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# The road to resilience: a systematic review and meta-analysis of resilience training programs and interventions

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## Abstract

**Objectives**: The aim of the present systematic review and meta-analysis is to synthesise the available research evidence on resilience interventions. Specifically, to examine what types of resilience training have an evidence base for altering valid and reliable measures of psychological resilience. Identifying effective interventions and strategies that bolster individual resilience may play an important role in protecting and supporting long-term psychological health. A growing body of research has emerged examining the efficacy of training programs aimed at enhancing psychological resilience among various groups and populations. Despite this, limited consensus exists on what, if any, interventions work best.

**Design**: A systematic review was conducted on published peer-reviewed literature for controlled trials and randomised controlled trials examining the efficacy of interventions aimed at improving psychological resilience.

**Outcome measures**: Outcome of resilience training as assessed by valid and reliable measures of psychological resilience.

**Results**: Overall, 437 citations were retrieved and 111 peer-reviewed articles were examined in full. Seventeen studies met the inclusion criteria and were subject to a quality assessment. Programs were stratified into one of three categories including 1) Cognitive Behavioural Therapy (CBT)-based interventions, 2) Mindfulness based interventions or 3) Mixed Interventions, those combining CBT and Mindfulness training. 80% of interventions were delivered via face-to-face training over multiple sessions. A meta-analysis and sub-analyses using the random effects model found a moderate positive effect of resilience interventions (0.44 (95% CI: 0.23, 0.64) and more specifically Mixed-Interventions (0.51 (95% CI: 0.12, 0.91).

**Conclusions**: Resilience interventions based on a combination of CBT and mindfulness techniques have a positive impact on individual resilience. This finding has wide reaching implications in terms of the role resilience training may play in the realm of public health and prevention, particularly amongst high risk groups.

**Key words: resilience; resilience training; mindfulness; cognitive behavioural therapy.**

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**Strengths and limitations of this review and meta-analysis:**

- We employed a systematic strategy to search for the best quality evidence for effectiveness.
- We used a validated quality assessment tool to rate the methodological rigour for each included study.
- We completed sub-analyses to provide further insight regarding the effectiveness of different types of resilience training.
- There were however relatively small sample sizes across many of the RCTs and over a third of the included studies did not provide adequate data for inclusion in the main meta-analysis.
- None of the included studies investigated the impact of adverse situations following intervention meaning improvement in resilience was detected solely by a change in scores on resilience scales.

## Introduction

Managing the ups and downs of daily life requires resilience. A growing body of research supports the idea that resilience can not only enhance general wellbeing but also bolster an individual's ability to cope effectively with stressful life events. Given the impact of stress-related illness on global economies, resilience is not only a topic of immense personal and familial importance but also has major social and financial significance (1-3). To meet this challenge, research is increasingly focusing on what constitutes resilience and how it can be developed or enhanced. Resilience would appear to go beyond simple genetic inheritance. It is a multifaceted phenomenon, which is influenced by the presence or absence of various resilience-promoting resources(4). When such resources are cultivated they enhance a person's overall ability to effectively cope with heightened stress and adverse life circumstances (4-9)

Definitions of resilience are diverse and plentiful. Some researchers have described it as the ability to adapt positively to stressful circumstances (10) others have defined resilience as being able to remain functionally stable and well despite ongoing stress(11). Resilience has also been recognized as the capacity to function above average in the face of adversity(12). With a plethora of competing definitions, it is an ongoing challenge for researchers and clinicians to reach consensus on what constitutes resilience. In recognition that people often fluctuate in their levels of functioning, some researchers emphasize the need to utilise longitudinal assessments. This allows identification of resilient individuals who consistently display high functioning or psychological well-being over time (13, 14)for a review, see (15)). More recently, there has also been a tendency to confuse resilience with 'well-being'. The American Psychological Society (APA) define resilience as a process of "bouncing back" from difficult experiences and "adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress"(16) . Several researchers have emphasized this "bounce-back" characteristic as the central quality of resilience (4, 17) In this way resilience can be viewed as being on a continuum ranging from low (poor bounce-back ability) to high (strong capacity to recover) and extremely high, which in the literature has been termed "thriving" and reflects a person's ability to reach a superior level of functioning following an adverse or stressful event (17, 18).

A growing number of studies have found a positive link between psychological resilience and mental health outcomes. More specifically, higher self-reported resilience has been associated with lower levels of anxiety, psychological distress and mixed anxiety/depression(5, 19-21) Researchers have also found that resilience, as measured by various self-report tools, has a mitigating effect on depression symptoms among individuals who have experienced trauma in both childhood and later life(22-25) as well as among patients experiencing severe health conditions(26). Together these studies suggest that the measurable components of individual resilience may play an important protective role in easing the negative effects of stress, trauma and adversity.

In terms of resilience training, several studies have examined the benefits of such programs using various specific groups, including intensive care nurses, college students, cancer survivors, youth workers, radiologists, immigrants, physicians, military officers and general office workers (4-9)

While the training programs typically share the common aim of enhancing resilience or resilience resources, they tend to differ greatly in terms of content, delivery and length. An important limitation in the resilience literature is aptly noted by Leppin and colleagues (2014) who observe that "no single accepted theoretical framework or consensus statement exists to guide the development or application of these programs"(27) In spite of these concerns, a number of recent reviews have highlighted the growing body of research supporting the benefits of resilience training for health and wellbeing(27-29). Over recent years, a large number of new resilience

studies have been published. It is also important to note that previous reviews are limited by the process by which training efficacy was examined, and specifically the tendency to include studies that utilised mental health, wellbeing or psychosocial outcomes as measures of resilience (27, 28). This approach provides limited insight into whether a resilience intervention can truly facilitate change in an individual's overall ability to bounce back from adversity. Whilst research continues to highlight a positive relationship between resilience and psychological wellbeing, it is important to note that resilience cannot simply be measured via psychometric tools examining wellbeing and mental health symptomology. A training program may enhance and improve mental health symptoms, yet not improve a person's overall psychological resilience or vice versa.(30, 31) Moreover, in groups where people are 'mentally healthy' other measures are needed to examine the efficacy of resilience programs beyond simple wellbeing outcomes.

Given these concerns, when appraising the evidence for resilience training, it is crucial to consider how resilience as an outcome is measured. A recent review analysed the validity and reliability of various resilience measures currently in use. (32) They systematically reviewed the psychometric rigor of resilience measurement scales developed for use in general and clinical populations. Each measure was subject to a detailed quality assessment, which examined content and construct validity, internal consistency, reliability, responsiveness as well as interpretability, floor and ceiling effects. They found no current gold standard among the 15 included measures of resilience and stipulated that all require additional validation work. The Connors Davidson Resilience Scale (CD-RISC) (21), The Brief Resilience Scale (BRS) (4) and the 14-item Resilience Scale received the best psychometric rating and were identified as the most valid and reliable measures currently available to researchers attempting to examine the construct of resilience. These self-report measures aim to assess an individual's ability to adapt to change and cope effectively with significant life adversity, which may include illness, failure and personal challenges. For example, items from the CD-RISC include "I tend to bounce back after illness, injury or other hardship", "Under pressure, I stay focused and think clearly" and "I am able to handle unpleasant or painful feelings like sadness, fear and anger". Higher scores on such measures have been positively associated with greater psychological health.(20, 21)

The main aim of the present systematic review and meta-analysis is to synthesize the available research evidence on resilience interventions, specifically in terms of content, length of training and efficacy. Given the aforementioned difficulties surrounding measurement accuracy, a unique aspect of the present review is that we aim to only include studies that utilised valid and reliable measures of resilience as previously identified by Windle and colleagues(32)

## Methods

### Search Strategy

A systematic search was carried out using the PRISMA guidelines (33). In June 2016 the following electronic databases were searched: Ovid Medline, Ovid EMBASE, PsycINFO, and Ovid Cochrane Library. Search items, summarized in Table 1, included: "resilience", "resilience training" or "resilience intervention". No time restrictions were placed on the search strategy. The references of each included paper were also searched for relevant resilience intervention studies. Additionally, in order to reduce the risk of publication bias, in July 2016 we searched the World Health Organisation (WHO) Clinical Trails Registry using the term "resilience" to identify any trials that had not published their findings.

*Table 1. Search Strategy terms*

| Database | Search Terms |
|---|---|
| **Embase, PsycINFO, Wiley, Cochrane Library** | Resilience, Psych or resilience or resiliency *and* controlled trial *and* training and/or intervention |
| **Medline** | Resilience *and/or* resiliency *and* resilience training *and/or* resilience intervention |
| **WHO registry** | 'Resilience' |

**Eligibility Criteria**

Eligible studies were randomised controlled trials or controlled trials assessing the efficacy of any program designed to develop, enhance or improve resilience in adults. Studies had to describe a specific aim to improve resilience and employ a validated measure of resilience as one of the outcome measures. No restrictions were made based on the type of comparator used and length of follow up. Studies that only evaluated the implementation or receptivity of a resilience program were excluded. Non-English publications and studies that exclusively utilised wellbeing or mental health outcomes as the main measure of resilience were also excluded.

## Study Selection

Two researchers (SJ and JT) worked independently to initially screen the titles and abstracts retrieved by the literature. Following the initial screening, relevant papers were retrieved in full text and specific inclusion criteria were utilised to identify eligible studies. Discrepancies between the researchers' selection results, which were infrequent, were discussed with a third researcher (SBH) until consensus on inclusion or exclusion was reached. One of the main eligibility criteria for the present review was that studies must utilise a valid and reliable measure of resilience. In keeping with the conclusions by Windle, Bennet and Noyes(32) the following three measures of resilience would meet this criteria; The Connors and Davidson Resilience Scale, The Brief Resilience Scale and The 14-item Resilience Scale. For those studies that employed other measures of resilience, we more closely examined the scale used in terms of the construct that it aimed to measure and the degree to which it had been validated.

## Quality Assessment

Methodological quality of each included study was assessed using the Downs and Black Checklist.(34) Minor modifications were made to the tool for use in this review. In line with previous studies, (35-37) the scoring for question 27 on statistical power was simplified to either zero or one, based on whether or not there was sufficient power in the study to detect a clinically significant effect (i.e., studies reporting power of less than 0.80 with alpha at 0.05 obtained a zero score). The maximum score for the modified checklist was 28 with all individual items rated as either yes (=1) or no/unable to determine (= 0), with the exception of item 5, "Are the distributions of principals confounders in each group of subjects to be compared clearly described?" in which responses were rated as yes (=2), partially (=1) and no (=0). Scores were grouped into four categories based on ranges: Excellent (26 to 28), good (20 to 25), fair (15 to 19) and poor (14 and less). Studies with an overall "poor" quality assessment were excluded from the final review.

**Contact with researchers**

Where additional information was required for effect size calculations the study's lead researchers were contacted. Contact details were obtained through the correspondence addresses provided on

the study's publication. At times, website searches were also performed to ensure that contact details were still valid and in use. Researchers were contacted by email and non-responders were sent two follow-up emails at fortnightly intervals.

**Data synthesis/statistical analysis**

The meta-analyses were performed using the statistical software package STATA, version 12.1. The main outcomes of interest in each study were at least one validated measure of psychological resilience. As studies utilised various measures of resilience, the effect size was represented by the standardized mean difference (SMD), which was computed by subtracting the average score of the control group from that of the intervention group, and dividing the result by the pooled standard deviations. A positive effect size indicates that the intervention group had superior effects to the control group. Generally, effect sizes of 0.8, 0.5 and 0.2 are labeled large, moderate and small, respectively(38). The pooled mean effect sizes were expressed as SMD with 95% confidence intervals (95% CI). The studies were weighted by the inverse-variation method. Considerable heterogeneity was anticipated given the varying populations and interventions employed across included studies. Therefore pooled effect size estimates were calculated utilizing the random effects model of analysis. This model is a conservative approach, which infers that all studies are estimating different effects resulting from disparities in factors such as study population (39)or sampling variation within and between studies. It consequently generates larger scale confidence intervals(40). The $I^2$ statistic was reported to determine the level and impact of heterogeneity and the percentage of outcome variability, which may result from heterogeneity present across studies. An $I^2$ value of 0% reflects no observed heterogeneity, whilst 25% is deemed "low", 50% is "moderate" and 75% is "high" heterogeneity. (41) A range of sub group meta-analyses were planned *a priori* to examine the evidence base for different types of resilience training (for example training based on Cognitive Behavioural Therapy (CBT) skills and/or Mindfulness-training). Finally, a separate meta-analysis examined studies that provided 6-month follow-up data to determine the longer-term effects of different types of resilience training. Publication biases were examined through visual inspection of a funnel plot with the SMD plotted against the SMD standard error and quantitatively through Egger's test for small study effects.

