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WORKING PAPER

Work Package 3

Developing indicators and indicators systems of societal resilience to disasters: benefits of systematic reviews

Deliverable 3.3

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Short Description: This report assesses some shortcomings in the development of indicators of societal resilience to disasters. We focus our approach on the selection and assessment of the scientific evidence. We showcase these problems through a review of the literature on indicators of psychological resilience in the Web of Knowledge.

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About emBRACE

The primary aim of the emBRACE project is to build resilience to disasters amongst communities in Europe. To achieve this, it is vital to merge research knowledge, networking and practices as a prerequisite for more coherent scientific approaches. This we will do in the most collaborative way possible.

Specific Objectives

- ⇨ Identify the key dimensions of resilience across a range of disciplines and domains
- ⇨ Develop indicators and indicator systems to measure resilience concerning natural disaster events
- ⇨ Model societal resilience through simulation experiments
- ⇨ Provide a general conceptual framework of resilience, tested and grounded in cross-cultural contexts
- ⇨ Build networks and share knowledge across a range of stakeholders
- ⇨ Tailor communication products and project outputs and outcomes effectively to multiple collaborators, stakeholders and user groups

The emBRACE Methodology

The emBRACE project is methodologically rich and draws on partner expertise across the research methods spectrum. It will apply these methods across scales from the very local to the European.

emBRACE is structured around 9 Work Packages. WP1 will be a systematic evaluation of literature on resilience in the context of natural hazards and disasters. WP2 will develop a conceptual framework. WP3 comprises a disaster data review and needs assessment. WP4 will model societal resilience. WP5 will contextualise resilience using a series of Case studies (floods, heat waves, earthquakes and alpine hazards) across Europe (Czech Republic, Germany, Italy, Poland, Switzerland, Turkey and UK). WP6 will refine the framework: bridging theory, methods and practice. WP7 will exchange knowledge amongst a range of stakeholders. WP8 Policy and practice communication outputs to improve resilience-building in European societies.

Partners

- ⇨ Université catholique de Louvain (UCL) - **Belgium**
- ⇨ University of Northumbria at Newcastle (UoN) - **UK**
- ⇨ King's College London (KCL) - **UK**
- ⇨ United Nations University Institute for Environment and Human Security (UNU), **Bonn**
- ⇨ Accademia Europea per la Ricerca Applicata ed il Per-fezionamento Professionale Bolzano (EURAC) - **Italy**
- ⇨ Helmholtz-Zentrum Fuer Umweltforschung GMBH - UFZ (UFZ) - **Germany**
- ⇨ University of York (SEI-Y) - **UK**
- ⇨ Stockholm Environment Institute - Oxford Office Limited (SEI-O) - **UK**
- ⇨ Swiss Federal Institute for Forest, Snow and Landscape Research - WSL (WSL) - **Switzerland**
- ⇨ Middle East Technical University - Ankara (METU) - **Turkey**

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Summary

Background

If the science of resilience is taking its first steps, the development of disaster resilience indicators is still at a germinal stage. Previous work on indicators is positive but it lacks a systematic review of the rapidly-growing literature, and a clear methodology to identify robust and representative empirical evidence. Moreover, the few available approaches fail to include psychological resilience as an important source of indicators for societal resilience.

Methods

Here we systematically reviewed the literature on psychological resilience to fill this important gap first, and second to illustrate a more exhaustive methodological approach which might serve as a potential framework to identify indicators in other disciplinary areas. Using a priori specified search terms and a structured search configuration we identified 58 potentially relevant articles in the Web of Knowledge. All articles were screened by title and abstract by two researchers separately using a list of inclusion and exclusion criteria. At this stage, we included empirical studies, review articles, and theoretical studies clearly identifying resilience indicators. Twenty-nine studies were initially retained, carefully read, and ten further studies excluded. Indicators of resilience, resilient outcomes and variables describing methods and studied populations were extracted from the remaining 19 studies. Only six studies were considered suitable to produce indicators of resilience. The indicators were grouped and the plausibility of each indicator was assessed considering the consistency of their results across studies.

Results

A total of 177 (non-exclusive) indicators were obtained from 19 articles. The final six articles selected produced 58 (non-exclusive) indicators of psychological resilience. These were grouped in 16 more homogeneous indicator categories. Overall, social support and female gender were the most consistent predictors of psychological resilience after a disaster. Previous trauma and health status were probable indicators. Other probable indicators were disaster-exposure level, human loss and resource loss.

Discussion

A more systematic approach to search, select and assess the empirical evidence on indicators of psychological resilience to disasters might help to determine the most reliable indicators, especially given the high heterogeneity of the available research.

Proxies of social support after disasters should be further investigated as a likely indicator of psychological resilience. Female gender emerged as an important risk factor for low psychological resilience after disasters and provides early support for targeted interventions on this at high-risk group.

With the exception of previous trauma, most potential indicators (level of exposure, human loss, and resource loss) occurred after the disaster. A distinction of indicators measurable before or after the event emerged here as an important topic that deserves attention in the development of indicators and warrants further research.

1. Introduction

The science of resilience is emerging rapidly, boosted up by increased awareness in the policy circles (Cutter, Burton, & Emrich, 2010). Europe will face important challenges in the next decades. Recent research predicts important losses in household welfare and health due to climate change in Europe by 2080, in absence of adequate adaptation (Ciscar et al., 2011). In fact, as occurred with past economic crises, the current ongoing one has been suggested as already affecting important aspects of human health and well-being (Stuckler, Basu, Suhrcke, Coutts, & McKee, 2009, 2011; Stuckler & Basu, 2009). It thus set a worse health status to face new adversities. Neither will the evolving global economic situation will be helped by the already increased number of disasters, which were reported to be especially costly in most recent years (EM-DAT, 2013). Improving our capacity to adapt in a rapidly changing world should be seen as an important priority, in the developing as well as in the developed world.

The building of disaster resilient societies, or those able to absorb the impact and bounce back in a timely manner from any disturbance, is seen today as a desirable target to make our societies safer while contributing to their sustainability (United Nations, 2012).

But how can the concept of resilience be operationalized to help policy makers in their mission? Measuring resilience is one critical element of the chain; however it is a challenging task, as resilience is a complex construct whose understanding

requires multidisciplinary perspective and input. A recurrent problem cited by many authors is the lack of a clear definition of resilience (Davydov, Stewart, Ritchie, & Chaudieu, 2010; Truffino, 2010, this consortium). Others, have also pointed at the heterogeneity of available research that complicates the overall assessment of findings, for example, through meta-analysis (Davydov et al., 2010).

A second crucial element is the production of indicators. In general the literature shows that we can differentiate between resilience as an outcome measure and as an indicator. The first concept shows resilience post-facto, i.e. once the disturbance has interacted with a community. Low mortality and low injury rates, absence of or low PTSD symptoms among the exposed, or high rates of timely relocation of the displaced due to disasters are examples of resilience outcomes. The second concept generally refers to baseline conditions measurable in a community ante-facto. Those attributes, called here resilience indicators, have the potential to predict disaster resilience within that community before a disaster occurs (Bonanno, 2008; Cutter et al., 2010).

