

PTSD in the aftermath of a natural disaster: what we learned from the Pisa-L'Aquila Collaboration Project

Claudia Carmassi¹, Alessandro Rossi², Virginia Pedrinelli¹,
Ivan Mirko Cremonese¹, Valerio Dell'Oste¹, Paolo Stratta²,
Carlo Antonio Bertelloni¹, Liliana Dell'Osso¹

¹ Department of Clinical and Experimental Medicine, University of Pisa, Italy; ² Department of Clinical and Experimental Medicine, University of L'Aquila, Italy

SUMMARY

Objectives

Several studies have shown that survivors of natural disasters present high PTSD rates. On 6th April 2009, L'Aquila (Central Italy) was jolted by a 6.3 Richter scale magnitude earthquake causing a massive destruction of the town. More than 300 individuals died, 1,600 were injured and about 65,000 displaced. The aim of this paper is to review the researches conducted on survivors to this earthquake in the context of the Pisa-L'Aquila Collaboration Project which is going on since 2009, in order to assess post-traumatic stress spectrum psychopathology and its correlates.

Methods

An overall sample of more than 2000 earthquake survivors was assessed by means of the Trauma and Loss Spectrum-Self Report (TALS-SR), a questionnaire exploring post-traumatic stress spectrum symptoms. The TALS-SR offers a multidimensional approach that considers three major dimensions: potentially traumatic events, including losses and the so-called low magnitude events; symptoms of the acute/peri-traumatic reaction; post-traumatic spectrum symptoms. Survivors were also assessed by means of Mood Spectrum-Self Report (MOODS-SR), to detect correlations between post-traumatic stress spectrum and mood spectrum symptoms.

Results

High prevalence rates of both full and partial PTSD were found, as well as several factors (e.g. younger age, female gender, degree of exposure, bereavement experiences) associated with an increased likelihood of post-traumatic stress symptoms. Survivors with PTSD also reported significantly higher prevalence rates of specific symptoms, such as maladaptive behaviors including suicidality, and impairment in eating behaviors and somatic symptoms.

Conclusions

These studies highlighted the heavy burden of PTSD in the aftermath of the earthquake, even months after exposure, and a close relationship between post-traumatic stress spectrum and mood spectrum symptoms, suggesting the need of additional research.

Key words: PTSD, post-traumatic stress spectrum, mood spectrum, earthquake, natural disaster

Received: November 30, 2019
Accepted: January 20, 2020

Correspondence

Virginia Pedrinelli

Section of Psychiatry, Department of Clinical and Experimental Medicine, University of Pisa, via Roma 55, 56126 Pisa, Italy
E-mail: virginia.pedrinelli@gmail.com

Conflict of interest

The Authors declare no conflict of interest

How to cite this article: Carmassi C, Rossi A, Pedrinelli V, et al. PTSD in the aftermath of a natural disaster: what we learned from the Pisa-L'Aquila Collaboration Project. *Journal of Psychopathology* 2020;26:99-106. <https://doi.org/10.36148/2284-0249-377>

© Copyright by Pacini Editore Srl



OPEN ACCESS

This is an open access Journal distributed in accordance with the Creative Commons Attribution Non-Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Introduction

Earthquakes represent, above all, one of the most frightening and frequent natural disasters a person can experience, bringing not only damage to one's properties and physical health, but also significant psychological distress^{1,2}. These mass trauma, indeed, happen without warning all around the world, causing massive destruction and major damage in populated areas, being often responsible of other natural disasters (e.g.

tsunami and landslides), causing death or injuries instantaneously or rapidly and widespread³⁻⁵. Earthquakes have the characteristics to strike suddenly and affect a large amount of people simultaneously, representing a particular setting for interplay between risk and vulnerability factors for trauma-related psychopathology. For all these reasons, over the past several decades, seismic events gained a growing attention of researchers and clinicians^{6,7}. Increasing attention to mental health has been paid, trying to find effective interventions, to provide high standard prevention and rehabilitation services in affected populations, given that there's now agreement that earthquakes survivors need mental health professionals' support^{3,8}.

Extensive research, especially over the past twenty years, has been focusing on mental disorders development after earthquakes. Indeed, the psychopathological sequelae associated with these experiences represent a challenge for healthcare systems throughout the world⁹⁻¹³. High rates of many mental disorders can be detected in the aftermath of these traumatic events. Among them, post-traumatic stress reactions, especially Post-Traumatic Stress Disorder (PTSD) both in its full-blown and partial manifestations, are the most frequently reported and are often characterized by a chronic course and high risk for suicide^{4,14,15}. Post-traumatic stress reactions are a challenge for mental health professionals, as they have consequences impacting affected individuals not only in the phase immediately after trauma exposure, but also in the long term. Moreover, even if the symptoms' onset is usually in the first month after the traumatic event, in a minority of cases, there can be a delay of months or years before symptoms start to appear^{16,17}.

