



Review

Interventions to reduce stress in university students: A review and meta-analysis

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ARTICLE INFO

Article history:

Received 14 October 2012

Accepted 6 November 2012

Available online 13 December 2012

Keywords:

Anxiety

Stress

Depression

University student

Cognitive-behavioral

Mindfulness

ABSTRACT

Background: Recent research has revealed concerning rates of anxiety and depression among university students. Nevertheless, only a small percentage of these students receive treatment from university health services. Universities are thus challenged with instituting preventative programs that address student stress and reduce resultant anxiety and depression.

Method: A systematic review of the literature and meta-analysis was conducted to examine the effectiveness of interventions aimed at reducing stress in university students. Studies were eligible for inclusion if the assignment of study participants to experimental or control groups was by random allocation or parallel cohort design.

Results: Retrieved studies represented a variety of intervention approaches with students in a broad range of programs and disciplines. Twenty-four studies, involving 1431 students were included in the meta-analysis. Cognitive, behavioral and mindfulness interventions were associated with decreased symptoms of anxiety. Secondary outcomes included lower levels of depression and cortisol.

Limitations: Included studies were limited to those published in peer reviewed journals. These studies over-represent interventions with female students in Western countries. Studies on some types of interventions such as psycho-educational and arts based interventions did not have sufficient data for inclusion in the meta-analysis.

Conclusion: This review provides evidence that cognitive, behavioral, and mindfulness interventions are effective in reducing stress in university students. Universities are encouraged to make such programs widely available to students. In addition however, future work should focus on developing stress reduction programs that attract male students and address their needs.

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1. Introduction

On September 5, 2012, a Canadian national news magazine ran a cover story entitled “Mental Health Crisis on Campus: Canadian students feel hopeless, depressed, even suicidal” (Lunau, 2012). The story highlighted a 2011 survey at University of Alberta in which over 50% of 1600 students reported feeling hopeless and overwhelming anxiety over the past 12 months. The story continued by recounting incidents of suicide across Canadian campuses. The following month, the CBC reported a survey conducted at another Canadian university indicating that 88.8% of the students identified feeling generally overwhelmed, 50.2% stated that they were overwhelmed with anxiety, 66.1% indicated they were very sad, and 34.2% reported feeling depressed (Craggs, 2012).

Other studies confirm concerning rates of anxiety and depression in university students. The American Foundation for Suicide Prevention sponsored a suicide screening project at Emory University in the United States between 2002 and 2005 (Garlow et al., 2008). Of the sample of 729 student participants, only 16.5% reported no symptoms of depression, while 30.6% reported moderate depression and an additional 23.2% reported moderately severe or severe depression using the Physician Health Questionnaire (PHQ-9). Among the 5689 American university students who participated in a 2007 Healthy Minds Survey, 50.7% tested positive for major depression, panic disorder and/or generalized anxiety using the PHQ-9 (Keyes et al., 2012). A study of 1,616 Turkish university students revealed rates of moderate depression in 27.1%, anxiety in 47.1%, and stress in 27.1% of the sample (Bayran and Bilgel, 2008). A large study in the United Kingdom involving 16,460 undergraduate students charted the longitudinal course of anxiety and depression over the course of their university careers (Bewick et al., 2010). This study revealed that student anxiety scores peaked in the first term of second year and final year, whereas depression scores rose steadily over time, peaking at the end of the final year. Nevertheless, anxiety symptoms were significantly higher than depression scores at all time points, and at no time during university did psychological distress fall to pre-admission levels (Bewick et al., 2010).

Students with mental health problems report poorer relationships with other students and faculty members, lower levels of engagement in campus clubs and activities, lower grade averages, and lower rates of graduation than students not suffering from mental health problems (Byrd and McKinney, 2012; Keyes et al., 2012; Salzer, 2012; Storrer et al., 2010). Furthermore, 11.1% of the Emory University students reported suicidal ideation over the preceding 4 weeks, and 16.5% reported a life-time incidence of suicide or self-harm behavior (Garlow et al., 2008). In a random sample of 8155 students from 15 US universities, 6.75% reported suicidal ideation and 0.5% reported an attempt in the past year (Downs and Eisenberg, 2012). Thus, stress and its mental health implications amongst students is a significant issue for universities.

Studies indicate that few students experiencing stress-related mental health problems receive treatment. Garlow et al. (2008) reported that only 15% of the students with moderately severe or severe depression or with suicidal ideation in their sample were receiving treatment. Downs and Eisenberg (2012) reported that just over half (51.5%) of the students with suicidal ideation

received some type of treatment. In part, low treatment rates are related to help-seeking behaviors among students. In the Downs and Eisenberg (2012) study, the most commonly reported barriers to seeking treatment were: (1) a preference for dealing with stress alone (73.3%); (2) the belief that stress is normal in university (52.2%); (3) not seeing their needs as serious (52.1%); and (4) not having time for treatment (46.7%).

In light of repeated studies that suggest that approximately 50% of the student body experiences significant levels of stress in the form of anxiety and/or depression, we conclude that universities must employ preventative interventions that have the potential to reach larger groups of students and not merely rely on individual counseling services to meet student needs. This paper is a meta-analysis of such interventions with the aim of providing an evidence-based approach for interventions to reduce stress in university students. While meta-analyses have previously been conducted on the use of various models of invention for mixed groups of people suffering from anxiety and depression (Hunot et al., 2007; Jorm et al., 2008; Krisanaprakornkit et al., 2006), previous meta-analyses and reviews have not shed light on whether such interventions are effective for university students.