Resilience indicators that can be measured ante-facto are important to inform policy. These indicators, which can be altered through directed policies to improve resilience, interestingly target the side of prevention. Likewise, communities can be compared on their levels of resilience, pinpointing those communities with lower resilience levels. Thus their use is important for resource allocation (Cutter, Burton, & Emrich, 2010). The efficiency of this approach might be further amplified if the indicators apply to all-hazards versus a single-hazard approach.

Obviously, the value of the final output will be a function of the comprehensiveness, representativeness, and robustness of the compiled empirical evidence as well as of the methodological quality behind the work produced. Finally, the implementation of indicators will depend on the availability of suitable data or political will to gather the required data.

Summarizing, the present work is motivated by two major gaps in the literature. First, psychological resilience is acknowledged as one of the main constructs of societal resilience, but it has never been targeted in the development of policy-actionable indicators (Cutter et al., 2010). Second, the approaches undertaken so far present some limitations. Most researches failed to clearly report on the variables (resilient outcomes) to which the indicators apply. We think this is an important feature, as one indicator can predict different outcomes with similar or dissimilar strength and

direction. This is relevant information that can be part of the criteria for indicator selection.

Moreover, the scientific criteria to select the evidence that supports the development of indicators are often not reported. This prevents us from building on previous approaches and slows down the development of improved methodologies. Also, there exist risks in any adoption of methods, used to develop indicators, which are constructed according to issues of data availability, rather than upon the best available evidence; such constrained approaches are almost inevitably more subject to bias (Simpson and Katirai, 2006).

Systematic reviews are widely used in the medical sciences (Moher, Liberati, Tetzlaff, & Altman, 2009a). "A systematic review is a review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review. Statistical methods (meta-analysis) may or may not be used to analyze and summarize the results of the included studies. Meta-analysis refers to the use of statistical techniques in a systematic review to integrate the results of included studies" (Moher, Liberati, Tetzlaff, & Altman, 2009b)

Here we review the scientific literature providing indicators of psychological resilience to disasters. The main objective is to identify the main barriers to the development of resilience indicators, to recognize gaps and to provide possible solutions to overcome these problems.

2. Materials and Methods

In this review we examined, using the Web of Knowledge, the available literature on indicators that show psychological resilience to disasters. The objective was to identify and compile from the peer-reviewed literature empirical evidence studying **indicators of resilience** in which the resilient outcomes are identified. We selected this evidence using predefined key terms and a search strategy, including clear inclusion and exclusion criteria to select any empirical evidence. Our focus was more on the evidence-based approach to select the indicators and assess the indicator plausibility, rather than on further issues such as weighting issues or data availability. The methodology developed here might be used as a basis, if agreed by the

consortium, to expand the work produced by this consortium in Deliverables 1.1. and 1.2.

Selection of key terms and search strategy

We first selected the key terms for our search related to indicators of psychological resilience to natural disasters. We based our selection on key scientific articles and previous work of the emBRACE consortium. The list of terms attempted to capture three main components, using main terms and synonyms to identify:

− outcomes (of psychological resilience);
− the event (disasters and other stressors); and
− indicators of resilience.

To have an initial estimation of the amount of sensibility and specificity of our search, an initial test search was made in Web of Knowledge with the key words and synonyms for 'psychological resilience', 'natural disasters' and 'indicator' (Supplementary Table 1, see Search 1). Next, key words for events other than natural disasters were added, such as 'traumatic events' and 'terrorist attack', since the number of studies focussed only on natural disasters was relatively small (see Supplementary Table 1: Search 2). Additional key words for factors that are related to psychological resilience, such as 'coping behaviour' and 'positive emotion', were further investigated (Supplementary Table 1: Search 3). The outcome of each search was stored, and articles were scrutinized to estimate their relevance based on title, abstract and key words. Based on this preliminary overview, final key words for the literature review were selected (Figure 1).

The literature search was performed in the Web of Knowledge using the access to "All Databases" form with key words in the "Topic field" (including searches in Title, Abstract, Author Keywords and Keywords Plus®). The time span was set at "All years", which includes all published articles from 1969 to the 25th January 2013.

We excluded articles on non-civilian populations or distant populations nearly unaffected, those articles that did not study indicators of psychological resilience, or included other stressors (e.g. disease). Studies that did not focus on and did not define psychological resilience as an outcome (e.g. no symptom or one symptom of PTSD) were also excluded. Finally, book chapters, editorials, and studies written in a

language other than English were left out of this review (see Table 1 for detailed reasons of exclusion). The search in Web of Knowledge[SM] resulted in 58 references.

Figure 1. Key terms used and search strategy used in this review[1]

Resilient outcome

TS=(("psychological resilienc*" OR "psychosocial resilienc*")

Disaster/Stressor

AND (disaster* OR hazard* OR catastrophe* OR earthquake* OR volcano* OR "mass movement*" OR storm* OR flood* OR "extreme temperature*" OR drought* OR wildfire* OR "wild fire*" OR rockfall* OR landslide* OR avalanche* OR subsidence OR "storm surge*" OR "heat wave*" OR heatwave* OR "cold wave*" OR coldwave* OR "extreme winter condition*" OR inundation* OR windstorm* OR "industrial accident*" OR "transport accident*" OR "terrorist attack*" OR "potentially traumatic event*" OR "traumatic event*" OR "adverse event*" OR "extreme event*" OR "psychological trauma" OR conflict OR war OR violence OR adversity)

Indicator of resilience

AND (factor* OR indicator* OR variable* OR characteristic* OR examination* OR assessment* OR measure* OR association* OR predictor* OR determinant* OR psychometric*))

[1]For truncated search terms (e.g. resilienc*), a search is submitted for all words starting with these letters and would in this example search for ''resilience,'' ''resiliency,'' etc. For nontruncated search terms with ''*'' (e.g. disaster*), a search for plurals of the term (e.g. disasters) is performed.

Screening on title and abstract

Full references were stored in a Microsoft Office Access database management system. As a first step, the collected references were screened by title to make a preliminary selection (Figure 2). Six articles were excluded as they were considered outside the scope of this review. These excluded articles were on decisional conflict of cancer patients when choosing treatment; response of the stock market to long periods of terrorism; psychological resilience in adults undergoing genetic testing for

cancer; editorial comment on a study of psychological resilience in veterans; academic performance in children of divorce. One article was published in a language other than English and was excluded (Figure 2, Table1).

Second, the remaining 52 references were screened on the abstracts by two researchers independently. Discrepancies between the outcomes of the screenings were jointly discussed and a common final decision on articles to be included for further review was made.