Italy is one of the highest seismic risk countries in Europe, but luckily deadly earthquakes occur rarely. In the last ten years, three massive destructive earthquakes affected the Country: the one happened in L'Aquila in 2009, the one that struck the Emilia-Romagna region (Northern Italy), in 2012 and, more recently, the one that hit Amatrice (Central Italy), in 2016. On April 6th 2009, at 03:32 hours, Central European Time, a terrific 6.3 magnitude seism jolted L'Aquila and its province. L'Aquila is a town with 72,000 inhabitants in the Abruzzo, region of Central Italy: the town was massively destroyed, more than 100,000 buildings were severely damaged, 309 people were killed at 19 different localities, 66,000 individuals were left homeless and 1600 were injured, among whom more than 200 seriously. Marks of this event are still visible: today, the town is still under reconstruction and about 10,000 people are still displaced, living in temporary accommodations. The historic centre of L'Aquila, which was home to around 20,000 people before the earthquake, is a tale of two cities: one still

emerging from the rubble, the other resiliently trying to return to normal.

In this context, a collaboration between researchers of the Universities of Pisa and L'Aquila has given the chance to conduct studies on the impact of L'Aquila earthquake on mental health. Large-scale surveys on a total of over 2,000 people affected have been carried out, with a focus on post-traumatic stress spectrum and its correlates. Survivors were assessed by means of a specific instrument developed to assess post-traumatic stress spectrum symptoms: the Trauma and Loss Spectrum-Self Report (TALS-SR)¹⁸, referred to the earthquake exposure.

The TALS-SR is an instrument developed in the framework of an international collaborative research project called *Spectrum Project* going on since 1995, exploring common clinical features that accompany each disorder, as it is classified through DSM diagnostic criteria^{19,20}. According to this view, the spectrum approach refers to a dimensional view of psychopathology that takes into account, besides the core and most severe DSM symptoms, a wide number of atypical and sub-threshold manifestations, as well as temperamental traits, that might be prodromals, precursors or sequelae of the target disorder. A Structured Clinical Interview for Trauma and Loss Spectrum (SCI-TALS)²¹, and its Self Report (TALS-SR)¹⁸, have been developed and validated. The TALS-SR consists of 116 dichotomous items (yes/no), grouped in nine domains that explore the trauma and loss spectrum through a multidimensional approach. This approach refers to three major dimensions: the one of lifetime exposure to several potentially traumatic events (included the so-called "low magnitude" and loss events), that of the acute/peri-traumatic reactions and that of post-traumatic stress and/or Complicated Grief (CG) spectrum symptoms.

Through this paper, we aimed to re-examine the lessons we have learned from the results of the researches conducted on survivors to the L'Aquila earthquake, assessed by means of the TALS-SR, showing the data gave a relevant contribution to understand post-traumatic stress symptomatology related to the exposure to a natural disaster.

Full and partial symptomatological PTSD: the impact of nosographic evolution in the DSM-5

The rates of full and partial symptomatological PTSD, as well as the role of specific risk factors, were assessed at 10 and 21 months after the event. In later studies, the impact on PTSD diagnosis of the changes in the DSM diagnostic criteria from the fourth to the fifth edition were also investigated, as the TALS-SR included a wide range of post-traumatic stress spectrum symp-

toms comprising also those that had been later acknowledged among DSM-5 criteria for PTSD. In particular, symptomatological PTSD, according to DSM-IV-TR criteria, emerged in 37,5% of 512 survivors attending the last year of high school assessed ten months after the event; a further 29,9% reported partial PTSD². After twenty-one months rates of full and partial PTSD resulted to be of 30,7 and 31,4%, respectively, according to literature data^{4,6,11,22}. After DSM-5 was published, we first adopted the new diagnostic criteria by means of an algorithm including symptomatic criteria for PTSD diagnosis encoded by TALS-SR items¹³, showing full-blown PTSD rates as high as 39,8%. Moreover, an accurate analysis of the differences in the criteria endorsed was performed.

Our findings on L'Aquila survivors also confirmed the higher vulnerability of females to the impact of traumatic events, both in terms of PTSD prevalence rates, as well as severity of symptoms. In the above mentioned study², in fact, a significant difference was found between females and males in PTSD prevalence rates, with about double rates in female sex, in line with prior studies^{22,23}. On the contrary, no significant differences between genders were reported in partial PTSD rates. Consistently, females showed higher TALS-SR domain scores and symptoms with respect to males. Data were confirmed according to DSM-5 criteria²⁴, also on a larger sample of more than 900 survivors, demonstrating the main effect of gender on development of post-traumatic stress symptoms after a natural disaster¹².

Our findings also add up on the weight of age effect as a vulnerability factor element on development of PTSD: age differences emerged only among females, with younger ones being the most affected^{12,25}. A significant interaction between exposure*age and gender*age of TALS-SR symptoms emerged, these latter being higher in young subjects than in unexposed elderly ones, and in young females with respect to the older ones¹². In line with some authors^{26,27}, these results suggest that females and younger individuals are more prone to the development of post-traumatic stress symptomatology when exposed to trauma, even if we found an impact of age only within the less affected ones and among females.