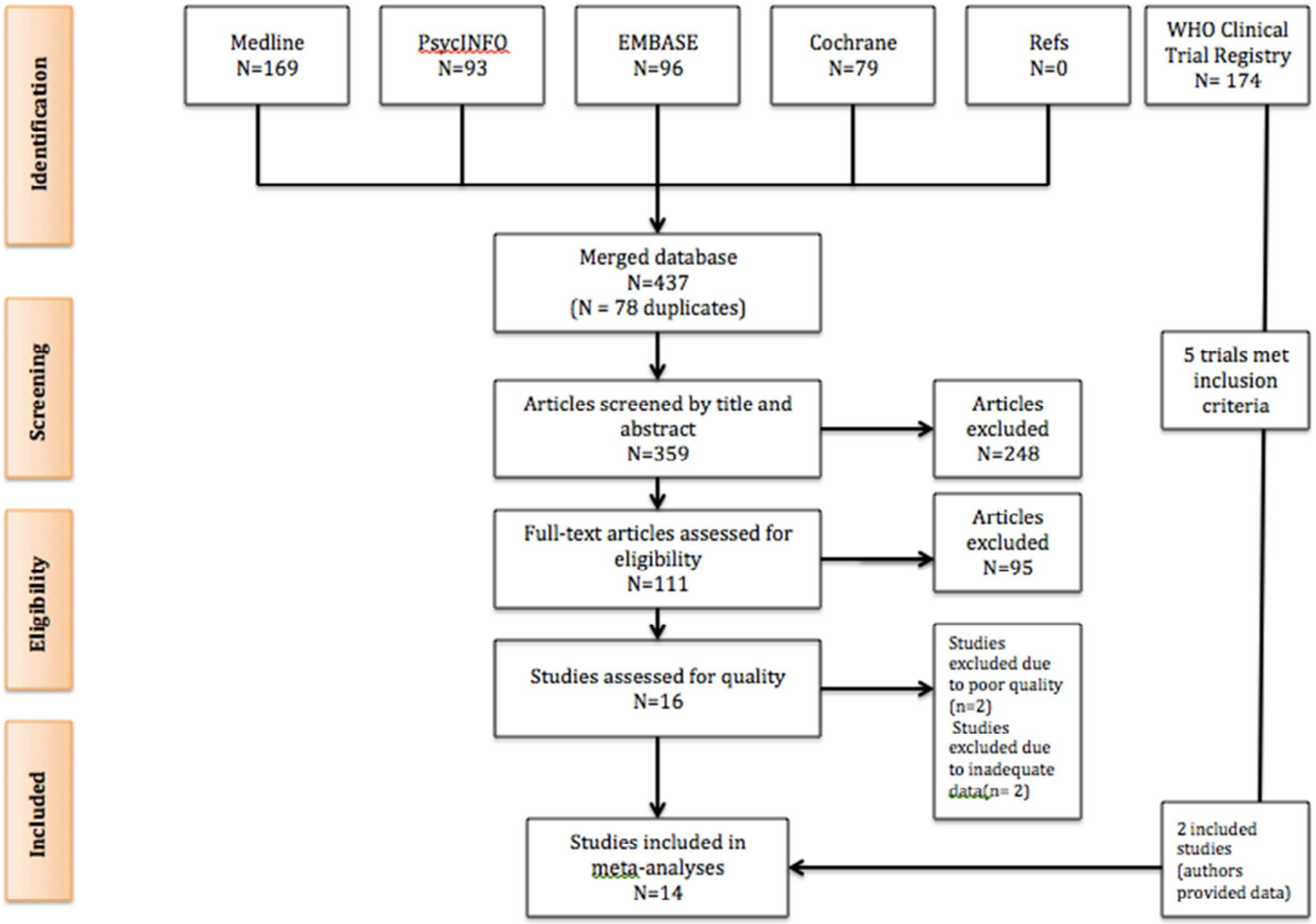



**Figure 1 Flow diagram of study selection**

## Results

### Overview of search results and included studies

The search of the databases of published papers retrieved 437 citations. Following the screening of title and abstract, a total of 111 papers were examined in full. Fifteen studies were considered eligible for inclusion and were subject to quality assessment (Figure 1). A search of the WHO clinical trial Registry produced 174 citations, with five studies meeting the inclusion criteria. The lead researchers of each of these studies were contacted, with two providing the requested data, resulting in a total of 17 included studies for the present review (A list of included studies is provided in supplementary document 1). Six studies were deemed to be of "good" quality, 10 were "fair" and one was deemed "poor" quality (Table 2). A detailed summary of each study's characteristics and the methodological assessment score is outlined in supplementary document 2. Fifteen studies were randomised controlled trials (RCTs) with pre/post evaluation. Two papers described controlled studies that were not randomised. Eleven of these studies provided adequate post intervention data for inclusion in the meta-analysis. Five RCTs included a 6-month follow-up and appropriate data for analysis. The included studies employed the following measures of resilience; Connors Davidson Resilience Scale 25-item (CDRISC) (21) Connor Davidson Resilience Scale 10-item (CDRISC_10) (24), The Resilience Scale (RS14) (42),The Dispositional Resilience Scale (DRS) (43) and The Response to Stressful Experiences Scale (RSES)(44).

There was considerable variation in the type of resilience training provided, although most involved a combination of psychoeducation, mindfulness, cognitive skills, self-compassion skills, gratitude practise, emotional regulation training, relaxation and goal setting. Two practicing psychologists reviewed the intervention descriptions of the included studies and organised them into treatment categories outlined in Table 2. Six of the studies described mixed interventions that combined mindfulness and Cognitive Behavioural Therapy (CBT) while four studies used only CBT-based interventions and two focused on mindfulness-based techniques. Training hours for interventions varied considerably and ranged from a 2-hour single session to 28 hours of training over multiple sessions. 80% of interventions were delivered via face-to-face training over multiple sessions.

**Table 2: Overview of interventions and studies included in sub-group analyses**

| Treatment Approach | Studies | Quality Summary | Included in Analysis |
|---|---|---|---|
| Mixed (Mindfulness + CBT) | Cerezo et al., (45)<br>Kahn et al.,(46)<br>Loprinizi et al., (5)<br>Sood et al., (2011) (19)<br>Sood et al., (2014)(7)<br>Mealer et al.(6) * | Fair<br>Good<br>Fair<br>Fair<br>Fair<br>Fair | N=5 Studies<br><br>*Combined Sample:*<br>Treatment (n=212)<br>Control (n = 205) |
| CBT-based | McGonagle et al.,(47)<br>Nichols et al.(31) *<br>Songprakun & McCann (48)<br>Steindhardt et al., (2015)(49)*<br>Steindhardt & Dolbier (2008)(20)<br>Yu et al., (2014) (9) | Fair<br>Good<br>Good<br>Fair<br>Fair<br>Good | N=4 Studies<br><br>*Combined Sample:*<br>Treatment (n=144)<br>Control (n = 154) |
| Mindfulness-based | Aikens et al., (50)<br>Chesak et al. (51)*<br>Erogul et al., (30)<br>Johnson et al. (52) *<br>Pigeon et al. (53)** | Good<br>Fair<br>Fair<br>Fair<br>Poor | N=2 Studies<br><br>*Combined Sample:*<br>Treatment (n=62)<br>Control (n = 62) |

* post intervention data not available and study therefore excluded from sub-group analyses,
**poor quality, excluded from analysis

## Meta-analysis

**Effects of resilience intervention programs compared to control conditions**

Figure 2 presents the SMDs of resilience levels at the completion of training and the pooled mean effect size using the random effects model (REM) for the 11 studies included in the meta-analysis. The standardized mean difference between the intervention and control groups was 0.44 (95% CI: 0.23, 0.64), reflecting a moderate positive effect favoring the intervention group. A sensitivity analysis including only those studies deemed of 'good' quality (n=5) also revealed a similar moderate positive effect size estimate (0.50, 95% CI: 0.22, 0.79).

**Effects of Mixed Interventions incorporating Mindfulness and CBT skills**

As noted above, six of the included studies tested 'Mixed' resilience interventions incorporating both Mindfulness and CBT skills. Five of these studies provided sufficient data to permit a sub-group analysis and the results are presented in figure 3. The standardized mean difference between Mixed Interventions and the control groups was 0.51 (95% CI: 0.12, 0.91), indicating a positive moderate effect.

**Effects of CBT-based resilience interventions**

Four studies providing sufficient data to permit a sub-group analysis examining the effect of CBT-based resilience interventions. The results are presented in Figure 3b. The standardized mean difference between CBT-based resilience interventions and the control groups was 0.27 (95% CI: 0.05, 0.50), indicating a small positive effect.

**Effects of Mindfulness-based resilience interventions**

Five included studies were Mindfulness based, however only two of these studies provided adequate data to permit a sub-group analysis and the results are presented in Figure 3c. The standardized mean difference between Mindfulness based interventions and the control groups was 0.46 (95% CI: 0.10, 0.82), indicating a positive moderate effect.

**Effect of resilience interventions compared to control conditions at 6-month follow-up**

Five studies reported a 6-month follow-up assessment, three of which involved Mindfulness based interventions and 2 CBT-based interventions. Two separate sub-group analyses were performed to examine the long-term effects of each intervention type. For Mindfulness based interventions, the standardized mean difference between the intervention and control groups was 0.58 (95% CI: 0.27, 0.89), which is similar to the effect size seen immediately after training. With regards to CBT-based interventions, the standardized mean difference between the intervention and control groups was 0.76 (95% CI: -0.04, 1.55), although this is based on only two studies and there was a high level of heterogeneity ($I^2$=94%, p=0.01).

**Examination for evidence of publication bias**

Visual inspection of a funnel plot of the SMD and standard error for each study revealed no suggestion of asymmetry, indicating a low likelihood of publication bias (see Supplementary Document 3). Results of the Egger's test for funnel plot asymmetry confirmed this (p=0.31).

***Figure 2: Meta-analysis examining the effect of resilience training on self-reported measures of resilience***

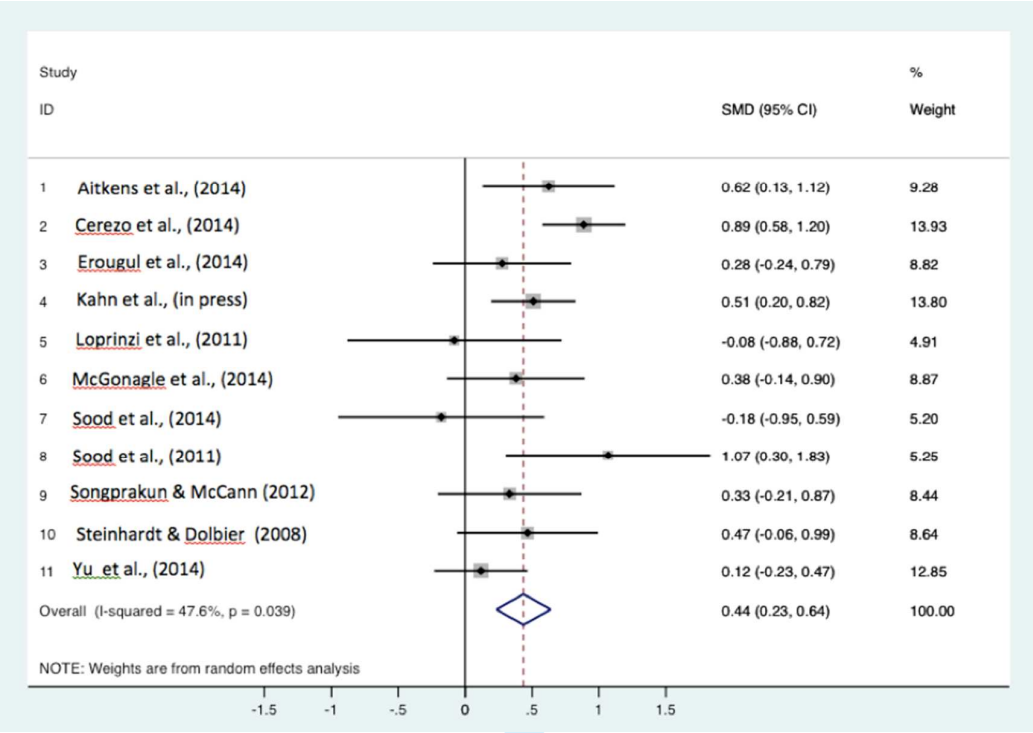
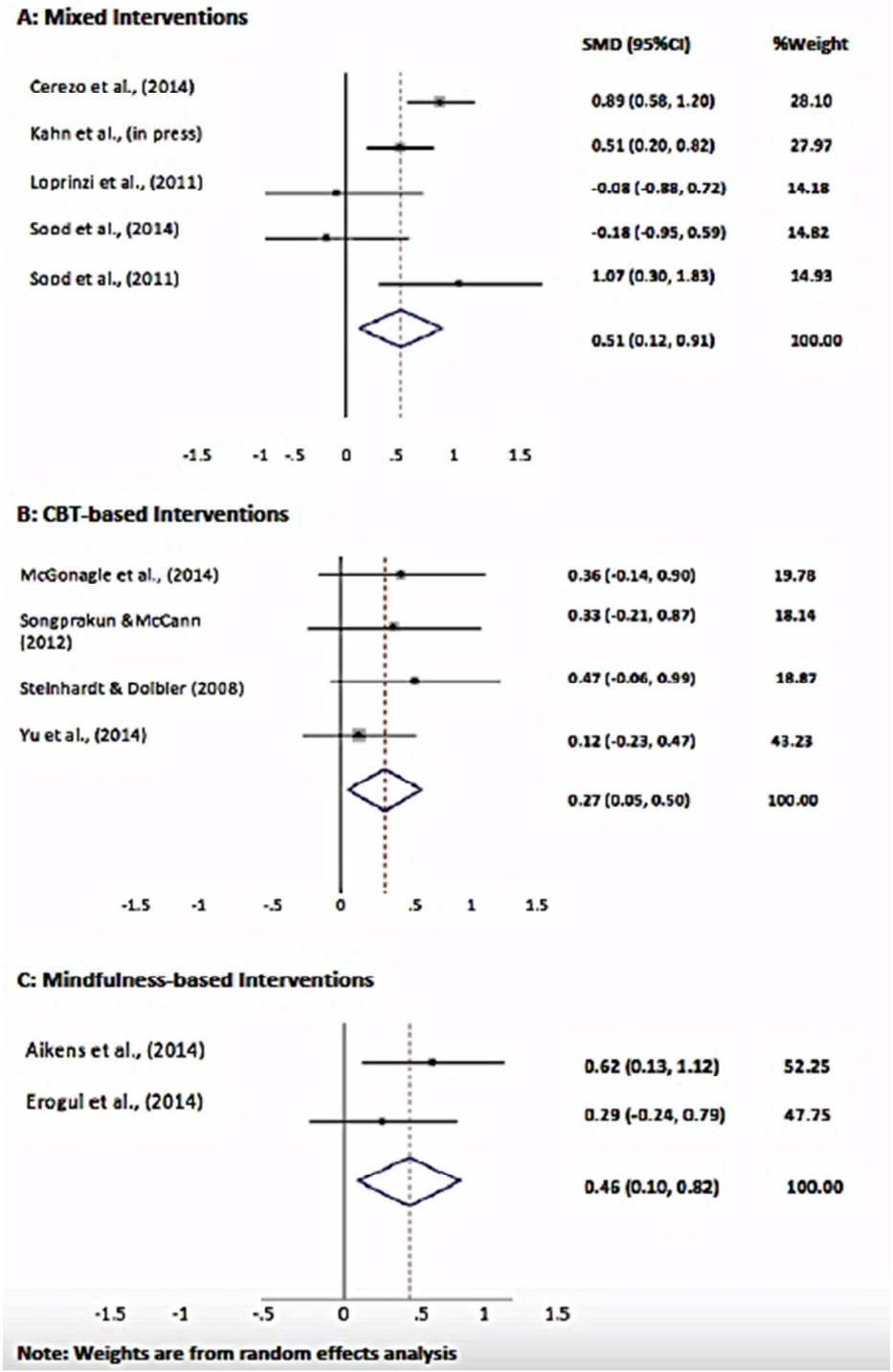


