

Effectiveness of relaxation techniques to reduce distress, anxiety and depression in adolescents: An insight analysis report based on systematic review, meta-analysis and qualitative narrative review of literature

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Abstract

'Relaxation Techniques' are a "set of strategies to improve physiological response to stress". They are categorised into somatic, cognitive and behavioural techniques and work as a prophylaxis for the stress-related neurochemical changes linked with the development of depression and anxiety. Relaxation techniques most commonly reported in the studies include, somatic (Progressive Muscle Relaxation (PMR), deep breathing, exercise, walk, stretching, relaxation) and cognitive relaxation techniques (imagery and meditation). The current evidence indicates that relaxation techniques are highly effective in treating anxiety (pooled effect size of (SMD) -0.54 (95% CI: -0.69 to -0.40); moderately effective in reducing distress (SMD= -0.48, 95% CI: -0.71 to -0.24) and have only a weak effect on improving depression in adolescents (SMD= -0.28 (95% CI: -0.40% to -0.15) aged 14-24 years. The somatic mode of relaxation was identified as the most effective method of relaxation in reducing distress and anxiety. Somatic mode of relaxation combined with behavioural relaxation training yielded a slightly better but non-significant improvement in depression post-intervention. Face-to-face delivered 'relaxation techniques' yielded higher effect size (SMD=-0.47, 95% CI: -0.64 to -0.30) compared to online delivery of relaxation techniques (SMD=-0.22, 95% CI: -0.48 to 0.04) to reduce anxiety in adolescents. Majority of the studies included in our analysis were conducted in an educational setting of High Income Countries (HICs). Qualitative narrative review of studies revealed that adolescents found relaxation techniques easy to understand, learn and use. Frequently reported challenges were difficulty in finding time to practice the techniques and heightened sensory sensitivity associated with the practice of relaxation techniques.

Introduction:

'Relaxation Techniques' are "a set of strategies to improve physiological response to stress" (Murray et al, 2018). Relaxation techniques are referred to in the literature in two different ways: a) Techniques to deal with muscular tension in which relaxation works to lengthen muscle fibres to release tension from muscles; b) a conscious state of peace where a person does not experience negative thoughts such as tension, anxiety or fear. Examples of relaxation techniques include, but are not limited to deep breathing, meditation, progressive muscle relaxation, imagery, and others based on local cultures. Therefore, relaxation techniques involve somatic, cognitive and behavioural dimensions. According to Titlebaum 1988, 'relaxation' a) protects body from unnecessary pain (caused by stress); b) helps to relieve stress from the body when conditions like panic (Öst 1988) and tension headache occur (Spinhoven et al 1992), and; c) calms the mind to promote positive and clearer thinking (Peveler & Johnston 1986) which gets blurred when a stressful situation occurs.

How relaxation techniques work?

Relaxation techniques work through physiological and psychological mechanisms (Payne, 2005).

Physiological mechanism: Three body systems are associated with the state of stress and relaxation. These include autonomic nervous system, the endocrine system and the skeletal musculature. The autonomic system consists of sympathetic and parasympathetic nervous systems. Their functions are involuntary and prepare the individual to survive. In a stressful situation, sympathetic nervous system gets activated which results in physiological symptoms of stress. The parasympathetic nervous system works in the opposite way; it gets activated in a non-challenging situation when the sympathetic nervous system stops working. The endocrine system works by releasing catecholamines (adrenaline and noradrenaline hormones) from the adrenal medulla and prepares the body organs for quick action in a stressful situation. Acting in the longer term, the pituitary gland stimulates the release of adrenocorticotrophic hormone (ACTH) from adrenal cortex to produce mineralocorticoids and glucocorticoids, the most important of which is cortisol, which helps to maintain the fuel supply to the muscles (Waugh & Grant 2001) (Figure 1). When the challenging situation passes, the neurotransmitter acetylcholine is released to restore a state of balance in the autonomic nervous system. The organs which were previously stimulated now weaken their hold and their actions subside. The neuromuscular system works as a mediator in the relief of stress and anxiety (Jacobson, 1938). The relaxation techniques involving muscles, e.g. progressive muscle relaxation technique, work by increasing awareness of muscular sensations and consciously releasing muscle tensions. The release of tension from skeletal musculature has the impact of calming the mind. Muscular relaxation works to create a pleasant mental state

by reducing anxiety responses; an increase in parasympathetic activities, improved concentration, increased feeling of control and improved ability to block inner talk.