The impact of the characteristics of the “trauma”

In the past decades increasing literature has highlighted the role of the kind of trauma and/or severity of exposure as risk factor for PTSD²⁸. In this regard, the DSM-5 has risen the threshold for defining an event as traumatic. However, studies on survivors to the 9/11 terroristic attack pointed out PTSD reactions even in

subjects far from the epicenter of the event^{29,30}. In the aftermath of an earthquake, the degree of exposure, in terms of distance from the seismic epicenter, has been suggested as a major risk factor, with higher symptom levels being reported in individuals who were closer to the seismic epicenter at the time of the earthquake^{3,5}. We explored two samples of a total of more than 1,500 survivors to the L'Aquila earthquake, located at different distances from the epicenter at the time of the event. Results confirmed significantly higher post-traumatic stress spectrum symptoms in survivors located in the closest area to the epicenter, corroborating a close relationship between degree of exposure and severity of the psychopathological sequelae^{12,25}. Another interesting finding regarded traumatic loss, as a risk factor for post-traumatic stress symptoms. It is well known that significant losses in the framework of earthquakes are considered to be a contributory factor to PTSD development, both in adolescents and adults^{3,31}. Pathological grief reactions (variously described as CG, Traumatic Grief or Prolonged Grief Disorder), have been widely studied, since they have been associated with persistent impairment of global functioning and with a higher suicidal risk in people affected³²⁻³⁴. Loss of beloved one represents a possible contributor to the traumatic impact of an event leading to an increased risk of PTSD development. In L'Aquila, the 2009 earthquake caused the death of more than 300 people and the weight of loss had an impact on affected individuals; in a sample of 475 young adult survivors, 15,2% reported a loss and these showed significantly higher PTSD rates and post-traumatic stress symptoms levels with respect to not bereaved ones¹¹.

Suicidality and maladaptive behaviors

Not surprisingly, earthquakes are the most studied natural disasters for their impact on suicidal attempts³⁵, with increasing data showing high rates of suicidality in people survived, especially after highly destructive events^{36,37}, and PTSD was found to be one of the principal mediators between mass traumas and suicidality³⁸⁻⁴⁰. Data on L'Aquila earthquake survivors, reported significantly higher rates of suicidal ideation and attempts related to PTSD diagnosis, with rates of suicidal ideation present in about 7-14% of the sample and rates of suicidal attempts ranging between 2 and 5%.^{2,41} This variability could be explained by many factors, such as age, gender, concomitant mood symptoms and different coping strategies. In particular, our results demonstrated a significant association between suicidality and male gender in PTSD survivors, suggesting, as others have highlighted^{27,42}, that men tend to express psychological disturbances through acting out and external behavior, whilst women tend to express their distress

by turning their feelings inwards, leading to depression and anxiety⁴³.

In this regard, the DSM-5 included a new set of symptoms for PTSD diagnosis, among which the so-called maladaptive behaviors. These are defined as volitional behaviors whose outcome and negative consequences impact everyday activities^{25,42,44,45}. Reckless or self-destructive behaviors are one of the three new criteria included in DSM-5 for PTSD diagnosis as part of criterion E. As for pathological grief reactions, the *Spectrum approach* of TALS-SR^{18,46}, that includes a specific domain addicted to maladaptive behaviors, allowed to explore these psychopathological traits years before the DSM-5 acknowledgement⁴⁷. Maladaptive symptoms encompass behaviors such as reckless driving, promiscuous sex, self-injuring behaviors, alcohol, substance or drug use, ceasing to take care of oneself or to take prescribed therapies and suicidal behaviors⁴⁴⁻⁴⁸. Many interesting evidences came out in L'Aquila survivors' samples: in all the studies emerged survivors with PTSD reported significantly higher prevalence rates of maladaptive behaviors than those without^{2,49,50}. On the impulse of previous studies^{51,52}, 512 high school students were recruited ten months after the event and screened for these behaviors by means of TALS-SR. A significantly higher number (almost double) of females with respect to males reported they had stopped taking care of themselves; males, on the contrary, reported significantly higher percentage for other maladaptive behaviors, such as use of alcohol or substance use and promiscuous sex². Gender differences in the context of maladaptive symptoms were investigated also in a larger sample of 900 survivors, including adult individuals⁵⁰. A statistically significant association between male gender and a presence of at least one maladaptive behavior among PTSD survivors was reported. Data showed significantly higher rates of alcohol or substance use among earthquake survivors with PTSD, with rates as high as more than 20%, compared to the ones who did not report PTSD, presenting rates around 10%. These evidences were confirmed by other studies among young people exposed to this same event, with marked increase in levels of abuse compared to prior to the trauma⁵³. Furthermore, almost half of individuals with PTSD, also reported a decrease in self-care (e.g. not getting enough rest, not eating properly), with more than 10% reporting suspension of on-going treatments or medical recommendations. In line with other studies on the same sample⁵⁴, we reported significantly higher rates of risk-taking behaviors, including self-injuring and suicide attempts, among survivors with PTSD. Moreover, in this group, emerged significant correlations between maladaptive coping and symptoms of re-experiencing, avoidance and numbing and arousal in women, while

