The art of balance: addressing occupational stress and well-being in emergency department nurses

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CHAPTER 4

The effectiveness of stress management interventions for nurses: Capturing 14 years of research.

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Abstract

Nurses are considered to have one of the most demanding professions and are at risk of developing stress-related outcomes. As a result, many stress management interventions (SMIs) have been published in the literature, but there is a lack of a systematic quantitative approach to assess their effectiveness. The current study uses meta-analytic techniques to evaluate their overall effectiveness and potential moderators related to greater intervention success. Databases were searched for articles published between 2007-2020, measuring stress-related outcomes before and after the SMI and including a control group. Based on 85 publications (83 SMIs) a combined medium effect (Hedges' g = 0.42) was found. Person-directed interventions yielded larger effects than organization-directed or multilevel interventions, but this could only be concluded regarding their short-term effectiveness. For person-directed interventions, higher exposure and a homogenous sample of nurses were related to greater effectiveness, whereas the type (cognitive behavioral, relaxation, work skills or a mix), the length of the intervention, target group (primary or secondary) and type of control group used, were not. In addition, person-directed interventions were more effective on current stress levels (e.g. work-related stress) than on outcomes indicating strain (e.g. burnout). As all organization-directed interventions used a participatory approach, this process variable could not be examined as potential moderator. To conclude, SMIs can effectively prevent and reduce stress-related outcomes in nurses. To further evaluate factors contributing to their effectiveness, more detailed reporting in publications is necessary. Furthermore, especially for person-directed interventions, long term measurements are needed to determine the longevity of their effects.

Introduction

Background

It is well known that nursing is a stressful profession. Nurses are exposed to a wide range of work-related stressors including heavy workload, rotating schedules and night work, confrontation with loss, grief and suffering in patients, and aggression/conflict situations with patients and/or their accompanies (Liu et al., 2019; McVicar, 2016). In addition, they often have limited resources to deal with these demands, including limited decision authority and staffing shortages (McVicar, 2016). High stress levels in nurses can have serious consequences. First of all, it has been related to a range of mental health problems and physical complaints (Roberts & Grubb, 2014). Not surprisingly, stress-related outcomes are highly prevalent in this occupational group, with one out of three nurses reporting symptoms of burnout (Monsalve-Reyes et al., 2018). Furthermore, high workload can cause nurses to miss important changes in their patient (McHugh et al., 2011), leading to a rise of seven percent in mortality rates with every patient added per nurse (Aiken et al., 2002). Finally, high stress levels in nurses are related to decreased job satisfaction, more absenteeism and higher turnover intentions (Roberts & Grubb, 2014). Scholars predict that stress levels in nurses will only rise in the future as the number of patients increases with the aging population and less people are choosing for the nursing profession (Aiken et al., 2002; McVicar, 2016). As such, effective interventions to reduce stress in nurses are imperative.

Stress management interventions

According to the transactional model of stress, stress arises in the judgement that environmental demands exceed individual psychological or physical resources (Lazarus, 1995). This judgement is based on two consecutive processes. During the primary appraisal process meaning is given to the event as the person judges the situation as harmful, threating or challenging. During the second appraisal process, available coping resources to deal with the event are evaluated. As such, the resulting stress response depends upon the interpretation of the event given by the person (primary appraisal) and his or her coping resources (secondary appraisal) (Lazarus, 1995). Strong stress responses (e.g. due to a traumatic event) or enduring stress responses (e.g. due to continuous exposure to high job demands) can lead to a depletion of coping resources, deregulate the sympathetic nervous system, and eventually result in stress-related outcomes (e.g. anxiety or symptoms of burnout, depression or post-traumatic stress) (Heaney & van Ryn, 1990). To prevent and/or reduce the negative impact of

work stress on employee well-being many organizations have adopted stress management interventions (SMIs), which can be defined as "(…) any activity, or program, or opportunity initiated by an organization, which focuses on reducing the presence of work-related stressors or on assisting individuals to minimize the negative outcomes of exposure to these stressors" (Ivancevich et al., 1990, p. 252). In the literature these interventions are commonly categorized in person-directed and organization-directed interventions.

Person-directed interventions aim to enhance employees` skills to manage, cope and reduce stress (Holman et al., 2018). Two types of person-directed interventions that are extensively reported in the literature include interventions based on cognitive behavioral techniques and relaxation interventions. In line with the transactional model of stress, cognitive behavioral interventions focus on the interpretation of the stressor (primary appraisal process) as well as enhancing available coping resources (secondary appraisal process) and thereby aim to prevent and/or reduce a stress response. Within these interventions maladaptive thoughts are challenged and changed into more helpful ones and/or problem solving skills are learned (Beck & Dozois, 2011).

Relaxation interventions, including both mental (e.g. meditation) and physical relaxation techniques (e.g. progressive muscle relaxation), aim to prevent stress reactions to endure and become pathological by using breathing exercises, autogenic training or progressive muscle relaxation. In addition, practicing relaxation on a regular basis can increase available coping resources (secondary appraisals) to deal with potentially threatening events. The effectiveness of these interventions is generally based on the assumption that stress and relaxation are opposite poles on the same continuum, which implies that relaxation equals less stress (Holman et al., 2018).

A second type of SMIs focusses on the working environment, and has been labelled as organization-directed interventions (Ivancevich et al., 1990). Most organization-directed interventions are based on the Job Demands-Resources model which postulates that work stress mainly occurs in poorly designed working environments referring to a combination of high job demands (e.g. work time demands, emotional demands) and limited job resources (e.g. social support, autonomy, and feedback) (Bakker & Demerouti, 2017). Examples of organization-directed interventions include the implementation of rostering fitting to the

circadian rhythm of employees, optimizing workflow, and changes in leadership style (e.g. from transactional to transformational leadership). An important difference between person-directed and organization-directed interventions is that the first focuses on preventing and/or reducing the stress response, whereas the latter addresses the contextual causes of stress by reducing job demands and/or enhancing job resources. As such, organization-directed interventions often work preventative.

Finally, multilevel interventions intervene at both the organizational and the individual level. The advantage of a multilevel approach is that it can reduce the causes of stress as well as help those employees that are at risk of, or already experiencing stress-related outcomes (Holman et al., 2018). Not surprisingly, the implementation of multilevel interventions is often advocated by scholars in the field (Lamontagne et al., 2007; McVicar, 2016; Murphy, 1996; Semmer, 2006).

Stress management interventions for nurses

Concerns over stress levels and their consequences have made nurses a popular target group for SMIs. In the past, multiple (systematic) reviews have summarized the effectiveness of these interventions (Henry, 2014; Mimura & Griffiths, 2003; Westermann et al., 2014). The first documented review on SMIs for nurses was performed by Mimura and Griffiths in 2003 and included seven randomized controlled and three quasi-experimental studies. Overall, positive effects were reported of SMIs on stress-related outcomes. However, due to the limited amount and low quality of the included studies no conclusions could be drawn concerning what approach (for example implementing a person-directed or organization-directed intervention) would be most effective. Reviews after Mimura and Griffiths (2003) focused on a specific group of nurses (e.g. mental health nurses (Edwards & Burnard, 2003), oncology nurses (Henry, 2014; Wentzel & Brysiewicz, 2017) and nurses working in the inpatient elderly and geriatric long term care (Westermann et al., 2014)) and on specific stress-related outcomes (burnout or compassion fatigue). Although the focus on a specific group of nurses has several benefits (e.g. taking into account the various settings in which nurses work), it often leads to a small number of studies to be included. Since studies are likely to differ in terms of the type of intervention implemented and how the effect is measured, this makes it difficult to reach conclusions regarding effective elements, or assess the generalizability of the overall results (Richardson & Rothstein, 2008). Furthermore, although burnout and

compassion fatigue are highly prevalent amongst nurses and insight in SMIs to prevent and reduce these outcomes is warranted, the focus on a limited number of stress-related outcomes does not capture the full potential of SMIs in this setting. For example, some interventions might not be very effective in reducing burnout levels, but are able to reduce milder stress-symptoms such as psychological distress. Finally, none of these reviews used meta-analytic techniques to quantify the effectiveness of SMIs and thus provide little insight regarding *how* effective these interventions are.

As a result, most insight in the effectiveness of SMIs comes from a meta-analysis by Ruotsalainen et al. (2015), which focused on healthcare professionals in general but included a number of studies conducted in the nursing population. Based on 58 publications, published up to and including 2013, they found moderate effects of person-directed interventions on the reduction of stress levels and limited evidence for the effectiveness of organization-directed interventions. Given the rise in popularity of SMIs for the nursing population, and the changing healthcare sector, an up-to-date overview including more recent studies is warranted.

The current study

The current meta-analysis focusses on the following research question: How effective are SMIs in reducing and/or preventing stress-related outcomes in the nursing population and what factors relate to greater effectiveness? It aims to provide an update to previous (systematic) reviews and a better understanding regarding the effectiveness of SMIs for the nursing population by including a wide range of SMIs and stress-related outcomes, using a meta-analytic approach and assessing the potential moderating effects of intervention characteristics and the process by which these are implemented (i.e. a participatory approach). In addition, potential biasing effects regarding the study design and quality will be evaluated. To be able to compare interventions adequately we aim for a homogenous population, including studies with a sample of at least 50% registered nurses working in a hospital setting.

Level of the intervention

As mentioned, the meta-analysis of Ruotsalainen et al. (2015) found more evidence for the effectiveness of person-directed interventions than of organization-directed interventions on stress-related outcomes. The effectiveness of a multilevel approach was however not assessed. Person-directed interventions can be very effective in relieving stress-related outcomes, but if

a highly demanding working environment is not improved, these effects are likely to be of short or medium term only (van Wyk & Pillay-Van Wyk, 2010). In contrast, a solely organization-directed approach works mainly preventative and is unlikely to be sufficient to ameliorate outcomes in nurses experiencing severe stress-related symptoms. This might also explain the limited effects found for these interventions in the meta-analysis of Ruotsalainen et al. (2015). In line with the recommendations of McVicar et al. (2016), we expect that an approach focused on improving the working environment as well as individual coping is most effective in reducing and preventing stress-related outcomes in the nursing population. The following hypothesis will be tested:

Hypothesis 1: Multilevel interventions are more effective in preventing and reducing stress-related outcomes in the nursing population compared to an intervention solely on the organizational level or the individual level.

Identifying moderating factors

Since person-directed interventions and organization-directed interventions are based on different theories and thus different mechanisms are at play, we aim to identify moderating factors for each of these types of interventions separately. For person-directed interventions, we will first assess the effect of the *type of intervention* (e.g. cognitive behavioral versus relaxation). Since cognitive behavioral interventions intervene both on primary as well as secondary appraisals, their effectiveness is expected to be greater than for example relaxation interventions which focus on reducing the stress reaction but do not change the interpretation of the event. In line with this, previous meta-analyses regarding SMIs for the working population in general consistently find higher effects for cognitive behavioral interventions compared to other person-directed interventions (Richardson & Rothstein, 2008; van der Klink et al., 2001). Furthermore, one of the elements that makes nursing a stressful profession is the exposure to high emotional demands, such as suffering in patients, grief and death. According to research on loss and grief, these kind of stressors can change a persons` fundamental idea of the world being a safe place in which they have some control over their own faith (Beder, 2016). Inability to reappraise these events in a more bearable way, can lead to feelings of helplessness and depression (Beder, 2016). As such, cognitive behavioral interventions might be particularly beneficial to nurses.

Second, we will examine the influence of *the length of the intervention* and *exposure* to the sessions (i.e. attending the majority of the planned sessions). Although positive effects have been found for brief stress management interventions (e.g. Gilmartin et al., 2017), there is a lack of studies comparing their effectiveness to those with a longer intervention time period. Person-directed interventions include learning new skills, and as such require changes in thought patterns and/or behavior. For these changes to occur and be integrated in daily working life, repetition and practice is necessary (Lally & Gardner, 2013). As such, it is possible that longer interventions are more effective than shorter interventions and that studies in which participants attended more sessions (i.e. have greater *exposure to the intervention*) will reach greater effects in comparison to those with lower attendance.

Finally, the *target group* of the intervention could be a potential moderator in the effectiveness of person-directed interventions. Secondary interventions (aimed at nurses already experiencing high stress-related symptoms) are likely to reach greater effect sizes compared to primary interventions (aimed to prevent stress and stress-related outcomes), simply as there is more to gain in terms of stress reduction.

For organization-directed interventions, it has been argued that the process through which the intervention is designed and implemented is a crucial factor determining its effectiveness (Nielsen & Noblet, 2018; Nielsen & Randall, 2013). In this meta-analysis we will examine the participatory approach, the involvement of employees in the design and/or implementation of the intervention, as a potential moderating factor. As described by Nielsen et al. (2013) a participatory approach is one of the most important process related factors and may contribute to the success of organization-directed interventions due to four reasons: 1. It can optimize the fit of the intervention to the organizations' culture and context by making use of employees' expertise and knowledge. 2. It can increase exposure of employees to the intervention and create employee commitment and ownership. 3. It can work as an intervention on its own by empowering employees to make changes to their working environment. 4. It can enhance a better understanding between managers and employees as they actively have to work together.

Study design and quality

Finally, we will assess potential biasing effects regarding the study design and quality. For person-directed interventions we will assess the impact of the study sample and the type of control group used. This was done for the following reasons: *Study sample* (only nurses versus a mixed sample of at least 50% registered nurses) will be assessed to ensure that the inclusion criteria regarding a sample did not influence the effects. The *type of control group* will be assessed since the reported effect of an intervention may be smaller when compared to a minimal intervention (e.g. education), than to standard care or a wait-list control group (Karlsson & Bergmark, 2015). Furthermore, for all interventions (person-directed, organization-directed and multilevel) we will assess the potential biasing effect of the study quality (including whether or not participants were randomly allocated to the intervention and control group).

Relevance of the current study

The current meta-analysis adds to the literature in multiple ways. First of all, it is the first meta-analysis focusing on the effectiveness of SMIs in nurses working in the hospital setting including the full range of person- and organization-directed interventions and examining a broad variety of stress-related outcomes. By studying potentially moderating factors (regarding intervention characteristics, the use of a participatory approach, and the study design and quality) it provides a more comprehensive insight in the effectiveness of SMIs for the nursing population compared to previous reviews (Henry, 2014; Mimura & Griffiths, 2003; Wentzel & Brysiewicz, 2017; Westermann et al., 2014). This insight will yield practical recommendations for the design and implementation of effective interventions. Second, in comparison to previous reviews (Henry, 2014; Mimura & Griffiths, 2003; Wentzel & Brysiewicz, 2017; Westermann et al., 2014), the present meta-analysis will not only indicate *whether* SMIs are effective, but by quantifying the effects also indicate *how* effective SMIs are for the nursing population. Third, compared to the meta-analysis of Ruotsalainen et al. (2015) on healthcare professionals, the focus on a specific setting and specific population increases homogeneity of the studies, and as such enables better comparison regarding the effectiveness of the interventions. Finally, this study answers to the plea of researchers to include process variables in evaluating the effectiveness of organization-directed interventions (Nielsen & Noblet, 2018; Nielsen & Randall, 2012; Semmer, 2006). Interventions that have great potential but receive

far less attention in the literature and are often, perhaps unjustified, regarded as the least effective approach (e.g. Richardson & Rothstein, 2008; van der Klink et al., 2001).

Methods

This meta-analysis is performed in accordance with PRISMA guidelines (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009).

Search strategy

A search strategy was developed based on the technique described by van der Ploeg et al. (2017), by starting with a basic search strategy covering the most important subsets (TS=(nurse*) AND TS=(intervention) AND TS=(burnout)) and adding synonyms to each subset (e.g. TS=(nurse*) AND TS=(intervention) AND TS= (burnout OR "emotional exhaustion")). The relevance of each synonym was assessed by subtracting the articles found with the old strategy from the articles found with the new strategy using the NOT function. Relevant search terms were kept in the search string and irrelevant search terms were disposed (see appendix table 1-3 for the final search strategy). Next, the databases PubMed, Web of Science and PsycInfo were systematically searched for articles published between January 2007 up till and including December 2020. PubMed provides access to approximately 7,000 journals in the field of biomedical and life sciences. It includes records from PubMed Central, MEDLINE and other National Library of Medicine resources (e.g. in process citations, citations to articles that are out-of-scope from certain MEDLINE journals, and the National Center for Biotechnology Information (NCBI) bookshelf) and is one of the most popular databases in the field (Williamson & Minter, 2019). Web of Science covers over 8,700 journals in the field of social sciences, health sciences, life sciences, technology, arts and humanities (Falagas et al., 2008). Finally, the American Psychological Associations' PsycInfo was included as a more specialized database. PsycInfo covers 2,300 peer reviewed journals and includes 5 million records (e.g. articles, book chapters, abstracts, dissertations) in the field of behavioral science and mental health (see http://www.apa.org/psycinfo). Although these databases overlap, they complement each other in terms of different disciplinary bases. Reference lists of all included studies and relevant reviews and meta-analyses in the field were screened for additional studies.

Eligibility criteria

Studies were included based on the following inclusion criteria: 1. evaluating the effectiveness of an intervention to reduce and/or prevent stress in comparison to a control group, 2. including a pre- and a post measurement of an outcome representing stress-related outcomes (e.g. stress, burnout symptoms, anxiety, depression, or post-traumatic stress symptoms), 3. including a sample consisting of at least 50 percent registered nurses working in a hospital setting, 4. reporting statistics that can be calculated to effect sizes, and 5. written in English. No criteria about randomization were set, as for studies evaluating the effectiveness of an organization-directed intervention this is often not feasible.

Selection of studies

Duplicates of studies found in Pubmed, Web of Science and PsycInfo were removed. Titles and abstracts were screened for eligibility. Two reviewers independently read the full texts of eligible articles to assess whether they met the inclusion criteria. Interventions that relied on ergonomics or physical processes rather than psychological processes were excluded. Examples of these studies are the use of zinc supplementation (Baradari et al., 2018), aromatherapy (Chen et al., 2015), acupuncture (Kurebayashi & da Silva, 2015) and the use of special glasses during the nightshift (Boivin et al., 2012).

Data extraction and management

Two researchers independently coded the articles by means of a standard coding form. Disagreements were discussed until consensus was found. In case of no consensus the second author of this paper was consulted. For the calculation of the effect sizes, means and standard deviations of the experimental and control group(s) were obtained from the studies. Missing standard deviations were calculated based on the reported standard errors or confidence intervals. In case of any other missing data, authors were contacted via e-mail. Since only a few authors replied to our request, it was chosen to calculate effect sizes for the remaining studies based on the data that was available. For four studies (Moody et al., 2013; Nooryan et al., 2012; Udo et al., 2013; Villani et al., 2013) we calculated the effect size based on the available post-test data, which could be justified as intervention and control group did not differ on the outcome(s) under study at pre-test. For another four studies (Fang & Li, 2015; Ketelaar et al., 2013; Koivu et al., 2012; Mealer et al., 2014), we used the percentage of the study population that scored above the cut-off for high stress levels before and after the intervention to

calculate an effect size. This data is less refined as it includes the change from one group (high stress) to another (low stress) instead of the change in stress-related outcomes on a continuous scale. As a result, only three studies (Duchemin et al., 2015; Leao et al., 2017; Romig et al., 2012) needed to be excluded due to missing data.

Data items

In line with other reviews on SMIs (Richardson & Rothstein, 2008; van der Klink et al., 2001) we first categorized interventions into person-directed, organization-directed and multilevel interventions. Next, in line with Ruotsalainen and colleagues (2015), we further divided the person-directed interventions into two subcategories, the first focusing on cognitive behavioral techniques (changing the way one thinks/interprets stressors and consequently act) and the second focusing on mental and/or physical relaxation (e.g. mindfulness, progressive muscle relaxation). During the coding process some studies did not fit any of the above-mentioned categories or fitted both categories. Therefore, two additional subgroups of person-directed interventions were created. The first included interventions that aim to improve work skills and/or focus on professional development (e.g. assertiveness training, communication training). This category was considered person-directed as it focusses on increasing personal resources to help cope better with the demands at work, whilst no changes were made to the working environment. The second category included programs in which different person-directed interventions were combined (e.g. combining a cognitive behavioral training and relaxation).