2. Method

Studies in this analysis included experimental and parallel cohort quasi-experimental evaluations of psychological intervention programs to reduce stress in university students. Studies were eligible for the review if they used: (1) random assignment to create treatment and comparison or control groups or (2) parallel cohort designs in which groups were assessed at the same points in time. Single-group designs were excluded from the analysis but are included in the summary of studies (Table 1). Study participants included undergraduate, graduate, and professional students who had participated in interventions aimed at reducing their levels of stress. Any type of psychological, psycho-educational, and/or psychosocial intervention aimed at reducing stress in university students was eligible for inclusion in the review. Studies that exclusively examined pharmacological interventions; that compared psychosocial, psychological, or psycho-educational treatments to pharmacological treatment; or studies that combined these treatments with pharmacological treatments, were excluded.

The assessment of the primary outcome of psychological stress and anxiety symptoms included various standardized measures such as the Spielberger State-Trait Anxiety Inventory (STAI) (Spielberger, 1983) and the Perceived Stress Scale (PSS) (Cohen et al., 1983). Secondary outcomes were decreased levels of depression and physiological stress responses. Secondary outcome measures included: severity of depressive symptoms using scales such as the Beck Depression Inventory (BDI) (Beck and Steer, 1996) and physiological arousal as measured by salivary cortisol.

3. Search strategy

Searches were conducted on electronic databases, including the Cochrane database on systematic reviews, Medline, Embase, PsychINFO, ERIC, Applied Social Science Abstracts, Social Sciences

Table 1
Summary of stress interventions for university students studies.

Study	Design and N	Population	Nature of intervention	Length of intervention	Stress outcome measures	Meta-analyses
Controlled trials cognitive/behavioral/mindfulness-based interventions						
Astin (1997)	Randomized 12 int/7 controls 1 male/18 females	Behavioral medicine undergraduate students, USA	Mindfulness-based stress reduction (MBSR)	8–2 h sessions over 8 weeks	SCL-90 (depression and anxiety)	Anxiety Depression
Charlesworth et al. (1981)	Parallel cohort 10 int/8 controls 1 males/17 females	Med-Surg nursing students, USA	Relaxation training Visual imagery Modified systematic desensitization	5–2 h sessions over 5 weeks	State-Trait Anxiety Inventory (STAI)	Anxiety
Deckro, et al. (2002)	Randomized 63 int/65 controls 51 males/77 females	Undergraduate students, USA	Relaxation response CBT skills	6–90 min training sessions	STAI PSS SCL-90	Anxiety
Dehghan-Nayeri and Adib-Hajbaghery (2011)	Parallel cohort 100 int/100 control 0 male/200 females	Medical science students, Tehran	Simple relaxation Progressive muscle relaxation	30 min session, 15 min daily practice 8 weeks	STAI	Anxiety
Enright et al. (2000)	Randomized 18 int/17 controls 11 males/24 females	Students with test anxiety, USA	Eye-movement desensitization (EMDR)	2–1 h sessions	Test anxiety inventory	Anxiety
Fehring (1983)	Randomized 26 per group 17 males/61 females	Undergraduate students, USA	Bio-feedback and relaxation training	1 session, independent daily practice with tapes	STAI POMS	Anxiety
Gaab et al. (2003)	Randomized 24 int/24 controls All male	Institute of Technology students, Switzerland	Stress inoculation training (SIT) and CBSM	2–7 h sessions	PSS Salivary cortisol CES depression scale	Anxiety Depression Biological arousal
Gaab et al. (2006)	Randomized 13 int/15 controls 17 males/11 females	Economic students taking qualifying exam, Switzerland	Cognitive-Behavioral Stress Management (CBSM)	4 weekly sessions, 1 booster session	STAI Salivary cortisol	Anxiety Biological arousal
Godbey and Courage (1994)	Parallel cohort 7 int/12 controls All women	Nursing students, USA	Stress management techniques	6 week individual counseling	STAI	Anxiety
Hamdan-Mansour et al. (2009)	Randomized 44 int/40 controls 46 males/38 females	Students suffering from depression, Jordan	Cognitive-behavioral therapy—teaching kids to cope	10–45 min weekly sessions	PSS BDI	Anxiety Depression
Hammerfald et al. (2006)	Randomized 42 int/41 controls 14 males/59 females	UG psychology students, Switzerland	Cognitive-behavioral stress management (CBSM)	2–5 h sessions	Salivary cortisol	Biological arousal
Heaman (1995)	Randomized 21 int/19 controls All female	Nursing students, USA	Bio-feedback aided relaxation training	5–90 min sessions	STAI	Anxiety
Jain et al. (2007)	Randomized 27/24/30 controls 15 males/66 females	Medical, nursing or premed students, USA	1. MBSR 2. Relaxation	4–1.5 h sessions	Brief symptom inventory (BSI) POMS	Anxiety
Jones and Johnston (2000)	Randomized 40 int/30 controls	Student nurses, Scotland	Multi-modal stress management	6–2 h sessions	GHQ STAI BDI	Anxiety Depression

Table 1
(Continued)