***Figure 3: Meta-analysis examining effect of resilience interventions stratified by a) Mixed Interventions, b) CBT-based interventions and c) Mindfulness-based interventions***



**Discussion**

There has been increasing interest in the concept of resilience and whether training programs can enhance individual resilience and protect overall wellbeing. To the best of our knowledge this is the first systematic review and meta-analysis focused on examining the ability of different interventions to successfully alter resilience as assessed by validated and reliable resilience measures. Our results highlight that certain types of resilience training are beneficial. In particular interventions utilizing Mindfulness or CBT techniques enhanced validated measures of resilience. There is less evidence regarding the long-term effect of resilience training but the research evidence thus far suggests that the positive impact of Mindfulness or CBT-based resilience training lasts up to 6-months.

The key strengths of the present review and meta-analysis include the detailed systematic search strategy, the inclusion of unpublished data and the quality assessment of each study's methodological rigor. Despite this, a number of important limitations require consideration. Firstly, there were relatively small sample sizes across many of the RCTs and over a third of the included studies did not provide adequate data for inclusion in the main meta-analysis. Second, none of the included studies investigated the impact of adverse situations following intervention meaning improvement in resilience was detected solely by a change in scores on resilience scales. Given the definition of resilience as the ability to bounce-back from 'adverse circumstances' (16), it is arguable that the most accurate measure of resilience would require a significant challenge or threat to the individual. When confronted with such adversity, the quality of adaptation and bounce back is more accurately assessed. However, this approach would only be feasible with certain groups (e.g. army/police/emergency workers) who regularly encounter challenging circumstances given the nature of their daily work. Moreover, if the capacity to 'bounce back' is properly assessed, established resilience measures should be ideally combined with measures of functioning or other indices of one's capacity to manage adverse circumstances. In the absence of indices of exposure to adversity and measures of functioning, the validated measures of resilience utilised in this review constitute the best available measures. Whilst we limited the present review to include only those studies which employed valid and reliable measures of resilience, it remains unclear as to whether each of these scales are capturing exactly the same construct of resilience. The majority of studies in the present review utilised a single measure of resilience. In future studies it may be advantageous to include several measures of resilience. Doing so is likely to provide clarity regarding which facets of resilience are related to psychological health and are most sensitive to change. This would also further inform the development of targeted interventions aimed at bolstering successful adaptation to significant adversity.
Finally, as with any review, there is a risk of publication biases, however the detailed search of the WHO Clinical Trial Registry for unpublished data should have reduced the probability of bias and both qualitative and quantitative tests for publication bias suggested significant bias was unlikely.

There is growing consensus that resilience is a malleable characteristic, wherein an individual's ability to adapt and 'bounce-back' effectively from adversity can be developed and enhanced. Our findings highlight the benefits of mindfulness training and cognitive and behavioural skills when taught either in isolation or as a mixed intervention. The positive benefits of such strategies as treatment interventions for established mental health conditions have been examined thoroughly in the past. Several reviews have highlighted the value of such skills when treating common mental health conditions such as anxiety and depression (54-57) and have also been associated with improving psychological and physical

health(56, 58, 59). Moreover, a large body of theoretical and clinical research over the last 30 years has seen the emergence of a third wave of evidence-based therapies (e.g. Mindfulness based Cognitive Therapy, Acceptance and Commitment Therapy, Dialectical Behavioural Therapy, Compassion Focused Therapy, Mindfulness-based Stress Reduction), many of which incorporate mindfulness as a core adaptive skill that assists a person manage difficult cognitions and emotions and have been established as effective treatments across a range of psychological conditions (59, 60).In light of these findings, it is perhaps unsurprising that the positive effect of combining mindfulness, cognitive and behavioural strategies extends to enhancing and protecting individual resilience and one's ability to adapt successfully in the face of adversity.

There was considerable variation in the type of CBT skills offered in these mixed interventions, and additional research is required to determine what combination of cognitive skills, behavior and mindfulness strategies produce the best outcomes.
It was also noted in our review that training times varied considerably across studies and ranged from two-hour single session seminars to 28 hours of multiple training sessions. The two studies that involved single session training (7, 19)had conflicting results, which precludes any insight regarding the efficacy of brief resilience training. Most interventions tended to follow the traditional group-therapy format of multiple 60-90min sessions over several weeks. This is understandable given the fact that time is typically an influential factor during any new skill acquisition including skills acquired through psychological strategies. Eighty per cent of interventions were delivered via face-to-face training, with the remaining 20% involving a mix of biblio-therapy, online webinars or phone coaching. Despite the increased popularity of resilience training in the corporate sector, the predominance of face-to-face training poses specific challenges with regards to accessibility and engagement. These limitations may result in resilience programs being costly, time consuming and in certain workplaces (e.g., those of first responders or shift workers) may also involve additional challenges and expenses such as disruption to critical services and the cost of replacement staff.

In response to these logistical challenges, there is an emerging literature examining the effectiveness of online e-health interventions, which target resilience in the workplace (50). This online approach seeks to address the issues of accessibility and engagement as well as providing a more cost-effective alternative to face-to-face training. Furthermore, the autonomy inherent in e-health programs facilitates self-paced learning and may encourage help seeking behavior. The self-guided nature of e-health programs may also address adherence rates, which can be impacted by group training due to lessened confidentiality and continued stigma around topics associated with psychology and mental health. While e-health interventions offer some potential solutions to the logistic challenges associated with effective resilience training, our review demonstrates the lack of currently available evidence regarding the effectiveness of online resilience training and highlights the needs for trials examining this possibility.

In conclusion, resilience interventions based on a combination of CBT and mindfulness techniques have a positive impact on individual resilience. This finding has wide reaching implications in terms of the role resilience training may play in the realm of public health and prevention, particularly amongst high risk groups. Additional research is warranted to help establish if these changes in self-reported resilience translate into better psychological outcomes following adversity and to test other modes of training delivery.

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**Contributors**
SJ, FS and SBH devised the study. SJ and JT carried out the systematic literature search. SJ, JT and SL extracted the data. SJ and SBH analysed and interpreted the data and SJ wrote the first draft of the manuscript. All authors read and contributed to subsequent versions, and approved the final manuscript.

**Conflict of Interest**
The authors declare that they have no competing interests.

**Data sharing statement:** The data obtained for the meta-analysis in the present review study was directly extracted from published peer-reviewed articles or via email contact with authors in the case of (Kahn et al., 2016; Yu et al., 2014 and Nichols et al., 2015).

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***Table 1. Search Strategy terms***

| Database | Search Terms |
|---|---|
| **Embase, PsyINFO, Wiley, Cochrane Library** | Resilience, Psych or resilience or resiliency *and* controlled trial *and* training and/or intervention |
| **Medline** | Resilience *and/or* resiliency *and* resilience training *and/or* resilience intervention |
| **WHO registry** | 'Resilience' |

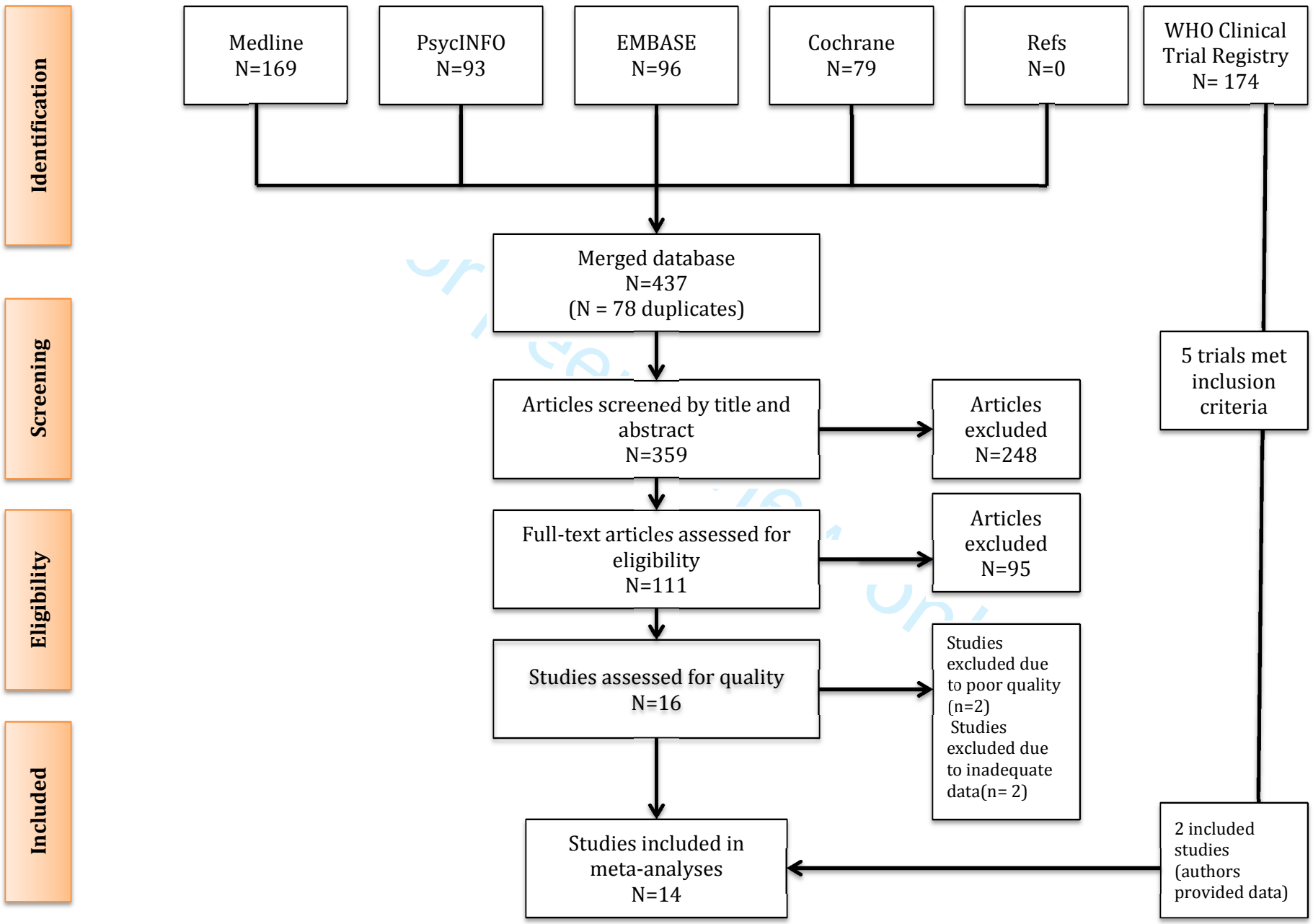

Identification
Screening
Eligibility
Included
Medline N=169
PsycINFO N=93
EMBASE N=96
Cochrane N=79
Refs N=0
WHO Clinical Trial Registry N= 174
Merged database N=437 (N = 78 duplicates)
Articles screened by title and abstract N=359
Articles excluded N=248
Full-text articles assessed for eligibility N=111
Articles excluded N=95
Studies assessed for quality N=16
Studies excluded due to poor quality (n=2)
Studies excluded due to inadequate data(n= 2)
5 trials met inclusion criteria
Studies included in meta-analyses N=14
2 included studies (authors provided data)

**Table 3: Overview of interventions and studies included in sub-group analyses**

| Treatment Approach | Studies | Included in Analysis |
|---|---|---|
| Mixed (Mindfulness + CBT) | Cerezo et al.,<br>Kahn et al.,<br>Loprinizi et al.,<br>Sood et al., (2014)<br>Sood et al., (2011)<br>Mealer et al.,* | N=5 Studies<br><br>*Combined Sample:*<br>Treatment (n=212)<br>Control (n = 205) |
| CBT-based | McGonagle et al.,<br>Nichols et al., *<br>Songprakun & McCann<br>Steindhart et al., (2015)*<br>Steindhart & Dolbier (2008)<br>Yu et al., (2014) | N=4 Studies<br><br>*Combined Sample:*<br>Treatment (n=144)<br>Control (n = 154) |
| Mindfulness-based | Aikens et al.,<br>Chesak et al.*<br>Erogul et al.,<br>Johnson et al.,*<br>Pigeon et al.,** | N=2 Studies<br><br>*Combined Sample:*<br>Treatment (n=62)<br>Control (n = 62) |