For person-directed studies we coded the intervention length (number of weeks of the intervention program), exposure to the intervention (<80% of the sample attended all sessions versus ≥80% of the sample attended all sessions), whether it was a primary (preventative) or secondary (aimed at nurses with high stress levels/stress complaints) intervention, the sample (only nurses versus a mixed sample), and the control group used (minimal intervention, standard care or waitlist control). For organization-directed interventions (both solely and when implemented in combination with a person-directed intervention) we coded the use of a participatory approach.

Solutions for multiplicity

Studies with multiple experimental groups were treated as follows: when the experimental groups received interventions of the same category (e.g. two types of relaxation interventions) we averaged the effect sizes. When interventions of two different categories (e.g. a cognitive behavioral intervention and a relaxation intervention) were reported, we treated them as two independent intervention studies. In that case the *N* of the control group was divided by the number of experimental groups (Higgins et al., 2011). In case of a cross-over design only the results after the implementation of the intervention were used in comparison to the wait-list control.

Outcome measures that were studied belong to one of the following categories: burnout, psychological distress, depression, anxiety, work related stress, fatigue or symptoms of post-traumatic stress (including secondary traumatic stress). Studies focusing on occupational stressors (e.g. role ambiguity, job demands, lack of job control) rather than stress as an outcome, were excluded. For studies reporting stress outcomes of the same category, the effect size of the most reliable instrument or the most comparable to other studies was included (e.g. anxiety measured on the Becks' Anxiety Inventory rather than measured on a visual scale, emotional exhaustion as opposed to the total burnout scale). When both state as well as trait anxiety was reported, only state anxiety was included as this indicates the intensity of anxiety symptoms during a specific period rather than one's general anxiety-proneness (Spielberger et al., 1971). For the main analysis, we averaged effect sizes of studies that reported outcomes in different categories (e.g. anxiety as well as burnout symptoms), to avoid double counting.

When the effectiveness was assessed on multiple time points, we used the first time point available (post-test). In addition, we reported the effect sizes for each stress outcome and time point measured (measured < 1 week post intervention, 1 week - ≤ 1 month post intervention, 1 month - ≤ 6 months post intervention, or > 6 months post intervention) to investigate whether this influenced the effectiveness. Studies that included multiple outcomes and/or measurements were represented more than once in this analysis.

Assessment of risk of bias in included studies

The Cochrane Risk of Bias tool was used to assess the amount of bias in each study (Higgins et al., 2011). RevMan was used to visualize the risk of bias in the included studies (Review Manager (RevMan), Version 5.3., 2014). To examine the presence of potential publication bias a funnel plot was made. Furthermore, Eggers' test of the intercept (Egger et al., 1997) and Duval and Tweedie's trim and fill analysis were conducted (Duval & Tweedie, 2000).

Analyses

We calculated the standardized mean difference (Hedges *g*) for each study including its 95% confidence level. A random effects model was used to assess the overall effect of the included studies, as we did not expect studies to be functionally equivalent (Borenstein et al., 2009). The significance of the effect sizes was determined by the *Q*-test with a *p*-value of below .05 considered a significant effect. The I^2 static was used as an indication of heterogeneity between the studies. In line with the meta-analysis of Ruotsalainen and colleagues (2015) we used an intra-cluster correlation of .10 for studies using a cluster-randomized design, when none was reported in the study.

Moderator analyses were performed for the intervention level (person-directed, organization-directed, or multilevel) and the quality of the studies (lower quality studies versus higher quality studies, based on the risk of bias assessment). For person-directed interventions moderator analyses regarding the type of intervention (cognitive behavioral, relaxation, work skills or a mix of person-directed interventions), the length of the intervention, exposure to the intervention (<80% of the sample attended all sessions versus ≥80% of the sample attended all sessions), the target group (primary versus secondary interventions), the sample (only nurses versus a mixed sample), and the control group used (minimal intervention, standard care, waitlist control). For organization-directed interventions we aimed to perform a moderator analysis on the use of a participatory approach.

All moderator analyses were done using mixed model analyses in which the random effects model was used to combine studies in one subgroup and a fixed effects model was used to compare across subgroups (Borenstein et al., 2009). For the mixed effects model the study-to-study variance (tau-squared) was assumed to be the same for all subgroups. This value was

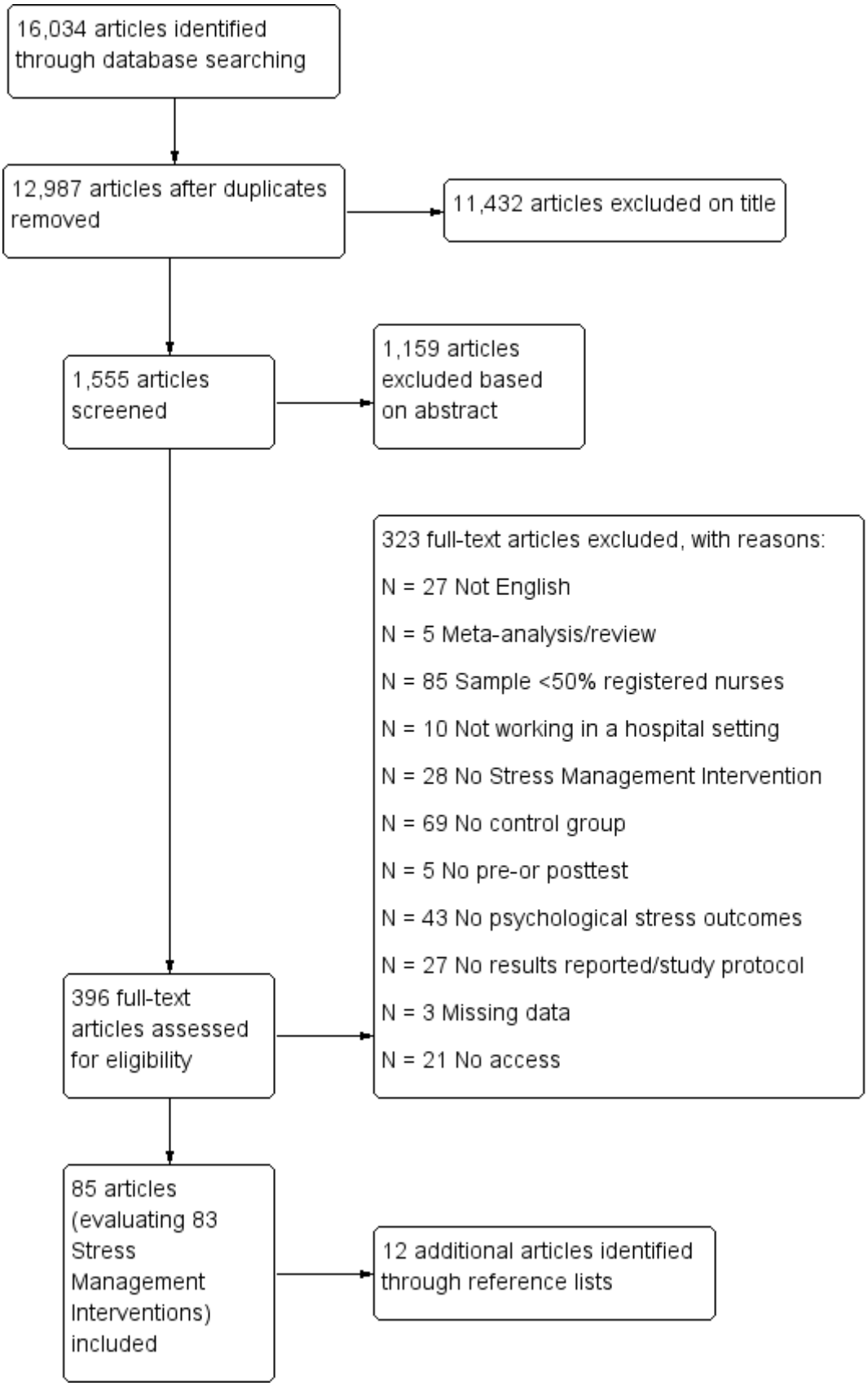


Figure 1. Flowchart of study inclusion and exclusion

computed within subgroups and then pooled across subgroups. All analyses were carried out using Comprehensive Meta-Analysis software v.3 (Borenstein et al., 2013).

Results

Selection of studies

A total of 12,987 unique references were retrieved from the search in the electronic databases. On the basis of title and abstract, 396 publications were selected for potential inclusion. In addition, 12 publications were identified based on screening of relevant reviews and reference lists of the included studies. After full-text examination 85 publications fulfilled all eligibility criteria and were included in the current meta-analysis (see figure 1).

Study characteristics

An overview of all included publications can be found in table 4 of the appendix. Most articles were from Asia (*k* = 42), followed by Europe (*k* = 22), North America (*k* = 19), Australia (*k* = 1) and one study was performed on multiple continents. More than half of the publications (*k* = 56, 65%) included a homogenous sample of only registered nurses the remainder included a mixed sample of at least 50 percent registered nurses. From the 85 publications found, three (Becker et al., 2020; Bourbonnais et al., 2011, Sampson et al., 2020) reported follow-up data of previously published papers (Becker et al., 2017; Bourbonnais et al., 2006; Sampson et al., 2019). To avoid double counting in assessing the effectiveness of the interventions, the data from these publications were combined. In addition, four publications reported studies including multiple experimental groups (Gunusen & Ustun, 2010; Onishi et al., 2016; Poulin et al., 2008; Sajadi et al., 2017). From these studies, one included two experimental groups of two different intervention categories and was therefore included as two separate interventions (Gunusen & Ustun, 2010). As a result, 83 interventions were included. Most comprised relaxation interventions (*k* = 35), followed by a mix of person-directed interventions (*k* = 17), cognitive behavioral interventions (*k* = 12), work skills interventions (*k* = 10), multilevel interventions (*k* = 5), and organization-directed interventions (*k* = 4).

Quality of the included studies

See figure 1 and figure 2 in the appendix for a visualization of the risk of bias assessment. Out of the 83 included interventions, the effectiveness of 58 interventions was assessed by the use of a randomized controlled trial. As for organization-directed interventions, individual

randomization is often not feasible, randomization on the department or hospital level was considered as 'low bias' in the quality assessment. Most articles did not report any information on the allocation process apart from stating that it was performed randomly, leading to an unclear bias for a number of interventions on this criterion. Furthermore, some interventions were labeled 'high bias' as employees were assigned to the intervention and control group based on employees` interest. Concerning selective reporting: Only 10 articles reported that the study was registered and the protocol was available online. For these articles we checked whether all intended measurements and measurement time points were reported. If no protocol was available (or the reported registration number did not work) the intervention received the label 'unclear bias' on selective reporting. For some of these articles, time points or outcomes mentioned in the methods section were not reported in the results section and as such received the label 'high bias' on selective reporting. Finally, blinding is almost impossible for the type of interventions that were assessed, and was therefore not included as quality assessment criterion.

Overall, we found evidence that interventions of low quality (one or more domains at high risk or no domain at low risk) deflated the effect of SMIs. The moderator analysis indicated that interventions of low quality reported lower effect sizes (g = 0.33, 95%CI (0.23-0.43), k = 46) compared to interventions of moderate to high quality (g = 0.54, 95%CI (0.39-0.69), k = 37) (Q = 5.62, p = .018). When comparting the quality of the intervention per intervention level, we found no significant difference between person-directed interventions of low quality (g = 0.39, 95%CI (0.26-0.52), k = 38) compared to person-directed interventions of moderate to high quality (g = 0.55, 95%CI (0.40-0.71), k = 36) (Q = 2.46, p = .117). Similar, we found no difference between low quality organization-directed interventions (g = 0.20, 95%CI (0.04-0.37), k = 4) versus the one publication of moderate to high quality (g = 0.31 95%CI (-0.08-0.69), k = 1) (Q =0.23, p = .635). All five multilevel interventions were coded low quality, which was mainly due to high drop out in these studies and/or a lack of randomization.

Intervention effectiveness

The SMIs had an overall medium effect on stress outcomes in comparison to control (Hedges' g = 0.42, 95%CI (0.34-0.51), p < .001, k = 83) (Cohen, 1992). Most studies included a measurement directly after the intervention (k = 58) and/or between one and six months after the intervention (k = 30). Only seven studies included a measurement more than six months

after the intervention. A calculation of the overall effect size based on the last point of measurement indicating long term effectiveness led to a similar effect size (g = 0.42, 95%CI (0.33-0.50), p < .001).

Table 1 shows the overall effect sizes for each intervention level, and time point of measurement. Organization-directed and multilevel interventions mainly focused on the outcomes burnout and psychological distress. Organization-directed interventions seemed little effective directly after the intervention, but (based on one study) a small significant effect was found in a follow-up measurement of more than six months after implementation. Multilevel interventions reached significant small effects on stress-related outcomes directly after the intervention, but insignificant effects more than one month after implementation. Person-directed interventions yielded large effect sizes on work-related stress (g = 0.89), followed by anxiety (g = 0.53) and smaller effect sizes for burnout symptoms, psychological distress, depression, fatigue and PTSD symptoms (respectively g = 0.30, g = 0.39, g = 0.31, g = 0.22, g = 0.26). Moderate to large effect sizes were found up till one month after the intervention, which seemed to decrease after this and led to an insignificant effect in the few studies (k = 6) measuring the effect six months after the intervention. To gain better understanding regarding the long-term effectiveness of person-directed interventions, we performed the analysis again including only person-directed interventions reporting a follow-up effect (k = 25). This resulted in a post effect of g = 0.38, 95%CI (0.24-0.52), p <.01, (k = 25), a follow-up effect of g = 0.38, 95%CI (0.19-0.58), p <.01, (k = 25) and a second follow-up effect of g = 0.35, (0.16-0.54), p <.01 (k = 6). Although this suggests that the effects of person-directed interventions remain stable over time, the time points of these follow-ups differed largely between studies (from within a month to over a year after the intervention), and thus this finding should be interpreted carefully. In addition, with only one out of three person- the result of publication bias. Studies that already find positive effects on the post-test might directed interventions reporting a follow-up measurement, it is also possible that this effect is be less likely to conduct follow-up measurements.

Moderators for person-directed interventions

Within the group of person-directed studies (k = 75) we found no significant difference between the type of intervention (cognitive behavioral, relaxation, work skills, mix of person-directed interventions) (Q = 3.15, p = .370). Similarly, we found no evidence for a moderation

Table 1. Overall analysis and analysis separately for each intervention level, each outcome, and time point of measurement.

		Overall (*k*=83)	**Person-directed (*k*=74)**	**Organization-directed (*k*= 4)**	**Multilevel (*k*=5)**
		Hedges g, 95%CI	*Hedges g*, 95%CI	*Hedges g*, 95%CI	*Hedges g*, 95%CI
Overall effect		0.42** (0.34-0.51)	0.47** (0.37-0.57)	0.12* (0.02-0.23)	0.22** (0.07-0.37)
	Heterogeneity test	Q=269.21**, I^2=70%	*Q*=230,81**, I^2=68%	*Q*=5.10, I^2=41%	Q=0.94, I^2=0%
Outcome †	Burnout	0.27** (0.18-0.35) (39)	0.30** (0.19-0.41) (33)	0.14 (0.01-0.27) (3)	0.25** (0.07-0.43) (3)
	Psych.Distr.	0.34** (0.24-0.44) (32)	0.39**(0.27-0.49) (28)	0.15 (-0.01-0.31) (1)	0.12 (-0.14-0.37) (3)
	Depression	0.29** (0.13-0.45) (25)	0.31** (0.14-0.47) (24)	0.03 (-0.19-0.25) (1)	*N/A*
	Anxiety	0.53** (0.29-0.76) (24)	0.53** (0.29-0.76) (24)	*N/A*	*N/A*
	Work rel. stress	0.85** (0.49-1.22) (15)	0.89** (0.50-1.29) (14)	*N/A*	0.42* (0.03-0.80) (1)
	Fatigue	0.22** (0.06-0.38) (10)	0.22** (0.06-0.38) (10)	*N/A*	*N/A*
	PTSD symptoms	0.26* (0.01-0.53) (6)	0.26* (0.01-0.52) (6)	*N/A*	*N/A*
Time point of measurement †	< 1 week after int.	0.40** (0.31-0.51) (58)	0.46** (0.35-0.56) (51)	0.09 (-0.06-0.24) (3)	0.20* (0.04-0.36) (4)
	1 week - ≤ 1 month	0.75** (0.50-1.00) (12)	0.75** (0.50-1.00) (12)	*N/A*	*N/A*
	>1 - ≤ 6 months	0.35** (0.20-0.50) (30)	0.37** (0.20-0.53) (28)	*N/A*	0.16 (0.06-0.38) (2)
	> 6 months	0.22* (0.03-0.40) (7)	0.23 (-0.05-0.51) (6)	0.18** (0.06-0.29) (1)	*N/A*

Note. **p < .01, * p < .05, number of studies between parentheses, † studies included multiple times, CI = Confidence Interval, N/A = not applicable, PD = Person-directed, Psych.Distr.= Psychological Distress, Work rel. stress = Work-related stress, PTSD symptoms = post-traumatic stress symptoms.

effect of the length of the intervention, the target group (primary or secondary intervention), or the type of control group used (see table 2). However, interventions in which the sample was exposed to the majority of the planned sessions reached greater effect sizes compared to interventions in which the exposure to the intervention/attendance to the planned sessions was lower (Q = 7.50, p = .006). In addition, interventions implemented in a sample of solely registered nurses reached greater effect sizes compared to interventions conducted in a mixed sample of at least 50% registered nurses (Q = 5.57, p = .018). The latter was mainly the case for cognitive behavioral interventions and work skills interventions, which showed significant effect sizes for studies conducted in a sample of registered nurses and non-significant effect sizes for studies conducted in a mixed sample.

The I^2 suggested moderate to substantial heterogeneity in all subgroups (cognitive behavioral interventions (86%), relaxation interventions (53%), the group of work skills interventions (50%), and the group including a mix of person-directed interventions (71%). To provide further insight, it was decided to repeat the moderator analyses for each type of person-directed intervention (see table 2). This resulted in one significant effect. The exposure to the intervention was a significant moderator in *relaxation interventions*: Interventions in which participants attended 80% or more of the scheduled sessions were more effective than interventions where participants attended less than 80% of the scheduled sessions (Q = 5.43, p = .02). Overall, there was a lot of missing data leading to a small number of studies per subgroup, therefore the results regarding the moderation analyses per type of intervention should be interpreted with caution.