Study	Design and N	Population	Nature of intervention	Length of intervention	Stress outcome measures	Meta-analyses
Kookan and Hayslip (1984)	Randomized 11 int/9 controls 9 males/20 females	Elderly undergrad students, USA	SIT	3 weekly sessions	STAI Test anxiety scale Fear of negative evaluation scale	Anxiety
Lynch et al. (2011)	Parallel cohort 10 int/6 controls 4 males/26 females	Undergraduate students, England	Mindfulness-based coping with university life (from MSBR)	8–1.5 h sessions, weekly	PSS Hospital anxiety and depression scale (HADS) Salivary cortisol	Anxiety Depression
Oman et al. (2008)	Randomized 28/15 control 9 males/35 females	Undergraduate students, USA	MBSR and eight point program (EPP)	8–90 min sessions	PSS	Anxiety
Russler (1991)	Randomized 19 int/19 controls Gender not reported	Nursing students, USA	Multi-modal stress management	2–8 h sessions	STAI reported emotions survey	Anxiety
Shapiro et al. (1998)	Randomized 37 int/36 controls 32 males/41 females	Paramedic and medical students, USA	MSRB	7–2.5 h sessions	STAI SCL-90	Anxiety Depression
Shapiro et al. (2011)	Randomized 15 int/15 controls 4 males/26 females	Undergraduate students, USA	MSRB		PSS	Anxiety
Sheehy and Horan (2004)	Randomized 11 int/11 controls 6 males/16 females	Law students, USA	SIT	4–90 min sessions	STAI symptoms of stress inventory (SSI) Derogatis stress profile	Anxiety
Stephens (1992)	Randomized 62/38 controls All female	Nursing students, USA	Imagery and relaxation	Audiotaped imagery 15 min per day for 5 days, then 3 times per week for 3 weeks	STAI	Anxiety
St. Lawrence et al. (1983)	Parallel cohort 11 int/10 controls Gender not reported	Law students, USA	Multi-model stress management	6–90 min sessions	Stressful situations inventory	Anxiety
Warnecke et al. (2011)	Parallel cohort 24 int/32 controls 14 males/42 females	Medical students, Tasmania	MSRB	Audio tape daily for 8 weeks	PSS Depression and anxiety stress scale	Anxiety Depression
Controlled trials educational interventions						
Chiauzzi et al., 2008	Randomized 80 int/80 controls 107 males/113 females	Mixed undergraduate students, USA	Website with stress strategies tailored to the student	20 min at least 4 times over 2 weeks	Perceived stress scale (PSS)	Insufficient data for meta-analysis
Dziegielewski et al. (2004)	Randomized 25 int/23 controls 9 males/39 females	Social work students, USA	Educational: signs of stress, measures to address stress	45 min seminar	Stressful situations questionnaire (SSQ)	No comparators
Controlled trials art-based interventions						
Bittman et al. (2004)	Parallel cohort 38 int/37 controls 11 males/64 females	Nursing students, USA	Recreational music making (RMM)	6–1 h sessions over six weeks	Profile of mood states (POMS) Maslach burnout inventory (MBI)	Insufficient data for meta-analysis

Mohammadian et al. (2011)	Randomized 14 int/14 controls All female	Undergraduate students in residence, Iran	Poetry	7–90 minute sessions	Depression anxiety stress scale	No comparators
Controlled trials other interventions						
Dowd, et al. (2007)	Randomized 12/14/13 controls 12 males/40 females	Undergraduate students, USA	Healing touch and coaching	3 weekly sessions	Stress test 26	No comparators
Single group design studies cognitive/behavioral/mindfulness-based interventions						
Burns et al. (2011)	Pre-test/post-test No control 43 int 18 males/25 females	Undergraduate students, USA	Transcendental meditation (TM)	6–45 min sessions over 6 days	PSS Beck anxiety inventory CES depression scale	No control group
Caldwell et al. (2010)	Pre-test/post-test 3 int 166 int 25 males/141 females	Undergraduate students, USA	Mindfulness-based movement classes	150 min per week for 15 weeks	PSS-4 4 Dimension mood scale	No control group
Collard et al. (2008)	Pre-test/post-test 16 int 2 males/14 females	Post-Graduate Counseling students, England	Mindfulness-based cognitive therapy (MBCT)	8 weeks	Positive and negative affect scale (PANAS)	No control group

Abstracts, PsycInfo, and Dissertation Abstracts International. Reviewers checked the reference lists of all relevant articles that were obtained, including those from previously published reviews. Potentially relevant articles were identified, retrieved, and assessed for possible inclusion in the review.

Screening of the studies was carried out by a three-stage procedure. The first stage of screening determined whether a study might be appropriate for the review based on the study's title and abstract. During the second stage of screening, full copies of articles were reviewed to determine whether studies should remain in the review based on the inclusion and exclusion criteria. The assessment of the methodological quality of each study was based on criteria established in the Cochrane Collaboration Handbook (Higgins and Green, 2011). The third stage consisted of data extraction from the articles that passed the two previous screenings. Where data was not available in the study report of eligible studies, the reviewers corresponded with investigators requesting further information.

The searches were conducted between February 10 and March 1, 2012 and yielded 3138 potentially relevant studies (see Fig. 1). Once duplicates were removed, 442 titles and abstracts were saved to a spread sheet and subjected to more detailed evaluation. During the second screen, studies were excluded because the intervention included pharmacological approaches; or because the focus of intervention was with another population including mental health counselors, persons with trauma histories, prisoners, elementary or adolescent aged children, or persons exclusively dealing with racial identity. The second screen of titles and abstracts resulted in 63 studies that were selected for full text analysis. Thirty-four studies were screened out at this stage as they were not intervention studies, or they did not have stress and/or anxiety as an outcome measure. In the end, 29 controlled studies on stress interventions for university students were deemed to be appropriate meta-analyses (Table 1). Twenty-four studies contained sufficient information for meta-analysis or had comparators in order to allow for meta-analysis. Three additional single-group design studies are included in the table in order to provide more complete information on the range of studies in this area.

