TECHNICAL COMMENTARY

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POST-TRAUMATIC STRESS DISORDER LIBRARY

Disasters

Introduction

For a person to be diagnosed with PTSD, at least one stressor is required. Stressors as determined by the latest version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) include being exposed to threatened death, actual or threatened serious injury, or actual or threatened sexual violence. Examples are direct exposure, witnessing the trauma, or learning that a relative or close friend was exposed to a trauma. Stressors can also be encountered in the course of professional duties.

This summary table presents the evidence for risk of PTSD in people exposed to disasters.

Method

We have included only systematic reviews (systematic literature search, detailed methodology with inclusion/exclusion criteria) published in full text, in English, from the year 2010 that report results separately for people with PTSD. Reviews were identified by searching the databases MEDLINE, EMBASE, and PsycINFO. When multiple copies of reviews were found, only the most recent version was included. We prioritised reviews with pooled data for inclusion.

Review reporting assessment was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist that describes a preferred way to present a meta-analysis[1]. Reviews with less than 50% of items checked have been excluded from the library. Note that early reviews may have been guided by less stringent reporting checklists than the PRISMA, and that some reviews may have been limited by journal guidelines.

Evidence was graded using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group approach where high quality evidence such as that gained from randomised controlled trials (RCTs) may be downgraded to moderate or low if review and study quality is limited, if there is inconsistency in results, indirect comparisons, imprecise or sparse data and high probability of reporting bias. It may also be downgraded if risks associated with the intervention or other matter under review are high. Conversely, low quality evidence such as that gained from observational studies may be upgraded if effect sizes are large or if there is a dose dependent response. We have also taken into account sample size and whether results are consistent, precise and direct with low associated risks (see end of table for an explanation of these terms)[2]. The resulting table represents an objective summary of the available evidence, although the conclusions are solely the opinion of staff of NeuRA (Neuroscience Research Australia).

Results

We found eight systematic reviews that met our inclusion criteria[3-10].

- Moderate quality evidence found a large effect of increased PTSD symptoms in people exposed to natural disasters compared to people not exposed to natural disasters.
- Moderate quality found small to medium-sized associations between exposure to disasters and PTSD symptoms in youth (≤18 years). The associations were strongest in females, in children exposed to disasters with a higher death toll, in children in close proximity to the disaster, and in children with increased perceived threat and distress. Studies using child informant measures found stronger associations than studies using parent informant measures. Outcome measures at 6-12 months showed stronger associations than outcome measures at <6 months or over 12 months. There were no moderating effects of child's age or whether the disaster was natural or man-made.
- Moderate quality evidence found a medium-sized effect of more PTSD symptoms in

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older adults (>60-65 years) than younger adults following exposure to natural disasters. A medium-sized effect was found for fewer PTSD symptoms in older adults than younger adults following exposure to man-made disasters. Review authors suggest this disparity may be explained by older adults having less likelihood of receiving advanced warnings or evacuating during a natural disaster, while previous experiences may better prepare older people to cope with human-induced disasters.

- Moderate to high quality evidence finds a small association between increased severity of exposure to Hurricane Katrina and increased PTSD symptoms.
- Moderate quality evidence finds the incidence rate of PTSD after a flood is around 16%. Incidence rates are highest within six months after exposure and in people who experience severe flood intensity.
- Moderate quality evidence finds the incidence rate of PTSD after an earthquake is around 24%. Incidence rates are highest within nine months after exposure, in females and in people who had damage to their houses. Being older, being trapped, experiencing fear, injury, or bereavement, and witnessing injury/death during the earthquake were all related to greater risk of PTSD. Having a higher education was associated with more PTSD in children but having a lower level of education was associated with more PTSD in adults.