only between maladaptive coping and avoidance and numbing in men. Finally, age showed to be an influential factor in the former sample, besides gender: males with respect to females, reacted to trauma with more maladaptive coping behaviors, particularly evident in the younger ones (< 40 years), suggesting the need to take into consideration age and gender on post-traumatic stress symptoms, in order to identify high-risk subjects. More recently, these data have been reanalyzed according to the new DSM-5 PTSD criteria. Exploring the TALS-SR main scores of the senior high school students, maladaptive behaviors were found to be endorsed by 36.8% of PTSD cases and were found to be essential in satisfying DSM-5 E2 diagnostic criterion threshold in 14.2% of PTSD diagnosis. Maladaptive behaviors were also critical in almost half of the PTSD diagnoses in males, but only in about one-fourth in females^{13,24}. Maladaptive behaviors were additionally studied from a new perspective that hypothesized an interplay with guilt and shame PTSD symptoms (new PTSD DSM-5 D3 symptom): among 869 L'Aquila earthquake survivors, 11.6% endorsed at least one guilt/shame symptoms, with significantly higher rates in PTSD with respect to no-PTSD ones and the presence of guilt or shame symptoms being positively correlated with maladaptive behaviors⁵⁵.

These constructs have also been investigated as to their possible relationships with lifetime mood spectrum, by means of the Mood Spectrum-Self Report (MOODS-SR)⁵⁶, upon the evidence of a strong relationship between bipolar comorbidity and increased PTSD severity⁵⁷⁻⁵⁹. In particular, lifetime manic spectrum symptoms were strongly related to TALS-SR "potentially traumatic events" and "maladaptive coping" domains, suggesting their notable role for PTSD development⁶⁰. On the other hand, the role of resilience factors has also been explored. Religion and spirituality are often seen as a source of comfort, meaning and hope, but findings about their role in dealing with psychological distress in the aftermath of trauma exposure have been equivocal⁶¹. On a sample of 901 survivors to the L'Aquila earthquake⁶², religiosity was reported to provide resilience against post-traumatic stress symptomatology, as a value for ritualistic than for spiritual religiosity. In a second study on 426 survivors, the same authors reported higher rates of suicidal ideation among survivors with negative religious coping, suggesting a more important role of positive versus negative religious coping rather than the presence of religiosity itself as a possible risk factor for suicidality³⁷. In 2016, on the sample of 475 high school students recruited 21 month after the L'Aquila seism, correlations between Spirituality/Mysticism/Psychoticism dimension of the MOODS-SR (including symptoms such as ecstatic experiences and

psychotic symptoms of mania) and suicidality were explored: higher rates of each of the Spirituality/Mysticism/Psychoticism item among subjects with PTSD diagnosis with respect to those without emerged and subjects with suicidal ideation (as well as suicide attempt), reported significantly higher scores in the MOODS-SR Spirituality items^{41,62}. Stratta et al.³⁷, suggested that separating religious coping from spirituality might represent a possible key of explanation for the conflicting results presented in literature: if rituals and social support derived from belonging to a religious community seem to provide resilience, on the other hand spirituality may have a role in increasing the risk of developing post-traumatic stress symptoms and even suicidality.

A new perspective: the interplay between trauma and eating behaviors and somatic complaints

Even if there's unanimous content about the linkage between PTSD and alterations of neurovegetative functions, literature mostly focused on some of them, such as sleep disturbancy (e.g., recurrent nightmares, frequent awakenings, disruptive nocturnal behaviors), finding greater rates in trauma exposed samples than in general population^{63,64}.

The co-somministration of the TALS-SR and MOODS-SR (that includes a rhythmicity and vegetative functions domain) has allowed to investigate the interplay between trauma and other neurovegetative functions, such as eating behaviors and somatic complaints in young adult survivors of L'Aquila earthquake.

Most recently, there has been growing interest on the correlations between eating disorders and somatic complaints and PTSD^{65,66}. Among the traumatic events more strongly associated with eating disorders have been reported interpersonal traumas such as childhood abuse, parental break-up and loss of a family member, but changings in eating habits and eventually the onset of eating disorders is a neglected area in the field of post-traumatic stress symptoms in the aftermath of a mass trauma. The study⁶⁷ enlightened impaired eating behaviors in up to 12,3% of survivors 21 months after trauma, with significant higher rates in women with respect to men in all eating behaviors explored. Moreover, significant higher rates of impaired eating among survivors with DSM-5 symptomatological PTSD diagnosis with respect to those without were found. An other noteworthy finding is that not only women, but also men with PTSD, reported significant higher levels of impaired eating behaviors with respect to those without, corroborating the need to accurately explore the influence of trauma exposure and PTSD on dietary habits in both genders. These behaviors could be encoded as an

atypical manifestation of stress exposure being part of maladaptive symptoms.