4. Data analysis

A meta-analysis was conducted to pool change in the primary outcome (self-reported anxiety) and secondary outcomes (self-reported depression and salivary cortisol level) from baseline to the post-intervention period using Comprehensive Meta-analysis software, version 2.0. All data were continuous and analyzed by measuring the standard mean difference between the treatment and comparison groups based on the reported means and standard deviations for each group. Standard mean differences (SMD) allowed for comparisons to be made across studies when scales measured the same outcomes using different standardized instruments, such as administering the STAI or the PSS to measure anxiety. Standard mean differences were determined by calculating the Hedges' *g* (Hedges, 1982). The Hedges' *g* is preferable to Cohen's *d* in this instance, as it includes an adjustment for small sample bias. To pool SMDs, inverse variance methods were used to weigh each effect size by the inverse of its variance to obtain an overall estimate of effect size. Standard differences in means (SDMs) point estimates and 95% confidence intervals (CIs) were computed using a random effects model. Heterogeneity between studies was calculated using I^2 (Higgins et al., 2003). This statistic provides an estimate of the percentage of variability in results across studies that are likely due to treatment effect rather than chance (Guyatt et al., 2008).

5. Results

Twenty-nine controlled trials on stress interventions for university students met the criteria for inclusion in the meta-analysis. Three additional studies using single-group designs are included in the summary table (Table 1) in order to provide full information to readers (Burns et al., 2011; Caldwell et al., 2010; Collard et al., 2008). Controlled trial studies covered students in a wide range of disciplines, including nursing, medical science, medicine, economics, social work, law, psychology, technology, and general arts and science. While the majority of controlled trial studies (19) involved students in the United States, studies also included students in Tehran (Dehghan-Nayeri and Adib-Hajbaghery, 2011), Switzerland (Gaab et al., 2003, 2006; Hammerfald et al., 2006), Jordan (Hamdan-Mansour et al., 2009), Scotland (Jones and Johnston, 2000), England (Lynch et al., 2011), Iran (Mohammadian et al., 2011), and Tasmania (Warnecke et al., 2011). The combined controlled trials had 1802 student participants. Of the total number of participants in these studies, 24.7% were male, 72.4% were female, and in 2.8% of the cases gender was not reported. Thus in the reported cases 25.5% of participants were male.

5.1. Stress interventions

For the purposes of meta-analysis, stress interventions were grouped into three broad categories: (1) arts-based interventions; (2) psycho-educational interventions; and (3) cognitive/behavioral/mindfulness-based interventions. One controlled trial (Dowd et al., 2007) was not classified as appropriate to any of the three categories and thus was not included in the meta-analysis. The one study classified in the *other interventions* category used a combination of energy therapy through healing touch and self-care coaching based on comfort theory. Dowd and colleagues concluded that a healing touch provided greater reduction in stress immediately after intervention; however, when combined with the coaching intervention it had better carryover effects. These findings have not been replicated and a Cochrane Review conducted in 2007 was unable to locate randomized or quasi-randomized trials for inclusion in a meta-analysis (Robinson et al., 2007).

Two studies were classified as *arts-based interventions*. Bittman and colleagues tested the efficacy of Group Empowerment Drumming, a form of recreational music making (Bittman et al., 2004). This intervention followed the HealthRHYTHMS protocol (Bittman et al., 2001) and used drumming to enhance social support, provide exercise and intellectual stimulation, and heighten spirituality. The intervention was conducted on a group basis, one hour each week for six weeks. The published version of this paper did not contain sufficient data for meta-analysis, and given the time elapsed since the study was conducted, the authors were unable to provide the required data (Bittman, 2012 personal communication). Mohammadian and colleagues tested a seven-session Poetry Therapy intervention with students in Iran. In this intervention, Persian poetry was read to students and used as a means to elicit emotions, analyze feelings, and promote collaborative writing. Poetry Therapy is described as a means to express feelings and thoughts that might otherwise be repressed. While this study reported depression and anxiety as outcomes, it was not included in the meta-analysis due to an absence of comparators (Mohammadian et al., 2011).

Two controlled trials examined *psycho-educational interventions*. Chaiuzzi and colleagues created an online stress intervention, MyStudentBody-Stress, tailored to provide tools, strategies and stories related to stress management and individual feedback

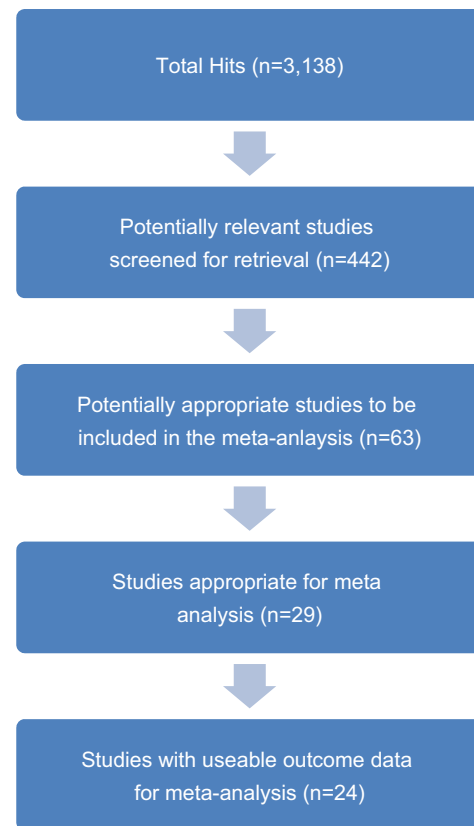


Fig. 1. Search results.

on personal stress management strategies. In the intervention condition, students were instructed to spend at least 20 min on the website on four occasions over a two-week period (Chiauzzi et al., 2008). The authors report that there was no significant condition-by-time interaction effect on anxiety as measured by the Perceived Stress Scale; however, there was insufficient data to include the study in a meta-analysis. Dziegielewski, Turnage, and Roest-Marti provided a 45-min seminar for social work students covering personality styles and behavior, signs of stress, and concrete methods for managing stress. While this study reported significant reduction in stress in the intervention as measured by the Stress Situations Questionnaire, it was not included in the meta-analysis due to an absence of comparators (Dziegielewski et al., 2004).