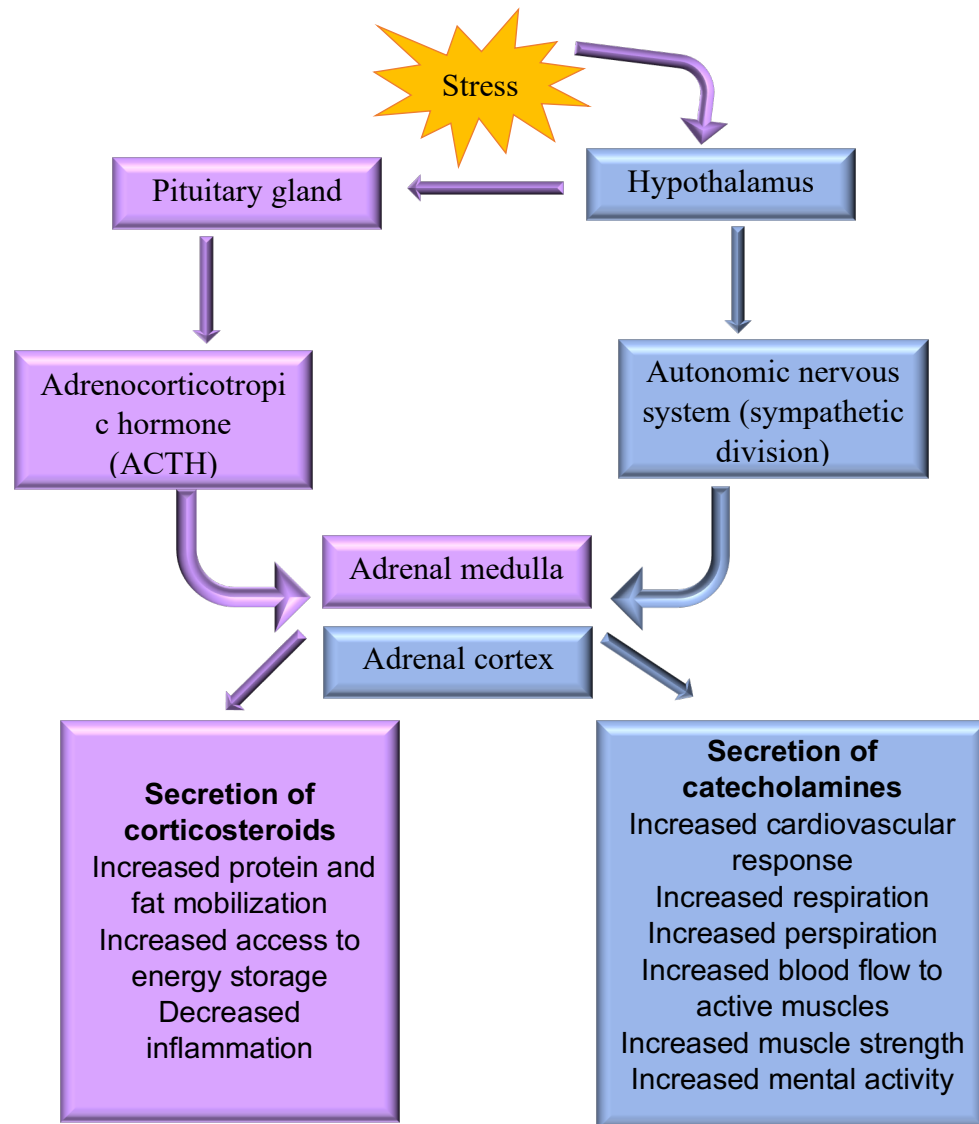


Figure 1- Brain-body pathways in stress (adapted from Weiten, 2013)

Psychological mechanisms of relaxation are cognitive, behaviour and cognitive behaviour pathways.