* post intervention data not available,
**poor quality, excluded

***Figure 2: Meta-analysis examining the effect of resilience training on self-reported measures of resilience***

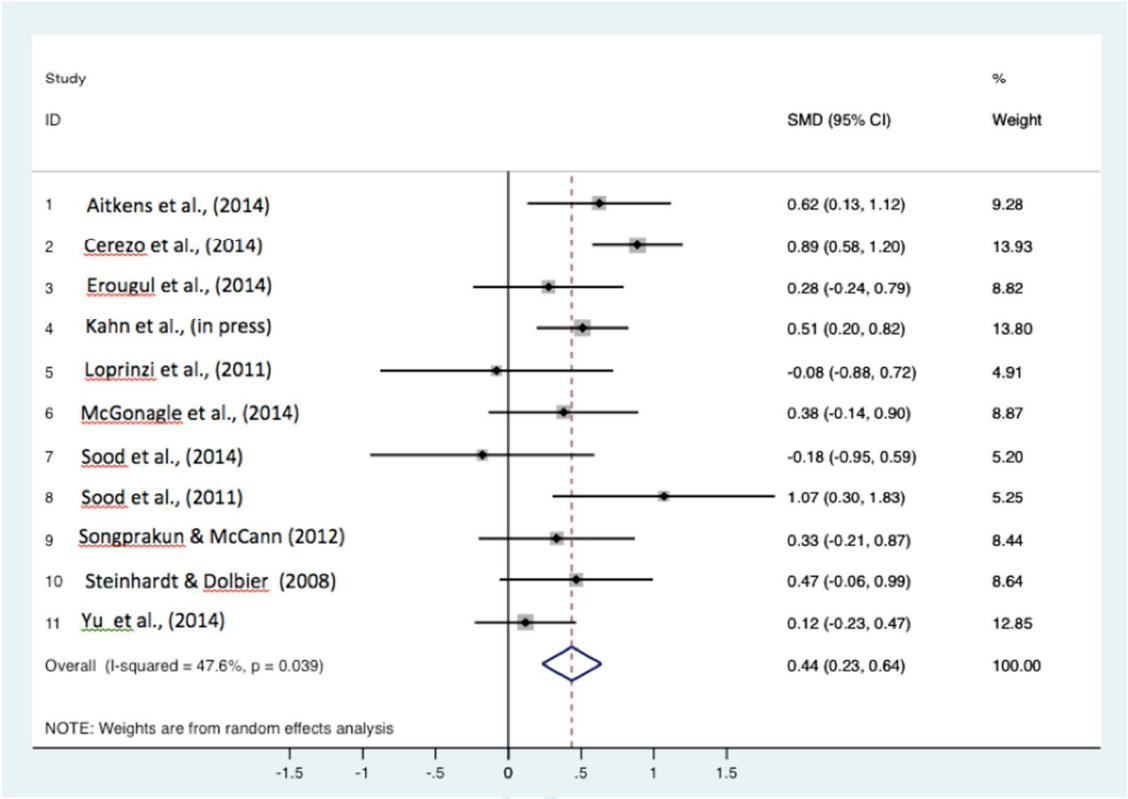
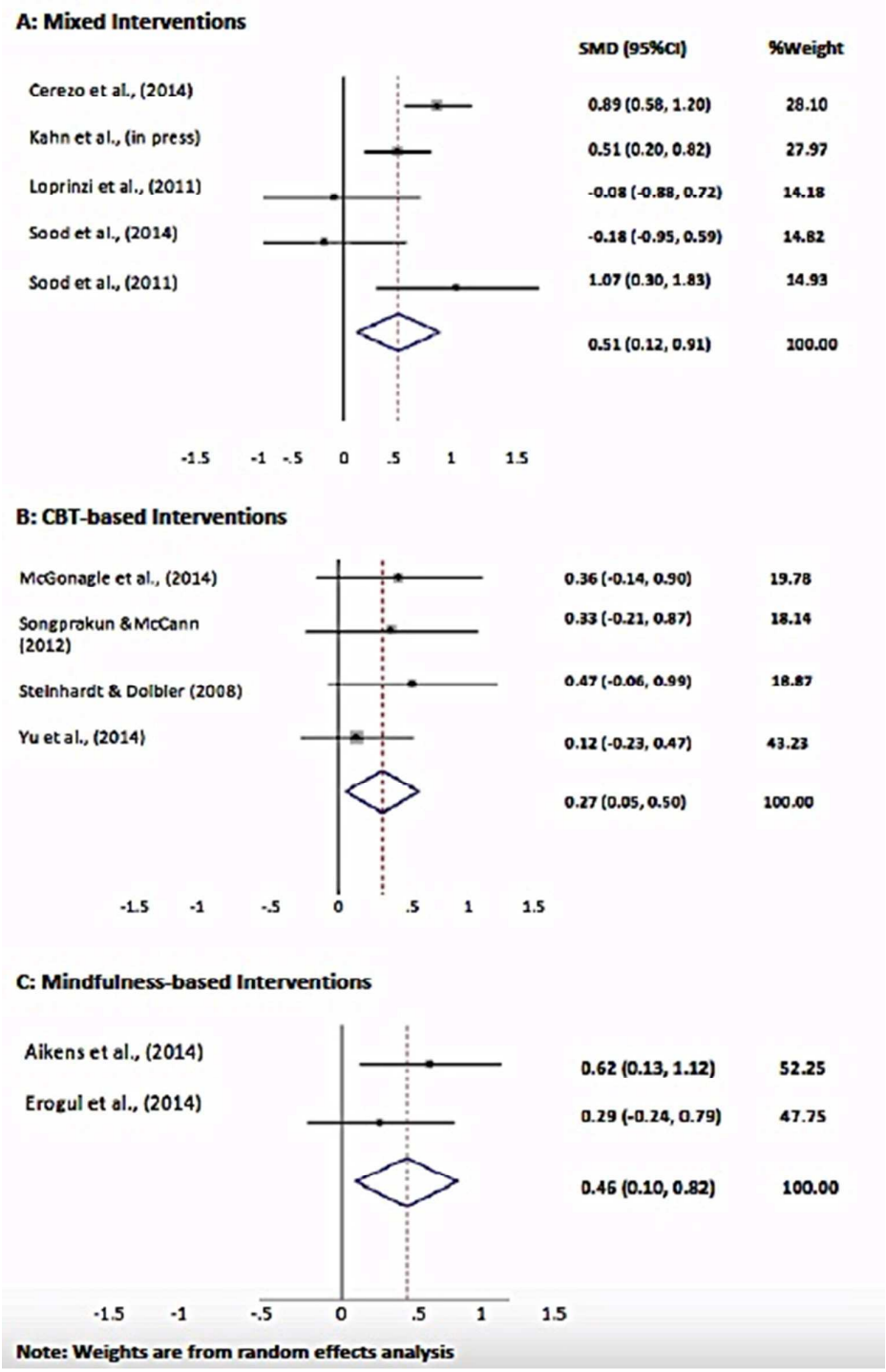


***Figure 3: Meta-analysis examining effect of resilience interventions stratified by a) Mixed Interventions, b) CBT-based interventions and c) Mindfulness-based interventions***



**References of studies included in Systematic Review and Meta-analysis**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## Supplementary Table 1: Overview of study characteristics

| Author + Year | Setting & Population | Participants | Design | Intervention | Control Group | Evidence of Effectiveness | Valid Resilience Scale | Quality Ax Score |
|---|---|---|---|---|---|---|---|---|
| **Aikens et al., (2014) USA** (42) | Full-time employees at The Dow Chemical Company | N = 66<br><br>Age range: (18 – 65)<br><br>Intervention Group: (n=34)<br><br>Control Group: (n=32) | RCT with pre/post evaluation + 6-month follow-up | 7-week mindfulness based program combining live, weekly 1hr-long virtual class meetings with accompanying online applied training via program website and workbook. Intervention based on Mindfulness based Stress Reduction (MBSR) and involved mindfulness and focusing techniques, education material on mindfulness and daily at home practise. | Y: Wait List<br><br>Received the equivalent mindfulness program immediately following intervention group completion. | Y | CD-RISC | **20 (Good)** |
| **Cerezo et al., (2014) SPAIN** (43) | Breast Cancer Patients | N= 175<br><br>Intervention Group: (n =87) (Mean age: 49.3 SD: 9.8)<br><br>Control Group: (n=88) (Mean age: 50.7, SD: 9.4)<br><br>100% Female | RCT with pre/post evaluation | 14 X 2hrs Group Sessions: 1 Session per week. Intervention based on positive psychology incorporating psychoeducation, emotional regulation training, coping strategies, cognitive restructuring role play, gratitude techniques, mindfulness strategies, relaxation, meditation and guided imagery techniques. | Y: Wait List | Y | CD-RISC | **20 (Good)** |
| **Chesak et al., (2015) USA** (44) | Registered Nurses enrolled in a nurse orientation class at Mayo Clinic, USA | Total N = 40 Intervention Group:(n=19) (Mean age: 27.9, SD: 7.1) Control Group: (n=21) Mean age: 28.4, SD:9.4 95% Female | RCT pilot study,<br><br>baseline & 3 month follow-up | 90 min session focusing on the neuroscience of resilience & stress and mind/body approaches to manage stress (mindfulness, compassion, acceptance skills, purpose and gratitude practise). 1 hr. follow-up session to address questions Biweekly handouts on each of the topics via email | Y: Wait List | N | CD-RISC | **16**<br><br>**(Fair)** |
| **Erogul et al., (2014)** (30) | 1st year Medical Students | Total N = 58 Intervention Group =(n= 28)Mean age: 23.6, SD: 1.9 Control Group = | RCT Baseline, post-treatment (8-weeks) & 6 month follow | 8 week Mindfulness Intervention based on Mindfulness Based Stress Reduction (MBSR). 1 X 75 min session per week + 1 X 5 hrs Retreat | Y: Wait List | N | RS -14 | **17 (Fair)** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (n=30),Mean age: 23.3, SD: 1.4 | up. | | | | | |
| **Author + Year** | **Setting** | **Participants** | **Design** | **Intervention** | **Control Group** | **Evidence of Effectiveness** | **Valid Resilience Scale** | **Quality Ax Score** |
| **Johnson et al., (2014) USA** (45) | Marines Receiving training at the Marine Corp Base Camp CA, USA | Total N = 281<br><br>Intervention Group:(n=147)<br>Mean age: 21.7<br>SD: 2.6<br><br>Control Group: (n=134)<br>Mean age: 21.4<br>SD: 2.5 | CT (baseline, Pre/Post and 1 week follow-up) | 20 hours of Mindfulness Based Mind Fitness Training. 8 X 2hr weekly sessions. 1 X 4hr workshop with a longer session of silent practise to refine mindfulness skills 30mins of mindfulness and self-regulation exercises across several practise periods each day.<br><br>Content focused on relationship between mindfulness, military stress inoculation and complex decision-making. Program emphasizes understanding the stress response and attention control and tolerance for challenging experiences both external (harsh environmental conditions) and internal (e.g. physical pain, intense emotions, distressing thoughts) | Y: Standard pre-deployment training as usual | Y | RSES | **19 (Fair)** |
| **Kahn et al.,(2016) USA** (46) | USA Armed Services Veterans and their partners | Total N = 320<br><br>Intervention Group = (80)<br><br>Attention Control Group = (80)<br><br>Intervention + Attention Control Group = (80)<br><br>Wait List Control Group = (80)<br>32% of veterans still in service<br>68% retired.<br>Veterans had on | 4-arm RCT Pre/Post: Baseline, half-way (8 weeks) and 16 weeks. | Mission Reconnect: 16-week self-directed online program involving mind and body based wellness skills. Founded on the biopsychosocial model of health, mindfulness based therapies; massage therapy, positive emotions and caregiver education. Delivered via program website and utilises audio exercises, videos and written material. | Y:<br>1) Attention Control: (PREP) – widely used evidence based (CBT) post-deployment reintegration program for relationship enhancement. Facilitated via weekend treatments by trained Army | Y | RSES | **20 (Good)** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | average served 2 deployments. | | | Chaplains.<br><br>2) Wait List Control Group. | | | |
| **Author + Year** | **Setting** | **Participants** | **Design** | **Intervention** | **Control Group** | **Evidence of Effectiveness** | **Valid Resilience Scale** | **Quality Ax Score** |
| **Loprinzi et al., (2011) USA** (5) | Breast Cancer survivors and mentors at Mayo Clinic, USA | Total N = 24<br>Age range:(46-75)<br><br>Intervention Group: (n=12)<br><br>Control Group: (n=12) | RCT pilot study<br><br>Pre/post evaluation | 2 x 90-mins group training sessions, a brief individual session and 3 x follow-up telephone calls.<br><br>(Based on Attention and Interpretation Therapy (AIT), relaxation, attention training, as well as skills cultivating compassion, gratitude, forgiveness, acceptance and purpose). | Y: Wait List | Y | CD-RISC | **16 (Fair)** |
| **McGonagle et al., (2014**) (47) | Full time workers with chronic illnesses | N = 59<br><br>Intervention Group:(n=30) (Mean age: 38.3, SD: 8.2)<br><br>Control Group: (n=29) (Mean age:39.1 (SD: 7.8)<br><br>86% Female<br>14% Male | RCT with Pre/Post evaluation and 12 week follow-up | 6 x 1hr phone-based coaching sessions delivered fortnightly over a 12 week period.<br><br>Intervention based on stress theory and resource activation and the GROW model of coaching. Sessions aimed to help boost workers' level of internal resources to help manage stress related to working with chronic illness. Each session was tailored to the needs and goals of the individual. | Y: Waitlist Control | Y | CD-RISC10 | **18 (Fair)** |
| **Mealer et al., (2014) USA** (48) | Nurses based in ICU (Intensive Care Unit) USA | N = 27<br>Age range not provided.<br><br>Intervention Group =<br>(n = 13)<br><br>Control Group = (n = 14)<br><br>Mean age: | RCT<br><br>Pre/Post evaluation | multifaceted resilience training program based on psycho-education on stress, self-care, cognitive Behavioural therapy topics, Mindfulness based Stress Reduction (MBSR), Pennebaker's expressive writing framework.<br><br>2-Day educational workshop followed by 12 weeks of written exposure sessions (via email), event-triggered counseling sessions, mindfulness-based stress reduction exercises, aerobic exercise | Y: Control group were asked to enter amount of time spent exercising per week into an online database. No other activity | Uncertain: due to change in resilience in Control Group | CD-RISC | **18**<br><br>**(Fair)** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 92%Female<br>8% Male | | regimen. | involved. | | | |
| **Author + Year** | **Setting** | **Participants** | **Design** | **Intervention** | **Control Group** | **Evidence of Effectiveness** | **Valid Resilience Scale** | **Quality Ax Score** |
| **Nichols et al., (2015)**( 31) | Spouses and significant others of USA Army members who were at least 1 month post-deployment in Iraq or Afghanistan | N = 228<br><br>Intervention Group = (n =76)<br><br>Attentional Control Group = (n= 76)<br><br>Usual Care Control Group (n =75 ) | 3-arm RCT<br><br>Pre/Post evaluation with 6 month and 12 month follow-up | *READI* (Resilience Education & Deployment Information) ~ Based on Lazarus Stress Model and focused on skills building for reintegration, involved strengthening psychosocial resources, assertiveness, relaxation techniques, cognitive restructuring, intrapersonal coping strategies.<br>Delivered via telephone support groups, 2 x 1 hour sessions per month over a 6 month period. | Y: 2 Control groups<br><br>Attentional Control Group: Received Educational Webinars. 12 X ½ hr education sessions on same topics as treatment group. Received same workbook but no interaction support and no skills building included.<br><br>Usual Care Control Group: at end of study received offer of workbook and workshop covering topics targeted to individual needs. | N<br><br>*Trend towards sig. among participants who completed min. of 6 sessions.* | CD-RISC | **21 (Good)** |