Twenty-four studies examined the effects of various models of *cognitive, behavioural, and/or mindfulness-based techniques* on stress in university students. All of these studies had sufficient data for inclusion in the meta-analysis. Cognitive-behavioral therapy incorporates cognitive, behavioral, and social learning theory components to explain functioning as a product of reciprocal interactions between personal and environmental variables. In the realm of stress, behavioral interventions often focus on control of physical stress reactions through controlled breathing or muscle relaxation. Cognitive therapy components aim to assist individuals in identifying and modifying dysfunctional beliefs that influence response to stimuli and subsequent physiological and psychological distress. The studies in this analysis used a variety of strategies in the broad category of cognitive behavioral interventions. Most interventions involved 4–8 weekly sessions. However, some interventions (Dehghan-Nayeri and Adib-Hajbaghery, 2011; Fehring, 1983) involved only one session, followed by independent practice with relaxation tapes (see Table 1).

Five studies (Gaab et al., 2003, 2006; Hammerfeld et al., 2006; Kookon and Hayslip, 1984; Sheehy and Horan, 2004) examined interventions based on *Stress Inoculation Training (SIT)*. First developed by Meichenbaum in 1977, this model of intervention involves three interlocking and overlapping phases: (1) education regarding sources of stress, including irrational thinking, and ways to reduce psychological and physiological stress; (2) coping skills, including relaxation training and cognitive restructuring; and (3) application of new strategies to real or simulated situations (Meichenbaum, 1977, 1993; Meichenbaum and Deffenbacher, 1988). While originally developed for clinical populations, stress inoculation training has increasingly been used in a variety of populations to assist with the management of occupational stress and enhance performance under stress (Saunders et al., 1996). Meichenbaum (1993) describes SIT as a flexible, multifaceted form of cognitive-behavioral therapy that can be modified to suit the specific situation. In this vein, Gaab and colleagues explicitly state they have slightly adapted SIT into a model they call *Cognitive-Behavioral Stress Management (CBSM)* for use on Swiss students.

Other studies in this review use a combination of techniques encompassed in SIT, including psycho-educational elements, relaxation training, and cognitive restructuring. Four studies (Dehghan-Nayeri and Adib-Hajbaghery, 2011; Fehring, 1983; Heaman, 1995; Stephens, 1992) used combinations of relaxation training, education, and imagery. Commonly, these models incorporate group training sessions and homework practice, often through the use of relaxation and guided imagery tapes. Seven studies incorporated relaxation techniques and education with various forms of cognitive restructuring, entitling their approaches multidimensional or multi-modal (Charlesworth et al., 1981; Deckro et al., 2002; Godbey and Courage, 1994; Hamdan-Mansour et al., 2009; Jones and Johnston, 2000; Russler, 1991; St. Lawrence et al., 1983). One study (Enright et al., 2000) used *Eye-Movement Desensitization and Reprocessing (EMDR)* with students experiencing test anxiety. EMDR incorporates cognitive-behavioral interventions with desensitization through therapeutic exposure and saccadic eye movements. During treatment, the client's attention is directed to the external stimulus (usually eye movements) while simultaneously concentrating on the source of emotional distress (Shapiro, 1996).

An approach that has been gaining increased attention over the last two decades is *Mindfulness-Based Stress Reduction (MBSR)*. While there are intersections between mindfulness-based approaches and cognitive therapy, most explicitly in *Mindfulness-Based Cognitive Therapy (Segal et al., 2002)*, the studies included in this review do not specifically describe the integration of cognitive-behavioral techniques into their approaches. Nevertheless, it is difficult to draw clear distinctions between the approaches using imagery and relaxation and those using mindfulness. As a result, meta-analyses were conducted that combined cognitive-behavioral and mindfulness interventions and that examined their effectiveness separately.

Developed by Kabat-Zinn, MBSR incorporates three mindfulness practices: (1) sweeping, or an awareness of the body focussing on breath awareness and relaxation; (2) mindfulness of breath; and (3) hatha yoga postures. Sessions generally cover mindfulness in stressful situations and social interactions, and acceptance of self and others. In this model, weekly MBSR sessions are augmented by audio cassettes that lead to practice at home. Originally designed as a behavioral medicine technique for patients with chronic pain (Kabat-Zinn, 1982), the model has subsequently been tested on people with a broad spectrum of issues, including anxiety disorders (Kabat-Zinn et al., 1991). In this review, seven studies examined approaches based on MBSR (Astin, 1997; Jain et al., 2007; Lynch et al., 2011; Oman et al., 2008; Shapiro et al., 1998, 2011; Warnecke et al., 2011).

5.2. Meta-analysis results

Twenty-four studies including 1431 participants contained sufficient information and had comparators for meta-analysis. Of those included in the meta-analysis, 24.0% of the participants were male.

Twenty-three cognitive, behavioural, and mindfulness-based studies contributed data to a pooled analysis for the primary outcome of self-reported anxiety. Results are significant for treatment against the control group (Standard Difference in Means point estimate -0.77 ; 95% CI -0.88 to -0.58). Heterogeneity as assessed by the I^2 is moderate (29.4%; see Fig. 2). In addition, cognitive, behavioural, and mindfulness-based approaches were assessed independently for the impact on anxiety. The pooled results for 16 cognitive behavioral interventions (SDM -0.77 ; 95% CI -0.97 to -0.57 ; $I^2=43.0\%$) and 9 mindfulness-based interventions (SDM -0.73 ; 95% CI -1.00 to -0.45 ; $I^2=36.9\%$) showed significant improvement over control groups (see Figs. 3 and 4). Despite the differences in approach, moderate heterogeneity suggests a considerable degree of similarity.