Similar to eating behaviors, even if complaints of somatic symptoms have been correlated to stressful life events and PTSD^{62,63}, they have been poorly investigated in the setting of natural disasters. In this regard, a recent research on the same sample of survivors, emphasized the strong link between PTSD and somatic symptoms burden, finding up to 14% survivors complaining somatic symptoms 21 months after the exposure, with the PTSD group showing higher ratio of endorsing at least one MOODS-SR somatic symptom than the no-PTSD group⁶⁸. These data are in line with prior evidence in children and adolescents exposed to Lushuan 2013 earthquake⁶⁵. The physical disorders most frequently lamented were chronic pain, gastrointestinal disorders, headaches and thermal/painful stimuli hypo-hypersensitivity. Further, higher rates of somatic symptoms were shown in females rather than in males. Moreover, the latter were positively correlated to TALS-SR maladaptive coping domain (including "having stopped to take care of themselves" and "the use of drugs or over the counter medications to relief symptoms"), in line with previous studies on adolescents exposed to trauma, showing higher rates of use of drugs or medications to relieve emotive and physical pain^{51,52}.

This issue deserves more scientific and clinical attention, since, as demonstrated, these clinical features have an impact not only in the short term but also over the long term after the traumatic experience.

Conclusions

Albeit additional researches on larger and more representative samples are essential in understanding the nature and the course of post-traumatic stress symptoms in the aftermath of mass disasters, the studies reported on L'Aquila earthquake survivors highlighted the heavy burden of these symptoms, suggesting the necessity of effective preventive and treatment strategies. The *Spectrum approach* adopted by the TALS-SR allowed a more accurate assessment of trauma-exposed people. Further, the co-somministration of MOODS-SR allowed us to explore the trauma-related psychopathological features from a different angle, focusing on the close relationship between post-traumatic and mood spectrum symptoms. Indeed, from this perspective, the trauma-exposure psychopathological sequelae can be interpreted as the intersection of symptoms belonging to different pathological matrices, ending in a common final pathway. Increasing neurobiological and clinical evidences about the impact of post-traumatic stress symptoms on alterations of neurovegetative functions have been confirmed by surveys in our samples, that highlighted higher rates of them in PTSD patients, such

as impaired eating behaviors and somatic symptoms. These findings suggest that more studies are warranted to detect these symptoms in high-risk populations, in or-

der to provide a proper clinical management of affected individuals.

