorbidity. We argued the relevance of sub-threshold manic comorbidity as one of the leading correlates to PTSD development after trauma. Accordingly, the 'Sociability/Extraversion' MOODS-SR lifetime factor was confirmed as the only predictor of PTSD, except for the Axis I co-

morbidity for lifetime major depressive episodes, when a multiple logistic regression analysis was performed. The 'Sociability/Extraversion' MOODS-SR lifetime factor explored the lifetime presence of personality traits, such as proneness to enthusiasm, optimism, and high levels of self-confidence, sociability and extraversion. This finding was consistent with previous studies in which the occurrence of manic/hypomanic or mixed symptoms among subjects with PTSD was described^{16 21 47}. Given the variety of genetic and environmental factors influencing brain systems that are crucial for the development of anger, mixed irritability, and mood instability, it is not surprising that traumatic events might potentially modulate the expression of both depressive and mixed/irritable mood. It remains unclear, therefore, whether pre-existing traits, belonging to the manic/hypomanic realm, might have a specific role as risk factors for onset, severity or other clinical parameters of PTSD, beyond a 'general adverse background' effect. Our results should be interpreted with caution, keeping in mind some limitations. The most important is related to the fact that subjects spontaneously referred to an outpatient service dedicated to the Viareggio population exposed to the rail crash. This might represent a selection bias for the rates of disorders reported with respect to studies on general population samples. Moreover, the number of subjects was small. Finally, to detect mood spectrum symptoms we adopted a lifetime instru-

ment (the MOODS-SR) that did not allow us determining which symptoms occurred before and which after the trauma exposure⁴⁸⁻⁵¹.

Conclusions

Although further research is needed to elucidate if there is a specific link between PTSD and manic/hypomanic lifetime mood spectrum features, we submit that the systematic detection of such signs and symptoms should be part of the risk assessment and prevention strate-

gies, when a population is exposed to a severe traumatic event. With the above-mentioned limitations, in light of our finding, we could speculate that the presence of sub-threshold manic/hypomanic lifetime features might be one of the predictors for a subsequent PTSD onset.

Acknowledgments

None.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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