Only papers were sought that clearly addressed the study of indicators for psychological resilience or a related definition, such as the near absence of PTSD symptoms. Despite the evidence of distress and mental disorder following adverse life events, the recent literature also demonstrates remarkable resilience of people to the effects of adverse events (Bonanno, 2004). The review of risk factors for distress and mental disorder following adversity, such as PTSD, falls outside the scope of the current study. The main reason is that this study area covers a very wide range of topics. In effect, with such a tremendous amount of information available nowadays, a completely comprehensive review would be impossible due to time and/or resource restrictions. Furthermore, if studies are focused on posttraumatic stress symptoms without putting it within the context of resilience, they have limited relevance for the development of resilience indicators, which is one of the objectives of the emBRACE project. Therefore, only studies in which posttraumatic stress symptoms (such as PTSD and depression) are set within the context of psychological resilience (e.g. resilience is defined as the absence of PTSD symptoms and/or depression), were included in our review.

Hence, articles were excluded if only the prevalence of trauma and stress related disorders in a population were studied. Studies addressing long term resilience or development that investigated life following events, such as childhood trauma, were excluded, since we focused on more acute stressors with a relatively direct and multifaceted impact, as is often the case in disasters. For this same reason, studies on combat-related psychological disorders in war veterans were also excluded. Furthermore, since we focused on peer reviewed journal articles, book chapters were not included (Table 1, Figure 2).

In all, twenty-three articles were excluded based on the screening of abstracts (Figure 2). These articles were not relevant for the objectives of our study, as they focused on: prevalence of psychopathology (n=3), or no resilience indicators were

studied (n=6); they focus on veterans (n=6); or investigated long-term resilience-developmental study (n=6), and two were book chapters.

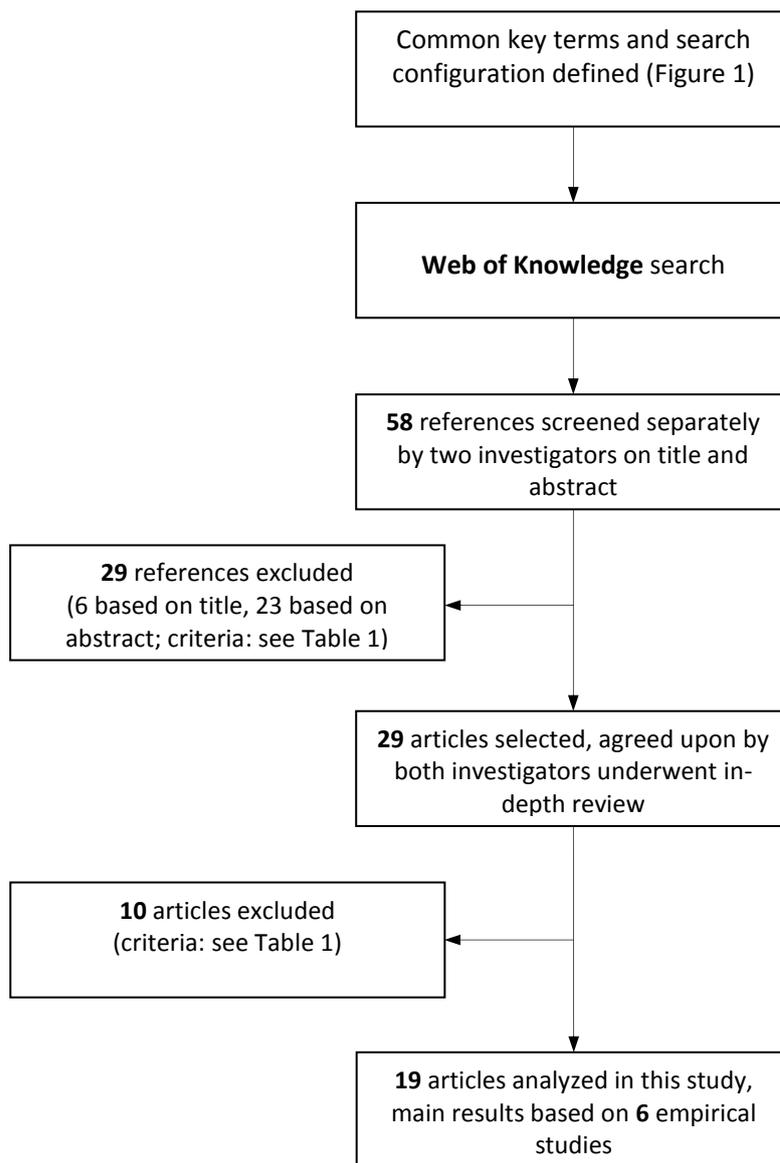**Figure 2.** Flow diagram of this study.

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                    ┌─────────────────────────────────┐
                    │  Common key terms and search    │
                    │  configuration defined (Figure 1)│
                    └─────────────────────────────────┘
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                    │    Web of Knowledge search      │
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                    ┌─────────────────────────────────┐
                    │  58 references screened         │
                    │  separately by two investigators│
                    │  on title and abstract          │
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┌──────────────────────────────┐   │
│ 29 references excluded        │◄──┤
│ (6 based on title, 23 based on│   │
│ abstract; criteria: see Table 1)  │
└──────────────────────────────┘   │
                                    ▼
                    ┌─────────────────────────────────┐
                    │  29 articles selected, agreed   │
                    │  upon by both investigators     │
                    │  underwent in-depth review      │
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│ 10 articles excluded          │◄──┤
│ (criteria: see Table 1)       │   │
└──────────────────────────────┘   │
                                    ▼
                    ┌─────────────────────────────────┐
                    │  19 articles analyzed in this   │
                    │  study, main results based on   │
                    │  6 empirical studies            │
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Table 1. Main reasons for exclusion of articles during title and abstract screening and full text review.

Main reasons for exclusion	No. of articles
Title screening (6 articles excluded)	
Decisional conflict of cancer patients when choosing treatment	1
Response of stock market to long periods of terrorism	1
Psychological resilience in adults undergoing genetic testing for cancer	1
Editorial comment on study of psychological resilience in veterans	1
Language other than English	1
Academic performance in children with divorced parents	1
Abstract screening (23 articles excluded)	
Prevalence of psychopathology	3
No resilience indicators studied	6
Non civilian populations (study on veterans)	6
Long-term resilience / developmental study	6
Book chapter	2
Full text reading (10 articles excluded)	
Non civilian populations	2
Cross-sectional data with outcome psychopathology	2
No indicators of resilience studied	3
No stressor, confusion of outcome and indicator	1
Study not representative of the exposed population	2

During the screening of abstracts two attributes were extracted from each article to help the screening and selection process. We classified articles according to whether they were qualitative and whether they clearly defined the resilience outcome, or otherwise as theoretical papers and reviews. The following six categories were used: 1) quantitative study measuring resilience factors with the outcome 'resilience' clearly defined; 2) quantitative study measuring factors related to resilience with the outcome 'resilience' not clearly defined; 3) qualitative study studying resilience factors with the outcome 'resilience' clearly defined; 4) qualitative study studying factors related to resilience with the outcome 'resilience' not clearly described; 5) theoretical article; 6) review article.