Moderators for organization-directed interventions

There was moderate heterogeneity in the group of organization-directed studies (I^2 = 41%), whereas the group of multilevel interventions suggested an absence of heterogeneity (I^2 = 0%) and therefore an absence of moderators. However, the I^2 can be biased and should be interpreted with care, especially in small meta-analyses (e.g. less than 7 studies) (von Hippel, 2015). In addition, based on the small number of interventions it was decided to use a descriptive method rather than a moderation analysis to provide further insight in the effect of a participative approach. A closer look revealed that all organization-directed interventions (whether or not part of a multilevel approach) included their employees in the design and/or implementation. Three studies were based on participatory action research in which employees were empowered to find potential (psychosocial) stressors in the current working

Table 2. Moderators of intervention effectiveness of person-directed interventions

		All PD interventions (*k*=74)	**Cognitive Behavioral (*k*=12)**	**Relaxation (*k*=35)**	**Work skills (*k*=10)**	**Mix of PD interventions (*k*=17)**
		Hedges g, 95%CI	*Hedges g, 95%CI*	*Hedges g, 95%CI*	*Hedges g, 95%CI*	*Hedges g, 95%CI*
Overall effect		0.47** (0.37-0.57)	0.51** (0.15-0.86)	0.49** (0.37-0.61)	0.27* (0.04-0.50)	0.52** (0.31-0.73)
	Heterogeneity test	Q=230,81, $p < .01$ I^2=68%	$Q = 80.8$, $p < .01$ I^2=86%	$Q = 71.9$, $p < .01$ $I^2 = 53\%$	$Q = 17,82$, $p = .02$ $I^2 = 50\%$	$Q = 54.9$, $p < .01$ $I^2 = 71\%$
Length of intervention	≤ 1 week	0.40** (0.18-0.62) (8)	*N/A*	0.53** (0.16-0.89) (5)	0.25 (-0.02-0.51) (3)	*N/A*
	2-4 weeks	0.48**(0.24-0.71) (11)	0.33 (-0.05-0.72) (2)	0.51** (0.28-0.73) (5)	0.06 (-0.34-0.46) (1)	0.70 (-0.08-1.49) (3)
	5-8 weeks	0.49** (0.32-0.66) (31)	0.42 (-0.10-0.94) (6)	0.53** (0.30-0.75) (16)	0.12 (-0.36-0.60) (1)	0.54** (0.30-0.78) (8)
	9-12 weeks	0.44** (0.17-0.70) (9)	*N/A*	0.34* (0.02-0.67) (2)	0.25 (-0.24-0.75) (3)	0.84** (0.48-0.70) (3)
	>12 weeks	0.62** (0.21-1.03) (9)	1.16 (-0.82-3.13) (2)	0.56* (0.12-1.00) (4)	0.39 (-0.85-1.62) (2)	0.14 (-0.23-0.52) (1)
	Q for difference	$Q = .99$, $p = .910$	$Q = 0.99$, $p = .800$	$Q = 1.07$, $p = .900$	$Q = 0.85$, $p = .930$	$Q = 7.05$, $p = .070$
	Not reported	0.20** (0.06-0.34) (6)	0.40* (0.17-0.63) (2)	0.29 (-0.01-0.58) (3)	*N/A*	0.12 (-0.05-0.29) (2)
Exposure to intervention	High (≥80% sessions attended)	0.39** (0.27-0.52) (24)	0.47 (-0.01-0.95) (1)	0.46** (0.34-0.59) (14)	0.22 (-0.02-0.46) (4)	0.38 (-0.10-0.85) (5)
	Low (<80% sessions attended)	0.15** (0.04-0.27) (12)	0.23 (-0.04-0.51) (4)	0.19 (-0.01-0.38) (5)	0.06 (-0.34-0.46) (1)	0.17 (-0.32-0.66) (2)
	Q for difference	**$Q = 7.50$, $p = .006$**	$Q = 0.74$, $p = .390$	**$Q = 5.43$, $p = .020$**	$Q = 0.780$, $p = .677$	$Q = 0.349$, $p = .555$
	Not reported	0.61** (0.44-0.77) (38)	0.65 (-0.03-1.33) (7)	0.635** (0.40-0.87) (16)	0.33 (-0.17-0.83) (5)	0.631** (0.42-0.84) (10)
Target group	Primary interventions	0.44 (0.33-0.55) (59)	0.61* (0.13-1.09) (9)	0.44** (0.32-0.55) (28)	0.29*(0.03-0.55) (9)	0.45** (0.22-0.68) (13)
	Secondary interventions	0.60 (0.33-0.86) (15)	0.07 (-0.12-0.26) (3)	0.76** (0.33-1.18) (7)	0.12 (-0.36-0.60) (1)	0.77** (0.36-0.72) (4)
	Q for difference	$Q = 1.18$, $p = .277$	$Q = 1.60$, $p = .110$	Q=2.07, $p = .150$	$Q = 0.38$, p=.539	$Q = 1.83$, $p = .175$

Note. ** $p < .01$, * $p < .05$, number of interventions between parentheses, PD = person-directed, N/A = Not applicable

Table 2. *Continued*

		All PD interventions (*k*=74)	**Cognitive Behavioral (*k*=12)**	**Relaxation (*k*=35)**	**Work skills (*k*=10)**	**Mix of PD interventions (*k*=17)**
		Hedges g, 95%CI	*Hedges g, 95%CI*	*Hedges g, 95%CI*	*Hedges g, 95%CI*	*Hedges g, 95%CI*
Sample	Sample 100% RN	0.54** (0.41-0.68) (51)	0.69* (0.04-1.34) (7)	0.55** (0.39-0.71) (23)	0.36** (0.09-0.63) (7)	0.55** (0.30-0.80) (14)
	Mixed sample >50% RN	0.32** (0.19-0.45) (23)	0.24 (-0.01-0.48) (5)	0.39** (0.20-0.57) (12)	0.02 (-0.38-0.42) (3)	0.40* (0.02-0.78) (3)
	Q for difference	**Q = 5.57, *p* = .018**	*Q* = 1.65, *p* = .200	*Q* = 1.70, *p* = .190	*Q* = 1.90, *p* = .170	Q = 0.425, *p* = .514
Control group	Minimal intervention	0.50** (0.34-0.66) (22)	0.61 (-0.18-1.39) (4)	0.45** (0.30-0.61) (11)	0.60 (0.04-1-15) (3)	0.46** (0.18-0.74) (4)
	Standard care	0.49** (0.32-0.66) (36)	0.59 (-0.11-1.28) (5)	0.53** (0.28-0.79) (15)	0.14 (-0.07-0.35) (6)	0.62** (0.27-0.97) (10)
	Waitlist control	0.28** (0.13-0.44) (12)	0.02 (-0.18-0.23) (1)	0.41** (0.23-0.60) (8)	0.19 (-0.24-0.62) (1)	0.19 (-0.12-0.50) (2)
	Q for difference	*Q* = 4.64, *p* = .099	*Q* = 4.067, *p* = .131	*Q* = 0.597, *p* = .740	*Q* = 2.24, *p* = .326	*Q* = 3.41, *p* = .182
	Not reported	0.54** (0.29-0.78) (4)	0.47* (0.09-0.85) (2)	0.60** (0.20-1.00) (1)	*N/A*	0.55 (-0.02-1.13) (1)

Note. **$p < .01$, * $p < .05$, number of interventions between parentheses, PD = person-directed, N/A = Not applicable

situation and develop and initiate solutions for these (Bourbonnais et al., 2011; Le Blanc et al., 2007; Uchiyama et al., 2013). One study included an intervention based upon lean principles (e.g. a process in which the workflow is optimized to reduce waste of resources). This was implemented during a transformational process from a hierarchical hospital setting to one including a participative management style in which decisions were made in consultation with the employees (Van Bogaert et al., 2014). Two other studies included job crafting which is by content an intervention in which the employee is empowered to make changes in his or her work and/or working environment (Gordon et al., 2018; Muller et al., 2015). One study included a web-based SMI in which employees were particularly involved during the developmental phase by the use of focus groups (Hersch et al., 2016). Finally, one study included a team-based civility training for employees. Which, although this was most likely initiated by management considering the content of the intervention, the intervention itself included a participative approach; Nurses identified problems regarding incivility amongst employees, and developed and implemented actions (Leiter et al., 2011).

Publication bias

A visual examination of the funnel plot suggested asymmetry in the found effect sizes which was confirmed by Egger's test of the intercept (intercept 1.69, 95%CI (0.93-2.45), t (81) = 4.43, $p < .001$). Duval and Tweedie's trim and fill analysis indicated a potential lack of 14 studies with higher effect sizes (see appendix figure 3). After statistical imputation of these studies, the adjusted effect size would still include a medium effect (from g = 0.42, 95%CI (0.34-0.51) to g = 0.52, 95%CI (0.42-0.61)). The trim and fill analysis indicated no absence of studies with lower effect sizes. As such, we can conclude that potential publication bias may have resulted in the reported results regarding effectiveness being slightly conservative

Discussion

The current meta-analysis aims to assess the effectiveness of stress management interventions (SMIs) for registered nurses working in a hospital setting and to identify moderating factors concerning interventions characteristics and the use of a participatory approach (i.e. involvement of employees in designing and/or implementing the intervention). In addition, potentially biasing effects regarding the study design and quality were assessed. Based on 85 publications including 83 interventions, an overall medium effect of SMIs on stress-related outcomes was found (Hedges' g = 0.42, 95%CI (0.34-0.51), $p < .001$). This result confirms and

quantifies findings of previous (systematic) reviews that SMIs can effectively prevent and/or reduce stress-related outcomes in the nursing population (Henry, 2014; Mimura & Griffiths, 2003; Wentzel & Brysiewicz, 2017).

Concerning the level of the intervention, the results show that person-directed, organization-directed and multilevel interventions can all effectively reduce stress-related outcomes compared to a control group. However, against our expectations multilevel interventions did not reach greater effect sizes compared to the other approaches. Instead, a solely person-directed approach was significantly more effective in reducing and/or preventing stress-related outcomes than either a solely organization-directed or multilevel approach. Two issues can explain this finding.

First of all, methodological difficulties in assessing the effect of an organization-directed intervention (with or without a person-directed intervention) could have led to an underestimation of their effectiveness (Nielsen & Noblet, 2018). For example, in organization-directed and multilevel studies the effect is often based on whether an intervention was implemented in the department/organization rather than who received the intervention. Since it is unlikely that all employees in the department/organization were equally exposed to the intervention, this might lead to small effect sizes (Nielsen & Noblet, 2018; Randall et al., 2005). It has been suggested that comparing the exposed to the unexposed employees gives a better grasp of the intervention effectiveness in these studies than the comparison of an intervention with a control group (Randall et al., 2005). Furthermore, in contrast to person-directed interventions, studies evaluating an organization-directed or multilevel intervention often use department based or hospital based allocation to create control and intervention groups, which makes it more difficult to control for possible confounding variables (e.g. management style or organizational culture) (Nielsen & Noblet, 2018).

Second, due to differences in follow-up data collection across the studies, we can only conclude that person-directed interventions are more effective directly after the intervention. Yet, organization-directed interventions often work preventative and their effectiveness is more likely to appear over time (Randall et al., 2005). In comparison, person-directed interventions can yield high effect sizes on the short term, but these effects might wear off if the intervention is not practiced regularly and integrated into the daily routine (van Wyk &

Pillay-Van Wyk, 2010). Indeed, we found moderate to large effect sizes for person-directed interventions up till and including one month after the intervention, but the few studies using a follow-up measurement after six months showed no significant effects at all. In comparison, for organization-directed interventions the first significant effect size was reported six months or longer after the intervention. Similar findings, including short term effectiveness for person-directed and long-term effectiveness for organization-directed interventions, have been reported in narrative reviews on burnout interventions (Awa et al., 2010; Westermann et al., 2014). Finally, it must be noted that only a small amount (8%) of the person-directed interventions in the current meta-analysis included a follow-up measurement longer than six months after the intervention. For an adequate comparison of the long-term effectiveness of person-directed and organization-directed interventions, long term follow-up measurements are necessary.

Next to the level of the intervention, the current meta-analysis assessed moderators regarding intervention characteristics, study design for person-directed interventions and the effect of a participatory approach for organization-directed interventions. For person-directed interventions moderating effects were found regarding exposure to the intervention and the sample (registered nurses only versus a mixed sample) but not for the type of intervention (cognitive behavioral, relaxation, work skills or a mix), the length of the intervention, the target group (primary versus secondary) or the control group used. For organization-directed interventions all studies included some form of employee involvement and therefore the effect of a participatory approach could not be assessed. The findings are discussed in more detail below.

In line with previous meta-analyses regarding SMIs for the working population in general (Richardson & Rothstein, 2008; van der Klink et al., 2001), it was expected that cognitive behavioral interventions would yield greater effect sizes than other person-directed interventions. However, no significant moderating effect regarding the type of intervention implemented was found in the current study. This result is similar to the findings of the meta-analysis of Ruotsalainen et al., 2015 regarding SMIs for healthcare professionals, in which cognitive behavioral interventions and relaxation interventions yielded comparable effect sizes. It is possible that the nursing profession (and perhaps healthcare in general) attracts and retains people with better coping and problem-solving skills. In addition, there is increased attention

for the development of "soft skills" (including problem solving skills) in nursing education programs (Ng, 2020). As such, cognitive behavioral interventions might focus on enhancing skills that are (at least up to a certain level) present in this population and thus not necessarily lead to greater effects on stress levels than other person-directed interventions.

Second, as person-directed interventions include learning new skills, and as such require changes in thought patterns and/or behavior, we expected that the effects of these interventions would be stronger in case of longer interventions and when nurses attended the majority of the planned sessions (i.e. had greater exposure to the intervention). Although the results showed no moderating effect for the length of the intervention, exposure to the sessions (i.e. interventions in which the sample attended the majority of the planned sessions) was related to greater effect sizes. This may also explain why previous meta-analyses regarding SMIs for the general working population have found limited evidence that the length of the intervention mattered in the overall effect (Richardson & Rothstein, 2008; van der Klink et al., 2001), and suggests that brief interventions may be just as effective as longer interventions as long as participants attend the sessions. These findings are important in terms of practical implications. For example, considering the busy schedules of nurses, brief person-directed interventions can be considered to (at least on the short term) relieve stress-related symptoms. In addition, when conducting person-directed interventions, special care should be taken to increase adherence. This could for example be achieved by implementing the intervention at work and/or during worktime. Nevertheless, it must be noted that many studies (k = 38) did not evaluate attendance to the sessions and thus this finding should be interpreted carefully.

Another moderating effect was found for the sample; person-directed interventions were more effective in a sample including solely registered nurses compared to a mixed sample in which the majority were registered nurses. This seemed mainly the case for cognitive behavioral interventions and work skills interventions. A potential explanation is that these interventions are more occupation specific including discussing cases, and practicing coping and/or work skills to deal more effectively with these situations in the future. As such, it is possible that the content of these interventions was fitted to the majority of the sample (i.e. the nursing population) and thus appealed less to other healthcare professionals also joining the intervention. In comparison, relaxation interventions are less likely to include the content

of work and rather focus on reducing the stress response. This finding may also indicate that tailoring the content of the cognitive behavioral or work skills intervention to different target populations could increase the effectiveness of person-directed interventions. Nevertheless, to understand if tailoring indeed played a role in the current effect found, better reporting is necessary regarding the content by which the interventions were designed and implemented.

Finally, the current results suggest a possible moderation effect of the type of outcome used in the study. For example, we found the largest effect size on work-related stress, followed by anxiety, whereas effect sizes for burnout symptoms, psychological distress, symptoms of depression, fatigue and post-traumatic stress symptoms were smaller. A potential explanation is that work-related stress and to a certain level anxiety, indicate levels of experienced stress rather than stress-related outcomes or strain and thus may be more sensitive to change. For example, work-related stress was mainly measured with the Nursing Stress Scale, which asks nurses to indicate how stressful they experience certain work situations. In addition, anxiety in the current study mainly reflects "state anxiety" (i.e. reactions directly related to certain situations) rather than more stable levels of anxiety. Overall, it is possible that person-directed interventions are very effective in reducing stress levels, whereas more intensive interventions (e.g. therapy sessions with a psychologist) are necessary to reduce the more severe stress reactions (e.g. symptoms of burnout and post-traumatic stress). Another possibility is that it takes more time until effects of SMIs are reflected in stress reactions that are less sensitive to change. To understand the effectiveness of SMIs on different stress-related outcomes over different time frames, as mentioned previously, more long-term follow-up measurements are necessary in intervention evaluation studies.

Concerning organization-directed interventions (with or without a person-directed intervention) we mainly focused on one success factor: The use of a participatory approach in the design and implementation of the intervention (Nielsen & Randall, 2012). However, only a few studies including an organization-directed intervention were found and all studies involved their employees in the design and/or implementation of the intervention, at least to a certain extend. This indicates that the importance of employee involvement is not only recognized by scholars in the field but also seems to have become the norm in organization-directed interventions. Yet, the overall effect sizes for these types of interventions were rather small and few studies reported on other success factors (readiness for change, management

support) or barriers encountered (budget cuts, other interventions implemented during the study period). In fact, only one of the included studies performed and reported the effects of a process evaluation (Uchiyama et al., 2013), which led to an informative list of obstacles and success factors that might have influenced the intervention effectiveness. Standard incorporation of process evaluations is warranted to fully understand and improve the effectiveness of these types of interventions. Further guidance on how to pursue such evaluations can be found in publications by Abildgaard et al. (2016) and Nielsen and Noblet (2018).

Limitations

As with all meta-analyses, publication bias might have affected the current findings. However, the statistical techniques used indicated that in case of any publication bias, the current results are more likely to be conservative rather than an overestimation of the effect. Second, we could only include a small number of organization-directed and multilevel interventions. This seems to be a common problem of meta-analyses on SMIs and can be explained in various ways. First, studies including organization-directed interventions might be performed less often as it is far more difficult for researchers to convince organizations to take part in an intervention that would involve changes to work processes or the working environment. Second, some studies might have been excluded from the current meta-analysis as the criterion of a control group is more difficult to meet for these types of studies (Nielsen et al., 2016). Although there is no strict rule regarding the minimum number of studies within a meta-analysis (Sterne et al., 2000), our results concerning the effectiveness of organization-directed and multilevel interventions might be less reliable.

Finally, the current meta-analysis was limited by suboptimal reporting in the intervention studies. First of all, some studies could not be included as important statistical information was missing. Second, incomplete reporting in the included studies made it difficult to assess the quality of the study and adequately examine moderating factors. A number of possible moderators were considered but had to be omitted due to limited reporting: the place of intervening (in the work setting, an external setting or at home), when the intervention took place (during work time, during leisure time), the qualification of the instructor (qualified, not qualified, self-instructed), the delivery of the intervention (group based, individual based), and the involvement of employees in the design and implementation of person-directed

interventions. Third, it is possible that cultural values moderated the uptake of SMIs (Kotera, van Laethem, & Ohshima, 2020). However, cultural values are hardly reported in SMI studies and determining cultural values (e.g. collectivistic versus individualistic cultures) based on the country of study is strongly discouraged (Sawang et al., 2016). It was therefore decided not to perform such an analysis. Finally, future meta-analyses might consider the possible moderating effects of other contextual factors including starting conditions of the intervention (e.g. intervention fatigue among employees, informal social norms), changes during the intervention (e.g. downsizing, budget cuts, restructuring of the organization) (Nytro, 2000, Nielsen et al. 2017) and whether or not the implemented intervention fits the current causes of work stress (e.g. was the intervention based on a risk assessment) (Nielsen & Randall, 2013). Nevertheless, to conduct these moderation analyses, improved reporting is necessary. We therefore strongly encourage the use of reporting guidelines such as the 'template for intervention description and replication (TIDieR)' checklist (Hoffmann et al., 2014) and the incorporation of process evaluations (Nielsen et al., 2018; Abildgaard et al., 2016) in future studies.

Finally, as the current study also includes interventions aimed at improving the working environment, it was decided to focus on one specific setting, namely the hospital setting. As such, we cannot be certain about the generalizability of the current findings to other care contexts (e.g. nursing homes, mental health institutions, ambulatory care). Still, as there are some similarities regarding the tasks of nurses working in different settings (e.g. in all settings nurses face emotional demands), this is mainly a concern regarding the results of organization-directed and multilevel interventions and less for the results of person-directed interventions.

Concluding remarks

In conclusion, the current meta-analysis shows that SMIs for nurses working in a hospital setting can effectively reduce and/or prevent stress-related outcomes. Although person-directed interventions were more effective than organization-directed and multilevel interventions, we can only conclude this in terms of short-term effectiveness. Concerning person-directed interventions, the results indicate that interventions conducted in a sample of solely registered nurses, in which attendance was high and the effect was measured on stress-related outcomes that are more sensitive to change, are more likely to yield larger (short term) effects. Concerning organization-directed interventions, the importance of involving employees in the development and/or implementation of interventions seems highly

recognized. Still effect sizes for these interventions remain rather low. To further understand factors that contribute to the effectiveness of SMIs for the nursing population, better reporting on intervention characteristics, and the process of design and implementation is necessary. Furthermore, to determine the longevity of their effects, long term measurements especially for person-directed interventions are needed.