References

- 1 Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for post-traumatic stress disorder in trauma exposed adults. *J Consult Clin Psychol* 2000;68:746-66. <https://doi.org/10.1037//0022-006x.68.5.748>
- 2 Dell'Osso L, Carmassi C, Massimetti G, et al. Full and partial PTSD among young adult survivors 10 months after the L'Aquila 2009 earthquake: gender differences. *J Affect Disord* 2011;131:79-83. <https://doi.org/10.1016/j.jad.2010.11.023>
- 3 Armenian HK, Morikawa M, Melkonian AK, et al. Loss as a determinant of PTSD in a cohort of adult survivors of the 1988 earthquake in Armenia: implications for policy. *Acta Psychiatr Scand* 2000;102:58-64. <https://doi.org/10.1034/j.1600-0447.2000.102001058.x>
- 4 Lai TJ, Chang CM, Connor KM, et al. Full and partial PTSD among earthquake survivors in rural Taiwan. *J Psychiatr Res* 2004;38:313-22. <https://doi.org/10.1016/j.jpsychires.2003.08.005>
- 5 Wang B, Ni C, Chen J, et al. Posttraumatic stress disorder 1 month after 2008 earthquake in China: Wenchuan earthquake survey. *Psychiatry Res* 2011;187:392-6. <https://doi.org/10.1016/j.psychres.2009.07.001>
- 6 Dai W, Chen L, Lai Z, et al. The incidence of post-traumatic stress disorder among survivors after earthquakes: a systematic review and meta-analysis. *BMC Psychiatry* 2016;16:188. <https://doi.org/10.1186/s12888-016-0891-9>
- 7 Farroqui M, Suryja SS, Adhnan Khan M, et al. Posttraumatic stress disorder: a serious post-earthquake complication. *Trends Psych Psychother* 2017;39:135-43. <https://doi.org/10.1590/2237-6089-2016-0029>
- 8 Stratta P, de Cataldo S, Bonanni RL. Community mental health service utilization after the L'Aquila earthquake. *Commun Mental Health J* 2015;51:504-8. <https://doi.org/10.1007/s10597-014-9822-8>
- 9 Armenian HK, Morikawa M, Melkonian AK, et al. Risk factors for depression in the survivors of the 1988 earthquake in Armenia. *J Urban Health* 2002;79:373-82. <https://doi.org/10.1093/jurban/79.3.373>
- 10 Kun P, Han S, Chen X, et al. Prevalence and risk factors for post-traumatic stress disorder: a cross-sectional study among survivors of the Wenchuan 2008 earthquake in China. *Depress Anxiety* 2009;26:1134-40. <https://doi.org/10.1002/da.20612>
- 11 Dell'Osso L, Carmassi C, Massimetti G, et al. Impact of traumatic loss on post-traumatic spectrum symptoms in high school students after the L'Aquila 2009 earthquake in Italy. *J Affect Disord* 2011;134:59-64. <https://doi.org/10.1016/j.jad.2011.06.025>
- 12 Dell'Osso L, Carmassi C, Massimetti G, et al. Age, gender and epicenter proximity effects on post-traumatic stress symptoms in L'Aquila 2009 earthquake survivors. *J Affect Disord* 2013;146:174-80. <https://doi.org/10.1016/j.jad.2012.08.048>
- 13 Carmassi C, Akiskal HS, Yong SS, et al. Post-traumatic stress disorder in DSM-5: estimates of prevalence and criteria comparison *versus* DSM-IV-TR in a non-clinical sample of earthquake survivors. *J Affect Disord* 2013;151:843-8. <https://doi.org/10.1016/j.jad.2013.07.020>
- 14 Bal A, Jensen B. Post-traumatic stress disorder symptom clusters in Turkish child and adolescent trauma survivors. *Eur Child Adolesc Psychiatry* 2007;16:449-57. <https://doi.org/10.1007/s00787-007-0618-z>
- 15 Dell'Osso L, Carmassi C, Rucci P, et al. Complicated grief and suicidality: the impact of subthreshold mood symptoms. *CNS Spectr* 2011;16:1-6. <https://doi.org/10.1017/S1092852912000090>
- 16 McNally RJ. *Remembering trauma*. Cambridge, MA: Harvard University Press 2003.
- 17 Horesh D, Solomon Z, Keinan G. The clinical picture of late-onset PTSD: a 20-year longitudinal study of Israeli war veterans. *Psychiatry Research* 2013;208:265-73. <https://doi.org/10.1016/j.psychres.2012.12.004>
- 18 Dell'Osso L, Carmassi C, Rucci P, et al. A multidimensional spectrum approach to post-traumatic stress disorder: comparison between the Structured Clinical Interview for Trauma and Loss Spectrum (SCI-TALS) and the Self-Report instrument (TALS-SR). *Compr Psychiatry* 2009;50:485-90. <https://doi.org/10.1016/j.comppsy.2008.11.006>
- 19 Frank E, Cassano GB, Shear MK, et al. The spectrum model: a more coherent approach to the complexity of psychiatric symptomatology. *CNS Spectr* 1998;3:23-34. <https://doi.org/10.1017/S1092852900005836>
- 20 Cassano GB, Dell'Osso L, Frank E, et al. The bipolar spectrum: a clinical reality in search of diagnostic criteria and an assessment methodology. *J Affect Disord* 1999;54:319-28. [https://doi.org/10.1016/s0165-0327\(98\)00158-x](https://doi.org/10.1016/s0165-0327(98)00158-x)
- 21 Dell'Osso L, Shear MK, Carmassi C, et al. Validity and reliability of the Structured Clinical Interview for the Trauma and Loss Spectrum (SCI-TALS). *Clin Pract Epidemiol Ment Health* 2008;28:2. <https://doi.org/10.1016/j.comppsy.2008.11.006>
- 22 Kun P, Han S, Chen X, et al. Prevalence and risk factors for post-traumatic stress disorder: a cross-sectional study among survivors of the Wenchuan 2008 earthquake in China. *Depress Anxiety* 2009;26:1134-40. <https://doi.org/10.1002/da.20612>
- 23 Tang B, Deng Q, Glik D, et al. A meta-analysis of risk factors for post-traumatic stress disorder (PTSD) in adults and children after earthquakes. *Int J Environ Res Public Health* 2017;14.pii:E1537. <https://doi.org/10.3390/ijerph14121537>
- 24 Carmassi C, Akiskal HS, Bessonov D, et al. Gender differences in DSM-5 *versus* DSM-IV-TR PTSD prevalence and criteria comparison among 512 survivors of the L'Aquila earthquake. *J Affect Disord* 2014;160:55-61. <https://doi.org/10.1016/j.jad.2014.02.028>
- 25 Dell'Osso L, Carmassi C, Conversano C, et al. Post traumatic stress spectrum and maladaptive behaviours (drug abuse included) after catastrophic events: L'Aquila 2009 earthquake as case study. *Heroin Addict Relat Clin Probl* 2012;34:59-64.
- 26 Chan CL, Wang CW, Qu Z, et al. Posttraumatic stress disorder symptoms among adult survivors of the 2008 Sichuan earthquake in China. *J Trauma Stress* 2011;24:295-302. <https://doi.org/10.1002/jts.20645>
- 27 Xu J, Song X. Posttraumatic stress disorder among survivors of the Wenchuan earthquake 1 year after: prevalence and risk factors. *Comprehensive Psychiatry* 2011;52:431-7. <https://doi.org/10.1016/j.comppsy.2010.08.002>
- 28 Carmassi C, Dell'Osso L, Manni C, et al. Frequency of trauma exposure and post-traumatic stress disorder in Italy: analysis from the World Mental Health Survey Initiative. *J Psychiatr Res* 2014;59:77-84. <https://doi.org/10.1016/j.jpsychires.2014.09.006>
- 29 Suvak M, Maguen S, Litz BT, et al. Indirect exposure to the September 11 terrorist attacks: does symptom structure resemble PTSD? *J Trauma Stress* 2008;21:30-9. <https://doi.org/10.1002/jts.20289>
- 30 Piotrowski CS, Brannen SJ. Exposure, threat appraisal, and lost confidence as predictors of PTSD symptoms fol-