Two analyses were conducted for secondary outcomes. Six cognitive behavioral and mindfulness-based studies contributed to a pooled analysis for depression. Results are significant for treatment against the control group (SDM -0.81 ; 95% CI -1.49 to -0.13 ; see Fig. 5). Heterogeneity in this analysis is high ($I^2=86.6\%$). In one study of a self-directed intervention using mindfulness-based audio recordings, the intervention did not result in lower levels of depression (Warnecke et al., 2011). Three studies contributed to a pooled analysis for salivary cortisol (SDM -0.52 ; 95% CI -0.83 to -0.20). Heterogeneity as assessed by the I^2 is 0% in this analysis, which speaks to the consistency in the approach used across trials (see Fig. 6).

6. Discussion

A range of studies conducted in various jurisdictions reveal that approximately half of the university students report moderate levels of stress-related mental health concerns, including anxiety and depression (Bayran and Bilgel, 2008; Garlow et al., 2008; Keyes et al., 2012; Lunau, 2012). Students experiencing these symptoms also report lower levels of engagement, lower GPA, and suicidal ideation (Byrd and McKinney, 2012; Downs and Eisenberg, 2012; Garlow et al., 2008). Clearly, this is a critical issue for universities to address. This paper reports a systematic review and meta-analysis of 24 controlled studies that examine the effectiveness of interventions aimed at reducing stress in university students.

The findings of the meta-analysis suggest that cognitive, behavioral, and mindfulness-based interventions focused on stress reduction significantly reduce symptoms of anxiety. Further, despite variations in approaches in terms of length of intervention and specific components of the intervention (including such aspects as cognitive restructuring, relaxation, and meditation) with students in different programs and in different countries, these results are remarkably consistent. In five of six studies, depression scores were also significantly reduced in the intervention group. Furthermore, three studies that assessed the impact of a stress inoculation training-based intervention demonstrated significant impact on salivary cortisol levels, suggesting that the intervention has an impact not only on individual appraisal of stress symptoms, but also on biological arousal.

These findings are supported by meta-analyses conducted with other populations. A Cochrane Review based on an analysis of 22 studies reported that CBT approaches are effective in addressing generalized anxiety disorders in mixed populations with a mean overall age of 47.2 years (Hunot et al., 2007). Other systematic reviews have established that cognitive-behavioral