References

References marked with an asterisk (*) indicate studies included in the meta-analysis.

Abildgaard, J. S., Saksvik, P. O., & Nielsen, K. (2016). How to Measure the Intervention Process? An Assessment of Qualitative and Quantitative Approaches to Data Collection in the Process Evaluation of Organizational Interventions. *Front Psychol*, *7*, 1380. https://doi.org/10.3389/fpsyg.2016.01380

Aiken, L. H., Clarke, S. P., Sloane, D. M., Sochalski, J., & Silber, J. H. (2002). Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*, *288*(16), 1987-1993. https://doi.org/10.1001/jama.288.16.1987

*Akyurek, G., Avci, N., & Ekici, G. (2020). The effects of "Workplace Health Promotion Program" in nurses: A randomized controlled trial and one-year follow-up. *Health Care Women Int*, 1-17. https://doi.org/10.1080/07399332.2020.1800013

*Alexander, G. K., Rollins, K., Walker, D., Wong, L., & Pennings, J. (2015). Yoga for Self-Care and Burnout Prevention Among Nurses. *Workplace Health Saf*, *63*(10), 462-470; quiz 471. https://doi.org/10.1177/2165079915596102

Awa, W. L., Plaumann, M., & Walter, U. (2010). Burnout prevention: a review of intervention programs. *Patient Educ Couns*, *78*(2), 184-190. https://doi.org/10.1016/j.pec.2009.04.008

Bakker, A. B., & Demerouti, E. (2017). Job demands-resources theory: Taking stock and looking forward. *J Occup Health Psychol*, *22*(3), 273-285. https://doi.org/10.1037/ocp0000056

*Barattucci, M., Padovan, A. M., Vitale, E., Rapisarda, V., Ramaci, T., & De Giorgio, A. (2019). Mindfulness-Based IARA Model((R)) Proves Effective to Reduce Stress and Anxiety in Health Care Professionals. A Six-Month Follow-Up Study. *Int J Environ Res Public Health*, *16*(22). https://doi.org/10.3390/ijerph16224421

Beck, A. T., & Dozois, D. J. (2011). Cognitive therapy: current status and future directions. *Annu Rev Med*, *62*, 397-409. https://doi.org/10.1146/annurev-med-052209-100032

Beck, C., McSweeney, J. C., Richards, K. C., Roberson, P. K., Tsai, P. F., & Souder, E. (2010). Challenges in tailored intervention research. *Nurs Outlook*, *58*(2), 104-110. https://doi.org/10.1016/j.outlook.2009.10.004

*Becker, A., Angerer, P., & Muller, A. (2017). The prevention of musculoskeletal complaints: a randomized controlled trial on additional effects of a work-related psychosocial coaching intervention compared to physiotherapy alone. *Int Arch Occup Environ Health*, *90*(4), 357-371. https://doi.org/10.1007/s00420-017-1202-6

*Becker, A., Angerer, P., Weber, J., & Muller, A. (2020). The prevention of musculoskeletal complaints: long-term effect of a work-related psychosocial coaching intervention compared to physiotherapy alone-a randomized controlled trial. *Int Arch Occup Environ Health*, *93*(7), 877-889. https://doi.org/10.1007/s00420-020-01538-1

Beder, J. (2016). Loss of the Assumptive World—How We Deal with Death and Loss. *OMEGA - Journal of Death and Dying*, *50*(4), 255-265. https://doi.org/10.2190/gxh6-8vy6-bq0r-gc04

Boivin, D. B., Boudreau, P., James, F. O., & Kin, N. M. (2012). Photic resetting in night-shift work: impact on nurses' sleep. *Chronobiol Int*, *29*(5), 619-628. https://doi.org/10.3109/07420528.2012.675257

*Bolier, L., Ketelaar, S. M., Nieuwenhuijsen, K., Smeets, O., Gärtner, F. R., & Sluiter, J. K. (2014). Workplace mental health promotion online to enhance well-being of nurses and allied health professionals: A cluster-randomized controlled trial. *Internet Interventions*, *1*(4), 196-204. https://doi.org/10.1016/j.invent.2014.10.002

Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2009). *Introduction to meta-analysis.* Wiley.

Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2013). *Comprehensive Meta-Analysis Version 3*. Biostat.

*Bourbonnais, R., Brisson, C., & Vezina, M. (2011). Long-term effects of an intervention on psychosocial work factors among healthcare professionals in a hospital setting. *Occup Environ Med*, *68*(7), 479-486. https://doi.org/10.1136/oem.2010.055202

*Bourbonnais, R., Brisson, C., Vinet, A., Vezina, M., Abdous, B., & Gaudet, M. (2006). Effectiveness of a participative intervention on psychosocial work factors to prevent mental health problems in a hospital setting. *Occup Environ Med*, *63*(5), 335-342. https://doi.org/10.1136/oem.2004.018077

*Brooks, D. M., Bradt, J., Eyre, L., Hunt, A., & Dileo, C. (2010). Creative approaches for reducing burnout in medical personnel. *Arts in Psychotherapy*, *37*(3), 255-263. https://doi.org/10.1016/j.aip.2010.05.001

*Calisi, C. C. (2017). The Effects of the Relaxation Response on Nurses' Level of Anxiety, Depression, Well-Being, Work-Related Stress, and Confidence to Teach Patients. *J Holist Nurs*, *35*(4), 318-327. https://doi.org/10.1177/0898010117719207

*Chen, H. M., Wang, H. H., & Chiu, M. H. (2016). Effectiveness of a Releasing Exercise Program on Anxiety and Self-Efficacy Among Nurses. *West J Nurs Res*, *38*(2), 169-182. https://doi.org/10.1177/0193945914555405

Chen, M. C., Fang, S. H., & Fang, L. (2015). The effects of aromatherapy in relieving symptoms related to job stress among nurses. *Int J Nurs Pract*, *21*(1), 87-93. https://doi.org/10.1111/ijn.12229

*Chen, S. H., Chen, S. C., Lee, S. C., Chang, Y. L., & Yeh, K. Y. (2017). Impact of interactive situated and simulated teaching program on novice nursing practitioners' clinical competence, confidence, and stress. *Nurse Educ Today*, *55*, 11-16. https://doi.org/10.1016/j.nedt.2017.04.025

*Cheng, S. T., Tsui, P. K., & Lam, J. H. (2015). Improving mental health in health care practitioners: randomized controlled trial of a gratitude intervention. *J Consult Clin Psychol*, *83*(1), 177-186. https://doi.org/10.1037/a0037895

*Chesak, S. S., Bhagra, A., Schroeder, D. R., Foy, D. A., Cutshall, S. M., & Sood, A. (2015). Enhancing Resilience Among New Nurses: Feasibility and Efficacy of a Pilot Intervention. *Ochsner Journal*, *15*(1), 38-44. MID: 25829879; PMCID: PMC4365845.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155-159. https://doi.org/10.1037/0033-2909.112.1.155

*Daigle, S., Talbot, F., & French, D. J. (2018). Mindfulness-based stress reduction training yields improvements in well-being and rates of perceived nursing errors among hospital nurses. *J Adv Nurs*, *74*(10), 2427-2430. https://doi.org/10.1111/jan.13729

*Darban, F., Balouchi, A., Narouipour, A., Safarzaei, E., & Shahdadi, H. (2016). Effect of Communication Skills Training on the Burnout of Nurses: A Cross-Sectional Study. *J Clin Diagn Res*, *10*(4), IC01-IC04. https://doi.org/10.7860/JCDR/2016/19312.7667

*Duarte, J., & Pinto-Gouveia, J. (2016). Effectiveness of a mindfulness-based intervention on oncology nurses' burnout and compassion fatigue symptoms: A non-randomized study. *Int J Nurs Stud*, *64*, 98-107. https://doi.org/10.1016/j.ijnurstu.2016.10.002

Duchemin, A. M., Steinberg, B. A., Marks, D. R., Vanover, K., & Klatt, M. (2015). A small randomized pilot study of a workplace mindfulness-based intervention for surgical intensive care unit personnel: effects on salivary alpha-amylase levels. *J Occup Environ Med*, *57*(4), 393-399. https://doi.org/10.1097/JOM.0000000000000371

*Dunne, P. J., Lynch, J., Prihodova, L., O'Leary, C., Ghoreyshi, A., Basdeo, S. A., . . . White, B. (2019). Burnout in the emergency department: Randomized controlled trial of an attention-based training program. *J Integr Med*, *17*(3), 173-180. https://doi.org/10.1016/j.joim.2019.03.009

Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, *56*(2), 455-463. https://doi.org/10.1111/j.0006-341x.2000.00455.x

Edwards, D., & Burnard, P. (2003). A systematic review of stress and stress management interventions for mental health nurses. *J Adv Nurs*, *42*(2), 169-200. https://doi.org/10.1046/j.1365-2648.2003.02600.x

Egger, M., Davey Smith, G., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, *315*(7109), 629-634. https://doi.org/10.1136/bmj.315.7109.629

Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. *FASEB J*, *22*(2), 338-342. https://doi.org/10.1096/fj.07-9492LSF

*Fang, R., & Li, X. (2015). A regular yoga intervention for staff nurse sleep quality and work stress: a randomised controlled trial. *J Clin Nurs*, *24*(23-24), 3374-3379. https://doi.org/10.1111/jocn.12983

*Geary, C., & Rosenthal, S. L. (2011). Sustained impact of MBSR on stress, well-being, and daily spiritual experiences for 1 year in academic health care employees. *J Altern Complement Med*, *17*(10), 939-944. https://doi.org/10.1089/acm.2010.0335

*Ghawadra, S. F., Lim Abdullah, K., Choo, W. Y., Danaee, M., & Phang, C. K. (2020). The effect of mindfulness-based training on stress, anxiety, depression and job satisfaction among ward nurses: A randomized control trial. *J Nurs Manag*, *28*(5), 1088-1097. https://doi.org/10.1111/jonm.13049

*Ghazavi, Z., Mardany, Z., & Pahlavanzadeh, S. (2016). Effect of happiness educational program on the level of stress, anxiety and depression of the cancer patients' nurses. *Iran J Nurs Midwifery Res*, *21*(5), 534-540. https://doi.org/10.4103/1735-9066.193419

Gholipour Baradari, A., Alipour, A., Mahdavi, A., Sharifi, H., Nouraei, S. M., & Emami Zeydi, A. (2018). The Effect of Zinc Supplementation on Sleep Quality of ICU Nurses: A Double Blinded Randomized Controlled Trial. *Workplace Health Saf*, *66*(4), 191-200. https://doi.org/10.1177/2165079917734880

*Gholizadeh, M., Khademohosseini, S. M., Mokhtari Nouri, J., & Ahmaditahoor, M. (2017). The Effect of Mindfulness Intervention on Job Stress in Nurses of Intensive Care Units. *Journal of Critical Care Nursing*, *10*(3). https://doi.org/10.5812/ccn.57555

Gilmartin, H., Goyal, A., Hamati, M. C., Mann, J., Saint, S., & Chopra, V. (2017). Brief Mindfulness Practices for Healthcare Providers - A Systematic Literature Review. *Am J Med*, *130*(10), 1219 e1211-1219 e1217. https://doi.org/10.1016/j.amjmed.2017.05.041

*Gordon, H. J., Demerouti, E., Le Blanc, P. M., Bakker, A. B., Bipp, T., & Verhagen, M. A. M. T. (2018). Individual job redesign: Job crafting interventions in healthcare. *Journal of Vocational Behavior*, *104*, 98-114. https://doi.org/10.1016/j.jvb.2017.07.002

*Grabbe, L., Higgins, M. K., Baird, M., Craven, P. A., & San Fratello, S. (2020). The Community Resiliency Model(R) to promote nurse well-being. *Nurs Outlook*, *68*(3), 324-336. https://doi.org/10.1016/j.outlook.2019.11.002

*Gunusen, N. P., & Ustun, B. (2010). An RCT of coping and support groups to reduce burnout among nurses. *Int Nurs Rev*, *57*(4), 485-492. https://doi.org/10.1111/j.1466-7657.2010.00808.x

*Habibian, Z., Sadri, Z., & Nazmiyeh, H. (2018). Effects of Group Acceptance and Commitment Therapy -Based Training on Job Stress and Burnout among Pediatric Oncology and Special Diseases Nurses. *Iranian Journal of Pediatric Hematology and Oncology*, *8*(2), 118-125.

Heaney, C. A., & van Ryn, M. (1990). Broadening the scope of worksite stress programs: a guiding framework. *Am J Health Promot*, *4*(6), 413-420. https://doi.org/10.4278/0890-1171-4.6.413

*HemmatiMaslakpak, M., Farhadi, M., & Fereidoni, J. (2016). The effect of neuro-linguistic programming on occupational stress in critical care nurses. *Iran J Nurs Midwifery Res*, *21*(1), 38-44. https://doi.org/10.4103/1735-9066.174754

Henry, B. J. (2014). Nursing burnout interventions: what is being done? *Clin J Oncol Nurs*, *18*(2), 211-214. https://doi.org/10.1188/14.CJON.211-214

*Hersch, R. K., Cook, R. F., Deitz, D. K., Kaplan, S., Hughes, D., Friesen, M. A., & Vezina, M. (2016). Reducing nurses' stress: A randomized controlled trial of a web-based stress management program for nurses. *Appl Nurs Res*, *32*, 18-25. https://doi.org/10.1016/j.apnr.2016.04.003

Higgins, J. P. T., Altman, D. G., & Jonathan, A. C. (2011). 16.5.4 How to include multiple groups from one study. In J. P. T. Higgins & S. Green (Eds.), *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0* The Cochrane Collaboration. www.handbook.cochrane.org.

Holman, D., Johnson, S., & O'Connor, E. (2018). Stress management interventions: Improving subjective psychological well-being in the workplace. In E. Diener, S. Oishi, & L. Tay (Eds.), *Handbook of well-being*. DEF Publishers. https://doi.org/nobascholar.com

*Horner, J. K., Piercy, B. S., Eure, L., & Woodard, E. K. (2014). A pilot study to evaluate mindfulness as a strategy to improve inpatient nurse and patient experiences. *Appl Nurs Res*, *27*(3), 198-201. https://doi.org/10.1016/j.apnr.2014.01.003

*Inoue, M., Kaneko, F., & Okamura, H. (2011). Evaluation of the effectiveness of a group intervention approach for nurses exposed to violent speech or violence caused by patients: a randomized controlled trial. *ISRN Nurs*, *2011*, 325614. https://doi.org/10.5402/2011/325614

Ivancevich, J. M., Matteson, M. T., Freedman, S. M., & Phillips, J. S. (1990). Worksite stress management interventions. *Am Psychol*, *45*(2), 252-261. https://doi.org/10.1037//0003-066x.45.2.252

*Jakel, P., Kenney, J., Ludan, N., Miller, P. S., McNair, N., & Matesic, E. (2016). Effects of the Use of the Provider Resilience Mobile Application in Reducing Compassion Fatigue in Oncology Nursing. *Clin J Oncol Nurs*, *20*(6), 611-616. https://doi.org/10.1188/16.CJON.611-616

Karlsson, P., & Bergmark, A. (2015). Compared with what? An analysis of control-group types in Cochrane and Campbell reviews of psychosocial treatment efficacy with substance use disorders. *Addiction*, *110*(3), 420-428. https://doi.org/10.1111/add.12799

*Karpaviciute, S., & Macijauskiene, J. (2016). The Impact of Arts Activity on Nursing Staff Well-Being: An Intervention in the Workplace. *Int J Environ Res Public Health*, *13*(4), 435, Article 435. https://doi.org/10.3390/ijerph13040435

Keng, S.-L., Choo, X., & Tong, E. M. W. (2018). Association between Trait Mindfulness and Variability of Coping Strategies: a Diary Study. *Mindfulness*, *9*(5), 1423-1432. https://doi.org/10.1007/s12671-018-0885-4

*Kersten, M., Vincent-Hoper, S., Krampitz, H., & Nienhaus, A. (2019). Development and evaluation of a training program for dialysis nurses - an intervention study. *J Occup Med Toxicol*, *14*, 3. https://doi.org/10.1186/s12995-019-0223-3

*Ketelaar, S. M., Nieuwenhuijsen, K., Gartner, F. R., Bolier, L., Smeets, O., & Sluiter, J. K. (2013). Effect of an E-mental health approach to workers' health surveillance versus control group on work functioning of hospital employees: a cluster-RCT. *PLoS One*, *8*(9), e72546. https://doi.org/10.1371/journal.pone.0072546

*Kharatzadeh, H., Alavi, M., Mohammadi, A., Visentin, D., & Cleary, M. (2020). Emotional regulation training for intensive and critical care nurses. *Nurs Health Sci*, *22*(2), 445-453. https://doi.org/10.1111/nhs.12679

*Kim, S. H., Schneider, S. M., Bevans, M., Kravitz, L., Mermier, C., Qualls, C., & Burge, M. R. (2013). PTSD symptom reduction with mindfulness-based stretching and deep breathing exercise: randomized controlled clinical trial of efficacy. *J Clin Endocrinol Metab*, *98*(7), 2984-2992. https://doi.org/10.1210/jc.2012-3742

*Koivu, A., Saarinen, P. I., & Hyrkas, K. (2012). Does clinical supervision promote medical-surgical nurses' well-being at work? A quasi-experimental 4-year follow-up study. *J Nurs Manag*, *20*(3), 401-413. https://doi.org/10.1111/j.1365-2834.2012.01388.x

*Kubota, Y., Okuyama, T., Uchida, M., Umezawa, S., Nakaguchi, T., Sugano, K., . . . Akechi, T. (2016). Effectiveness of a psycho-oncology training program for oncology nurses: a randomized controlled trial. *Psychooncology*, *25*(6), 712-718. https://doi.org/10.1002/pon.4000

Kurebayashi, L. F., & da Silva, M. J. (2015). Chinese auriculotherapy to improve quality of life of nursing team. *Rev Bras Enferm*, *68*(1), 109-115, 117-123. https://doi.org/10.1590/0034-7167.2015680116p

Lally, P., & Gardner, B. (2013). Promoting habit formation. *Health Psychology Review*, *7*(1), 137-158. https://doi.org/10.1080/17437199.2011.603640

Lamontagne, A. D., Keegel, T., Louie, A. M., Ostry, A., & Landsbergis, P. A. (2007). A systematic review of the job-stress intervention evaluation literature, 1990-2005. *Int J Occup Environ Health*, *13*(3), 268-280. https://doi.org/10.1179/oeh.2007.13.3.268

*Lary, A., Borimnejad, L., & Mardani-Hamooleh, M. (2019). The Impact of a Stress Management Program on the Stress Response of Nurses in Neonatal Intensive Care Units: A Quasi-Experimental Study. *J Perinat Neonatal Nurs*, *33*(2), 189-195. https://doi.org/10.1097/JPN.0000000000000396

Lazarus, R. S. (1995). Psychological stress in the workplace. *Occupational stress: A handbook.* (pp. 3-14). Taylor & Francis.