Review of full text articles

Subsequently, the full text of the 29 selected articles was reviewed in depth. From each paper we extracted relevant information on methods, study design, populations targeted, and outcome and predictive variables, as well as measures of effect size with their statistical significance, if available. The extracted information was stored in the database and included the following variables:

- the type of stressor
- definition of resilience
- study site
- target population (if any, including age groups investigated)
- study design (e.g. cross-sectional, longitudinal, focus group discussion)
- sample size
- resilient outcome
- resilience indicator
- a measure of the plausibility of the indicator to explain the outcome or a measure of the strength of association (e.g. correlation coefficient, odds ratio, relative risks, regression coefficient)
- direction of effect of indicator on resilience
- level of precision of indicator (the degree of indicator quantification)
- limitation of indicator
- data availability of indicator (an estimation of where to find such data when developing new resilience indicators).

Only a set of these variables, relevant to the objectives here, were reported in this study.

Based on the full text review, 6 articles were excluded, as they were considered not relevant for the objectives of our study. These articles concerned: cross-sectional data with psychopathological outcome (n=2); non civilian populations (n=2); no indicators of resilience studied (comparison of implicit and explicit measurement of environmental resources of resilience); absence of stressor and a study with inverted resilience outcome and indicator.

Finally, a total of 19 articles were used for further investigation, namely:

- to develop an overview table summarizing the available evidence
- to organize and evaluate the relevance and consistency of the available evidence based on further criteria.

Nineteen studies (9 empirical papers, 9 were reviews, one theoretical) were retained and indicators of resilience, along with other descriptive variables were extracted. The nine empirical studies provided 78 (non-exclusive) indicators of psychological resilience. These indicators always reported the effect on resilience as well as the

resilient outcome. Of these, six empirical studies analyzed post-disaster settings and provided 58 (non-exclusive) indicators.

Within the nine reviews and one theoretical study, a total of 135 (non-exclusive) resilience indicators were initially identified. Of these, 36 were excluded as the information on their effect on resilience was unclear or unreported (Supplementary tables 2 and 3).

To facilitate visualization, we separated the indicators identified in reviews that focused exclusively on disasters (Supplementary table 2) from those extracted from reviews focusing more generally on potentially traumatic events (PTEs). PTEs refer also to disasters but may include single traumatic events, such as the loss of friends or relatives, traumatic injury, stress, etc. Because disasters are often multi traumatic events, including many of the previous stressors as well as a life-threatening experiences, resource loss, increased risk of disease, displacement, we prioritized and analyzed here those approaches focused on disasters. Only two reviews applied exclusively to disaster situations and provided a limited number of indicators (see Supplementary table 3).

Indicators from empirical studies focusing on other stressors or reviews were used as a comparison but not as the main source of evidence for this review. The evidence arising from reviews is very heterogeneous (see Supplementary table 2 and 3): stressors were often not reported, the direction of effect was often missing, as well as the resilient outcomes. Importantly, the review methodology was reported in none of the nine studies. Thus the evidence considered in this study comes from 6 empirical studies which provided 58 indicators. Further these indicators were grouped in more homogeneous categories and a qualitative evaluation of the evidence was performed based on the consistency of the effect of each indicator on resilience across studies.

It is important to note that the six empirical studies analyzed here were heterogeneous for a number of characteristics, mainly the resilient outcomes, which precluded a meta-analysis on this sample of studies, but also on the disaster types and disaster intensity. In detail, these are:

      1) Resilient outcomes differed in terms of the variables used to measure resilience (eg, absence of PTSD, low depression, low stress reactions, high level of wellbeing)

      2) The set of variables (indicators) tested differed across empirical studies (not reported here);

3) Disasters were diverse and with different levels of severity and destruction, from very high, such as the terrorist attacks of September 11 in New York, to low in the Severe Acute Respiratory Syndrome (SARS) epidemic in Hong Kong;

On the other side all studies were technically well conducted, used state of the art statistical analysis and considered large cohorts. More in detail (see also Table 2):

1) All studies focused on adult populations, 18 or older age, except for the study on Swedish tsunami survivors, for which persons older than 16 years old were also interviewed;

2) The size of the study populations ranged from 1,331 (hospital-based study on SARS epidemics) to around 6 million in the case of New York citizens potentially affected by the 11/9 terrorists attacks. All studies worked on large cohorts, with results potentially generalizable to around 13 million adults exposed to diverse disaster settings and intensities of exposure. Excluding two studies which did not test the plausibility of these generalizations, the results would still apply to 10 million individuals;

3) Four studies were longitudinal and two were cross-sectional but all focused on psychological resilience within a period of 3 years after the disaster;

4) All studies used multivariate analysis to produce their final results. Each resilient indicator was derived from controlled analysis in which the confounding or moderating effect of other covariates was also considered.

Table 2. Key methodological features of the 6 analyzed studies.

Authors, year	Event, location and year	Study population (sampling frame)	Study design	Sample size	Analysis	Sample representative of population
Bonanno et al., 2008	SARS epidemic, Hong Kong 2003	Hospitalized SARS adult (≥ 18 years) survivors tracked by the Hong Kong Hospital Authority (N=1,331). Total of 1,775 individuals infected by SARS in Hong Kong	A face-to-face longitudinal study, including 3 interviews at 6, 12, and 18 months after SARS-related hospitalization	n=951 (6 months); n=977 (12 months); n=856 (18 months)	Latent class growth curve modeling (test the association of a trajectory with a set of predictors)	Approximated well Hong Kong's population characteristics, except by having a higher proportion of women (59.2%) compared to the 2001 census (51.7%). All analysis controlled by this factor
Lee et al., 2009	Hurricane Katrina, New Orleans (USA) 2005	African American Hurricane Katrina evacuees aged 18 or older living in New Orleans area but residing in Houston, Texas, in emergency shelters (N≈8,000 evacuees)	A face-to-face cross-sectional survey, administered on a random sample of evacuees in emergency shelters located in Houston, Texas (Kaiser Washington Post Harvard Poll #2005 WPH020) within one month after the hurricane	n=621, but analysis conducted only on 363 respondents with complete questionnaires (list wise deletion used)	Logistic regression and LISREL analysis (path diagram and path analysis)	No analyses to account for differences were reported
Johannesson et al. 2011	Tsunami, South East Asia 2005	All Swedish citizens registered at Swedish airports during the first weeks after the disaster and older than 16 (N=10,501)	A longitudinal mail survey using exhaustive sampling 14 months and 36 months after disaster	n=4,910 at 14 months (T1); n=3,457 at 36 months (T2)	Analysis of resilient trajectories related to exposure levels and bereavement status (descriptive). Odds Ratios for the association of mental health and each risk factor in multivariate logistic regression analysis (adjusted by all covariates)	Likely, as no difference detected between respondents and non-respondents
Hobfoll et al., 2009	Terrorist attacks, Israel 2004-2005	All Jews and Arabs, 18 years of age of older, living in Israel (N=4,503,785 according to 2004 census - total population, excluding an estimated 34% of the population younger than 18). Sampling frame selection based on telephone land lines	A face-to-face longitudinal survey on a random sample, including 2 interviews (August-September 2004, August-October 2005) coincident with the latter period of the Second Intifada	n=1,613 (August-September 2004); n=709 (August-October 2005)	Analysis of resilient trajectories associated with a set of risk factors using multivariate logistic regressions (adjusting by all covariates with p<0.01 in bivariate analyses)	Likely, the sample represented the distribution in the Israeli population on gender, age, place of residence and voting behavior