Anxiety in Cognitive/ Behavioral / Mindfulness-Based Interventions

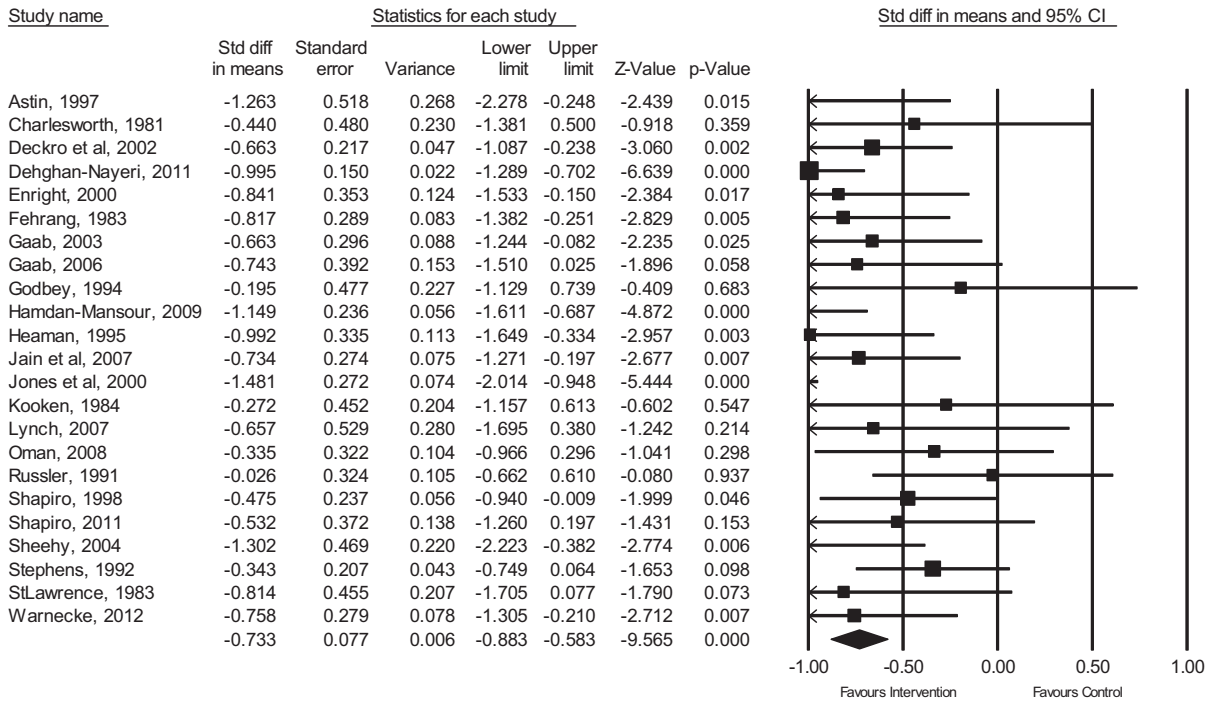


Fig. 2

Anxiety in Cognitive Behavioral Trials

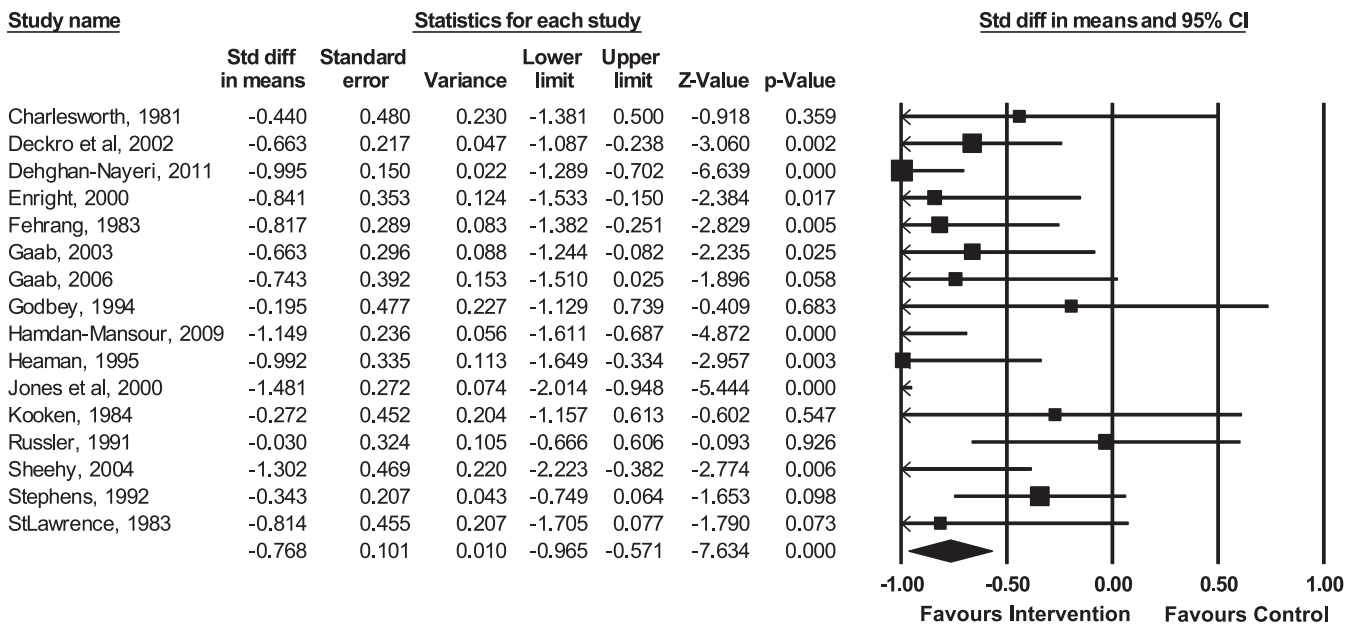


Fig. 3

approaches including SIT and EMDR are effective in reducing symptoms of post-traumatic stress disorder in populations ranging from accident victims to emergency responders, veterans, and victims of sexual violence (Bisson and Andrew, 2007; Regehr et al., 2012; Sherman, 1998). Jorm, Morgan, and Hetrick conclude in a Cochrane review of 15 trials that relaxation techniques are more effective in reducing depression than no treatment, but less effective than other CBT techniques (Jorm et al., 2008). Krisanaprakornkit and colleagues report the results of a Cochrane review with two controlled studies and concluded that mediation is comparable to other relaxation techniques in reducing anxiety (Krisanaprakornkit et al., 2006). This is confirmed by a more recent review that found MSBR and relaxation are both effective in reducing stress associated with a number of mental and physical disorders (Chiesa and Serretti, 2009). An additional review on mindfulness interventions similarly concluded that this approach reduces stress in individuals with a range of health

conditions (Grossman et al., 2004). This corroboration further adds to the compelling results of the current review and meta-analysis.

6.1. Limitations

Despite these strong findings, this review and meta-analysis has limitations. Studies in this analysis are limited to those published in the English language in peer-reviewed journals. The students represented in these studies were enrolled in a variety of academic programs including health sciences, general undergraduate, technology, and law. The intervention studies were conducted in a number of countries; however, the preponderance of research has been conducted in English-speaking Western countries and thus generalizability to other cultural contexts may be limited. In addition, the majority of participants in these studies were women. That being said, one study