*Le Blanc, P. M., Hox, J. J., Schaufeli, W. B., Taris, T. W., & Peeters, M. C. (2007). Take care! The evaluation of a team-based burnout intervention program for oncology care providers. *J Appl Psychol*, *92*(1), 213-227. https://doi.org/10.1037/0021-9010.92.1.213

Leao, E. R., Dal Fabbro, D. R., Oliveira, R. B., Santos, I. R., Victor, E. D., Aquarone, R. L., . . . Ferreira, D. S. (2017). Stress, self-esteem and well-being among female health professionals: A randomized clinical trial on the impact of a self-care intervention mediated by the senses. *PLoS One*, *12*(2), e0172455. https://doi.org/10.1371/journal.pone.0172455

*Leiter, M. P., Laschinger, H. K. S., Day, A., & Oore, D. G. (2011). The impact of civility interventions on employee social behavior, distress, and attitudes. *J Appl Psychol*, *96*(6), 1258-1274. https://doi.org/10.1037/a0024442

*Lin, L., He, G., Yan, J., Gu, C., & Xie, J. (2019). The Effects of a Modified Mindfulness-Based Stress Reduction Program for Nurses: A Randomized Controlled Trial. *Workplace Health Saf*, *67*(3), 111-122. https://doi.org/10.1177/2165079918801633

Liu, J., Gan, Y., Jiang, H., Li, L., Dwyer, R., Lu, K., . . . Lu, Z. (2019). Prevalence of workplace violence against healthcare workers: a systematic review and meta-analysis. *Occup Environ Med*, *76*(12), 927-937. https://doi.org/10.1136/oemed-2019-105849

*Luo, Y. H., Li, H., Plummer, V., Cross, W. M., Lam, L., Guo, Y. F., . . . Zhang, J. P. (2019). An evaluation of a positive psychological intervention to reduce burnout among nurses. *Arch Psychiatr Nurs*, *33*(6), 186-191. https://doi.org/10.1016/j.apnu.2019.08.004

*Maatouk, I., Muller, A., Angerer, P., Schmook, R., Nikendei, C., Herbst, K., . . . Gundel, H. (2018). Healthy ageing at work- Efficacy of group interventions on the mental health of nurses aged 45 and older: Results of a randomised, controlled trial. *PLoS One*, *13*(1), e0191000, Article e0191000. https://doi.org/10.1371/journal.pone.0191000

McHugh, M. D., Kutney-Lee, A., Cimiotti, J. P., Sloane, D. M., & Aiken, L. H. (2011). Nurses' widespread job dissatisfaction, burnout, and frustration with health benefits signal problems for patient care. *Health Aff (Millwood)*, *30*(2), 202-210. https://doi.org/10.1377/hlthaff.2010.0100

McVicar, A. (2016). Scoping the common antecedents of job stress and job satisfaction for nurses (2000-2013) using the job demands-resources model of stress. *J Nurs Manag*, *24*(2), E112-136. https://doi.org/10.1111/jonm.12326

*Mealer, M., Conrad, D., Evans, J., Jooste, K., Solyntjes, J., Rothbaum, B., & Moss, M. (2014). Feasibility and acceptability of a resilience training program for intensive care unit nurses. *Am J Crit Care*, *23*(6), e97-105. https://doi.org/10.4037/ajcc2014747

*Melo, C. G., & Oliver, D. (2018). Can Addressing Death Anxiety Reduce Health Care Workers' Burnout and Improve Patient Care? *Journal of Palliative Care*, *27*(4), 287-295. https://doi.org/10.1177/082585971102700405

Mimura, C., & Griffiths, P. (2003). The effectiveness of current approaches to workplace stress management in the nursing profession: an evidence based literature review. *Occup Environ Med*, *60*(1), 10-15. https://doi.org/10.1136/oem.60.1.10

*Moeini, B., Hazavehei, S. M., Hosseini, Z., Aghamolaei, T., & Moghimbeigi, A. (2011). The Impact of Cognitive-Behavioral Stress Management Training Program on Job Stress in Hospital Nurses: Applying PRECEDE Model. *J Res Health Sci*, *11*(2), 114-120. https://www.ncbi.nlm.nih.gov/pubmed/22911962

Moher D., Liberati A., Tetzlaff J., Altman D. G., & Group, T. P. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed1000097

Monsalve-Reyes, C. S., San Luis-Costas, C., Gomez-Urquiza, J. L., Albendin-Garcia, L., Aguayo, R., & Canadas-De la Fuente, G. A. (2018). Burnout syndrome and its prevalence in primary care nursing: a systematic review and meta-analysis. *BMC Fam Pract*, *19*(1), 59. https://doi.org/10.1186/s12875-018-0748-z

*Moody, K., Kramer, D., Santizo, R. O., Magro, L., Wyshogrod, D., Ambrosio, J., . . . Stein, J. (2013). Helping the helpers: mindfulness training for burnout in pediatric oncology-a pilot program. *J Pediatr Oncol Nurs*, *30*(5), 275-284. https://doi.org/10.1177/1043454213504497

*Morita, T., Tamura, K., Kusajima, E., Sakai, S., Kawa, M., Imura, C., . . . Uchitomi, Y. (2014). Nurse education program on meaninglessness in terminally ill cancer patients: a randomized controlled study of a novel two-day workshop. *J Palliat Med*, *17*(12), 1298-1305. https://doi.org/10.1089/jpm.2013.0559

*Motlagh, A. H., Alizadeh, Z., & Shahabadi, S. (2016). Determination of the Effect of C.B.T. on Stress, Anxiety and Depression among Nurses at Yasuj Shahid Beheshti Hospital in 2014. *International Journal of Medical Research & Health Sciences*, *5*(7), 391-394.

*Muller, A., Heiden, B., Herbig, B., Poppe, F., & Angerer, P. (2016). Improving well-being at work: A randomized controlled intervention based on selection, optimization, and compensation. *J Occup Health Psychol*, *21*(2), 169-181. https://doi.org/10.1037/a0039676

Murphy, L. R. (1996). Stress management in work settings: a critical review of the health effects. *Am J Health Promot*, *11*(2), 112-135. https://doi.org/10.4278/0890-1171-11.2.112

Ng, L. K. (2020). The perceived importance of soft (service) skills in nursing care: A research study. *Nurse Educ Today*, *85*, 104302. https://doi.org/10.1016/j.nedt.2019.104302

Nielsen, K., & Noblet, A. (2018). Organizational interventions: where we are, where we go from here? In K. Nielsen & A. Noblet (Eds.), *Organizational Interventions for Health and Well-being: A Handbook for Evidence-Based Practice* (pp. 1-22). Routledge. http://eprints.whiterose.ac.uk/133063/

Nielsen, K., & Randall, R. (2012). The importance of employee participation and perceptions of changes in procedures in a teamworking intervention. *Work and Stress*, *26*(2), 91-111. https://doi.org/10.1080/02678373.2012.682721

Nielsen, K., & Randall, R. (2013). Opening the black box: Presenting a model for evaluating organizational-level interventions. *European Journal of Work and Organizational Psychology*, *22*(5), 601-617. https://doi.org/10.1080/1359432x.2012.690556

Nielsen, K., Stage, M., Abildgaard, J. S., & Brauer, C. V. (2013). Participatory Intervention from an Organizational Perspective: Employees as Active Agents in Creating a Healthy Work Environment. In G. F. Bauer & G. J. Jenny (Eds.), *Salutogenic Organizations and Change: The Concepts Behind Organizational Health Intervention Research* (pp. 327-350). Springer Science + Business Media https://doi.org/10.1007/978-94-007-6470-5_18

*Nooryan, K., Gasparyan, K., Sharif, F., & Zoladl, M. (2011). The Effect of Teaching Emotional Intelligence (EI) Items on Job Related Stress in Physicians and Nurses Working in ICU Wards in Hospitals, Yerevan, Armenia. *International Journal of Collaborative Research on Internal Medicine & Public Health*, *3*(10), 704-713.

*Nooryan, K., Gasparyan, K., Sharif, F., & Zoladl, M. (2012). Controlling anxiety in physicians and nurses working in intensive care units using emotional intelligence items as an anxiety management tool in Iran. *Int J Gen Med*, *5*, 5-10. https://doi.org/10.2147/IJGM.S25850

*Norouzinia, R., Ramezani, Z., Khalili, A., Dehghani, M., & Sharifis, A. (2017). The Effect of Mindfulness-Based Stress Reduction Training on Stress and Burnout of Nurses. *Indo American Journal of Pharmaceutical Sciences*, *4*(5), 1296-1302. https://doi.org/10.5281/zenodo.802200

*Onishi, K., Tsujikawa, M., Inoue, K., Yoshida, K., & Goto, S. (2016). The Effect of Complementary Therapy for Hospital Nurses with High Stress. *Asia Pac J Oncol Nurs*, *3*(3), 272-280. https://doi.org/10.4103/2347-5625.189810

*Orly, S., Rivka, B., Rivka, E., & Dorit, S. E. (2012). Are cognitive-behavioral interventions effective in reducing occupational stress among nurses? *Appl Nurs Res*, *25*(3), 152-157. https://doi.org/10.1016/j.apnr.2011.01.004

*Ozbas, A. A., & Tel, H. (2016). The effect of a psychological empowerment program based on psychodrama on empowerment perception and burnout levels in oncology nurses: Psychological empowerment in oncology nurses. *Palliat Support Care*, *14*(4), 393-401. https://doi.org/10.1017/S1478951515001121

*Ozgundondu, B., & Gok Metin, Z. (2019). Effects of progressive muscle relaxation combined with music on stress, fatigue, and coping styles among intensive care nurses. *Intensive Crit Care Nurs*, *54*, 54-63. https://doi.org/10.1016/j.iccn.2019.07.007

*Ploukou, S., & Panagopoulou, E. (2018). Playing music improves well-being of oncology nurses. *Appl Nurs Res*, *39*, 77-80. https://doi.org/10.1016/j.apnr.2017.11.007

*Poulin, P. A., Mackenzie, C. S., Soloway, G., & Karayolas, E. (2008). Mindfulness training as an evidenced-based approach to reducing stress and promoting well-being among human services professionals. *International Journal of Health Promotion and Education*, *46*(2), 72-80. https://doi.org/10.1080/14635240.2008.10708132

Randall, R., Griffiths, A., & Cox, T. (2005). Evaluating organizational stress-management interventions using adapted study designs. *European Journal of Work and Organizational Psychology*, *14*(1), 23-41. https://doi.org/10.1080/13594320444000209

Richardson, K. M., & Rothstein, H. R. (2008). Effects of occupational stress management intervention programs: a meta-analysis. *J Occup Health Psychol*, *13*(1), 69-93. https://doi.org/10.1037/1076-8998.13.1.69

*Ricou, B., Gigon, F., Durand-Steiner, E., Liesenberg, M., Chemin-Renais, C., Merlani, P., & Delaloye, S. (2018). Initiative for Burnout of ICU Caregivers: Feasibility and Preliminary Results of a Psychological Support. *J Intensive Care Med*, *35*(6), 562-569. https://doi.org/10.1177/0885066618768223

Roberts, R. K., & Grubb, P. L. (2014). The consequences of nursing stress and need for integrated solutions. *Rehabil Nurs*, *39*(2), 62-69. https://doi.org/10.1002/rnj.97

Romig, M. C., Latif, A., Gill, R. S., Pronovost, P. J., & Sapirstein, A. (2012). Perceived benefit of a telemedicine consultative service in a highly staffed intensive care unit. *J Crit Care*, *27*(4), 426 e429-416, Article 426.e9. https://doi.org/10.1016/j.jcrc.2011.12.007

Ruotsalainen, J. H., Verbeek, J. H., Marine, A., & Serra, C. (2015). Preventing occupational stress in healthcare workers. *Cochrane Database Syst Rev*(4), CD002892. https://doi.org/10.1002/14651858.CD002892.pub5

*Sabanciogullari, S., & Dogan, S. (2015). Effects of the professional identity development programme on the professional identity, job satisfaction and burnout levels of nurses: A pilot study. *Int J Nurs Pract*, *21*(6), 847-857. https://doi.org/10.1111/ijn.12330

*Saedpanah, D., Salehi, S., & Moghaddam, L. F. (2016). The Effect of Emotion Regulation Training on Occupational Stress of Critical Care Nurses. *J Clin Diagn Res*, *10*(12), VC01-VC04. https://doi.org/10.7860/JCDR/2016/23693.9042

*Saeedi, S., Jouybari, L., Sanagoo, A., & Vakili, M. A. (2019). The effectiveness of narrative writing on the moral distress of intensive care nurses. *Nurs Ethics*, *26*(7-8), 2195-2203. https://doi.org/10.1177/0969733018806342

*Sajadi, M., Goudarzi, K., Khosravi, S., Farmahini-Farahani, M., & Mohammadbeig, A. (2017). Benson's Relaxation Effect in Comparing to Systematic Desensitization on Anxiety of Female Nurses: A Randomized Clinical Trial. *Indian J Med Paediatr Oncol*, *38*(2), 111-115. https://doi.org/10.4103/ijmpo.ijmpo_183_16

*Sallon, S., Katz-Eisner, D., Yaffe, H., & Bdolah-Abram, T. (2017). Caring for the Caregivers: Results of an Extended, Five-component Stress-reduction Intervention for Hospital Staff. *Behav Med*, *43*(1), 47-60. https://doi.org/10.1080/08964289.2015.1053426

*Sampson, M., Melnyk, B. M., & Hoying, J. (2019). Intervention Effects of the MINDBODYSTRONG Cognitive Behavioral Skills Building Program on Newly Licensed Registered Nurses' Mental Health, Healthy Lifestyle Behaviors, and Job Satisfaction. *J Nurs Adm*, *49*(10), 487-495. https://doi.org/10.1097/NNA.0000000000000792

*Sampson, M., Melnyk, B. M., & Hoying, J. (2020). The MINDBODYSTRONG Intervention for New Nurse Residents: 6-Month Effects on Mental Health Outcomes, Healthy Lifestyle Behaviors, and Job Satisfaction. *Worldviews Evid Based Nurs*, *17*(1), 16-23. https://doi.org/10.1111/wvn.12411

Sawang, S., Oei, T. P. S., & Goh, Y. W. (2016). Are Country and Culture Values Interchangeable? *International Journal of Cross-Cultural Management*, *6*(2), 205-219. https://doi.org/10.1177/1470595806066330

Semmer, N. K. (2006). Job stress interventions and the organization of work. *Scand J Work Environ Health*, *32*(6), 515-527. https://doi.org/10.5271/sjweh.1056

*Singh, R., & Jain, M. Efficacy of Self-Management Techniques in Reducing Perceived Occupational Stress among Nursing Staff. *Indian Journal of Positive Psychology*. https://doi.org/10.15614/IJPP/2017/V8I3/161982

*Slatyer, S., Craigie, M., Heritage, B., Davis, S., & Rees, C. (2018). Evaluating the Effectiveness of a Brief Mindful Self-Care and Resiliency (MSCR) Intervention for Nurses: a Controlled Trial. *Mindfulness*, *9*(2), 534-546. https://doi.org/10.1007/s12671-017-0795-x

Spielberger, C. D., Gonzalez-Reigosa, F., Martinez-Urrutia, A., Natalicio, L. F., & Natalicio, D. S. (1971). The State-Trait Anxiety Inventory. *Interamerican Journal of Psychology*, *5*(3&4). https://doi.org/10.30849/rip/ijp.v5i3%20&%204.620

Sterne, J. A., Gavaghan, D., & Egger, M. (2000). Publication and related bias in meta-analysis: power of statistical tests and prevalence in the literature. *J Clin Epidemiol*, *53*(11), 1119-1129. https://doi.org/10.1016/s0895-4356(00)00242-0

*Taniguchi, T., Hirokawa, K., Tsuchiya, M., & Kawakami, N. (2007). The immediate effects of 10-minute relaxation training on salivary immunoglobulin A (s-IgA) and mood state for Japanese female medical co-workers. *Acta Med Okayama*, *61*(3), 139-145. https://doi.org/10.18926/AMO/32902

*Uchiyama, A., Odagiri, Y., Ohya, Y., Takamiya, T., Inoue, S., & Shimomitsu, T. (2013). Effect on mental health of a participatory intervention to improve psychosocial work environment: a cluster randomized controlled trial among nurses. *J Occup Health*, *55*(3), 173-183. https://doi.org/10.1539/joh.12-0228-oa

*Udo, C., Danielson, E., Henoch, I., & Melin-Johansson, C. (2013). Surgical nurses' work-related stress when caring for severely ill and dying patients in cancer after participating in an educational intervention on existential issues. *Eur J Oncol Nurs*, *17*(5), 546-553. https://doi.org/10.1016/j.ejon.2013.02.002

*Val Palumbo, M., Wu, G., Shaner-McRae, H., Rambur, B., & McIntosh, B. (2012). Tai Chi for older nurses: a workplace wellness pilot study. *Appl Nurs Res*, *25*(1), 54-59. https://doi.org/10.1016/j.apnr.2010.01.002

*Van Bogaert, P., Van heusden, D., Somers, A., Tegenbos, M., Wouters, K., Van der Straeten, J., . . . Havens, D. S. (2014). The Productive Ward program: a longitudinal multilevel study of nurse perceived practice environment, burnout, and nurse-reported quality of care and job outcomes. *J Nurs Adm*, *44*(9), 452-461. https://doi.org/10.1097/NNA.0000000000000100

van der Klink, J. J., Blonk, R. W., Schene, A. H., & van Dijk, F. J. (2001). The benefits of interventions for work-related stress. *Am J Public Health*, *91*(2), 270-276. https://doi.org/10.2105/ajph.91.2.270

van der Ploeg, M. M., Brosschot, J. F., Versluis, A., & Verkuil, B. (2017). Peripheral physiological responses to subliminally presented negative affective stimuli: A systematic review. *Biol Psychol*, *129*, 131-153. https://doi.org/10.1016/j.biopsycho.2017.08.051

van Wyk, B. E., & Pillay-Van Wyk, V. (2010). Preventive staff-support interventions for health workers. *Cochrane Database Syst Rev*(3), CD003541. https://doi.org/10.1002/14651858.CD003541.pub2

*Villani, D., Grassi, A., Cognetta, C., Toniolo, D., Cipresso, P., & Riva, G. (2013). Self-help stress management training through mobile phones: an experience with oncology nurses. *Psychol Serv*, *10*(3), 315-322. https://doi.org/10.1037/a0026459

*Watanabe, N., Horikoshi, M., Shinmei, I., Oe, Y., Narisawa, T., Kumachi, M., . . . Furukawa, T. A. (2019). Brief mindfulness-based stress management program for a better mental state in working populations - Happy Nurse Project: A randomized controlled trial. *J Affect Disord*, *251*, 186-194. https://doi.org/10.1016/j.jad.2019.03.067

*Waters, C. S., Frude, N., Flaxman, P. E., & Boyd, J. (2018). Acceptance and commitment therapy (ACT) for clinically distressed health care workers: Waitlist-controlled evaluation of an ACT workshop in a routine practice setting. *Br J Clin Psychol*, *57*(1), 82-98. https://doi.org/10.1111/bjc.12155

*Wei, R., Ji, H., Li, J., & Zhang, L. (2017). Active Intervention Can Decrease Burnout In Ed Nurses. *J Emerg Nurs*, *43*(2), 145-149. https://doi.org/10.1016/j.jen.2016.07.011

Wentzel, D., & Brysiewicz, P. (2017). Integrative Review of Facility Interventions to Manage Compassion Fatigue in Oncology Nurses. *Oncol Nurs Forum*, *44*(3), E124-E140. https://doi.org/10.1188/17.ONF.E124-E140

Westermann, C., Kozak, A., Harling, M., & Nienhaus, A. (2014). Burnout intervention studies for inpatient elderly care nursing staff: systematic literature review. *Int J Nurs Stud*, *51*(1), 63-71. https://doi.org/10.1016/j.ijnurstu.2012.12.001

Williamson, P. O., & Minter, C. I. J. (2019). Exploring PubMed as a reliable resource for scholarly communications services. *J Med Libr Assoc*, *107*(1), 16-29. https://doi.org/10.5195/jmla.2019.433

*Xie, C., Zeng, Y., Lv, Y., Li, X., Xiao, J., & Hu, X. (2020). Educational intervention versus mindfulness-based intervention for ICU nurses with occupational burnout: A parallel, controlled trial. *Complement Ther Med*, *52*, 102485. https://doi.org/10.1016/j.ctim.2020.102485

*Yamagishi, M., Kobayashi, T., & Nakamura, Y. (2008). Effects of web-based career identity training for stress management among Japanese nurses: A randomized control trial. *Journal of Occupational Health*, *50*(2), 191-193. https://doi.org/10.1539/joh.L7086

*Yang, J., Tang, S., & Zhou, W. (2018). Effect of Mindfulness-Based Stress Reduction Therapy on Work Stress and Mental Health of Psychiatric Nurses. *Psychiatr Danub*, *30*(2), 189-196. https://doi.org/10.24869/psyd.2018.189

*Yektatalab, S., Honarmandnejad, K., Janghorban, R., & Zarifsanaiey, N. (2020). Effect of Web-Based Life Skills Education on Nurses' Job Burnout. *Turkish Online Journal of Distance Education*, 37-46. https://doi.org/10.17718/tojde.727974

*Zamanifar, S., Bagheri-Saveh, M. I., Nezakati, A., Mohammadi, R., & Seidi, J. (2020). The Effect of Music Therapy and Aromatherapy with Chamomile-Lavender Essential Oil on the Anxiety of Clinical Nurses: A Randomized and Double-Blind Clinical Trial. *J Med Life*, *13*(1), 87-93. https://doi.org/10.25122/jml-2019-0105

Appendix

Table 1. Search strategy for Web of Science

(((TS =(nurs* OR "health personnel" OR "healthcare provider*" OR "health care provider*" OR "healthcare professional*" OR "health care professional*" OR "healthcare worker*" OR "health care worker*" OR "hospital staff" OR "medical staff" OR "medical personnel" **OR caregiver* OR care-giver***) AND TS=(burnout OR burn-out OR exhaustion OR "compassion fatigue" OR depersonali?ation OR cynic* OR sleep* OR PTSD OR "Traumatic Stress" OR depress* OR anxie* OR anxious*) AND (TS=("stress manag*" OR "stress reduc*" OR interven* OR prevent* OR redesign OR mindful* OR yoga OR relax* OR meditati* OR training* OR educat* OR program* OR participatory OR participative OR *therapy)) AND TS=(random* OR control* OR experiment*) NOT TS=("informal caregiver*" OR "family caregiver*" OR "care-giving spouse*" OR "care-giving relative*")))) *AND* LANGUAGE: (English)
Indexes=SCI-EXPANDED, SSCI, A&HCI, ESCI Timespan=2007-2020

Note: As *"OR caregiver* OR care-giver*"* led to a great number of irrelevant articles (i.e. not focused on nurses), these words have been omitted when searching WoS for articles published in 2019 and 2020.