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Beaglehole B, Mulder RT, Frampton CM, Boden JM, Newton-Howes G, Bell CJ

Psychological distress and psychiatric disorder after natural disasters: systematic review and meta-analysis

British Journal of Psychiatry 2018; 213: 716-22

View review abstract online

Comparison	**PTSD after natural disasters vs. nonexposed controls.**
Summary of evidence	**Moderate quality evidence (large sample, inconsistent, imprecise, direct) found a large effect of increased PTSD symptoms in people exposed to natural disasters compared to people not exposed to natural disasters.**
Natural disasters	
A large effect showed increased PTSD symptoms in people exposed to natural disasters; 3 studies, N = 982, SMD = 1.38, 95%CI 0.43 to 2.34, $p = 0.004$, $I^2 = 97\%$ *There were no differences in studies reporting ORs;* 2 studies, N = 1,296, OR = 5.96, 95%CI 0.25 to 142.54, $p = 0.27$, $I^2 = 88\%$ Although 10% of the exposed group reported PTSD compared with 2% in the non-exposed group.	
Consistency in results‡	Inconsistent
Precision in results§	Imprecise
Directness of results‖	Direct

Chan CS, Rhodes JE

Measuring exposure in Hurricane Katrina: a meta-analysis and an integrative data analysis

PLoS ONE 2014; 9: e92899

View review abstract online

Comparison	**PTSD after Hurricane Katrina.**
Summary of evidence	**Moderate to high quality evidence (large sample, inconsistent, precise, direct) finds a small association between increased severity of exposure to Hurricane Katrina and increased PTSD**

	symptoms.
Hurricane Katrina	
A small association between exposure to Hurricane Katrina and PTSD symptoms; 8 studies, N = 2,934, r = 0.266, 95%CI 0.173 to 0.355, $p < 0.01$, I^2 = 84% Studies with a higher percentage of minority participants had smaller effect sizes. Increased number of exposure items was related to increased effect sizes.	
Consistency in results	Inconsistent
Precision in results	Precise
Directness of results	Direct

Chen L, Liu A

The Incidence of Posttraumatic Stress Disorder After Floods: A Meta-Analysis

Disaster Medicine and Public Health Preparedness 2015; 9: 329-33

View review abstract online

Comparison	**PTSD after floods.**
Summary of evidence	**Moderate quality evidence (large sample, inconsistent, imprecise, direct) finds the incidence of PTSD after a flood is around 16%. The incidence is highest in people who experience severe flood intensity and highest within six months after the flood.**
Floods	
14 studies, N = 40,600, incidence = 15.74%, 95%CI 11.25% to 20.82%, $Qp < 0.001$ The incidence of PTSD was higher in people who experienced severe or moderate flood intensity than in people who experienced mild flood intensity (20.06% vs. 12.82% vs. 4.41%). The incidence of PTSD was higher within the six months after the flood than after six months after the flood (18.44% vs. 9.78%).	
Consistency in results	Inconsistent
Precision in results	Appears imprecise
Directness of results	Direct

Dai W, Chen L, Lai Z, Li Y, Wang J, Liu A

The incidence of post-traumatic stress disorder among survivors after earthquakes: a systematic review and meta-analysis

BMC Psychiatry 2016; 16: 188

View review abstract online

Comparison	**PTSD after earthquakes.**
Summary of evidence	**Moderate quality evidence (large sample, inconsistent, imprecise, direct) finds the incidence of PTSD after an earthquake is around 24%. The incidence is highest within nine months after the earthquake, higher in females than males, higher in people with lower versus higher educational levels, higher in people who had damage versus no damage to their house, in bereaved people, those who had injury to their bodies, and those who witnessed death.**
Earthquakes	
46 studies, N = 76,101, incidence = 23.66%, 95%CI 19.34% to 28.27%, I^2 = 99.5%, The subgroup analyses showed that the incidence of PTSD after earthquake varied significantly across studies in relation to the time of PTSD assessment (<9 months = 28.76% vs. >9 months = 19.48%), sex (females = 34.82% vs. males = 22.57%), educational level (elementary school = 31.56% vs. higher than elementary school = 19.76%), damage to one's house (damage = 38.49% vs. no damage = 23.97%), bereavement (bereavement = 39.10% vs. no bereavement = 19.92%), injury of body (injury = 23.28% vs. no injury = 9.63%) and witnessing death (witnessing death = 26.28% vs. not witnessing death = 14.69%).	
Consistency in results	Inconsistent
Precision in results	Appears imprecise
Directness of results	Direct