Cognitive: The cognitive theory postulates that our thinking determines the way we feel, which in turn governs our behaviour (Lazarus & Folkman 1984). Anxiety, depression and distress stem from the wrong thoughts which allows the individual to have a distorted view of an event/situation. Techniques such as cognitive restructuring help individuals to have a realistic view of themselves and the world/event by challenging the faulty thinking patterns and test them against reality to deal with stressful situations (Beck 1976).

Behaviour theory: Behaviour theory focuses on observable actions and works on principles of conditioning and reinforcement. Behavioural approaches to reduce stress and anxiety include distraction, graded exposure and social skills training. Distraction consists of activities which divert the attention; graded exposure offers a step-by-step approach towards mastery over a feared object or situation; and social skills training concerns interpersonal communication and covers verbal and non-verbal behaviour.

Cognitive Behaviour Theory (CBT): The cognitive behaviour theory postulates that behaviour is mainly determined by an internal ‘self-talk’ to interpret the world/event. If a self-talk is positive, the person will have a positive view of world or vice versa. The CBT approach aims to empower an individual to have a control over his/her life to protect self from unnecessary stresses. At first, the person becomes aware of his/her thoughts, feelings and behaviours; then replaces his negative self-talk with a positive one by using coping skills e.g. relaxation, problem solving and finally, through graded exposure, role plays and mental rehearsal; and application of these adapted behaviours in real-life situations.

Table 1: Categories of relaxation techniques and how they work

Categories of relaxation techniques	Techniques	How relaxation techniques work?
Somatic	PMR	- Physiological mechanism- autonomic nervous system, the endocrine system and the skeletal musculature
	Deep breathing	
	Exercise	
	Walk	
	Stretches	
Cognitive	Cognitive restructuring	- Psychological mechanism- thinking
	Imagery	
	Goal directed visualization	
	Autogenic training	
	Positive self-talk	
	self-awareness	
Meditation (sitting, eating, walking)		
Behavioural	Assertiveness	- Psychological mechanism- change in observable action following the principles of conditioning and reinforcement
	Communication skills	
	Distraction	
	Graded exposure	

In a stressful situation, the physiological and psychological stressors automatically trigger fight or flight response. The opposite to flight or fight response is a consciously elicited response i.e. Relaxation response (RR). Introduced by Benson (1976), Benson’s relaxation response works by activating the parasympathetic division of the autonomic nervous system to decrease physiological arousal. The RR is categorised as an integrated set of physiological changes

including decrease in oxygen consumption, heart rate, arterial blood pressure and respiratory rate that helps individuals to effectively deal with the negative effects of stressors.

A Benson's relaxation session to elicit relaxation response

1. Sit quietly in a comfortable position
2. Close your eyes
3. Deeply relax all your muscles, beginning at your feet and progressing up to your face. Keep them relaxed.
4. Breathe through your nose. Become aware of your breathing. As you breathe out, say the word "one" silently to yourself. For example, breath in ... out, "one"; in ... out, "one"; and so forth. Breathe easily and naturally.
5. Continue for 10 to 20 minutes. You may open your eyes to check the time, but do not use an alarm. When you finish, sit quietly for several minutes, at first with your eyes closed and later with your eyes opened. Do not stand up for a few minutes.
6. Do not worry about whether you are successful in achieving a deep level of relaxation. Maintain a passive attitude and permit relaxation to occur at its own pace. When distracting thoughts occur, try to ignore them by not dwelling on them, and return to repeating "one". With practice, the response should come with little effort. Practice the technique once or twice daily but not within two hours after any meal, since, digestive processes seem to interfere with elicitation of the relaxation technique.