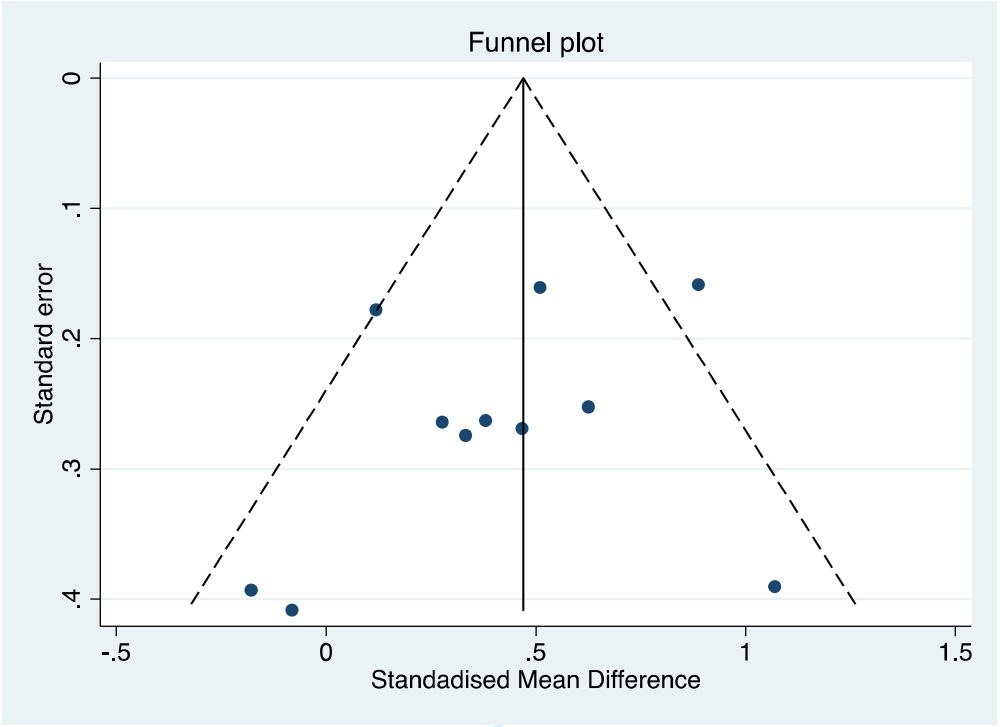
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Pidgeon et al., (2014) AUSTRALIA**(49) | Human Services Personnel working with disadvantaged youth | N = 25<br><br>Intervention Group : (n=14)<br><br>Control Group: (n = 21)<br><br>(Mean age: 40.7, SD: 12.3)<br>91% Females<br>9% Males | RCT<br>Pre-post evaluation + 1 month & 4 month follow-up | Retreat format : 2.5 Days training in mindfulness and metta skills, cognitive therapy strategies to increase mindfulness and self-compassion<br><br>2 X (4 hour) booster sessions over 12 week period : review of mindfulness practise , metta and cognitive strategies. | Y | N | RS-14 | **14**<br><br>**(Poor)** |
| **Author + Year** | **Setting** | **Participants** | **Design** | **Intervention** | **Control Group** | **Evidence of Effectiveness** | **Valid Resilience Scale** | **Quality Ax Score** |
| **Songprakun & McCann (2012) THAILAND** (50) | Outpatients with a diagnosis of moderate depression attending clinics at Suan Prung Psychiatric Hospital, Chiang Mai Province. | N = 54<br><br>Intervention Group: (n = 26)<br><br>Control Group: (n= 28)<br><br>(Mean age: 42.1, SD:9.7)<br><br>73% Female<br>27% Male | RCT with pre-post evaluation (8 weeks) + 3 month follow-up | 8 week bibliotherapy intervention incorporating a self-help manual and workbook developed by Lifeline South Coast, Australia (Good Mood Guide: A self-help manual for depression).<br><br>Participants competed 1 module per week over 2 month period.<br>Involved between session activities including reading, questionnaires, and homework exercises.<br>The manual was based on established principles of cognitive behavioural therapy (CBT) and self-help techniques and practises. | Y: Standard care and treatment + 1 weekly 5 minute phone call from the researcher to answer questions and provide brief support | Y | RS | **21 (Good)** |
| **Sood et al., (2011) USA** (19) | Physicians at Mayo Clinic, USA | N = 32<br>Intervention group: (n=20)<br>(Mean age: 46.8 SD: 8.3)<br>55%male, 45%female<br><br>Control Group: | RCT pilot study<br><br>Pre/post evaluation | Single 90 minute training session covering a range of resilience enhancing approaches.<br>Based on Attention and Interpretation Therapy (AIT), relaxation, attention training, as well as skills cultivating compassion, gratitude, forgiveness, acceptance and purpose.<br>Also included brief training in a daily | Y: Wait List | Y | CD-RISC | **17**<br><br>**(Fair)** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (n=12), (Mean age: 50.2 SD: 5.7) 50% male, 50% female | | meditation practise.Optional 30-60 follow-up session depending on individual needs. | | | | |
| **Sood et al., (2014) USA** (7) | Radiologists, Department of Radiology Mayo Clinic, USA | N = 26 Intervention group: (n=13) (Mean age: 47.4, SD: 8.8) 55%male, 45%female Control group: (n=13) (Mean age: 48.1, SD: 5.2), 50% male, 50% female | RCT pilot study<br><br>Pre/post Evaluation | Single 90 minute session aimed at decreasing personal stress and enhancing resiliency. Based on Attention and Interpretation Therapy (AIT), relaxation, attention training, as well as skills cultivating compassion, gratitude, forgiveness, acceptance and purpose. Also included brief training in a daily meditation practise. optional 30-60 follow-up session depending on individual needs. | Y: Wait List | N | CD-RISC | **17**<br><br>**(Fair)** |
| **Author + Year** | **Setting** | **Participants** | **Design** | **Intervention** | **Control Group** | **Evidence of Effectiveness** | **Valid Resilience Scale** | **Quality Ax Score** |
| **Steinhardt & Dolbier (2008) USA** (20) | Students enrolled at University *(during a period of high academic stress)* | N= 57<br><br>Intervention group: (n= 30)<br><br>Control group: (n= 27), 82% female 18% male median age: 21 years | RCT pilot study<br><br>Pre/post evaluation | 4 X 2 hour weekly sessions intervention to improve resilience, coping strategies and protective factors by focusing on cognitive behavioural strategies, social support and psychoeducation. | Y: Wait List | Y | CD-RISC & DRS | **17**<br><br>**(Fair)** |
| **Steinhardt et al., (2015) USA** (51) | African-American Type 2- Diabetes Patients | Total N=61 Intervention group: (n= 30) (64% Female, 36% Male) Control group: (n= 31) (81%Female, 19% Male) | CT | Group sessions delivered a Resilience – based diabetes self-management education program. Behavioural change protocol involving resilience and coping strategies with standard skills to effectively manage diabetes both physiologically and physiologically. | Y: Control group received standard Diabetes self-management and education training. | N | CD-RISC | **18 (Fair)** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (Mean age: 62, SD:10.3) | | | | | | |
| **Yu et al., (2013) CHINA** (52) | New immigrants relocating to Hong Kong (China) | N=183 Intervention group: (n= 58) (95% female. Mean age: 32.9, SD: 4.4) Comparison group: (n= 83) (97% female. Mean age: 31.9, SD: 4.6) Control group = 70 (95% female, Mean age: 33.8, SD: 5.5) | RCT pilot<br><br>Pre/post evaluation + 3 month follow-up | Program involved 4 x 2.5hrs weekly sessions over 4 consecutive weeks. Aimed to build personal resiliency and reduce adaptation difficulties. Skills: developing self-efficacy, positive thinking, positive reframing, and altruistic behavior and goal setting. Based on intervention and local evidence about positive characteristics that promote successful immigration. | Y: Control received 16-page informational booklet relevant to education, medical care, housing, employment and community resources. | Y | CD-RISC | **22**<br><br>**(Good)** |

RCT = Randomised Controlled Trial, CT = Controlled Trial, CD-RISC = Connors Davidson Resilience Scale, DRS = Dispositional Resilience Scale, RSES= Response to Stressful Experiences Scale, RS-14 = The Resilience Scale

Supplementary *Figure 1: Funnel plot examining for evidence of publication bias.*



# PRISMA 2009 Checklist

| Section/topic | # | Checklist item | Reported on page # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | 1 |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | 2 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 4-5 |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 5 |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | NA |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 5-6 |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 5,6,7 |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | 6 |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 6 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 6-7 |
| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 7 |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | 7 |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | 7 |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$) for each meta-analysis. | 7 |

# PRISMA 2009 Checklist



| Section/topic | # | Checklist item | Reported on page # |
|---|---|---|---|
| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | 7, 10 |
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | 7 |
| **RESULTS** | | | |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | 8 |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | 9 |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | 10 |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | 11 |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | 10, 11 |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | 10 |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | 12 |
| **DISCUSSION** | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 13 |
| Limitations | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 13 |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 13-14 |
| **FUNDING** | | | |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | 15 |

*From:* Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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BMJ Open

# The road to resilience: a systematic review and meta-analysis of resilience training programs and interventions.

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| | |

# The road to resilience: a systematic review and meta-analysis of resilience training programs and interventions

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## Abstract

**Objectives**: To synthesise the available evidence on interventions designed to improve individual resilience.

**Design**: A systematic review and meta-analysis

**Methods:** The following electronic databases were searched: Ovid Medline, Ovid EMBASE, PsycINFO, Ovid Cochrane and WHO Clinical Trials Registry in order to identify any controlled trials or randomised controlled trials (RCTs) examining the efficacy of interventions aimed at improving psychological resilience. Pooled effects sizes were calculated utilizing the random effects model of meta-analysis.

**Outcome measures**: Valid and reliable measures of psychological resilience.

**Results**: Overall, 437 citations were retrieved and 111 peer-reviewed articles were examined in full. Seventeen studies met the inclusion criteria and were subject to a quality assessment, with 11 RCTs being included in the final meta-analysis. Programs were stratified into one of three categories 1) Cognitive Behavioural Therapy (CBT)-based interventions, 2) Mindfulness based interventions or 3) Mixed Interventions, those combining CBT and Mindfulness training. A meta-analysis found a moderate positive effect of resilience interventions (0.44 (95% CI: 0.23, 0.64) with subgroup analysis suggesting CBT-based, mindfulness and mixed interventions were effective.

**Conclusions**: Resilience interventions based on a combination of CBT and mindfulness techniques appear to have a positive impact on individual resilience.

**Key words: resilience; resilience training; mindfulness; cognitive behavioural therapy.**

**Word count (excluding abstract, tables, figures and references): 3799**

**Strengths and limitations of this review and meta-analysis:**

- We employed a systematic strategy to search for the best quality evidence of effectiveness in resilience interventions and assessed the methodological rigor of each included study.
- We completed a priori planned sub-analyses to provide further insight regarding the effectiveness of different types of resilience training.
- There were relatively small sample sizes across many of the RCTs and over a third of the included studies did not provide adequate data for inclusion in the main meta-analysis.
- None of the included studies investigated the impact of adverse situations following intervention meaning improvement in resilience was detected solely by a change in scores on self-report resilience scales.
- There was not a prospectively published protocol for the systematic search and non-English articles were excluded

## Introduction

Managing the ups and downs of daily life requires resilience. Given the impact of stress-related illness on global economies, resilience is not only a topic of immense personal and familial importance but also has major social and financial significance (1-3). To meet this challenge, research is increasingly focusing on what constitutes resilience and how it can be developed or enhanced. Resilience is a multifaceted phenomenon, which is influenced by the presence or absence of various resilience-promoting resources(4). When such resources are cultivated they enhance a person's overall ability to effectively cope with heightened stress and adverse life circumstances (4-9)

Definitions of resilience are diverse and plentiful. Some researchers have described it as the ability to adapt positively to stressful circumstances (10), while others have defined resilience as being able to remain functionally stable and well despite ongoing stress(11). The American Psychological Society (APA) define resilience as a process of "bouncing back" from difficult experiences and "adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress"(12) . This definition captures the "bounce-back" characteristic, which a number of researchers have proposed as being one of the central qualities of resilience (4, 13). In this way resilience can be viewed as being on a continuum ranging from low (poor bounce-back ability) to high (strong capacity to recover) and extremely high, which in the literature has been termed "thriving" and reflects a person's ability to reach a superior level of functioning following an adverse or stressful event (13, 14).