Table 2. Search strategy for PubMed

(((random* OR control* OR experiment* OR randomized controlled trial [MeSH Terms] OR random allocation [MeSH Terms]) AND ("nurses"[MeSH Terms] OR "nursing staff"[MeSH Terms] OR Nurs* [Title/Abstract])) AND ("Stress, Psychological"[Mesh] OR depress*[tw] OR "Burnout, Professional"[Mesh] OR Burnout [tw] OR "Anxiety"[Mesh] OR anxie*[tw] OR anxious*[tw] OR PTSD OR Post Traumatic Stress OR Secondary traumatic stress OR sleep [MeSH Terms])) AND ("Psychotherapy" [MeSH Terms] OR "Complementary Therapies" [MeSH Terms] OR "Personnel Management" [MeSH Terms] OR stress manag*[Title/Abstract] OR stress reduc*[Title/Abstract] OR interven*[Title/Abstract] OR prevent*[Title/Abstract] OR Redesign*[Title/Abstract] OR mindful*[Title/Abstract] OR yoga[Title/Abstract] OR relax*[Title/Abstract] OR Meditat*[Title/Abstract] OR training*[Title/Abstract] OR educat*[Title/Abstract] OR program*[Title] OR Participatory[Title/Abstract] OR participative[Title/Abstract]) Filters: from 2007/1/1 - 2020/12/1

Table 3. Search strategy for PsychInfo

S4	S1 OR S2 OR S3	
S3	SU (nurs* OR "health personnel" OR "healthcare provider*" OR "health care provider*" OR "healthcare professional*" OR "health care professional*" OR "healthcare worker*" OR "health care worker*" OR "hospital staff" OR "medical staff" OR "medical personnel") AND SU (burnout OR burn-out OR exhaustion OR "compassion fatigue" OR depersonali?ation OR cynic* OR sleep* OR PTSD OR "Traumatic Stress" OR depress* OR anxie* OR anxious* OR "occupational stress" OR "occupational health" OR "job stress" OR "work* stress" OR "Nursing Stress Scale" OR "Perceived Stress Scale" OR "psychological *stress" OR "mental health outcome*" OR well-being OR wellbeing) AND SU ("stress manag*" OR "stress reduc*" OR interven* OR prevent* OR redesign OR mindful* OR yoga OR relax* OR meditati* OR training* OR educat* OR program* OR participatory OR participative OR *therapy) AND SU (random* OR control* OR experiment*) NOT SU ("informal caregiver*" OR "family caregiver*" OR "care-giving spouse*" OR "care-giving relative*")	Limiters - Published Date: 20070101-20201231; Peer Reviewed; Publication Type: All Journals; English; Population Group: Human; Methodology: CLINICAL TRIAL, EMPIRICAL STUDY, FIELD STUDY, QUANTITATIVE STUDY, TREATMENT OUTCOME; Exclude Dissertations
S2	AB (nurs* OR "health personnel" OR "healthcare provider*" OR "health care provider*" OR "healthcare professional*" OR "health care professional*" OR "healthcare worker*" OR "health care worker*" OR "hospital staff" OR "medical staff" OR "medical personnel") AND AB (burnout OR burn-out OR exhaustion OR "compassion fatigue" OR depersonali?ation OR cynic* OR sleep* OR PTSD OR "Traumatic Stress" OR depress* OR anxie* OR anxious* OR "occupational stress" OR "occupational health" OR "job stress" OR "work* stress" OR "Nursing Stress Scale" OR "Perceived Stress Scale" OR "psychological *stress" OR "mental health outcome*" OR well-being OR wellbeing) AND AB ("stress manag*" OR "stress reduc*" OR interven* OR prevent* OR redesign OR mindful* OR yoga OR relax* OR meditati* OR training* OR educat* OR program* OR participatory OR participative OR *therapy) AND AB (random* OR control* OR experiment*) NOT AB ("informal caregiver*" OR "family caregiver*" OR "care-giving spouse*" OR "care-giving relative*")	Limiters - Published Date: 20070101-20201231; Peer Reviewed; Publication Type: All Journals; English; Population Group: Human; Methodology: CLINICAL TRIAL, EMPIRICAL STUDY, FIELD STUDY, QUANTITATIVE STUDY, TREATMENT OUTCOME; Exclude Dissertations
S1	TI (nurs* OR "health personnel" OR "healthcare provider*" OR "health care provider*" OR "healthcare professional*" OR "health care professional*" OR "healthcare worker*" OR "health care worker*" OR "hospital staff" OR "medical staff" OR "medical personnel") AND TI (burnout OR burn-out OR exhaustion OR "compassion fatigue" OR depersonali?ation OR cynic* OR sleep* OR PTSD OR "Traumatic Stress" OR depress* OR anxie* OR anxious* OR "occupational stress" OR "occupational health" OR "job stress" OR "work* stress" OR "Nursing Stress Scale" OR "Perceived Stress Scale" OR "psychological *stress" OR "mental health outcome*" OR well-being OR wellbeing) AND TI ("stress manag*" OR "stress reduc*" OR interven* OR prevent* OR redesign OR mindful* OR yoga OR relax* OR meditati* OR training* OR educat* OR program* OR participatory OR participative OR *therapy) AND TI(random* OR control* OR experiment*) NOT TI("informal caregiver*" OR "family caregiver*" OR "care-giving spouse*" OR "care-giving relative*")	Limiters - Published Date: 20070101-20201231; Peer Reviewed; Publication Type: All Journals; English; Population Group: Human; Methodology: CLINICAL TRIAL, EMPIRICAL STUDY, FIELD STUDY, QUANTITATIVE STUDY, TREATMENT OUTCOME; Exclude Dissertations

Table 4. Overview of the included studies

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
1.	Akyurek et al., 2020	Hospital nurses	registered nurses	I=15 C=15	Workplace Health Promotion Program including sessions consisting of 5 minutes of breathing exercises, 20 minutes progressive muscle relaxation and 10 minutes posture exercises.	PD: relaxation techniques	5 weeks
2.	Alexander et al., 2015	Hospital nurses	registered nurses	I=20 C=20	Yoga	PD: relaxation techniques	8 weeks
3.	Barattucci et al., 2019	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=295 C=202	IARA training encompassing mindfulness, psycho-synthesis, and counseling principles using emotional education, role-play, relaxation and breathing techniques, guided imagery, inter-personal and self-management skill improvement.	PD: mix	4 sessions (not reported in what time frame
4.	Becker et al., 2017	Hospital nurses	registered nurses	I=33 C=32	Work-related psychosocial coaching intervention	PD: work skills	5 weeks
5.	Becker et al., 2020 (Follow-up Becker et al., 2017)	Hospital nurses	registered nurses	I=33 C=32	Work-related psychosocial coaching intervention	PD: work skills	5 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
6.	Bolier et al., 2014	Hospital nurses	registered nurses	I=188 C=178	E-health intervention "Mental Vitality @ Work": individual feedback on work functioning and mental well-being followed by a tailored choice of online interventions (mainly based on cognitive behavioral therapy).	PD: cognitive behavioral component	12 weeks (post-test) and 24 weeks (follow-up)
7.	Bourbonnais et al., 2006	Nurses working general and specialized short-term care	mixed sample of ≥ 50% registered nurses	I=302 C=310	A number of interventions aiming to improve teamwork, staffing, work organization, communication and ergonomics	Organization-directed	16 weeks
8.	Bourbonnais et al., 2010 (Follow-up Bourbonnais et al., 2006)	Nurses working general and specialized short-term care	mixed sample of ≥ 50% registered nurses	I=247 C=220	A number of interventions aiming to improve teamwork, staffing, work organization, communication and ergonomics	Organization-directed	16 weeks
9.	Brooks et al., 2010	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=26 C=26	Music-Imagery	PD: relaxation techniques	3 to 6 weeks
10.	Calisi et al., 2017	Cardiac nurses	registered nurses	I=24 C=22	Bensons Relaxation Response: practicing diaphragmatic breathing and repetitive mental focus to break the train of everyday thought	PD: relaxation techniques	8 weeks
11.	Chen et al., 2016	Emergency department and Intensive care nurses	registered nurses	I=50 C=49	Releasing Exercise Program (REP) consisting of a warm up, tension-releasing exercises and mood adjustment (i.e. meditation).	PD: relaxation techniques	24 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
12.	Chen et al., 2017	Hospital nurses (newly qualified nurses	registered nurses	I=16 C=15	Interactive Situated and Simulated Teaching program (ISST) for newly qualified nurses including interactive face-to-face support sessions with experienced nurse practitioners to reinforce learning incentives, promote understanding of care-related concepts and improve clinical communication through participation in situated and simulated nursing activities.	PD: work skills	12 weeks
13.	Cheng et al., 2015	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=34 C=34	Gratitude diary intervention	PD: cognitive behavioral component	4 weeks
14.	Chesak et al., 2015	Hospital nurses (new to the institution, transitioning to a new unit/new role or undergoing nurse orientation)	registered nurses	I=19 C=21	Stress Management and Resiliency Training (SMART) developing intentional attention and practicing gratitude, compassion, acceptance, forgiveness and higher meaning	PD: cognitive behavioral component	1 week
15.	Daigle at al., 2018	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=37 C=33	Mindfulness	PD: relaxation techniques	8 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
16.	Darban et al., 2016	Hospital nurses	registered nurses	I=30 C=30	Communication skills training	PD: work skills	1 week
17.	Duarte et al., 2016	Oncology nurses	registered nurses	I=29 C=19	Mindfulness	PD: relaxation techniques	6 weeks
18.	Dunne et al., 2019	Emergency department nurses	mixed sample of ≥ 50% registered nurses	I=17 C=25	Attention Based Training (ABT) involving repeatedly focusing one's attention on a chosen non-English phrase (maranatha) for 20 minutes twice a day	PD: relaxation techniques	7 weeks
19.	Fang et al., 2015	Hospital nurses	registered nurses	I=54 C=51	Yoga workshop	PD: relaxation techniques	26 weeks
20.	Geary et al., 2011	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=59 C=49	Mindfulness	PD: relaxation techniques	8 weeks
21.	Ghawadra et al., 2020	Nurses working in the Critical Care Units, medical department, surgical department, pediatric department, obstetrics and gynecology departments	registered nurses	I=118 C=106	MINDFULGym: A mindfulness-based stress reduction program consisting of one workshop followed by four weeks of self-practice at home.	PD: relaxation techniques	5 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
22.	Ghazavi et al., 2016	Hospital nurses	registered nurses	I=26 C=26	Happiness training including discarding concerns, lowering the degrees of expectations and ideals, and practicing positive and optimistic thinking	PD: cognitive behavioral component	6 weeks
23.	Gholizadeh et al., 2017	Intensive Care Unit nurses	registered nurses	I=30 C=30	Mindfulness including mindful eating, mindful walking and different kinds of mediation exercises	PD: relaxation techniques	8 weeks
24.	Gordon et al, 2017	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=32 C=26	Job crafting	Multilevel	3 weeks
25.	Grabbe et al., 2019	Hospital nurses	registered nurses	I=40 C=37	Community Resiliency Model (CRM), a non-cognitive variant of mindfulness using sensory awareness techniques to improve emotional balance	PD: relaxation techniques	1 session of 3 hours
26.	Gunusen et al., 2010	Hospital nurses	registered nurses	I=30 I=31 C=28	Exp. group 1: Training in coping skills Exp. group 2: Taking part in a support group intervention	Exp. group 1: PD: cognitive behavioral component Exp. group 2: PD: work skills	7 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
27.	Habibian et al., 2018	Pediatric oncology and special diseases nurses	registered nurses	I=30 C=30	Acceptance and Commitment Therapy (ACT)	PD: mix	Not reported
28.	HemmatiMaslakpak et al., 2016	Nurses working in the Critical Care Units	registered nurses	I=30 C=30	Neurolinguistic programming (NLP), which focusses on reactions towards stressful events and provides practical strategies to increase individual adaptation capacity and coping	PD: cognitive behavioral component	24 weeks
29.	Hersch et al., 2016	Hospital nurses	registered nurses	I=52 C=52	BREATHE: providing a number of person-directed stress management strategies and information for managers on identifying workplace stressors and reducing stress through positive management practices	Multilevel	12 weeks
30.	Horner et al., 2014	Medical surgical nurses	mixed sample of ≥ 50% registered nurses	I=31 C=12	Mindfulness	PD: relaxation techniques	10 weeks
31.	Inoue et al., 2011	Psychiatric nurses	registered nurses	I=25 C=25	Group intervention approach for nurses exposed to violence: psychotherapy-based discussion including stress management (progressive muscle relaxation and image therapy as well as behavioral therapy)	PD: mix	6 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
32.	Jakel et al., 2016	Oncology nurses	registered nurses	I=16 C=9	Providers Resilience mobile application: mobile app that tracks stress-related symptoms and gives reminders for self-care/brief interventions including psychoeducation.	PD: mix	6 weeks
33.	Karpaviciute et al., 2016	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=56 C=55	Arts activities	PD: relaxation techniques	10 weeks
34.	Kersten et al., 2019	Dialysis nurses	registered nurses	I=33 C=44	An intervention program mainly consisting of 1. a workshop for managers to create awareness for employee well-being and to train managers in conducting interviews with employees to set goals during the intervention program, and 2. three group sessions for nurses including education on stress and the stress response, group discussions on stressful situations at work, ways of coping, and to identify (missing) job resources, the development of an individual stress management program and a relaxation exercise	Multilevel	16 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
35.	Ketelaar et al., 2013	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=188 C=178	E-health intervention "Mental Vitality @ Work": individual feedback on work functioning and mental well-being followed by a tailored choice of online interventions (mainly based on cognitive behavioral therapy)	PD: cognitive behavioral component	12 weeks (post-test) and 24 weeks (follow-up)
36.	Kharatzadeh et al., 2019	Critical care nurses	Registered nurses	I=30 C=30	Emotion regulation training including psychoeducation, progressive muscle relaxation, nonjudgmental awareness, acceptance and tolerance of emotional responses, modification of attention, cognitive reappraisal, problem solving, and interpersonal skills	PD: mix	6 sessions, unclear over what period.
37.	Kim et al., 2013	Hospital nurses	registered nurses	I=11 C=11	Mindfulness-based stretching and deep breathing exercise	PD: relaxation techniques	8 weeks
38.	Koivu et al., 2012	Medical surgical nurses	mixed sample of ≥ 50% registered nurses	I=41 I=43 C=82	Clinical Supervision	PD: work skills	1 year
39.	Kubota et al., 2016	Oncology nurses	registered nurses	I=50 C=46	Training program aimed at enhancing the ability to assess and manage common psychological problems in cancer patients	PD: work skills	2 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
40.	Lary et al., 2019	Neonatal Intensive Care Unit nurses	registered nurses	I=35 C=35	Program including education on stress and the stress response, problem-and emotion-focused coping mechanisms, physical methods for coping with stress and information on the importance of a healthy lifestyle	PD: mix	6 weeks
41.	le Blanc et al., 2007	Palliative care nurses	mixed sample of ≥ 50% registered nurses	I=208 C=96	A participatory intervention in which teams identify the most prominent stressors at work and design and implement interventions to reduce these, supplemented by individual stress counseling	Multilevel	24 weeks
42.	Leiter et al., 2011	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=181 C=726	Civility, Respect, and Engagement at Work (CREW), a program aimed to enhance civility among colleagues. The program included an assessment of the units' baseline level of civility followed by employees setting agendas and priorities for addressing these issues directly (including establishing the ground rules for conversations around civility; treating people with respect, etc.)	Organization-directed	24 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
43.	Lin et al., 2019	Hospital nurses	Registered nurses	I=44 C=46	Mindfulness-based group intervention sessions and at home practice facilitated by a group app in which information and experiences were shared and participants could ask questions to the instructors	PD: relaxation techniques	8 weeks
44.	Luo et al., 2019	Hospital nurses	Registered nurses	I=43 C=46	Writing down three good things at the end of the workday using the mobile application WeChat	PD: cognitive behavioral component	24 weeks
45.	Maatouk et al., 2018	Older nurses (≥ 49 years working in a hospital setting)	registered nurses	I=52 C=55	Mix of person-directed interventions with the topic 'healthy aging at work'	PD: mix	13 weeks
46.	Mealer et al., 2014	Intensive Care Unit nurses	registered nurses	I=14 C=13	Resilience Training Program including cognitive behavioral based training, mindfulness, and expressive writing	PD: mix	12 weeks
47.	Melo et al., 2015	Palliative care nurses	mixed sample of ≥ 50% registered nurses	I=65 C=26	Communication training on offering emotional and spiritual support to patients	PD: work skills	6 days
48.	Moeini et al., 2011	Hospital nurses	registered nurses	I=29 C=29	Cognitive behavioral stress management training program including progressive muscle relaxation, aerobic exercises, creative problem solving and time management	PD: mix	3 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
49.	Moody et al., 2013	Pediatric oncology nurses	mixed sample of ≥ 50% registered nurses	I=21 C=24	Mindfulness	PD: relaxation techniques	8 weeks
50.	Morita et al., 2014	Palliative care nurses	registered nurses	I=40 C=43	Interactive education program focusing on addressing patients' feelings of meaninglessness including education on the use of an assessment tool, and creating nursing care plans through group work and group discussions	PD: work skills	2 days
51.	Motlagh et al., 2016	Hospital nurses	registered nurses	I=15 C=15	Cognitive behavioral therapy	PD: cognitive behavioral component	8 weeks
52.	Muller et al., 2015	Hospital nurses	Registered nurses	I=19 C=31	Intervention based on the theoretical model of selection, optimization and compensation (SOC). Participants individually developed and implemented a personal plan for coping better with job demands and for activating job resources	Multilevel	9 months