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Bonanno et al., 2007	9/11 terrorist attack, New York 2001	Adult (18 and older) citizens in New York City and contiguous geographic areas in New York State, New Jersey, and Lower Fairfield County in Connecticut (N≈6,080,000, according to census 2000, and excluding 24% of the population younger than 18 years)	Random digit-dial household cross-sectional survey with questionnaires administered face-to-face	n=2,752 approximately 6 months after September 11, 2001	Multivariate logistic regression. Final model selection taking a hierarchical approach (adjusted by all covariates)	Likely, the sample represented the distribution in this population on gender, age, and race
Hobfoll et al., 2012	Chronic exposure to political violence and social upheaval, Palestinian Authority 2007-2008	All citizens of the Palestinian Authority and East Jerusalem older than 18 years (2010 total population is estimated at N≈4,400,000 by United Nations). Around half should be <18 years old giving a rough final figure of 2,200,000	A longitudinal survey including three waves of interview (September-October 2007, April-May 2008, October-November 2008). A stratified three-stage cluster random sampling strategy was used to select the participants. The questionnaire were administered face-to-face	n=1,196 (initial sample) and n=769 (analysed)	Multivariate simultaneous equation models (SEM). This model estimates the complex relationship among variables. This analysis also control for other modeled variables.	Unknown, as the authors did not have data to analyze distribution of non-response and similarly they did not have a detailed census to compare with

3. Results

Indicators of psychological resilience

Fifty eight indicators of psychological resilience were obtained from the six empirical studies that focus exclusively on disaster settings (Table 3). The most consistent indicators of psychological resilience were **gender** and **social support**. All six studies found female gender and high levels of social support to be significant predictors of psychological resilience (Table 4). Whereas high levels of social support from relatives and friends increased all studied resilient outcomes, females were found at higher risk of suffering a worse resilient outcome after a disaster.

Probable indicators of psychological resilience

Previous trauma was assessed as a predictor of psychological resilience in half of the studies (Bonanno et al., 2008; Bonanno & Galea, 2007; Johannesson, Lundin, Fröjd, Hultman, & Michel, 2011). Two of these studies provided similar results, with trauma in the past negatively affecting future psychological resilience to disasters (Table 4). Evidence supporting **disaster-exposure level** as an indicator of resilience was rather solid too. Four of the five studies found low disaster-exposure levels to predict higher psychological resilience. **The loss of relatives or friends** was an important predictor of lower psychological resilience in the two studies that clearly tested this hypothesis (Johannesson et al., 2011; Lee & Tran, 2008). In all three studies in which **resource loss** (psychological or economic) was evaluated did the results show a positive association with the outcomes. Whenever tested, comorbid **physical and mental health** was an important predictor of psychological resilience (Tables 3, 4).

Potential indicators of psychological resilience that shows contrasting results

In general, **higher level of education** was predictive of a resilient psychological outcome. In two of the five studies in which education level was tested the association proved positive. In two other studies no association was found and in the final study a negative association was noted (Tables 3 and 4).

A **higher income** was connected to a resilient outcome in two studies. No clear effect was found in the other three studies. **Marital status** -having a partner or spouse**,** showed limited value as a predictor of a resilient psychological outcome. Despite five studies reported to include this variable, only one found a significant and positive effect on resilience (Johannesson et al., 2011).

The effect of **age** on psychological resilience remained unclear. Although all studies tested the effect of age, only in four studies was this association statistically significant, and the effect was contentious with two studies showing a positive effect of older age on resilience, and other two showing a negative effect of older age on resilience.

Hobfoll and collaborators (2009, 2012) considered **religiosity** as one important variable in two studies conducted in Israel and the Palestinian Authority respectively (Table 1). They found contrasting results with religiosity playing a positive role among Palestinians but having a negative effect on psychological resilience among Israelis.

Ethnicity played a different role in different settings and its use as an indicator is neither clear nor straightforward. While in Bonanno's study (Bonanno & Galea, 2007) being Asian played a positive role on resilience, other minorities (other than African American and Hispanic) were at higher risk of a worse psychological outcome. In Hobfoll's study, being Jewish was associated with higher likelihood of resilience (Hobfoll, Johnson, Canetti, Palmieri, & Hall, 2012).

Potential indicators of psychological resilience shown by only one study

Being insured was only tested in one study and was found to increase psychological resilience in face of a disaster (Lee & Tran, 2008).

The association of substance use and resilience was tested in one study. **Marijuana use** was connected with a decrease in psychological resilience (Table 3; Bonanno & Galea, 2007). In the same study, alcohol consumption and cigarette use were also tested, but no effect on psychological resilience was found.

Presence of **event-related worry** (fear) in the case of the SARS epidemic was also found to decrease psychological resilience.

Table 3. Key empirical studies that identify indicators of psychological resilience.

Authors, year	Event, location and year	Indicators of resilience	Effect of the indicator on resilience	Resilient outcome (measurement)
Bonanno et al., 2008	SARS epidemic, Hong Kong 2003	Physical functioning 6 months after hospitalization	positive	Psychological functioning (SF-12 - MCS)
		Female gender	negative	
		Social support	positive	
		Event-related worry	negative	
Lee et al., 2009	Hurricane Katrina, New Orleans (USA) 2005	Psychological distress	negative	Perceived sense of recovery (single dichotomous variable)
		Older age	negative	
		Male gender	positive	
		Income	positive	
		Human loss	negative	
		Insured	negative	Psychological distress (three dichotomous items)
		Human loss	positive	
		Home destroyed	positive	
Johannesson et al. 2011	Tsunami, South East Asia 2005	Intensity of exposure	negative	Resilient trajectory (IES-R ≤ 41.6 in two measurements)
		Loss of relatives	negative	
		Highly exposed	negative	Non-impaired mental health (General Health Questionnaire 12, GHQ-12, with cut-off ≥ 3 indicating impaired mental health)
		Female gender	negative	
		Loss of relatives	negative	
		Older age > 60 years	positive	
		Married	positive	
		Childhood trauma	negative	
		More than 3 traumas in adulthood	negative	
		Recent trauma	negative	
		Previous psychiatric illness	negative	
		Social support	positive	
Hobfoll et al., 2009	Terrorist attacks, Israel 2004-2005	Ethnic majority	Positive	Recovery trajectory (here called resilience recovery) Initial symptoms related to traumatic stress (17-item PTSD Symptom Scale) and depressive mood (5-item measure of depressive symptoms from the Patient Health Questionnaire) followed by recovery
		Income	positive	
		Psychosocial resource loss	negative	
		traumatic growth	negative	