Higher self-reported resilience has been associated with lower levels of anxiety, psychological distress and mixed anxiety/depression(5, 15-17). Researchers have also found that resilience, as measured by various self-report tools, has a mitigating effect on depression symptoms among individuals who have experienced trauma in both childhood and later life (18-21), as well as among patients experiencing severe health conditions(22). Together these studies suggest that the measurable components of individual resilience may play an important protective role in easing the negative effects of stress, trauma and adversity.

Several studies have examined the benefits of resilience training amongst various specific groups, including intensive care nurses, college students, cancer survivors, youth workers, radiologists, immigrants, physicians, military officers and general office workers (4-9). While the training programs typically share the common aim of enhancing resilience or resilience resources, they tend to differ greatly in terms of content, delivery and length. An important limitation in the resilience literature is aptly noted by Leppin and colleagues (2014) who observe that "no single accepted theoretical framework or consensus statement exists to guide the development or application of these programs"(23). In spite of these concerns, a number of recent reviews have highlighted the growing body of research supporting the benefits of resilience training for mental health and wellbeing (23-25). Whilst research highlighting the relationship between resilience and psychological wellbeing is vital, it is important to note that resilience cannot simply be measured via psychometric tools examining wellbeing and mental health symptomology. A training program may enhance and improve mental health symptoms, yet not improve a person's overall psychological resilience or vice versa (26, 27). Moreover, in groups where people are 'mentally healthy' other measures are needed to examine the efficacy of resilience programs beyond simple wellbeing outcomes. Given these concerns, when appraising the evidence for resilience training, it is crucial to consider how resilience as an outcome is measured. A recent review analysed the validity and reliability of various

resilience measures currently in use, and concluded that while there are a number of valid and reliable measures of resilience, at present there was no gold standard measure (28).

The main aim of the present systematic review and meta-analysis is to synthesize the available research evidence on the effectiveness of interventions designed to promote or enhance individual resilience.

# Methods

## Search Strategy

A systematic search was carried out in accordance with the PRISMA guidelines (29). In June 2016 the following electronic databases were searched: Ovid Medline, Ovid EMBASE, PsycINFO, and Ovid Cochrane Library. Search items, summarized in Table 1, included: "resilience", "resilience training" or "resilience intervention". An example of the full search strategy for one database is provided in Supplementary File 1. No time restrictions were placed on the search strategy, with all published articles up to June 2016 considered. The references of each included paper were also searched for relevant resilience intervention studies. Additionally, in order to reduce the risk of publication bias, in July 2016 we searched the World Health Organisation (WHO) Clinical Trials Registry using the term "resilience" to identify any trials that had not published their findings.

***Table 1. Search Strategy terms***

| **Database** | **Search Terms** |
|---|---|
| **Embase, PsycINFO, Wiley, Cochrane Library** | Resilience, Psych or resilience or resiliency *and* controlled trial *and* training and/or intervention |
| **Medline** | Resilience *and/or* resiliency *and* resilience training *and/or* resilience intervention |
| **WHO registry** | 'Resilience' |

## Eligibility Criteria

Eligible studies were randomised controlled trials or controlled trials assessing the efficacy of any program designed to develop, enhance or improve resilience in adults. Studies had to describe a specific aim to improve resilience and employ an acceptable measure of resilience as one of the outcome measures. It was decided a priori that in order to be an acceptable measure of resilience, the outcome measure used had to meet two criteria. Firstly, the measure had to assess an individual's ability to adapt to change and cope effectively with significant life adversity. Secondly, the measure had to have undergone some type of validity assessment. A recent review has systematically reviewed the psychometric rigor of resilience measurement scales developed for use in general and clinical populations (28). This concluded that there is currently no gold standard measure of resilience (28), which makes assessing criterion validity of various measures difficult. In keeping with the conclusions of this review (28) the following three measures of resilience were agreed a priori to have met both of our defined criteria; The Connors and Davidson Resilience Scale, The Brief Resilience Scale and The 14-item Resilience Scale. If studies were identified that employed other measures of resilience, these were closely examined in terms of the construct that was measured and the degree to which it had been validated against other recognized outcomes. No restrictions

were made based on the type of comparator used and length of follow up. Studies that only evaluated the implementation or receptivity of a resilience program were excluded. Non-English publications and studies that exclusively utilised wellbeing or mental health outcomes as the main measure of resilience were also excluded.

## Study Selection

Two researchers (SJ and JT) worked independently to initially screen the titles and abstracts retrieved by the literature. Following the initial screening, relevant papers were retrieved in full text and specific inclusion criteria were utilised to identify eligible studies. Discrepancies between the researchers' selection results, which were infrequent, were discussed with a third researcher (SBH) until consensus on inclusion or exclusion was reached.

## Quality Assessment

Methodological quality of each included study was assessed using the Downs and Black Checklist (30). Minor modifications were made to the tool for use in this review. In line with previous studies (31-33), the scoring for question 27 on statistical power was simplified to either zero or one, based on whether or not there was sufficient power in the study to detect a clinically significant effect (i.e., studies reporting power of less than 0.80 with alpha at 0.05 obtained a zero score). The maximum score for the modified checklist was 28 with all individual items rated as either yes (=1) or no/unable to determine (= 0), with the exception of item 5, "Are the distributions of principals confounders in each group of subjects to be compared clearly described?" in which responses were rated as yes (=2), partially (=1) and no (=0). Scores were grouped into four categories based on ranges: Excellent (26 to 28), good (20 to 25), fair (15 to 19) and poor (14 and less). Studies with an overall "poor" quality assessment were excluded from the final review.

### Data extraction and contact with researchers

Data from each study was extracted by the lead author (SJ). Where additional information was required for effect size calculations the study's lead researchers were contacted. Contact details were obtained through the correspondence addresses provided on the study's publication. At times, website searches were also performed to ensure that contact details were still valid and in use. Researchers were contacted by email and non-responders were sent two follow-up emails at fortnightly intervals.

Two authors (SJ and SL), both of who are practicing psychologists, reviewed the available information to determine whether the intervention being tested in each study was primarily based on cognitive behavioural therapy or mindfulness principles, or a combination of both. Most studies provided a detailed description of the theoretical basis of their interventions and examples of the content, which made this classification possible. If required, additional clarification was sought from the corresponding author.

### Data synthesis/statistical analysis

The meta-analyses were performed using the statistical software package STATA, version 12.1. The main outcomes of interest in each study was the measure of psychological resilience. As studies utilised various measures of resilience, the effect size was represented by the standardized mean difference (SMD), which was computed by subtracting the average score of the control group from that of the intervention group, and dividing the result by the pooled standard deviations. The pooled mean effect sizes were expressed as SMD with 95% confidence intervals (95% CI). Some heterogeneity was anticipated given the varying populations and interventions employed across included studies. Therefore pooled effect size estimates were calculated utilizing the random effects model of analysis using the method of

DerSimonian and Laird (34). In addition, the $I^2$ statistic was reported to determine the level and impact of heterogeneity and the percentage of outcome variability, which may result from heterogeneity present across studies. Two sub group meta-analyses were planned *a priori.* Firstly, in order to examine the evidence base for different types of resilience training, sub group analyses were planned for training based on Cognitive Behavioural Therapy (CBT) skills, Mindfulness-training and a combination of both. Secondly, a planned sub analysis examined studies that provided 6-month follow-up data to determine the longer-term effects of different types of resilience training. Publication biases were examined through visual inspection of a funnel plot with the SMD plotted against the SMD standard error and quantitatively through Egger's test for small study effects.

**Patient and public involvement**

The develop of the research question being addressed by this study was informed by consultations with a range of policy markers and industry groups, who expressed a keen interest in understanding if resilience training can work. Patients were not directly involved in the conduct of the analysis.

## Results

### Overview of search results and included studies

The search of the databases of published papers retrieved 437 citations. Following the screening of title and abstract, a total of 111 papers were examined in full. Ninety six papers were excluded as they did not meet the inclusion criteria. Thus, fifteen studies were considered eligible for inclusion and were subject to quality assessment (Figure 1). A search of the WHO Clinical Trial Registry produced 174 citations, with five studies meeting the inclusion criteria. The lead researchers of each of these studies were contacted, with two providing the requested data. These two papers were combined with the 15 published studies obtained to result in a total of 17 included studies for the present review. Six studies were deemed to be of "good" quality, 10 were "fair" and one was deemed "poor" quality. The quality rating for each study and a detailed summary of each study's characteristics including the control condition is outlined in Supplementary Table 1. Fifteen studies were randomised controlled trials (RCTs) with pre/post evaluation. Two papers described controlled studies that were not randomised. Eleven of these studies (all of which were RCTs) provided adequate post intervention data for inclusion in the meta-analysis. Of these, all but two used a wait list as the control condition. Five RCTs included a 6-month follow-up and appropriate data for analysis. The included studies employed the following measures of resilience; Connors Davidson Resilience Scale 25-item (CDRISC) (17) Connor Davidson Resilience Scale 10-item (CDRISC_10) (20), The Resilience Scale (RS14) (35),The Dispositional Resilience Scale (DRS) (36) and The Response to Stressful Experiences Scale (RSES)(37).

There was considerable variation in the type of resilience training provided, although most involved a combination of psychoeducation, mindfulness, cognitive skills, self-compassion skills, gratitude practise, emotional regulation training, relaxation and goal setting. As outlined in Table 2, six of the studies described mixed interventions that combined mindfulness and Cognitive Behavioural Therapy (CBT) while four studies used only CBT-based interventions and two focused on mindfulness-based techniques. Training hours for interventions varied considerably and ranged from a 2-hour single session to 28 hours of training over multiple sessions. 80% of interventions were delivered via face-to-face training over multiple sessions.

**Table 2: Overview of interventions and studies included in sub-group analyses**

| Treatment Approach | Studies | Quality Summary | Included in Analysis |
|---|---|---|---|
| Mixed (Mindfulness + CBT) | Cerezo et al., (38)<br>Kahn et al.,(39)<br>Loprinizi et al., (5)<br>Sood et al., (2011) (15)<br>Sood et al., (2014)(7)<br>Mealer et al.(6) * | Fair<br>Good<br>Fair<br>Fair<br>Fair<br>Fair | N=5 Studies<br><br>*Combined Sample:*<br>Treatment (n=212)<br>Control (n = 205) |
| CBT-based | McGonagle et al.,(40)<br>Nichols et al.(27) *<br>Songprakun & McCann (41)<br>Steindhardt et al., (2015)(42)*<br>Steindhardt & Dolbier (2008)(16)<br>Yu et al., (2014) (9) | Fair<br>Good<br>Good<br>Fair<br>Fair<br>Good | N=4 Studies<br><br>*Combined Sample:*<br>Treatment (n=144)<br>Control (n = 154) |
| Mindfulness-based | Aikens et al., (43)<br>Chesak et al. (44)*<br>Erogul et al., (26)<br>Johnson et al. (45) *<br>Pigeon et al. (46)** | Good<br>Fair<br>Fair<br>Fair<br>Poor | N=2 Studies<br><br>*Combined Sample:*<br>Treatment (n=62)<br>Control (n = 62) |

* post intervention data not available and study therefore excluded from sub-group analyses,
**poor quality, excluded from analysis

## Meta-analysis

### Effects of resilience intervention programs compared to control conditions

Figure 2 presents the SMDs of resilience levels at the completion of training and the pooled mean effect size using the random effects model (REM) for the 11 studies included in the meta-analysis. While only four of the 11 studies indicated a statistically significant effect of the interventions, the estimated pooled standardized mean difference between the intervention and control groups was 0.44 (95% CI: 0.23, 0.64), reflecting a moderate positive effect favoring the intervention group. A moderate amount of heterogeneity was present, with an $I^2$ estimate of 48%. A sensitivity analysis including only those studies deemed of 'good' quality (n=5) also revealed a similar moderate positive effect size estimate (0.50, 95% CI: 0.22, 0.79).

### Effects of Mixed Interventions incorporating Mindfulness and CBT skills

As noted above, six of the included studies tested 'Mixed' resilience interventions incorporating both Mindfulness and CBT skills. Five of these studies provided sufficient data to permit a sub-group analysis and the results are presented in Figure 3a. The standardized mean difference between mixed Interventions and the control groups was 0.51 (95% CI: 0.12, 0.91), indicating a moderate effect.

### Effects of CBT-based resilience interventions

Four studies providing sufficient data to permit a sub-group analysis examining the effect of CBT-based resilience interventions. The results are presented in Figure 3b. The standardized mean difference between CBT-based resilience interventions and the control groups was 0.27 (95% CI: 0.05, 0.50), indicating a small positive effect.

### Effects of Mindfulness-based resilience interventions

Five included studies were Mindfulness based, however only two of these studies provided adequate data to permit a sub-group analysis and the results are presented in Figure 3c. The standardized mean difference between Mindfulness based interventions and the control groups was 0.46 (95% CI: 0.10, 0.82), indicating a positive moderate effect.