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
53.	Nooryan et al., 2011	Intensive Care Unit nurses	mixed sample of ≥ 50% registered nurses	I=53 C=53	Emotional intelligence intervention including training on empathy, problem solving, thought control and methods to replace negative thoughts by positive thoughts, practicing relaxation and implementing techniques to control anxiety	PD: mix	5 weeks
54.	Nooryan et al., 2012	Intensive Care Unit nurses	mixed sample of ≥ 50% registered nurses	I=75 C=75	Emotional intelligence intervention including training on empathy, problem solving, thought control and methods to replace negative thoughts by positive thoughts, practicing relaxation and implementing techniques to control anxiety	PD: mix	5 weeks
55.	Norouzinia et al., 2017	Hospital nurses	registered nurses	I=30 C=30	Mindfulness	PD: relaxation techniques	Not reported
56.	Onishi et al., 2016	Hospital nurses	registered nurses	I=19 I=20 C=19	Complementary/alternative therapy including Exp. group 1: listening to relaxing music Exp. group 2: progressive muscle relaxation	PD: relaxation techniques	3 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
57.	Orly et al., 2012	Hospital nurses	registered nurses	I=20 C=16	Behavioral interventions including breathing techniques and progressive muscle training, psychoeducation, identification of irrational ways of thinking, training to modifying negative ways of thinking, and acquiring problem-solving skills	PD: mix	8 weeks
58.	Ozbas et al., 2016	Oncology nurses	registered nurses	I=38 C=44	Psychodrama-based psychological empowerment program including discussions on stress, learning relaxation techniques, problem solving, self-recognition, empathy, dispute resolution, assertiveness training and discussions on death.	PD: mix	10 weeks
59.	Ozgundondu et al., 2019	Intensive Care Unit nurses	registered nurses	I=28 C=28	Progressive Muscle Relaxation combined with music	PD: relaxation techniques	8 weeks
60.	Ploukou et al., 2018	Oncology nurses	mixed sample of ≥ 50% registered nurses	I=22 C=26	Music class	PD: relaxation techniques	4 weeks
61.	Poulin et al., 2008	Nurses working with elderly	mixed sample of ≥ 50% registered nurses	I=10 I=16 C=14	Exp. group 1: Brief mindfulness training Exp. group 2: Brief relaxation training	PD: relaxation techniques	Not reported

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
62.	Ricou et al., 2018	Intensive care unit nurses	mixed sample of ≥ 50% registered nurses	I=41 C=42	Team meetings in which nurses discussed solutions concerning the prevention and reduction of burnout at the workplace, followed by psychoeducation by a psychologist, with the aim "to help changing employees' perceptions and coping with difficulties related to the job"	PD: cognitive behavioral component	Not reported
63.	Sabanciogullari et al., 2015	Hospital nurses	registered nurses	I=33 C=30	Professional identity development program: including perception to nursing profession, attitudes, communication and assertiveness	PD: work skills	10 weeks
64.	Saedpanah et al., 2016	Intensive Care Unit and Critical Care Unit nurses	registered nurses	I=30 C=30	Emotion regulation training including eight educational sessions on emotions and their effects, interpersonal skills (communication, expression and solving conflict), expanding/shifting attention and stopping mental rumination, cognitive assessment and on changing the behavioral and physical outcomes of emotions	PD: mix	3 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
65.	Saeedi et al., 2019	Intensive Care Unit nurses	registered nurses	I=55 C=51	Narrative writing on traumatic experiences	PD: cognitive behavioral component	8 weeks
66.	Sajadi et al., 2017	Hospital nurses	registered nurses	I=24 I=24 C=24	Exp. group 1: Systematic desensitization. Exp. group 2: Bensons Relaxation Response: practicing diaphragmatic breathing and repetitive mental focus to break the train of everyday thought	PD: relaxation techniques	4 weeks
67.	Sallon et al., 2017	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=81 C=65	Caring for the Caregivers program including mindfulness, relaxation, mindful movement and postural alignment, interactive dance, laughter, qigong practice, drawing and writing	PD: relaxation techniques	30 weeks
68.	Sampson et al., 2019	Newly licensed hospital nurses	registered nurses	I=47 C=42	MINDBODYSTRONG program, a cognitive behavioral skill building program incorporating strategies to improve mental and physical health	PD: cognitive behavioral component	8 weeks
69.	Sampson et al., 2020 (Follow-up Sampson et al., 2019)	Newly licensed hospital nurses	registered nurses	I=47 C=42	MINDBODYSTRONG program, a cognitive behavioral skill building program incorporating strategies to improve mental and physical health	PD: cognitive behavioral component	8 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
70.	Singh et al., 2017	Hospital nurses	registered nurses	I=20 C= 20	Self-help interventions including education on environment/ personal stressors, relaxation training, breathing and muscular exercise, practicing techniques to help cognitively reappraising stressful situations, time management and building good social relationships	PD: mix	5-6 weeks
71.	Slatyer et al., 2018	Hospital nurses	registered nurses	I=60 C=16	Brief mindful self-care and resilience intervention	PD: relaxation techniques	4 weeks
72.	Taniguchi et al., 2007	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=38 C=41	10-minute relaxation training consisted of progressive muscle relaxation, abdominal respiration, mediation and stretching	PD: relaxation techniques	1 day
73.	Uchiyama et al., 2013	Hospital nurses	registered nurses	I=149 C=17 0	Participatory intervention in which teams identified the most prominent stressors at work and designed and implemented interventions to reduce these	Organization-directed	24 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
74.	Udo et al., 2013	Medical surgical nurses	mixed sample of ≥ 50% registered nurses	I=12 C=12	Education program to develop reflective strategies to handle and communicate on existential issues when providing care for severely ill patients including patients dying of cancer	PD: work skills	10 weeks
75.	Val Palumbo et al., 2012	Older nurses (≥ 49 years working in a hospital setting	Registered nurses	I=5 C=6	Tai Chi	PD: relaxation	15 weeks
76.	Van Bogaert et al., 2014	Nurses working in the medical units, surgical units, Intensive Care Units, pediatric care units and maternal care units.	mixed sample of ≥ 50% registered nurses	I=198 C=179	The Productive Ward Releasing time to Care program, a quality improvement program designed to provide staff with more time for direct patient care. The program offers 15 modules based on lean methodology to systematically enhance the delivery of safe, high-quality patient care by eliminate activities that add no value to patients (i.e. eliminating waste)	Organization directed	7 years

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
77.	Villani et al., 2013	Oncology nurses	registered nurses	I=15 C=15	Mobile Stress Inoculation Training (M-SIT) including a conceptual phase to raise awareness of the transactional nature of stress and a skill acquisition and rehearsal stage (consisting of Progressive Muscular Relaxation and Autogenic Training)	PD: relaxation techniques	4 weeks
78.	Watanabe et al., 2019	Junior nurses working in a hospital setting	registered nurses	I=40 C=40	Happy Nurse Project: Brief mindfulness-based stress management program including education on the cognitive behavioral model of stress and emotion, conducting a body scan and breathing exercises, promoting awareness of patients' cognitions and providing suggestions about increasing pleasant behaviors and planning a strategy to manage future stress	PD: mix	4 weeks
79.	Waters et al., 2018	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=17 C=18	Acceptance and commitment therapy (ACT)	PD: mix	1 day

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
80.	Wei et al., 2017	Emergency Department nurses	registered nurses	I=51 C=51	An active intervention including classes pertaining to communication skills, approaches to conflict, efficacy elevation, and emotion control as well as working skills	PD: work skills	26 weeks
81.	Xie et al., 2020	Intensive Care Unit nurses	registered nurses	I=53 C=53	Mindfulness	PD: relaxation techniques	8 weeks
82.	Yamagishi et al., 2008	Hospital nurses	mixed sample of ≥ 50% registered nurses	I=16 C=10	Career identity (defined as the cognitive representation of self, derived from past work experiences, beliefs, values, attributes, and motives that define individuals in terms of their work roles) training for stress management	PD: cognitive behavioral component	3 weeks
83.	Yang et al., 2018	Psychiatric nurses	registered nurses	I=48 C=47	Mindfulness	PD: relaxation techniques	8 weeks

Table 4. *Continued*

	Author	Type of nurses	Sample	N	Short description of the intervention	Intervention type	Intervention period
84.	Yektatalab et al., 2020	Hospital nurses	registered nurses	I=52 C=52	Life skill training in which every week a new skill was trained including self-awareness, empathy, decision-making, problem-solving, creative thinking, critical thinking, effective communication, interpersonal relationship skills, coping with emotions, and coping with stress	PD: mix	10 weeks
85.	Zamanifar et al., 2020	Hospital nurses	Registered nurses	I=30 C=30	Music therapy: listening to a selection of conventional and favorite music according to the interest of the sample during the work break	PD: relaxation techniques	3 consecutive shifts

Note. PD = Person-directed, I = Intervention group, C = Control group

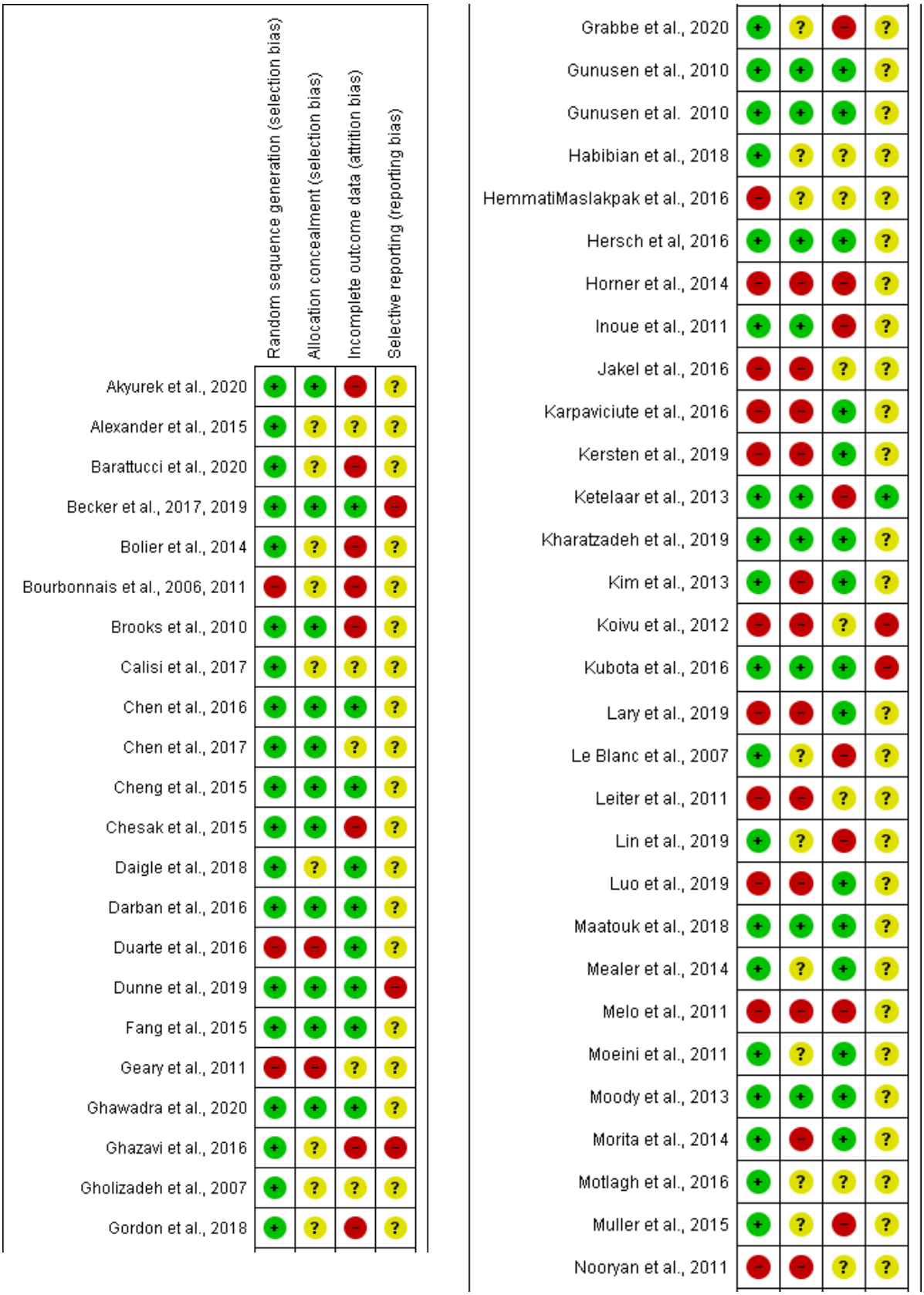
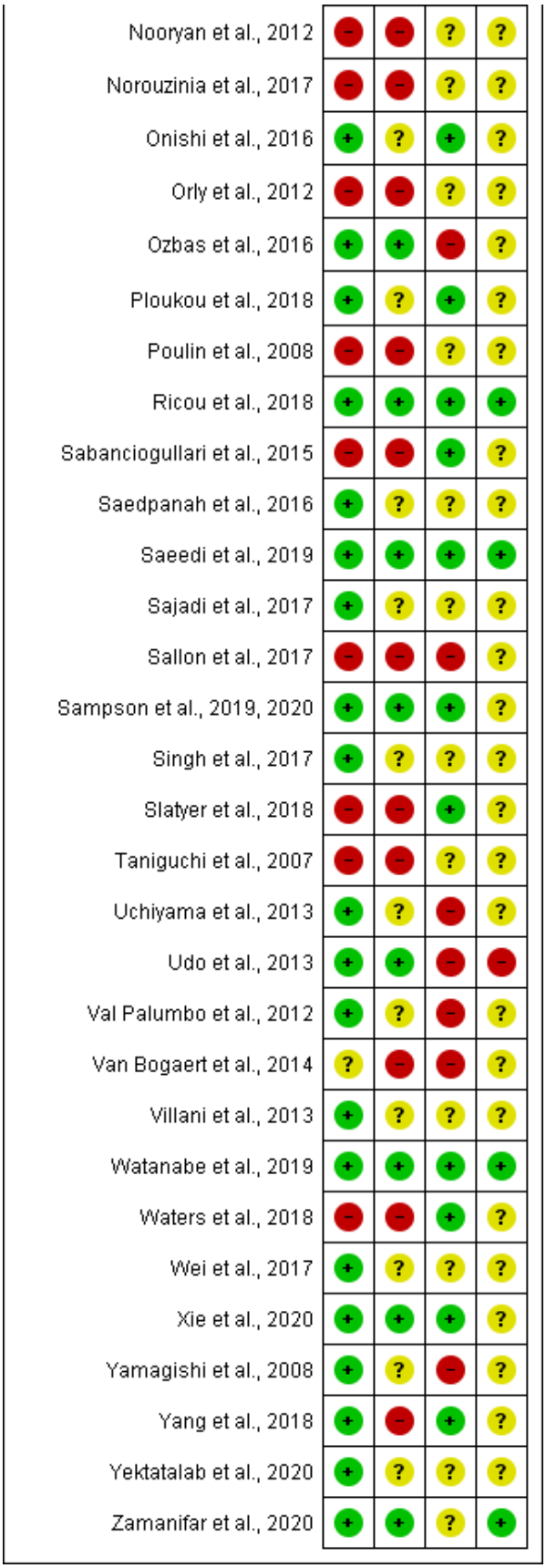


Figure 1. Risk of bias summary: review authors' judgements about each risk of bias item for each included intervention based on The Cochrane Risk of Bias tool



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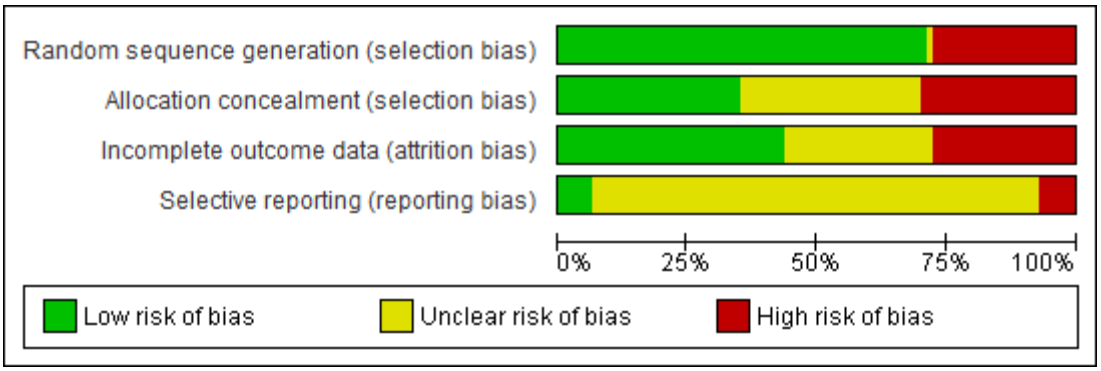

Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included interventions based on The Cochrane Risk of Bias tool

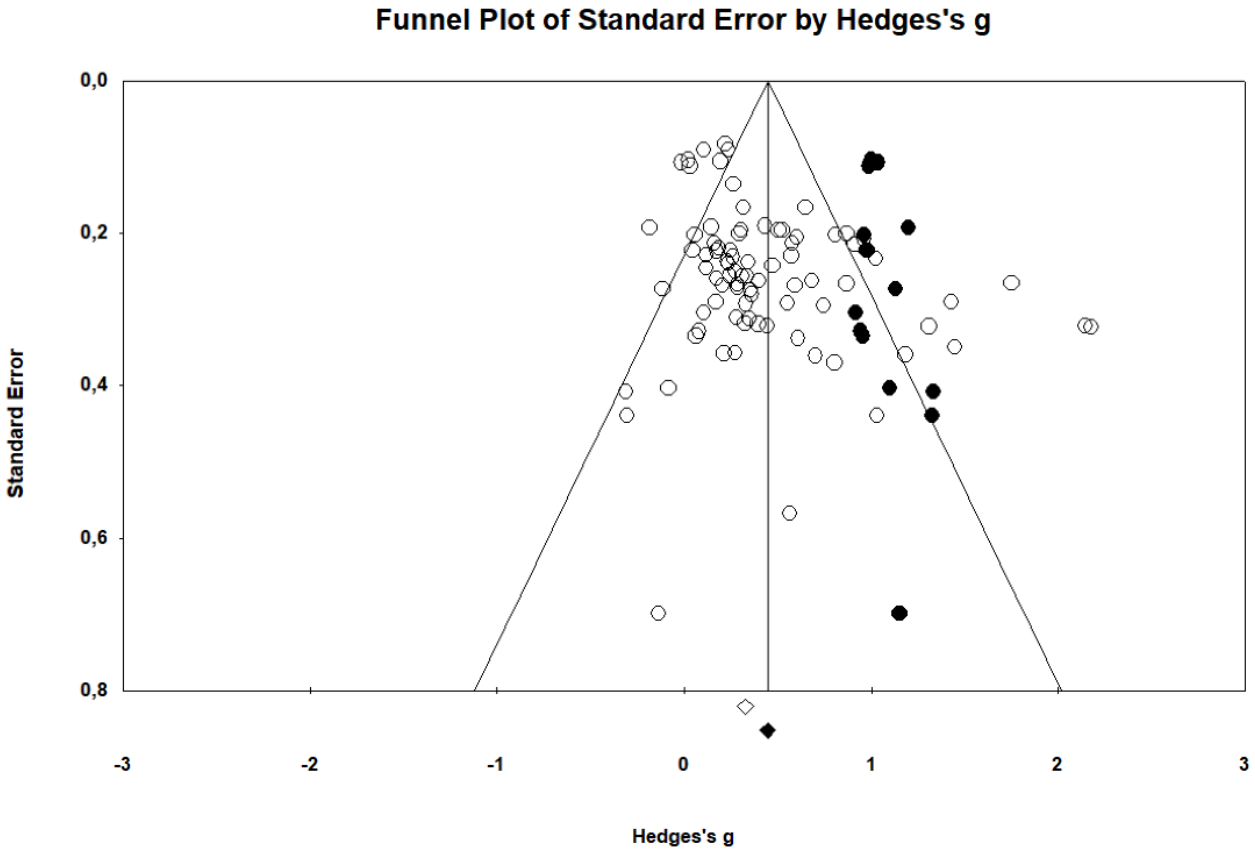

Figure 3. Funnel plot showing the effect of stress management interventions on stress-related outcomes.