		Male gender	positive	Resilient trajectory (here called resistance) is defined by absence of traumatic (17-item PTSD Symptom Scale) or depression symptoms (5-item measure of depressive symptoms from the Patient Health Questionnaire) at both points in time
		High income	positive	
		Being secular	positive	
		Higher education	positive	
		Ethnic majority	positive	
		Psychosocial resource loss	negative	
		Social support	positive	
Bonanno et al., 2007	9/11 terrorist attack, New York 2001	Female gender	negative	Having 1 or 0 PTSD symptoms (National Women's Study PTSD module) at any point in the first 6 months after event
		Age > 65 year	positive	
		Asian race/ethnicity	positive	
		College degree	negative	
		Depression	negative	
		Marihuana use	negative	
		Having an income decline	negative	
		Having 1 or 2 chronic diseases	negative	
		Having 3 or more chronic diseases	negative	
		Having a medium-low level of social support	negative	
		Being directly affected by event	negative	
		Having 1 additional recent life stressor	negative	
		Having 2 or more additional recent life stressors	negative	
		Having 2 or 3 prior traumas	negative	
		Having 4 or more prior traumas	negative	
		Experiencing post-event trauma	negative	
Hobfoll et al., 2012	Chronic exposure to political violence and social upheaval, Palestinian Authority 2007-2008	High social support	positive	Engagement, defined as a persistent, pervasive and positive affective-motivational state of fulfillment (8-item adapted from Schaufeli, Salanova, González-romá and Bakker 2002)
		Resource loss	negative	
		High traumatic exposure	positive	
		Male gender	positive	
		Being more educated	positive	
		Younger	positive	
		Religiosity	positive	
Studies focusing on other events (injury) or future potentially traumatic events (no specific event)				
Campbell-	No-event,	Female gender	negative	

Sills et al., 2009	Tennessee, Memphis (USA) 2006	Education level	positive	Individuals' perceptions of their abilities to adapt to change, deal with unexpected events, cope with illness and injury, handle unpleasant feelings, maintain positivity in the face of stress, and cope with obstacles (Connor-Davidson Resilience Scale 10-item version, CD-RISC-10)
		Income level	positive	
		Exposed to abuse or maltreatment when a child	negative	
Mealer et al., 2012	No-event, Tennessee, Memphis (USA) 2006	Absence of PTSD	positive	Resilient individuals (17-item Connor-Davidson Resilience Scale, CD-RISC. A score of >=92 defines a highly resilient individual)
		Absence of anxiety symptoms	positive	
		Absence of depression symptoms	positive	
		No problem to maintain friendship	positive	
		No problem to maintain family relationships	positive	
		General life satisfaction	positive	
		Overall good functionning	positive	
		Absence of burnout syndrome	positive	
deRoon-Cassini et al., 2010	Traumatic injury, Midwest hospital (USA) - year not reported	Human intention related to the injury	negative	Low symptoms of PTSD (Post-Traumatic Stress Diagnostic Scale, PDS)
		Education	positive	
		Coping self-efficacy	positive	
		Anger related to trauma	negative	
		Human intention related to the injury	negative	Low symptoms of Depression (The Brief Symptom Inventory, BSI)
		Education	positive	
		Coping self-efficacy	positive	
		Anger related to trauma	negative	

Temporal location of the probable indicators

Once the indicators were grouped in more homogeneous groups (Table 2), it seemed logical to analyze, at least for the most reliable, their temporal location in the disaster cycle (this is developed in detail within emBRACE, please see Deliverable 2.1). Female gender and previous trauma are attributes that can be characterized in a

community before any disaster occur. Cleary, others such as exposure level, resource loss, and human loss can be only precisely measured in a community after an event has occurred. Health status is more difficult to classify. In general chronic disease (eg, diabetes, hypertension) can be considered as baseline conditions in most studies even if asked at the times of the assessment.

Table 4. Grouping of main and potential indicators in this study.

Indicator	No. studies with tested hypothesis	No. studies with significant association	No. positive effect on PR	No. negative effect on PR
Female gender	6	6	0	6
Social support (high)	6	6	6	0
Exposure level (low)	5	4	4	0
Previous traumatic experiences	3	2	0	2
Resource loss (economic or psychosocial)	3	3	0	3
Human loss (friends or relatives)	2	2	0	2
Physical and mental health (poor)	4	4	0	4
Potential indicators, but limited or contentious evidence				
Being insured	1	1	1	0
Substance abuse (marijuana)	1	1	0	1
Event-related worry	1	1	0	1
Education (high)	5	3	2	1
Income (high)	5	2	2	0
Marital status (married or partner)	5	1	1	0
Older age (>60-65)	6	4	2	2
Being religious	2	2	1	1
Ethnicity (minority)	3	3	1	2

4. Discussion and key messages

In this study we identified barriers that need to be considered and solved in the production of indicators of psychological resilience to disasters. Likely, many of these constraints apply to other areas of resilience. We conducted a review using the entire Web of Knowledge to firstly identify evidence-based consistent indicators of

psychological resilience to disasters, and second to provide a clear methodological approach that might serve as a basis for selection of indicators in future work.

Despite the evidence on indicators of psychological resilience presenting important heterogeneity, a systematic methodology to select, filter, and group this evidence seems an attainable objective that is confirmed by this work. The use of this methodology helped us to identify the most consistent indicators (female gender and social support), and other probable indicators, (previous trauma, degree of disaster-exposure, human losses, resource loss and physical, and mental health) as the most important revealed by our analysis.

Limitations of this study

There are a number of limitations involved in our analysis that need consideration. First of all, the results of this work need to be considered with care, as we did not systematically analyze all sources of scientific evidence that might provide indication of what affects psychological resilience to disasters. Once a methodology is established and accepted, it should be much easier to upscale the process. Our objective was not to systematically review all the literature but rather to propose a methodology tested in a sample. Second, the studies only consider observable variables that were selected by the researchers conducting each study. We reported the number of studies in which similar predictors were used as a way as to estimate their presence across the studies and also to estimate the proportion of significant – positive or negative – effects of each variable on psychological resilience. Third, the heterogeneity found in resilient outcomes and study designs precluded meta-analysis. As an alternative we used a different approach considering as plausible indicators only those in which a majority of studies pointed to the same direction of the effect. Fourth, our approach did not capture a number of indicators focused on personality traits (e.g. positiveness, hardiness) which enhance resilience and that were present in some of the analyzed reviews.

A number of barriers that deserve further discussion were observed during this work and are commented below.

The available evidence does not always apply to disasters – to what extent should it be used?

Disasters produce many losses among the exposed. In the worst situations, survivors might have lost relatives, friends, and dwellings. They themselves might have been injured during the event or have suffered a life-threating experience, might be at higher risk of contracting a number of diseases, be more disabled than before the disaster, and their economic capacity might shrink with rising unemployment rates and the rise of prices that often occur after some disasters. We thus think that disasters are special events that challenge human and community capacities. As such, a first distinction among disasters and non-disaster events studies might help in developing resilience indicators.

We proposed to compare indicators arising from both types of stressors separately. If the relevant underlying mechanisms that increase psychological resilience are similarly identified in disasters and non-disasters settings, this evidence might be used as additional criteria to select indicators or indicator systems. Despite this, comparisons were not systematically used in our work, therefore, this might serve as a model for comparison in the future.