- lowing September 11, 2001. *Am J Orthopsychiatry* 2002;72:476-85. <https://doi.org/10.1037/0002-9432.72.4.476>
- 31 Johannesson KB, Lundin T, Hultman CM, et al. The effect of traumatic bereavement on tsunami-exposed survivors. *J Trauma Stress* 2009;22:497-504. <https://doi.org/10.1002/jts.20467>
- 32 Carmassi C, Shear MK, Succi C, et al. Complicated grief and manic comorbidity in the aftermath of the loss of a son. *J Psychiatr Pract* 2013;19:419-28. <https://doi.org/10.1097/01.pra.0000435042.13921.73>
- 33 Dell'Osso L, Carmassi C, Rucci P, et al. Complicated grief and suicidality: the impact of subthreshold mood symptoms. *CNS Spectr* 2011;16:1-6. <https://doi.org/10.1017/S1092852912000090>
- 34 Dell'Osso L, Carmassi C, Musetti L, et al. Lifetime mood symptoms and adult separation anxiety in patients with complicated grief and/or post-traumatic stress disorder: a preliminary report. *Psychiatry Res* 2012;198:436-40. <https://doi.org/10.1016/j.psychres.2011.12.020>
- 35 Kölves K, Kölves KE, De Leo D. Natural disasters and suicidal behaviours: a systematic literature review. *J Affect Disord* 2013;146:1-14. <https://doi.org/10.1016/j.jad.2012.07.037>
- 36 Wagenaar BH, Hagaman AK, Kaiser BN, et al. Depression, suicidal ideation, and associated factors: a cross-sectional study in rural Haiti. *BMC Psychiatry* 2012;12:149. <https://doi.org/10.1186/1471-244X-12-149>
- 37 Stratta P, Capanna C, Riccardi I, et al. Suicidal intention and negative spiritual coping one year after the earthquake of L'Aquila (Italy). *J Affect Disord* 2012;136:1227-31. <https://doi.org/10.1016/j.jad.2011.10.006>
- 38 Dell'Osso L, Carmassi C, Rucci P, et al. Lifetime subthreshold mania is related to suicidality in post-traumatic stress disorder. *CNS Spectr* 2009;14:262-6. <https://doi.org/10.1017/s1092852900025426>
- 39 Stratta P, Capanna C, Carmassi C, et al. The adolescent emotional coping after an earthquake: a risk factor for suicidal ideation. *J Adolesc* 2014. <https://doi.org/10.1016/j.adolescence.2014.03.015>
- 40 Arnberg FK, Gudmundsdottir R., Butwicka A, et al. Psychiatric disorders and suicide attempts in Swedish survivors of the 2004 southeast Asia tsunami: a 5 year matched cohort study. *Lancet Psychiatry* 2015;2:817-24. [https://doi.org/10.1016/S2215-0366\(15\)00124-8](https://doi.org/10.1016/S2215-0366(15)00124-8)
- 41 Carmassi C, Stratta P, Calderani E, et al. Impact of mood spectrum spirituality and mysticism symptoms on suicidality in earthquake survivors with PTSD. *J Relig Health* 2016;55:641-9. <https://doi.org/10.1007/s10943-015-0072-z>
- 42 Pat-Horenczyk R, Peled O, Miron T, et al. Risk taking behaviors among Israeli adolescents exposed to recurrent terrorism: provoking danger under continuous threat? *Am J Psychiatry* 2007;164:66-72. <https://doi.org/10.1176/ajp.2007.164.1.66>
- 43 Dell'Osso L, Carmassi C, Stratta P, et al. Gender differences in the relationship between maladaptive behaviors and post-traumatic stress disorder. A Study on 900 L'Aquila 2009 earthquake survivors. *Front Psych* 2013;4:111. <https://doi.org/10.3389/fpsy.2012.00111>
- 44 Dell'Osso L, Carmassi C, Stratta P, et al. Maladaptive behaviors in L'Aquila earthquake survivors: the contribute of a "spectrum" approach to PTSD. *Heroin Addict Relat Clin Probl* 2012;14:49-56.
- 45 Talevi D, Imburgia L, Luperini C, et al. Interpersonal violence: identification of associated features in a clinical sample. *Child Abus Negl* 2018;86:349-357. <https://doi.org/10.1016/j.chiabu.2018.08.017>
- 46 Dell'Osso L, Carmassi C, Massimetti G, et al. Post-traumatic stress spectrum in young versus middle-aged L'Aquila 2009 earthquake survivors. *J Psychopathol* 2012;18:281-9.
- 47 American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-5. Washington DC: Author 2013.
- 48 Rossi R, Longo L, Fiore D, et al. Dissociation in stress-related disorders and self-harm: a review of the literature and a systematic review of mediation models. *J Psychopathol* 2019;25:162-71.
- 49 Carmassi C, Stratta P, Massimetti G, et al. New DSM-5 maladaptive symptoms in PTSD: gender differences and correlations with mood spectrum symptoms in a sample of high school students following survival of an earthquake. *Ann Gen Psychiatry* 2014;13:28. <https://doi.org/10.1186/s12991-014-0028-9>
- 50 Dell'Osso L, Carmassi C, Stratta P, et al. Gender differences in the relationship between maladaptive behaviors and post-traumatic stress disorder. A study on 900 L'Aquila 2009 earthquake survivors. *Front Psych* 2013;4:3:111. doi: 10.3389/fpsy.2012.00111.
- 51 Glodich A, and Allen JG. Adolescents exposed to violence and abuse: a review of the group therapy literature with an emphasis on preventing trauma reenactment. *J Child Adolesc Group Ther* 1998;8:135-54.
- 52 Steven SJ, Murphy BS, McKnight K. Traumatic stress and gender differences in relationship to substance abuse, mental health, physical health and HIV risk-taking in a sample of adolescents enrolled in drug treatment. *Child Maltreat* 2003;8:46-57. doi: 10.1177/1077559502239611.
- 53 Pollice R, Bianchini V, Roncone R, et al. Marked increase in substance use among young people after L'Aquila earthquake. *Eur Child Adolesc Psychiatry* 2011;20:429-30.
- 54 Rossi A, Maggio R, Riccardi I, et al. A quantitative analysis of anti-depressant and antipsychotic prescriptions following an earthquake in Italy. *J Trauma Stress* 2011;24:129-32. <https://doi.org/10.1002/jts.20607>
- 55 Carmassi C, Bertelloni CA, Gesi C, et al. New DSM-5 PTSD guilt and shame symptoms among Italian earthquake survivors: impact on maladaptive behaviors. *Psychiatry Res* 2017;251:142-7. <https://doi.org/10.1016/j.psychres.2016.11.026>
- 56 Dell'Osso L, Armani A, Rucci P, et al. Measuring mood spectrum: comparison of interview (SCI-MOODS) and self-report (MOODS-SR) instruments. *Compr Psychiatry* 2002;43:69-73. <https://doi.org/10.1053/comp.2002.29852>
- 57 Mueser KT, Goodman LB, Trumbetta SL, et al. Trauma and post-traumatic stress disorder in severe mental illness. *J Consult Clin Psychol* 1998;66:493-9. <https://doi.org/10.1037//0022-006x.66.3.493>
- 58 Otto MW, Perlman CA, Wernicke R, et al. Posttraumatic stress disorder in patients with bipolar disorder: a review of prevalence, correlates, and treatment strategies. *Bipolar Disord* 2004;6:470-9. <https://doi.org/10.1111/j.1399-5618.2004.00151.x>
- 59 Merikangas KR, Akiskal KS, Angst J, et al. Lifetime and 12-month prevalence of bipolar spectrum disorder in the National Comorbidity Survey replication. *Arch Gen Psychiatry* 2007;64:543-52. <https://doi.org/10.1001/archpsyc.64.5.543>
- 60 Dell'Osso L, Stratta P, Conversano C, et al. Lifetime mania is related to post-traumatic stress symptoms in high school students exposed to the 2009 L'Aquila earthquake. *Compr Psychiatry* 2014;55:357-62. <https://doi.org/10.1016/j.comppsy.2013.08.017>
- 61 Ano GG, Vasconcelles EB. Religious coping and psychological adjustment to stress: a meta-analysis. *J Clin Psychol* 2005;61:461-80. <https://doi.org/10.1002/jclp.20049>
- 62 Stratta P, Capanna C, Riccardi I, et al. Spirituality and religiosity in the aftermath of a natural catastrophe in Italy. *J Rel and Health* 2013;52:1029-37. <https://doi.org/10.1007/s10943-012-9591-z>
- 63 Mellman TA, David D, Kulick-Bell R, et al. Sleep disturbance and its relationship to psychiatric morbidity after Hurricane An-