Study name	Subgroup within study	Outcome category	Time point	Hedges's g	Lower limit	Upper limit	Standard error	p-Value
Bolier et al., 2014	A	Combined	2.POST p2	0,02	-0,18	0,22	0,10	0,85
Cheng et al. 2015	Gratitude	Combined	0.POST p0	0,47	-0,00	0,95	0,24	0,05
Ghazavi et al., 2016	A	Combined	0.POST p0	0,36	-0,18	0,90	0,28	0,20
Gunusen et al. 2010	Coping	Combined	0.POST p0	0,45	-0,18	1,08	0,32	0,17
HemmatiMaslakpak et al., 2015	A	Work related stress	1.POST p1	2,18	1,55	2,81	0,32	0,00
Ketelaar et al., 2013	A	Combined	2.POST p2	0,21	-0,32	0,73	0,27	0,44
Luo et al., 2019	A	Combined	2.POST p2	0,16	-0,26	0,58	0,21	0,45
Motlagh et al., 2016	A	Combined	0.POST p0	0,21	-0,49	0,91	0,36	0,55
Ricou et al. 2018	A	Combined	0.POST p0	0,57	0,12	1,02	0,23	0,01
Saeedi et al., 2019	A	Work related stress	0.POST p0	-0,18	-0,56	0,20	0,19	0,35
Sampson et al., 2019, 2020	A	Combined	0.POST p0	1,75	1,23	2,27	0,27	0,00
Yamagishi et al., 2008	A	Combined	0.POST p0	0,08	-0,56	0,72	0,33	0,81
				0,50	0,15	0,86	0,18	0,01

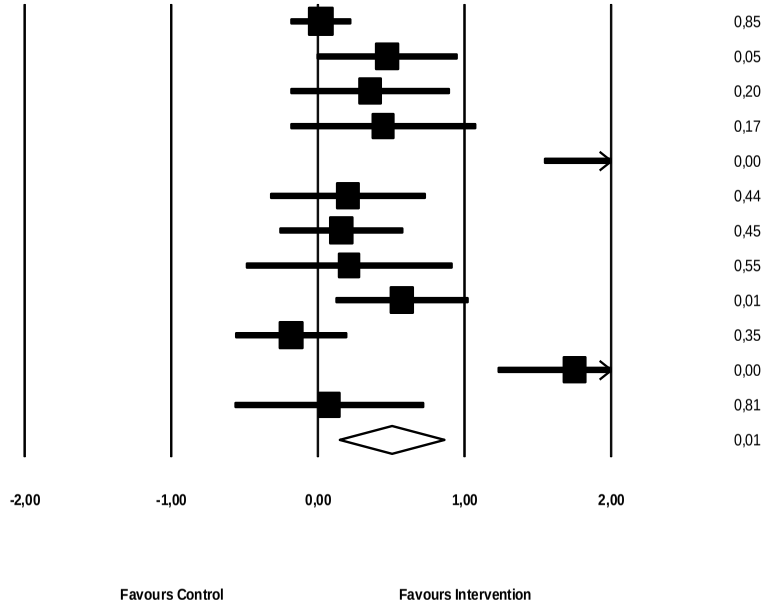

Figure 4. Forest plot of the effect sizes of person-directed interventions: cognitive behavioral

Study name	Subgroup within study	Outcome category	Time point	Hedges's g	Lower limit	Upper limit	Standard error	p-Value
Akyurek et al., 2020	A	Combined	0.POST p0	0,27	-0,43	0,98	0,36	0,44
Alexander et al., 2015	A	Combined	0.POST p0	0,35	-0,26	0,96	0,31	0,26
Brooks et al., 2010	A	Combined	0.POST p0	-0,11	-0,65	0,42	0,27	0,68
Calisi et al., 2017	A	Combined	0.POST p0	0,33	-0,25	0,90	0,29	0,26
Chen et al. 2016	A	Anxiety	0.POST p0	0,30	-0,10	0,69	0,20	0,14
Chesak et al. 2015	A	Combined	2.POST p2	0,40	-0,23	1,02	0,32	0,21
Daigle at al., 2018	A	Psychological distress	0.POST p0	0,35	-0,12	0,81	0,24	0,15
Duarte et al., 2016	A	Combined	0.POST p0	0,17	-0,40	0,74	0,29	0,56
Dunne et al., 2019	A	Combined	1.POST p1	0,28	-0,33	0,89	0,31	0,37
Fang et al. 2015	A	Work related stress	0.POST p0	1,31	0,68	1,94	0,32	0,00
Geary et al., 2011	A	Psychological distress	0.POST p0	0,87	0,48	1,26	0,20	0,00
Ghawadra et al., 2020	A	Combined	2.POST p2	0,26	-0,00	0,53	0,14	0,05
Gholizadeh et al., 2017	A	Work related stress	0.POST p0	2,15	1,52	2,78	0,32	0,00
Grabbe et al., 2019	A	Combined	1.POST p1	0,24	-0,23	0,70	0,24	0,33
Habibian et al. 2018	A	Combined	0.POST p0	0,24	-0,26	0,75	0,26	0,34
Horner et al. 2014	A	Combined	0.POST p0	0,06	-0,59	0,72	0,33	0,85
Karpaviciute et al., 2016	A	Combined	0.POST p0	0,43	0,06	0,81	0,19	0,02
Kim et al., 2013	A	PTSD symptoms	2.POST p2	1,03	0,17	1,89	0,44	0,02
Lin et al., 2019	A	Psychological distress	0.POST p0	0,58	0,16	0,99	0,21	0,01
Moody et al. 2013	A	Combined	0.POST p0	0,10	-0,50	0,70	0,30	0,74
Norouzinia et al. 2017	A	Combined	0.POST p0	0,34	-0,17	0,84	0,26	0,19
Onishi et al., 2016	Combined	Combined	0.POST p0	0,25	-0,19	0,68	0,22	0,27
Ozgundondu et al., 2019	A	Combined	0.POST p0	0,59	0,07	1,12	0,27	0,03
Ploukou et al. 2018	A	Combined	0.POST p0	0,75	0,17	1,33	0,30	0,01
Poulin et al. 2008	Combined	Combined	0.POST p0	0,28	-0,24	0,81	0,27	0,29
Sajadi et al., 2017	Combined	Anxiety	0.POST p0	0,60	0,20	1,00	0,21	0,00
Sallon et al. 2017	A	Combined	0.POST p0	0,32	-0,01	0,64	0,17	0,06
Slatyer et al. 2018	A	Combined	0.POST p0	0,36	-0,19	0,91	0,28	0,20
Taniguchi et al. 2007	A	Combined	0.POST p0	0,17	-0,27	0,61	0,22	0,44
Val Palumbo et al., 2012	A	Combined	0.POST p0	0,56	-0,55	1,67	0,57	0,32
Villani et al. 2013	A	Anxiety	0.POST p0	0,81	0,08	1,53	0,37	0,03
Waters, 2018	A	Psychological distress	2.POST p2	1,19	0,48	1,89	0,36	0,00
Xie et al., 2020	A	Combined	1.POST p1	0,50	0,12	0,89	0,20	0,01
Yang et al. 2018	A	Combined	1.POST p1	0,91	0,49	1,33	0,21	0,00
Zamanifar et al., 2020	A	Anxiety	0.POST p0	0,87	0,35	1,39	0,27	0,00
				0,49	0,37	0,61	0,06	0,00

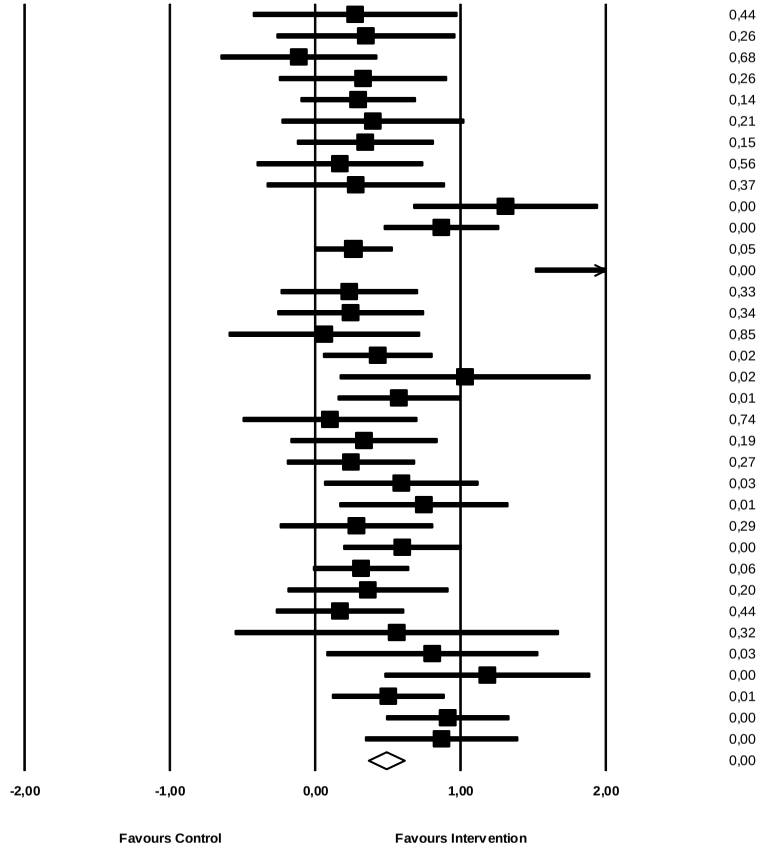

Figure 5. Forest plot of the effect sizes of person-directed interventions: relaxation

Study name	Subgroup within study	Outcome category	Time point	Hedges's g	Lower limit	Upper limit	Standard error	p-Value
Becker et al., 2017, 2020	A	Combined	0.POST p0	0,12	-0,36	0,60	0,25	0,63
Chen et al. 2017	A	Work related stress	0.POST p0	0,70	-0,01	1,41	0,36	0,05
Darban et al. 2016	A	Combined	0.POST p0	0,31	-0,19	0,82	0,26	0,22
Koivu et al., 2012	Combined	Emotional Exhaustion	3.POST p3	-0,31	-1,17	0,55	0,44	0,48
Kubota et al., 2016	A	Combined	2.POST p2	0,06	-0,34	0,45	0,20	0,78
Melo et al. 2015	A	Combined	2.POST p2	0,26	-0,19	0,72	0,23	0,26
Morita et al. 2014	A	Combined	2.POST p2	0,19	-0,24	0,62	0,22	0,40
Sabanciogullari et al., 2015	A	Combined	0.POST p0	0,27	-0,22	0,76	0,25	0,28
Udo et al., 2013	A	Work related stress	0.POST p0	-0,31	-1,11	0,49	0,41	0,44
Wei et al. 2017	A	Combined	0.POST p0	0,96	0,55	1,37	0,21	0,00
				0,27	0,04	0,50	0,12	0,02

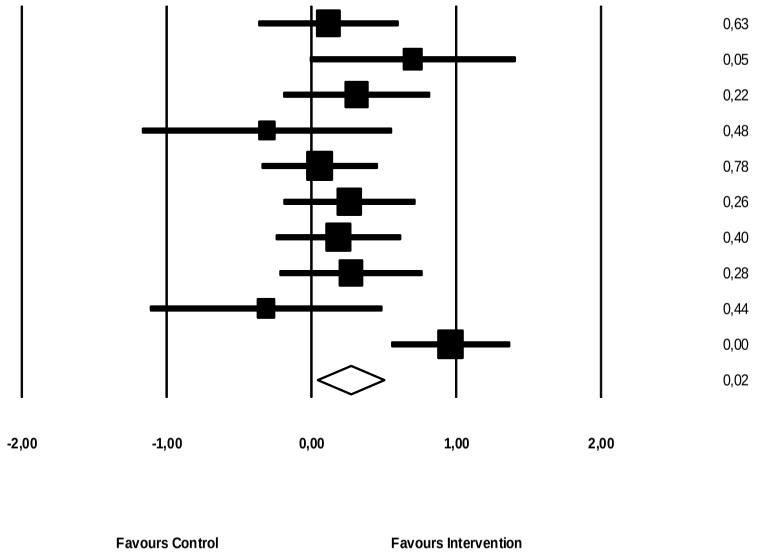

Figure 6. Forest plot of the effect sizes of person-directed interventions: work skills

Study name	Subgroup within study	Outcome category	Time point	Hedges's g	Lower limit	Upper limit	Standard error	p-Value
Barraccutti et al., 2020	A	Psychological distress	2.POST p2	0,10	-0,08	0,28	0,09	0,26
Gunusen et al., 2010	Support	Combined	0.POST p0	0,33	-0,30	0,95	0,32	0,31
Inoue et al., 2011	A	Combined	0.POST p0	0,55	-0,02	1,13	0,29	0,06
Jakel et al. 2016	A	Combined	0.POST p0	-0,08	-0,87	0,71	0,40	0,84
Kharatzadeh et al., 2019	A	Combined	0.POST p0	0,29	-0,25	0,82	0,27	0,29
Lary et al., 2019	A	Combined	0.POST p0	0,23	-0,23	0,70	0,24	0,33
Maatouk et al. 2018	A	Combined	0.POST p0	0,14	-0,23	0,52	0,19	0,46
Mealer et al. 2014	A	Combined	1.POST p1	-0,13	-1,50	1,24	0,70	0,85
Moeini et al. 2011	A	Work related stress	2.POST p2	1,43	0,86	2,00	0,29	0,00
Nooryan et al., 2011	A	Anxiety	0.POST p0	0,52	0,14	0,91	0,20	0,01
Nooryan et al., 2012	A	Anxiety	1.POST p1	0,65	0,32	0,98	0,17	0,00
Orly et al. 2012	A	Combined	0.POST p0	0,61	-0,05	1,27	0,34	0,07
Ozbas & Tel, 2016	A	Combined	1.POST p1	1,03	0,57	1,48	0,23	0,00
Saedpanah et al., 2016	A	Work related stress	0.POST p0	0,68	0,17	1,20	0,26	0,01
Singh et al., 2017	A	Work related stress	0.POST p0	1,45	0,76	2,13	0,35	0,00
Watanabe et al., 2019	A	Combined	2.POST p2	0,04	-0,39	0,48	0,22	0,85
Yektatalab et al., 2020	A	Combined	1.POST p1	0,81	0,41	1,20	0,20	0,00
				0,52	0,31	0,73	0,11	0,00

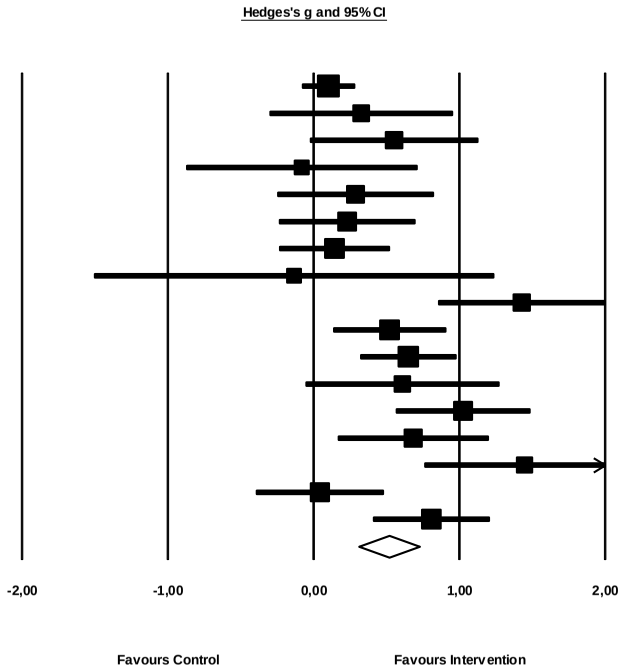

Figure 7. Forest plot of the effect sizes of person-directed interventions: mix

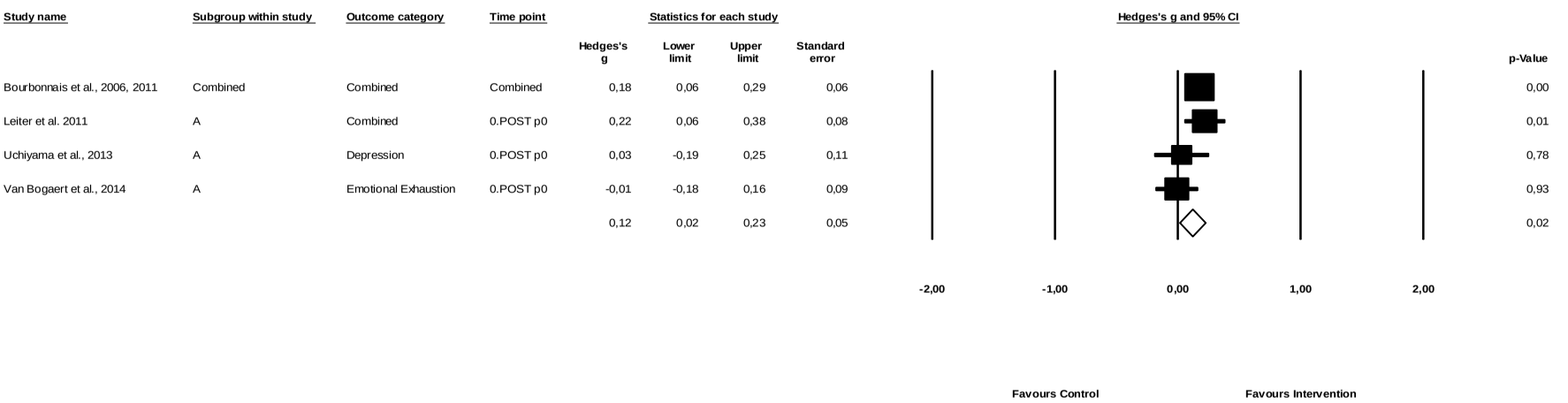

Figure 8. Forest plot of the effect sizes of organization directed interventions

Study name	Subgroup within study	Outcome category	Time point	Statistics for each study				Hedges's g and 95%CI
				Hedges's g	Lower limit	Upper limit	Standard error	p-Value
Gordon et al. 2017	A	Emotional Exhaustion	2.POST p2	0,40	-0,12	0,91	0,26	0,13
Hersch et al. 2016	A	Combined	0.POST p0	0,30	-0,08	0,69	0,20	0,12
Kersten et al., 2019	A	Combined	0.POST p0	0,12	-0,33	0,56	0,23	0,61
le Blanc et al. 2007	A	Combined	0.POST p0	0,20	-0,01	0,40	0,11	0,07
Muller et al., 2015	A	Psychological distress	0.POST p0	0,17	-0,34	0,68	0,26	0,51
				0,22	0,07	0,37	0,08	0,01

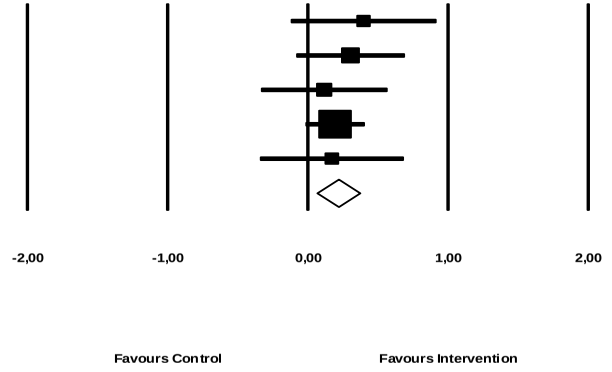

Figure 9. Forest plot of the effect sizes of multilevel interventions