Heterogeneity of studies – build more homogeneous groups

This work showed that studies on resilience indicators are highly heterogeneous. This is an issue that has been identified by other researchers (Davydov et al., 2010). One option to reduce at least part of this heterogeneity would consist of producing additional exclusion criteria, for example to exclude studies that focus on specific population groups, which might be less representative of a general civilian population. In this review the final studies represented the general civilian populations older than 18 years and affected by tsunamis, hurricanes, epidemic, conflict and terrorism in Sweden, USA (New York and New Orleans), Hong Kong, Israel and the Palestinian Authority. The exception was the study on the Hurricane Katrina, in which only African Americans were represented (Lee & Tran, 2008).

Review studies never reported a methodology – look for an added value on systematic reviews

None of the nine review studies reported their methodology to search and select available evidence on resilience indicators. The development of resilience indicators might benefit from the use of systematic reviews. Such reviews attempt to answer a

specific question and should include: 1) clear inclusion/exclusion criteria to select the available evidence, 2) an explicit search strategy, 3) systematic coding and analysis of included studies, 4) meta-analysis (if possible). We undertook this approach in this work (Moher et al., 2009a). We think this methodology might be especially useful in our setting, given the apparent high heterogeneity of studies on resilience.

Value of our findings and ways forward

The present report only attempted to revise the indicators of psychological resilience as a testing ground for future indicator development. As such we only focused on one of the principal areas that contribute to resilience (see Deliverable 1.1 produced by this consortium for a detailed assessment). Logically this approach might be expanded to explore further literature testing indicators of psychological resilience and similarly to cover other areas of resilience previously identified by our consortium, such as community resilience.

We do not discuss in depth the value of the indicators found with our approach. The literature needs to be further searched and the evidence re-evaluated using a more comprehensive selection of indicators supported by more studies. Having this in mind, the preliminary results obtained here suggest that a proxy of social support received during a disaster might be a robust indicator of psychological resilience after disasters. Female gender as a consistent driver of psychological resilience is an important finding. The ratio male-female in a community can vary across time and across communities due to migration or other factors, and thus gender should be importantly considered when developing indicators. However, to increase societal psychological resilience after an event has occurred, women will require targeted policies to increase their resilience. More discussion on the role of gender as an indicator of psychological resilience is needed. The methodological details might be further reviewed once the literature is comprehensively searched. Why gender is an important driver of psychological resilience is a key question, may be to be considered when designing our case-studies.

With the exception of those having suffered previous trauma, most potential indicators (level of disaster-exposure, human loss, and resource loss) occurred after the disaster. A distinction of indicators measurable before or after the event emerged here as an important topic that deserves attention in the development of indicators and warrants further research. Similarly, previous work conducted within the

consortium might be applied to these data to classify context indicators into individual, family, and community spheres. Also the indicators need to be better linked to the disaster cycle developed in detail within the context of resilience (work package 2). Again this should be logically attempted once a more comprehensive list of indicators will be made available by the consortium.

Deliverables 1.3 and 1.4 might consider revising the literature using the above or a similar methodology in order to provide a more restricted and evidence-base list of resilience indicators. The work presented here contributes to this objective, as part of the literature on psychological resilience was reviewed. A more refined list of indicators should pave the way to develop what was intended initially in Del. 3.3. and 3.4: provide disaster data needed to measure resilience. Future work on indicators and indicator systems should be continued in Deliverable 3.5, building on the abovementioned deliverables. As suggested this deliverable should focus on non-disaster data required to produce indicators, including scale issues, weighting and indicator combination issues. The final output should be logically enriched by the results of the empirical research conducted in the five case-studies.

Key messages

- Female gender predicted a worst psychological resilient outcome after a disaster. High social support predicted psychological resilience to disasters. Both were consistent indicators of psychological resilience in this study.

- The development of unbiased resilience indicators needs of an evidence-based approach against an approach based on data availability, which might be more prone to several biases.

- Given the high heterogeneity observed in the analyzed research, the study of resilience indicators might benefit from systematic review.

- Some indicators can be measured ante-facto but others can be precisely measured only post-facto. This suggests that a portion of societal resilience might depend on how severely the community was hit (impact) and reinforce disaster risk reduction as a top strategy to favor psychological resilience.

- Some variables, such as mortality can play a double role, as resilient outcomes and as indicators of resilience. This is shown in the literature, confirms the dynamic nature of resilience, and pinpoints the need to pay attention to both resilient outcomes and indicators of resilience.

5. Acknowledgements

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7. Supplementary information

Supplementary Table 1. Brainstormed potentially relevant key words for the literature review.*

Search 1			Search 2 (added to column 2)	Search 3
OUTCOME	**EVENT**	**'INDICATOR'**	**EVENT 2**	**INDICATORS OF RESILIENCE**
psychological resilience	disaster*	factor*	traumatic event*	coping behaviour
psychological resiliency	hazard*	indicator*	industrial accident*	psychological adaptation
	catastrophe*	variable*	transport accident*	psychological response
	earthquake*	characteristic*	adverse event*	psychological resources
psychosocial resilience	volcano*	examination*	terrorist attack*	psychological adjustment
	mass movement*	assessment*	extreme event*	psychological well being
	storm*	measure*	psychological trauma	mental health
	flood*	association*	conflict	demograph*
psychosocial resiliency	extreme temperature*	predictor*	war	exposure
	drought*	determinant*	violence	personality
	wildfire*	psychometric*	adversity	social resources
	wild fire*			economic resources
	rockfall*			stressor*
	landslide*			positive emotion*
	avalanche*			coping and appraisal
	subsidence			flexibility
	storm surge*			individual socio-demography
	heat wave*			individual resources
	heatwave*			community resources
	cold wave*			preparedness and mitigation
	coldwave*			social support
	extreme winter condition*			spirituality
	inundation*			disaster impact severity
	windstorm*			disaster experience*
				positive adjustment
				positive emotion*
				adaptive capacity
				vulnerability
				PTSD
				psychological recovery

*Search based on key terms identified in reviews (includes del. 3.1), key papers, and the authors' views.

Supplementary table 2. Review studies that identify potential indicators of psychological resilience to disasters.

Authors, year	Type of event	Indicators of resilience	Effect of the indicator on resilience	Resilient outcome
Neria et al., 2011	Terrorism, New York 9/11	Attachment style	not specified	Effective coping during exposure to trauma and reduced psychopathology in its aftermath.
		Hardiness	positive	
		Cognitive attributional style	not specified	
		Biological factors	not specified	
Drury and Williams, 2012	War, collective violence, conflict, terrorism	Community acceptance	positive	Protection against distress and/or mental disorders; psychosocial and mental health.
		Emotion regulation	positive	
		Parental support	positive	
		Community relations	positive	
		Socio-economic status	positive	
		Family cohesion	positive	
		Perceived support from friends	positive	
		Schools	positive	
		Perceived spiritual support	positive	
		Self-regulation capabilities	positive	

Supplementary table 3. Review studies that identify potential indicators of psychological resilience to potential traumatic events (PTEs).