- drew. *Am J Psychiatry* 1995;152:1659-63. <https://doi.org/10.1176/ajp.152.11.1659>
- ⁶⁴ Milanak ME, Zuromski KL, Cero I, et al. Traumatic event exposure, post-traumatic stress disorder, and sleep disturbances in a national sample of U.S. adults. *J Trauma Stress* 2019;32:14-22. <https://doi.org/10.1002/jts.22360>
- ⁶⁵ Zhang Y, Zhang J, Ren R, et al. Bidirectional associations of insomnia symptoms with somatic complaints and post-traumatic stress disorder in child and adolescent earthquake survivors: a longitudinal study. *Sleep Breath* 2019 Nov 8. <https://doi.org/10.1007/s11325-019-01955-8>
- ⁶⁶ Reyes-Rodriguez M, Von Holle A, Ulman TF, et al. Posttraumatic stress disorder in anorexia nervosa. *Psychosom Med* 2011;73:491-7. <https://doi.org/10.1097/PSY.0b013e31822232bb>
- ⁶⁷ Carmassi C, Bertelloni CA, Massimetti G, et al. Impact of DSM-5 PTSD and gender on impaired eating behaviors in 512 Italian earthquake survivors. *Psychiatry Res* 2015;225:64-9. <https://doi.org/10.1016/j.psychres.2014.10.008>
- ⁶⁸ Carmassi C, Dell'Oste V, Barberi FM, et al. Do somatic symptoms relate to PTSD and gender after earthquake exposure? A cross-sectional study on young adult survivors in Italy. *CNS Spectr* 2020 (in press).