**Effect of resilience interventions compared to control conditions at 6-month follow-up**

Five studies reported a 6-month follow-up assessment, three of which involved Mindfulness based interventions and 2 CBT-based interventions. Two separate sub-group analyses were performed to examine the long-term effects of each intervention type. For Mindfulness based interventions, the standardized mean difference between the intervention and control groups was 0.58 (95% CI: 0.27, 0.89), which is similar to the effect size seen immediately after training. With regards to CBT-based interventions, the standardized mean difference between the intervention and control groups was 0.76 (95% CI: -0.04, 1.55), although this is based on only two studies and there was a high level of heterogeneity ($I^2$=94%, p=0.01).

**Examination for evidence of publication bias**

Visual inspection of a funnel plot of the SMD and standard error for each study revealed no suggestion of asymmetry, indicating a low likelihood of publication bias (see Supplementary Figure 1). Results of the Egger's test for funnel plot asymmetry confirmed this (p=0.31).



## Discussion

There has been increasing interest in the concept of resilience and whether training programs can enhance individual resilience and protect overall wellbeing. To the best of our knowledge this is the first systematic review and meta-analysis focused on examining the ability of different interventions to successfully alter resilience as assessed by validated resilience measures. Our results highlight that certain types of resilience training appear to be beneficial. In particular interventions utilizing Mindfulness or CBT techniques appeared able to enhance measures of resilience.

The key strengths of the present review and meta-analysis include the detailed systematic search strategy, the inclusion of unpublished data and the quality assessment of each study's methodological rigor. Despite this, a number of important limitations both of our review process and the studies identified require consideration. Firstly, there were relatively small sample sizes across many of the RCTs and over a third of the included studies did not provide adequate data for inclusion in the main meta-analysis. Second, none of the included studies investigated the impact of adverse situations following intervention meaning improvement in resilience was detected solely by a change in scores on resilience scales. Given the definition of resilience is usually taken as the ability to bounce-back from 'adverse circumstances' (12), it is arguable that the most accurate measure of resilience would require a significant challenge or threat to the individual during the study period. When confronted with such adversity, the quality of adaptation and bounce back is more accurately assessed. However, this approach would only be feasible with certain groups (e.g. army/police/emergency workers) who regularly encounter challenging circumstances given the nature of their daily work. Moreover, established resilience measures should be ideally combined with measures of functioning or other indices of one's capacity to manage adverse circumstances. In the absence of indices of exposure to adversity and measures of functioning, the validated measures of resilience utilised in this review constitute the best available measures. Whilst we limited the present review to include only those studies which employed valid and reliable measures of resilience, it remains unclear as to whether each of these scales are capturing exactly the same construct of resilience. The majority of studies in the present review utilised a single measure of resilience. In future studies it may be advantageous to include several measures of resilience. Doing so is likely to provide clarity regarding which facets of resilience are related to psychological health and are most sensitive to change. This would also further inform the development of targeted interventions aimed at bolstering successful adaptation to significant adversity.

There are a number of additional limitations related to our review process which also need to be considered. Firstly, while key decisions on inclusion and exclusion criteria were made a priori, we did not publish a protocol outlining our full search and data extraction processes. Secondly, the exclusion of non-English articles may have introduced additional bias to our search. As with any review, there is a risk of publication biases, however the detailed search of the WHO Clinical Trial Registry for unpublished data should have reduced the probability of bias and both qualitative and quantitative tests for publication bias suggested significant bias was unlikely. Finally, there was a moderate amount of heterogeneity in our main meta-analysis, with an $I^2$ of 48%. This level of heterogeneity limits the interpretation of the pooled effect sizes as it suggests there is a significant amount of variation between the individual studies included, meaning pooling all results may not be appropriate. Possible explanations for the observed heterogeneity include the different types of training programs implemented, different lengths of training, different measures of resilience and the different control conditions. While the effects of different training programs were able to be explored in stratified analyses, there were only two studies that utilized a control

condition other than waitlist, which made examining the impact of this factor impossible. As a result, the cause of much of this heterogeneity and therefore the accuracy of the pooled effect estimate remains uncertain.

There is growing consensus that resilience is a malleable characteristic, wherein an individual's ability to adapt and 'bounce-back' effectively from adversity can be developed and enhanced. Our findings suggest that resilience training, particularly those based on mindfulness and/or cognitive and behavioural skills, may be able to enhance resilience. The positive benefits of such strategies as treatment interventions for established mental health conditions have been examined thoroughly in the past. Several reviews have highlighted the value of such skills when treating common mental health conditions such as anxiety and depression (47-50) and have also been associated with improving psychological and physical health(49, 51, 52). In spite of these parallels, considerable uncertainty remains regarding what type, if any, resilience training can be recommended. There was considerable variation in the type of CBT or mindfulness skills offered in the intervention studies examined, and training times varied considerably across studies, from two-hour single session seminars to 28 hours of multiple training sessions. The two studies that involved single session training (7, 15) had conflicting results, which precludes any insight regarding the efficacy of brief resilience training. Most interventions tended to follow the traditional group-therapy format of multiple 60-90min sessions over several weeks. This is understandable given the fact that time is typically an influential factor during any new skill acquisition including skills acquired through psychological strategies. Eighty per cent of interventions were delivered via face-to-face training, with the remaining 20% involving a mix of biblio-therapy, online webinars or phone coaching. Despite the increased popularity of resilience training in the corporate sector, the predominance of face-to-face training poses specific challenges with regards to accessibility and engagement. These limitations may result in resilience programs being costly and time consuming. In response to these logistical challenges, there is an emerging literature examining the effectiveness of online e-health interventions, which target resilience in the workplace (43). While e-health interventions offer some potential solutions to the logistic challenges associated with effective resilience training, our review demonstrates the lack of currently available evidence regarding the effectiveness of online resilience training and highlights the needs for trials examining this possibility.

The issue of resilience and the possible benefits of resilience training are particularly relevant to high risk industries, such as the medical workforce or first responders. Regular exposure to trauma or distress is very likely within such workforces, which leads to heightened rates of mental health problems (53, 54). Longitudinal studies of these high-risk workforces have begun to show that self-report resilience scales, similar to those used in the studies found in this review, can predict which workers will develop mental health problems during their career (55). Given the results of this review, which suggest that certain types of resilience training can modify these predictor variables, it is reasonable to consider whether those entering careers such as medicine, nursing, policing, paramedicine or firefighting should be provided with resilience training. Some professions, such as nursing, have begun to consider this possibility (56). In others, such as medicine, routine provision of resilience training remains very rare. Previous qualitative studies of doctors have found that a belief that 'doctors are invincible' is very common amongst those within the medical profession (57). These types of misperceptions will need to be addressed if additional resilience training is to become an acceptable part of career development within such industries.

In conclusion, resilience interventions based on a combination of CBT and mindfulness

techniques appear likely to have a positive impact on individual self-reported resilience, but their overall impact and the specific type of training most likely to be beneficial remain uncertain. Additional research is warranted to help establish if these changes in self-reported resilience translate into better psychological outcomes following adversity and to test other modes of training delivery.

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**Contributors**
SJ, FS, RAB, and SBH devised the study. SJ and JT carried out the systematic literature search. SJ, JT and SL extracted the data. SJ and SBH analysed and interpreted the data and SJ wrote the first draft of the manuscript. SJ, FS, RAB and SBH read and contributed to subsequent versions, and all authors approved the final manuscript.

**Conflict of Interest**
SJ and SBH are associated with a company which offers resilience training (RAW MindCoach). SBH and FS work for the Black Dog Institute, a not for profit organization that provide mental health and resilience training to various other organisations.

**Data sharing statement:** The data obtained for the meta-analysis in the present review study was directly extracted from published peer-reviewed articles or via email contact with authors in the case of (Kahn et al., 2016; Yu et al., 2014 and Nichols et al., 2015).

**Figure legends**

**Figure 1:** Flow diagram demonstrating how eligible studies were selected

**Figure 2:** Meta-analysis examining the effect of resilience training on self-reported measures of resilience

**Figure 3:** Meta-analysis examining effect of resilience interventions stratified by
a) Mixed Interventions,
b) CBT-based interventions and
c) Mindfulness-based interventions

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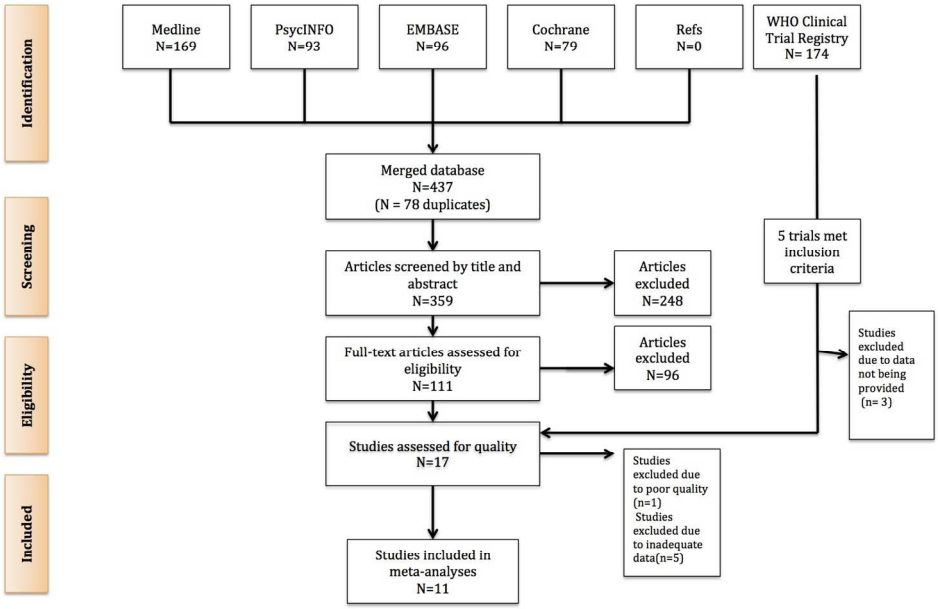


Figure 1

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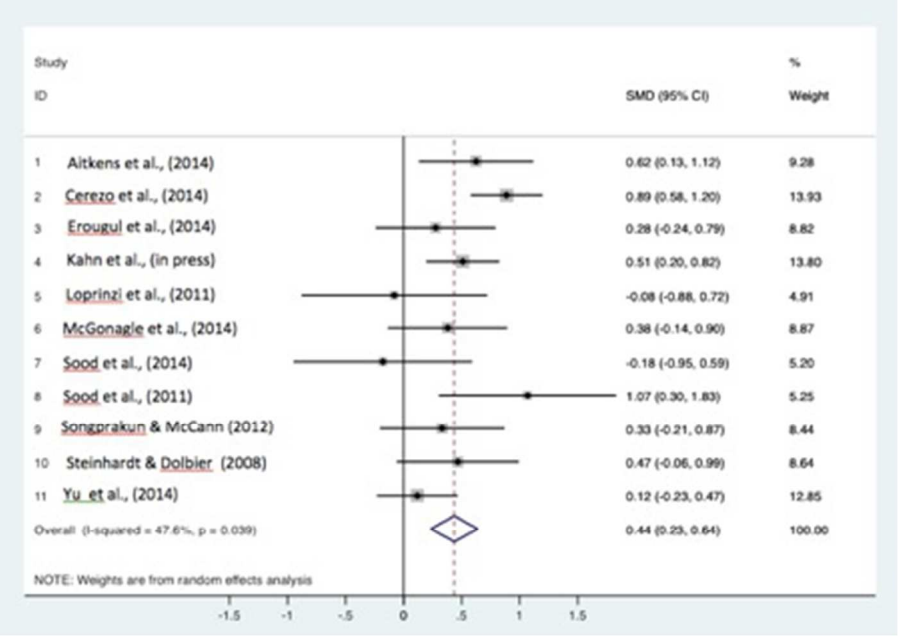


Figure 2: Meta-analysis examining the effect of resilience training on self-reported measures of resilience

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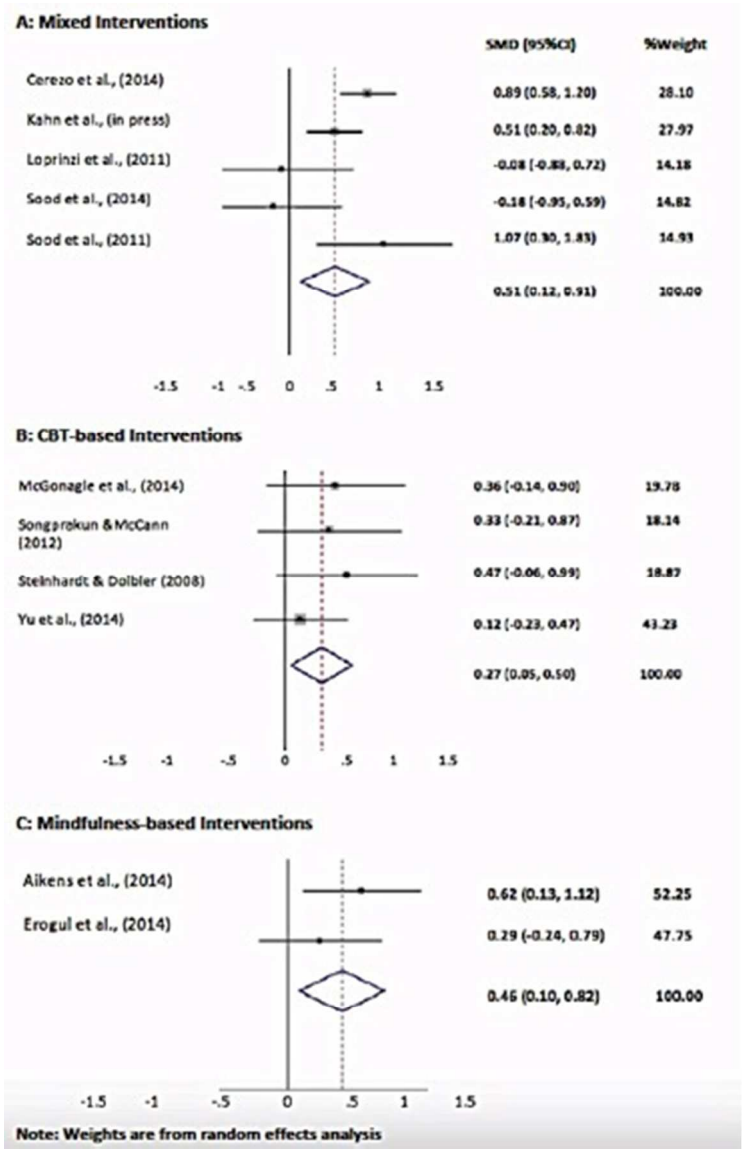