Furr JM, Comer JS, Edmunds JM, Kendall PC

Disasters and youth: a meta-analytic examination of posttraumatic stress

Journal of Consulting and Clinical Psychology 2010; 78: 765-80

Disasters

View review abstract online	
Comparison	**PTSD symptoms in youth (≤18 years) after disasters.**
Summary of evidence	**Moderate quality evidence (large sample, direct) found small to medium-sized associations between exposure to disasters and PTSD symptoms in youth ≤18 years. The associations were strongest in females, in children exposed to disasters with a higher death toll, in children exposed to close proximity to the disaster, and in children with increased perceived threat and distress. Studies using child informant measures found stronger associations than studies using parent informant measures. Outcome measures at 6-12 months showed stronger associations than outcome measures at <6 months or over 12 months. There were no moderating effects of child's age or whether the disaster was natural or man-made.**
Disasters	
96 studies, N = 74,154 *Small to medium-sized associations between exposure to disasters and PTSD symptoms;* All symptoms: 42 studies, $r = 0.19$, $p < 0.0001$ Reexperiencing: 12 studies, $r = 0.14$, $p < 0.01$ Avoidance: 15 studies, $r = 0.12$, $p < 0.05$ Hyperarousal: 12 studies, $r = 0.12$, $p < 0.10$ The associations were strongest in females, in children exposed to disasters with a higher death toll, in children exposed to close proximity to the disaster, and in children with increased perceived threat and distress. Studies using child informant measures found stronger associations than studies using parent informant measures. Outcome measures at 6-12 months showed stronger associations than outcome measures at <6 months or over 12 months. There were no moderating effects of child's age or whether the disaster was natural or man-made.	
Consistency in results	No measure of between study heterogeneity was reported (only between effect sizes).
Precision in results	No CIs are reported
Directness of results	Direct

Parker G, Lie D, Siskind DJ, Martin-Khan M, Raphael B, Crompton D, Kisely S

Mental health implications for older adults after natural disasters - A

systematic review and meta-analysis **International Psychogeriatrics 2016; 28: 11-20** View review abstract online	
Comparison	**PTSD symptoms in older adults (>60-65 years) vs. younger adults after natural disasters.**
Summary of evidence	**Moderate quality evidence (large sample, inconsistent, imprecise, direct) found a medium-sized effect of more PTSD symptoms in older adults than younger adults following exposure to natural disasters.**
Natural disasters	
A medium-sized effect of more PTSD symptoms in older adults; 5 studies, N = 5,779, OR = 2.11, 95%CI 1.40 to 3.17, p = 0.0004, I^2 = 80%	
Consistency in results	Inconsistent
Precision in results	Imprecise
Directness of results	Direct

Siskind DJ, Sawyer E, Lee I, Lie DC, Martin-Khan M, Farrington J, Crompton D, Kisely S

The mental health of older persons after human-induced disasters: A systematic review and meta-analysis of epidemiological data

American Journal of Geriatric Psychiatry 2016; 24: 379-88

View review abstract online

Comparison	**PTSD symptoms in older adults vs. younger adults (>60 years) after human-induced disasters.**
Summary of evidence	**Moderate quality evidence (large sample, inconsistent, imprecise, direct) found a medium-sized effect of fewer PTSD symptoms in older adults than younger adults following exposure to man-made disasters.**
Human-induced disasters	

A medium-sized effect of fewer PTSD symptoms in older adults; 7 studies, N = 23,924, OR = 2.85, 95%CI 1.42 to 5.70, p = 0.003, I^2 = 89% The effect was larger up to 6 months after the disaster than over 6 months after the disaster (OR = 3.13 vs. 2.23), and in those who had the greatest exposure (OR = 3.70). Authors suggest the disparity in findings between natural and human-induced disasters may be explained by older adults may be at greatest risk of worse outcomes following natural disasters because they are less likely to receive advanced warnings or evacuate, and so experience greater disruption or perceived loss. Whereas in the case of human-induced disasters, previous experiences may have better prepared older people to cope with such adversity.