Authors, year	Indicators of resilience	Effect of the indicator on resilience	Resilient outcome
Davydov et al., 2010	Effective coping	positive	A biopsychosocial model of resilience assumes the existence of multiple processes within and outside an organism protecting against disturbance in a manner similar to the complex model of somatic health protection system.
	Positive emotions	positive	
	Flexible use of emotional resources	positive	
	Adaptive capacities	positive	
	Old age	negative	
	Perceived severity of daily stressors	not specified	
	Quality of received interpersonal relationships	positive	
	Quality of perceived social support	positive	
	Quality of general national, economical and cultural barriers	positive	
	Quality of targeted assistance acquired from society	positive	
	Phenotype advantages	positive	
	Imprinting, implicit learning	positive	
	Epigenetic and meaning change mechanisms related to real life adversities (principal in childhood)	positive	
	'Fortification' programs for general regulation of behaviour or organism functioning in a community	positive	
	Externally imposed regulation of emotions and behaviours in a person	positive	
	Cognitive reappraisals related to cognitive therapy	positive	
	Resilience-promoting interventions	positive	
	Cognitive appraisal of an event and the emotions induced by the event	not specified	
	Learning from past events	positive	
	5-hydroxytryptamine transporter-linked promoter region (5-HTTLPR) s allele	positive or negative	
	Aspects of intellectual functioning and cognitive flexibility (positive explanatory style, reappraisal and acceptance)	not specified	
	Social attachment and social behaviours such as altruism	not specified	
	Positive selfconcept and effective self-regulation of emotions	not specified	
	Positive emotions including optimism and humour	not specified	
	Capacity to convert traumatic helplessness into learned helpfulness	not specified	
	Meaning including religion/spirituality	not specified	
	Social support including role models	not specified	
	Active coping style in confronting a stressor including exercise and training	not specified	
	Capacity to recover from negative events and stress inoculation	not specified	
	Capacity to accommodate the new trauma-related information in a positive direction	not specified	
	Hardiness	not specified	
	Perceived stress	not specified	
	Optimism and life attitude	not specified	
	Adaptive reactivity	not specified	

Bonanno et al., 2011	Personality traits	not specified	A stable trajectory of healthy adjustment across time.
	Perceived control	positive	
	Trait resilience	positive	
	negative affectivity	negative	
	ruminative response style	negative	
	trait self-enhancement	positive	
	high perceived coping self-efficacy	positive	
	Male gender	positive	
	Older age	positive	
	Greater education	positive	
	Exposure	not specified	
	Emotional support	positive	
	Social support	positive	
	Instrumental support (assistance with the tasks of daily living)	positive	
	Availability of economic resources	positive	
	Loss of economic resources	negative	
	Past and current life stress	not specified	
	Meaning making	not specified	
	Positive emotions	positive	
	A priori beliefs (pre-exisiting worldviews)	not specified	
de Terte et al., 2009*	Cognitions	not specified	Ability of an individual to maintain healthy psychological and physical wellbeing despite being exposed to adversity, including the wider community aspects.
	Emotions	not specified	
	Behaviours	not specified	
	Physical activities	not specified	
	Family support	positive	
	Community support	positive	
	Societal support	positive	
Yehuda et al., 2006	Positive affectivity	positive	Ability to bounce back from negative experience, or even significant adversity, by flexible adaptation to the ever-changing demands of life.
	Optimism	positive	
	Cognitive flexibility	positive	
	Active coping strategies	positive	
	Religion/spirituality	positive	
	Social support and intimacy	positive	
	Emotion regulation	positive	
	Mastery	positive	
Trufino, 2010	Control over the process of remembering traumatic experiences	positive	Despite suffering significant traumatic conditions of extreme deprivation, serious threat and major stress, some people manage to endure and recover fully. This unique ability has been called "resilience".
	Integration of memory and emotions	positive	
	Regulation of emotions related to trauma	positive	
	Control of symptoms	positive	
	Self-esteem	positive	
	Internal cohesion (thoughts, emotions and actions)	positive	
	Establishment of secure links	positive	
	Understanding the impact of the trauma	positive	
	Developing a positive meaning	positive	
	Balanced view of one's life	positive	
	Perseverance	positive	
	Self-confidence	positive	
	Personal autonomy	positive	

	Meaning of one's life	positive	
	Self-efficacy	positive	
	Self-esteem	positive	
	Problem-solving	positive	
	Positive self-concept	positive	
	Internal locus of control (self-control and emotion regulation)	positive	
	Personal autonomy	positive	
	Sense of humour	positive	
	Social competence	positive	
	Communication	not specified	
	Sense of belonging	positive	
	Empathy	positive	
	Optimism	positive	
	Transcendent meaning of life	positive	
	Religion	positive	
Thompson et al., 2012	Experiential avoidance	negative	Recovery from PTSD or never diagnosed PTSD
	Acceptance	negative	Posttraumatic growth
Bonanno and Mancini, 2008	Temperament	not specified	The ability of adults, and children, in otherwise normal circumstances who are exposed to an isolated and potentially highly disruptive event such as the death of a close relation or a violent or life-threatening situation to maintain relatively stable, healthy levels of psychological and physical functioning, as well as the capacity for generative experiences and positive emotions.
	Supportive relations	positive	
	Community resources	not specified	
	Pragmatic coping	positive	
	Adaptive flexibility	positive	
	Self-enhancement	positive	
	Repressive coping	positive	
	Type of exposure	not specified	
	Duration of exposure	not specified	
	Intensity of exposure	not specified	
	Male gender	positive	
	Age	positive	
	Education level	positive	
	Personal and social resources	not specified	
	Change in resources	negative	
	Employment loss	negative	
	Social support loss	negative	
	Current life stressors	negative	
	Previous life stressors	negative	
Bonanno and Mancini, 2008	Flexibility in appraisal of PTE	positive	Transient stress reaction that will be mild to moderate in degree and will not significantly interfere with their ability to continue functioning.
	Flexibility in response to PTE	positive	
	Rigid or context insensitive emotion and coping	negative	

Supplementary table 4. Target population by study type including number of articles and number of indicators.*

Study type	Target population	Number of articles	Number of Indicators
Quantitative study outcome defined	Adults	1	16
	Adults > 18 years	1	3
	Adults > 18 years indirectly exposed to event	1	6
	African American Evacuees > 18 years	1	3
	Distant witness college student > 18 years	1	1
	Hospitalized survivors	1	4
	Injured trauma survivors > 18 years	1	4
	Intensive care unit nurses	1	9
	Jews and Arabs in Israel > 18 years	1	4
Quantitative study outcome not defined	College women exposed to a mass shooting	1	6
	Residents of the Palestinian Authority >18 years	1	6
Review	Not provided	5	64
	Adults and children	3	48
	Children and young people, including refugees, displaced children, and child soldiers	1	10
	Highly exposed populations such as those living or working within close proximity, and first responders, including rescue, cleaning, and recovery workers	1	4
Theoretical article	Not provided	1	7

*Includes data on 23 articles.

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