Figure 3: Meta-analysis examining effect of resilience interventions stratified by; a)Mixed Interventions, b) CBT-based interventions and c) Mindfulness-based interventions

129x201mm (72 x 72 DPI)

## Supplementary Table 1: Overview of study characteristics

| Author + Year | Setting & Population | Participants | Design | Intervention | Control Group | Evidence of Effectiveness * | Valid Resilience Scale | Quality Ax Score |
|---|---|---|---|---|---|---|---|---|
| **Aikens et al., (2014) USA** (42) | Full-time employees at The Dow Chemical Company | N = 66<br><br>Age range: (18 – 65)<br><br>Intervention Group: (n=34)<br><br>Control Group: (n=32) | RCT with pre/post evaluation + 6-month follow-up | 7-week mindfulness based program combining live, weekly 1hr-long virtual class meetings with accompanying online applied training via program website and workbook. Intervention based on Mindfulness based Stress Reduction (MBSR) and involved mindfulness and focusing techniques, education material on mindfulness and daily at home practise. | Y: Wait List<br><br>Received the equivalent mindfulness program immediately following intervention group completion. | Y | CD-RISC | **20 (Good)** |
| **Cerezo et al., (2014) SPAIN** (43) | Breast Cancer Patients | N= 175<br><br>Intervention Group: (n =87) (Mean age: 49.3 SD: 9.8)<br><br>Control Group: (n=88) (Mean age: 50.7, SD: 9.4)<br><br>100% Female | RCT with pre/post evaluation | 14 X 2hrs Group Sessions: 1 Session per week. Intervention based on positive psychology incorporating psychoeducation, emotional regulation training, coping strategies, cognitive restructuring role play, gratitude techniques, mindfulness strategies, relaxation, meditation and guided imagery techniques. | Y: Wait List | Y | CD-RISC | **20 (Good)** |
| **Erogul et al., (2014)** (30) | 1st year Medical Students | Total N = 58 Intervention Group =(n= 28)Mean age: 23.6, SD: 1.9 Control Group = (n=30),Mean age: 23.3, SD: 1.4 | RCT Baseline, post-treatment (8-weeks) & 6 month follow up. | 8 week Mindfulness Intervention based on Mindfulness Based Stress Reduction (MBSR). 1 X 75 min session per week + 1 X 5 hrs Retreat | Y: Wait List | N | RS -14 | **17 (Fair)** |
| **Kahn et al.,(2016) USA** (46) | USA Armed Services Veterans and their partners | Total N = 320<br><br>Intervention Group = (80)<br><br>Attention Control | 4-arm RCT Pre/Post: Baseline, half-way (8 weeks) and 16 weeks. | Mission Reconnect: 16-week self-directed online program involving mind and body based wellness skills. Founded on the biopsychosocial model of health, mindfulness based therapies; massage therapy, positive emotions and | Y:<br>1) Attention Control: (PREP) – widely used evidence | Y | RSES | **20 (Good)** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group = (80)<br><br>Intervention + Attention Control Group = (80)<br><br>Wait List Control Group = (80)<br>32% of veterans still in service<br>68% retired.<br>Veterans had on average served 2 deployments. | | caregiver education. Delivered via program website and utilises audio exercises, videos and written material. | based (CBT) post-deployment reintegration program for relationship enhancement. Facilitated via weekend treatments by trained Army Chaplains.<br><br>2) Wait List Control Group. | | | |
| **Loprinzi et al., (2011) USA** (5) | Breast Cancer survivors and mentors at Mayo Clinic, USA | Total N = 24<br>Age range:(46-75)<br><br>Intervention Group: (n=12)<br><br>Control Group: (n=12) | RCT pilot study<br><br>Pre/post evaluation | 2 x 90-mins group training sessions, a brief individual session and 3 x follow-up telephone calls.<br><br>(Based on Attention and Interpretation Therapy (AIT), relaxation, attention training, as well as skills cultivating compassion, gratitude, forgiveness, acceptance and purpose). | Y: Wait List | Y | CD-RISC | **16 (Fair)** |
| **McGonagle et al., (2014**) (47) | Full time workers with chronic illnesses | N = 59<br><br>Intervention Group:(n=30) (Mean age: 38.3, SD: 8.2)<br><br>Control Group: (n=29) (Mean age:39.1 (SD: 7.8)<br><br>86% Female<br>14% Male | RCT with Pre/Post evaluation and 12 week follow-up | 6 x 1hr phone-based coaching sessions delivered fortnightly over a 12 week period.<br><br>Intervention based on stress theory and resource activation and the GROW model of coaching. Sessions aimed to help boost workers' level of internal resources to help manage stress related to working with chronic illness. Each session was tailored to the needs and goals of the individual. | Y: Waitlist Control | Y | CD-RISC10 | **18 (Fair)** |

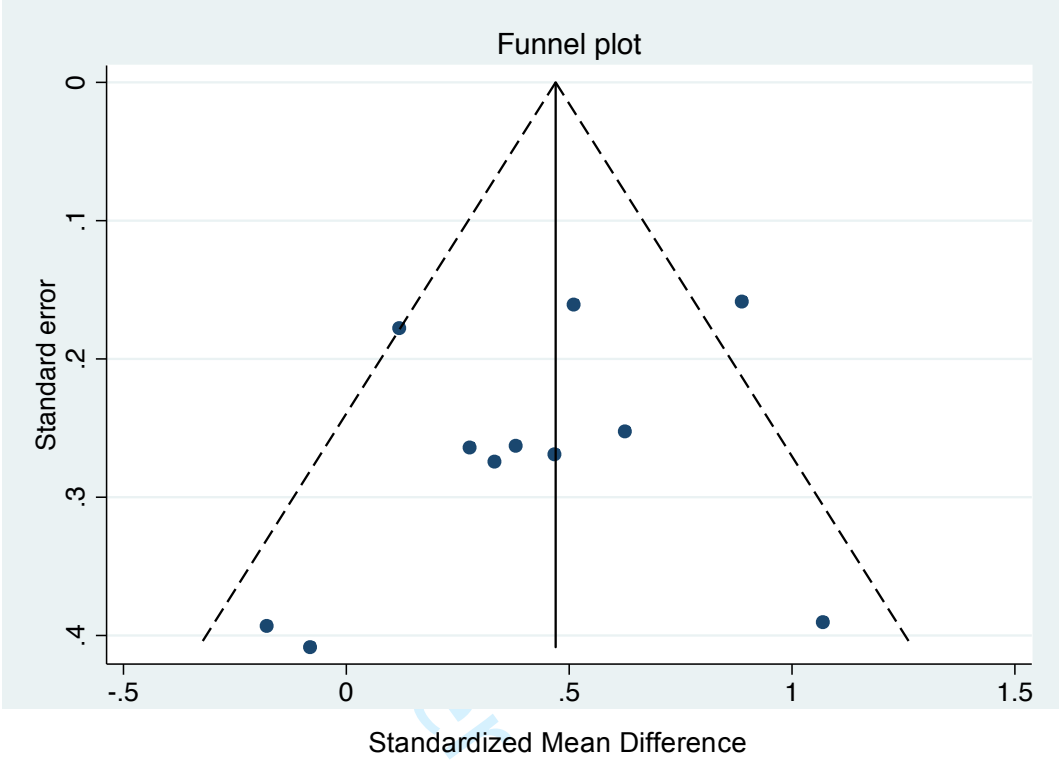
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Songprakun & McCann (2012) THAILAND** (50) | Outpatients with a diagnosis of moderate depression attending clinics at Suan Prung Psychiatric Hospital, Chiang Mai Province. | N = 54<br><br>Intervention Group: (n = 26)<br><br>Control Group: (n= 28)<br><br>(Mean age: 42.1, SD:9.7)<br><br>73% Female<br>27% Male | RCT with pre-post evaluation (8 weeks) + 3 month follow-up | 8 week bibliotherapy intervention incorporating a self-help manual and workbook developed by Lifeline South Coast, Australia (Good Mood Guide: A self-help manual for depression).<br><br>Participants competed 1 module per week over 2 month period.<br>Involved between session activities including reading, questionnaires, and homework exercises.<br>The manual was based on established principles of cognitive behavioural therapy (CBT) and self-help techniques and practises. | Y: Standard care and treatment + 1 weekly 5 minute phone call from the researcher to answer questions and provide brief support | Y | RS | **21 (Good)** |
| **Sood et al., (2011) USA** (19) | Physicians at Mayo Clinic, USA | N = 32<br>Intervention group: (n=20)<br>(Mean age: 46.8 SD: 8.3)<br>55%male,<br>45%female<br><br>Control Group: (n=12), (Mean age: 50.2 SD: 5.7)<br>50% male,<br>50% female | RCT pilot study<br><br>Pre/post evaluation | Single 90 minute training session covering a range of resilience enhancing approaches.<br>Based on Attention and Interpretation Therapy (AIT), relaxation, attention training, as well as skills cultivating compassion, gratitude, forgiveness, acceptance and purpose.<br>Also included brief training in a daily meditation practise.Optional 30-60 follow-up session depending on individual needs. | Y: Wait List | Y | CD-RISC | **17**<br><br>**(Fair)** |
| **Sood et al., (2014) USA** (7) | Radiologists, Department of Radiology Mayo Clinic, USA | N = 26<br>Intervention group: (n=13)<br>(Mean age: 47.4, SD: 8.8)<br>55%male,<br>45%female<br>Control group: (n=13) (Mean age: 48.1, SD: 5.2),<br>50% male,<br>50% female | RCT pilot study<br><br>Pre/post Evaluation | Single 90 minute session aimed at decreasing personal stress and enhancing resiliency.<br>Based on Attention and Interpretation Therapy (AIT), relaxation, attention training, as well as skills cultivating compassion, gratitude, forgiveness, acceptance and purpose.<br>Also included brief training in a daily meditation practise. optional 30-60 follow-up session depending on individual needs. | Y: Wait List | N | CD-RISC | **17**<br><br>**(Fair)** |
| **Steinhardt & Dolbier (2008)** | Students enrolled at | N= 57 | RCT pilot study | 4 X 2 hour weekly sessions intervention to improve resilience, coping strategies | Y: Wait List | Y | CD-RISC & | **17** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **USA** (20) | University *(during a period of high academic stress)* | Intervention group: (n= 30)<br><br>Control group: (n= 27),<br>82% female<br>18% male<br>median age: 21 years | Pre/post evaluation | and protective factors by focusing on cognitive behavioural strategies, social support and psychoeducation. | | | DRS | **(Fair)** |
| **Yu et al., (2013) CHINA** (52) | New immigrants relocating to Hong Kong (China) | N=183<br>Intervention group: (n= 58) (95% female. Mean age: 32.9, SD: 4.4)<br>Comparison group: (n= 83) (97% female. Mean age: 31.9, SD: 4.6)<br>Control group = 70 (95% female, Mean age: 33.8, SD: 5.5) | RCT pilot<br><br>Pre/post evaluation + 3 month follow-up | Program involved 4 x 2.5hrs weekly sessions over 4 consecutive weeks. Aimed to build personal resiliency and reduce adaptation difficulties. Skills: developing self-efficacy, positive thinking, positive reframing, and altruistic behavior and goal setting. Based on intervention and local evidence about positive characteristics that promote successful immigration. | Y: Control received 16-page informational booklet relevant to education, medical care, housing, employment and community resources. | Y | CD-RISC | **22**<br><br>**(Good)** |

RCT = Randomised Controlled Trial, CT = Controlled Trial, CD-RISC = Connors Davidson Resilience Scale, DRS = Dispositional Resilience Scale, RSES= Response to Stressful Experiences Scale, RS-14 = The Resilience Scale

* Evidence of effectiveness operationalized as the intervention condition being associated with a significant improvement in the measure of resilience compared to the control condition with an alpha value of 0.05

Supplementary *Figure 1: Funnel plot examining for evidence of publication bias.*



***Example of Full Search Strategy (used for Medline)***

#1: resilience.tw
*#2:* resiliency.tw
#3: #1 OR #2
#4: training.tw
#5: intervention.tw
#6: #4 OR #5
#7: #3 AND #6

# PRISMA 2009 Checklist

| Section/topic | # | Checklist item | Reported on page # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | 1 |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | 2 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 4-5 |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 5 |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | Not done |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 5-6 |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 5,6,7 |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | 6 |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 6 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 6-7 |
| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 7 |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | 7 |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | 7 |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$) for each meta-analysis. | 7 |

# PRISMA 2009 Checklist

| Section/topic | # | Checklist item | Reported on page # |
|---|---|---|---|
| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | 7, 10 |
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | 7 |
| **RESULTS** | | | |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | 8 |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | 9 |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | 10 |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | 11 |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | 10, 11 |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | 10 |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | 12 |
| **DISCUSSION** | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 13 |
| Limitations | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 13 |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 13-14 |
| **FUNDING** | | | |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | 15 |

*From:* Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097