Consistency in results	Inconsistent
Precision in results	Imprecise
Directness of results	Direct

Tang B, Deng Q, Glik D, Dong J, Zhang L

A Meta-Analysis of Risk Factors for Post-Traumatic Stress Disorder (PTSD) in Adults and Children after Earthquakes

International Journal of Environmental Research and Public Health 2017; 14: 1537

View review abstract online

Comparison	**PTSD after earthquakes.**
Summary of evidence	**Moderate quality evidence (large sample, inconsistent, imprecise, direct) found the prevalence of PTSD in adults exposed to an earthquake ranged from 4% to 67%, and prevalence of PTSD in children exposed to earthquake ranged from 2.5% to 60%. Being older, being trapped, experiencing fear, injury, or bereavement, and witnessing injury/death during the earthquakes were related to greater risk of PTSD. Having a higher education was associated with more PTSD in children but having a lower level of education was associated with more PTSD in adults.**
Earthquakes	
15 studies, N = 22,931 Adults The prevalence of PTSD in adults after earthquakes ranged from 4.10% to 67.07%. Adults who experienced being trapped (OR = 1.81, 95%CI 1.47 to 2.24), experienced fear (OR =	

2.97, 95%CI 1.78 to 4.95), injury (OR = 2.06, 95%CI 1.33 to 3.19), or bereavement (OR = 2.49, 95%CI 2.04 to 3.04) were more likely to have PTSD (medium-sized effects). Having low social support (OR = 0.81, 95%CI, 0.74 to 0.89), unemployment (OR = 2.07, 95%CI 1.49 to 2.88), loss of property (OR = 1.67, 95%CI 1.31 to 2.15), and house damage (OR = 1.87, 95%CI 1.52 to 2.30) were related to PTSD (small to medium-sized effects). Being older (OR = 1.17, 95%CI 1.08 to 1.27), being female (OR = 1.85, 95%CI 1.69 to 2.02), having a low-level of education (OR = 0.81, 95%CI 0.75 to 0.87), low socio-economic status (OR = 1.74, 95%CI 1.24 to 2.45), and having prior trauma (OR = 1.63, 95%CI 1.10 to 2.41) were related to PTSD (small effects). <u>Children</u> The prevalence of PTSD in children after earthquakes ranged from 2.50% to 60.00%. Children who experienced being trapped (OR = 1.94, 95%CI 1.52 to 2.47), experienced fear (OR = 2.24, 95%CI 1.52 to 3.32), injury (OR = 2.05, 95%CI 1.67 to 2.52), witnessed injury/death (OR = 201, 95%CI 1.44 to 2.80), or experienced bereavement (OR = 2.24, 95%CI 1.95 to 2.56) were more likely to have PTSD (medium-sized effects). Being older (OR = 1.34, 95%CI 1.12 to 1.61), being female (OR = 1.45, 95%CI 1.31 to 1.60), and having a higher level of education (OR = 1.57, 95%CI 1.11 to 2.21) were associated with having PTSD (small effects).

Consistency in results	Authors report data are inconsistent.
Precision in results	Imprecise
Directness of results	Direct

Explanation of acronyms

CI = confidence interval, I^2 = the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance), N = number of participants, OR = odds ratio, *p* = statistical probability of obtaining that result, Q = measure of heterogeneity, *r* = correlation coefficient, vs. = versus

Explanation of technical terms

* Bias has the potential to affect reviews of both RCT and observational studies. Forms of bias include; reporting bias – selective reporting of results; publication bias - trials that are not formally published tend to show less effect than published trials, further if there are statistically significant differences between groups in a trial, these trial results tend to get published before those of trials without significant differences; language bias – only including English language reports; funding bias - source of funding for the primary research with selective reporting of results within primary studies; outcome variable selection bias; database bias - including reports from some databases and not others; citation bias - preferential citation of authors. Trials can also be subject to bias when evaluators are not blind to treatment condition and selection bias of participants if trial samples are small[11].

† Different effect measures are reported by different reviews.