Anxiety in Mindfulness-Based Trials

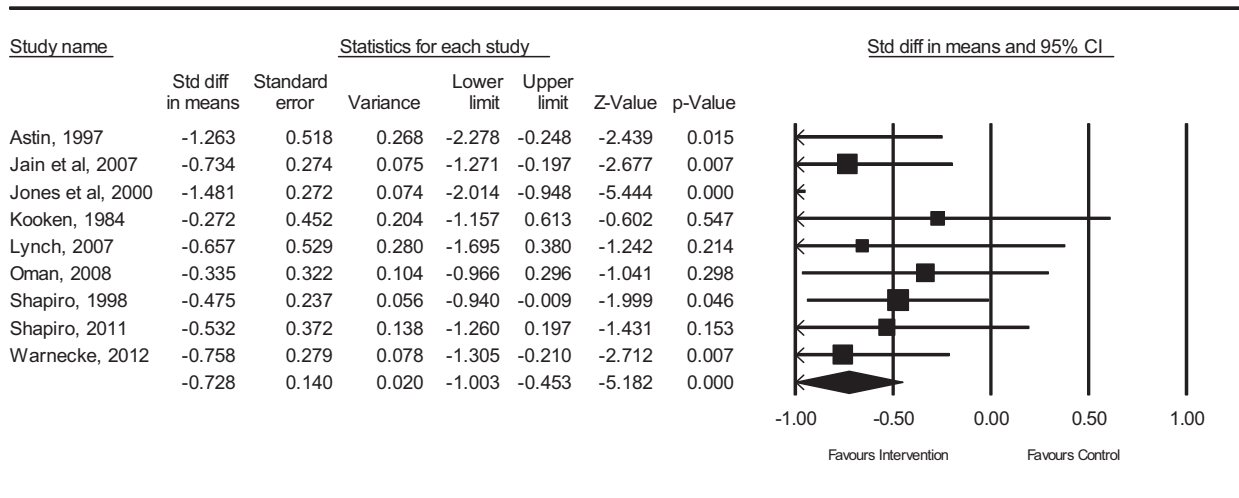
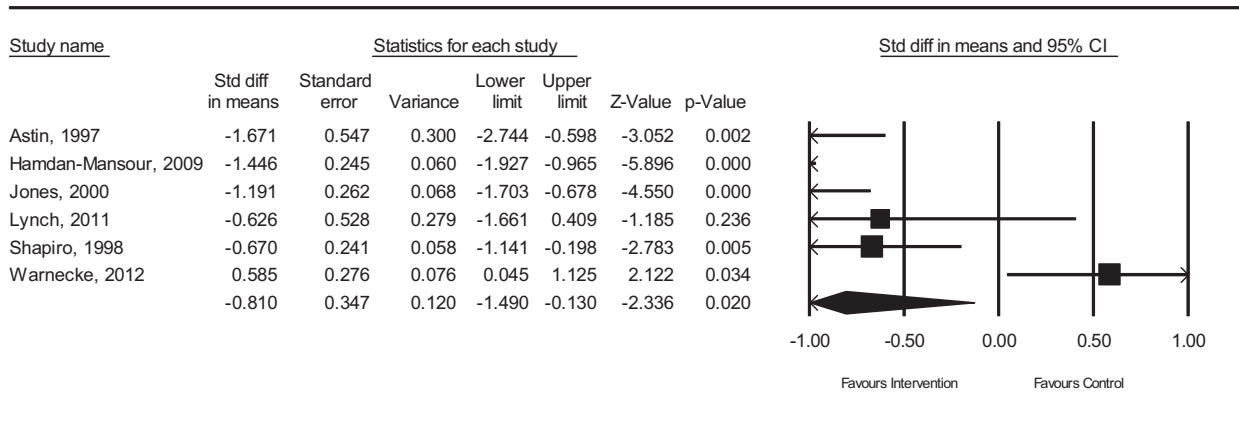


Fig. 4

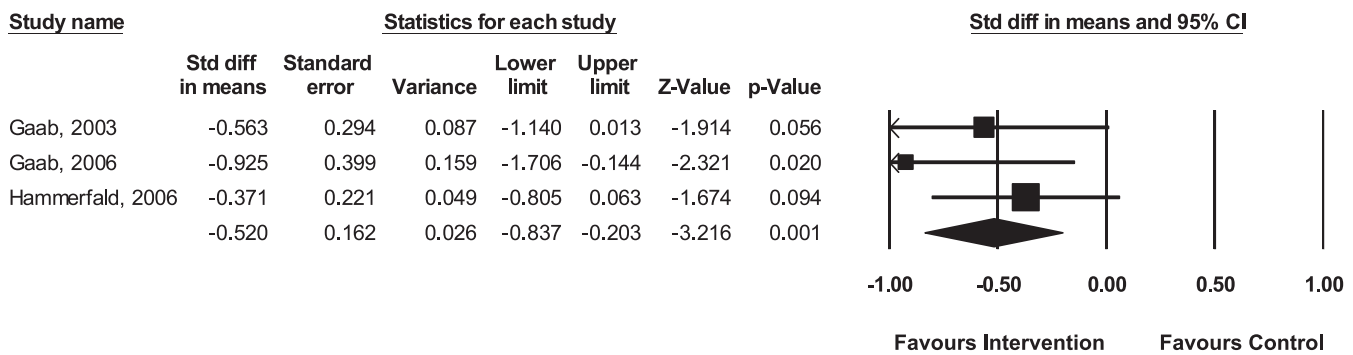
Depression in Cognitive/ Behavioral / Mindfulness-Based Interventions



Meta Analysis

Fig. 5

Cortisol Cognitive Behavioral Trials



Meta Analysis

Fig. 6

(Gaab et al., 2003) was conducted exclusively with male students and reported positive results in terms of anxiety, depression, and cortisol response when compared with the control condition. Nevertheless, focusing on strategies that will appeal to young men is an area for further development.

Finally, the meta-analysis in this review was limited to studies examining the effectiveness of cognitive, behavioral, and mindfulness-based interventions. While controlled studies were conducted with respect to arts-based and educational interventions, there was insufficient data to perform meta-analyses of these types of interventions. This represents an area for further investigation.

7. Conclusions

Results from this review and meta-analysis provide strong support that cognitive, behavioral, and mindfulness-based approaches are effective in reducing the effects of stress on university students, including reducing levels of anxiety, depression, and cortisol response. Given the high rates of stress-related mental health problems reported by university students, universities are advised to examine means to provide opportunities for a larger number of students to access these interventions. The favorable outcomes benefit not only individual students, but have the potential to provide wide-spread benefits to universities in terms of both enhancing student experience and reducing health service costs resulting from student mental health problems.

Conflict of interest

No conflict declared.

Role of funding source

Nothing declared.

Acknowledgements

The authors do not have any acknowledgements to declare.

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