Prevalence refers to how many existing cases there are at a particular point in time. Incidence refers to how many new cases there are per population in a specified time period. Incidence is usually reported as the number of new cases per 100,000 people per year. Alternatively some studies present the number of new cases that have accumulated over several years against a person-years denominator. This denominator is the sum of individual units of time that the persons in the population are at risk of becoming a case. It takes into account the size of the underlying population sample and its age structure over the duration of observation.

Reliability and validity refers to how accurate the instrument is. Sensitivity is the proportion of actual positives that are correctly identified (100% sensitivity = correct identification of all actual positives) and specificity is the proportion of negatives that are correctly identified (100% specificity = not identifying anyone as positive if they are truly not).

Weighted mean difference scores refer to mean differences between treatment and comparison groups after treatment (or occasionally pre to post treatment) and in a randomised trial there is an assumption that both groups are comparable on this measure prior to treatment. Standardised mean differences are divided by the pooled standard deviation (or the standard deviation of one group when groups are homogenous) that allows results from different scales to be combined and compared. Each study's mean difference is then given a weighting depending on the size of the sample and the variability in the data. Less than 0.4 represents a small effect, around 0.5 a medium effect, and over 0.8 represents a large effect[11].

Odds ratio (OR) or relative risk (RR) refers to the probability of a reduction (< 1) or an increase (> 1) in a particular outcome in a treatment group, or a group exposed to a risk factor, relative to the comparison group. For example, a RR of 0.75 translates to a reduction in risk of an outcome of 25% relative to those not receiving the treatment or not exposed to the risk factor. Conversely, a RR of 1.25 translates to an increased risk of 25% relative to those not receiving treatment or not having been exposed to a risk factor. A RR or OR of 1.00 means there is no difference between groups. A medium effect is considered if RR > 2 or < 0.5 and a large effect if RR > 5 or < 0.2[12]. lnOR stands for logarithmic OR where a lnOR of 0 shows no difference between groups. Hazard ratios measure the effect of an explanatory variable on the hazard or risk of an event.

Correlation coefficients (eg, r) indicate the strength of association or relationship between variables. They can provide an

indirect indication of prediction, but do not confirm causality due to possible and often unforseen confounding variables. An r of 0.10 represents a weak association, 0.25 a medium association and 0.40 and over represents a strong association. Unstandardised (*b*) regression coefficients indicate the average change in the dependent variable associated with a 1 unit change in the independent variable, statistically controlling for the other independent variables. Standardised regression coefficients represent the change being in units of standard deviations to allow comparison across different scales.

‡ Inconsistency refers to differing estimates of effect across studies (i.e. heterogeneity or variability in results) that is not explained by subgroup analyses and therefore reduces confidence in the effect estimate. I^2 is the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance) - 0% to 40%: heterogeneity might not be important, 30% to 60%: may represent moderate heterogeneity, 50% to 90%: may represent considerable heterogeneity and over this is considerable heterogeneity. I^2 can be calculated from Q (chi-square) for the test of heterogeneity with the following formula[11];

$$I^2 = \left(\frac{Q - df}{Q}\right) \times 100\%$$

§ Imprecision refers to wide confidence intervals indicating a lack of confidence in the effect estimate. Based on GRADE recommendations, a result for continuous data (standardised mean differences, not weighted mean differences) is considered imprecise if the upper or lower confidence limit crosses an effect size of 0.5 in either direction, and for binary and correlation data, an effect size of 0.25. GRADE also recommends downgrading the evidence when sample size is smaller than 300 (for binary data) and 400 (for continuous data), although for some topics, these criteria should be relaxed[13].

‖ Indirectness of comparison occurs when a comparison of intervention A versus B is not available but A was compared with C and B was compared with C that allows indirect comparisons of the magnitude of effect of A versus B. Indirectness of population, comparator and/or outcome can also occur when the available evidence regarding a particular population, intervention, comparator, or outcome is not available and is therefore inferred from available evidence. These inferred treatment effect sizes are of lower quality than those gained from head-to-head comparisons of A and B.

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