Source: Relaxation procedure (pp, 14-15) from Benson, H., & Klipper, M. Z. (1975, 1988). *The relaxation response*. New York: Morrow. Copyright © 1975 by William Morrow & Co. Reprinted of HarperCollins Publisher

Measuring the impact of relaxation techniques:

The impact of relaxation techniques can be measured using the physiological indicators, psychological and behavioural outcomes of mental health and wellbeing (Payne, 2005). Physiological indicators of arousal such as heart rate, blood pressure, respiratory rate, muscle tension, blood flow, sweating and electrical activity provide an objective measure of relaxation response. However, data collection on physiological stress response is challenging. While, some of the indicators are easy to measure, others require sophisticated equipment and expertise which is not frequently accessible. To be meaningful, the data on physiological parameters need to be collected at multiple time-points, in a controlled setting, from each subject and need to take into account a number of individual factors which may act as

confounders. Although, there are challenges to collect objective data on physiological stress response, physiological measurement is an important part of relaxation response assessment (Payne, 2005).

Questionnaire, interview schedules and self-report measures such as the Beck Depression Inventory (Beck et al 1961, Beck 1988) and Depression Anxiety and Stress Scale-21 (DASS-21) (Lovibond & Lovibond, 1995) have been used to measure the relaxation response in adolescents. Each of these outcome measures have their own strengths and limitations. A standardized, validated questionnaire, interview schedule or a self-report measure can all yield highly meaningful information and have the advantage of being quick, cheap and easy to complete and collate the results. However, these outcome measures are subject to bias in data collection, reporting and interpretation.

Table 2: Selected tools to measure physiological, psychological and behavioural impact of relaxation interventions

Constructs		Measure/instrument	Notes
Psychological outcomes	Depression	Centre for Epidemiological Studies-Depression Scale (CES-D) (SR,1)	<ul style="list-style-type: none"> • Taps on depressive symptoms.
		Beck Depression Inventory (BDI) (SR,1)	<ul style="list-style-type: none"> • Measures characteristic attitudes and symptoms of depression
		Kessler 10 depression scale (K10)	<ul style="list-style-type: none"> • Tools used to screen for psychological distress, such as anxiety or depression.
	Anxiety	Profile of Mood States short form (SR,1)	<ul style="list-style-type: none"> • Measures six different dimensions of mood swings
		Spielberger State-Trait Anxiety Inventory (STAI) (SR,1)	<ul style="list-style-type: none"> • Assess state anxiety and trait anxiety
		Spence Children Anxiety Scale (PR,1)	<ul style="list-style-type: none"> • Assess severity of anxiety symptoms
	Depression/Anxiety	Depression, Anxiety and Stress Scale (DASS) (SR,1)	<ul style="list-style-type: none"> • Measure the negative emotional states of depression, anxiety and stress
	Stress/Distress	Perceived Stress Scale (SR,1)	<ul style="list-style-type: none"> • Measure of the degree to which situations in one's life are appraised as stressful
		Kessler Perceived Distress Scale (SR,1)	<ul style="list-style-type: none"> • Taps on emotional states
Physiological indicators	Salivary cytokines, urinary cortisol, epinephrine levels, physical fitness, cardiovascular fitness, autonomic nervous system activity, somatic and autonomic regulation, physical health outcomes (triglycerides and lipoproteins)		

(SR=self-rated, PR=practitioner rated, 1=1-time assessment)

Relaxation techniques to reduce anxiety and depression:

Relaxation techniques are one of the widely used techniques to manage anxiety and depression. They are either used as a standalone intervention or part of a complex therapy to manage anxiety and reduce depression (Manzoni, Pagnini, Castelnuovo & Molinari, 2008). Stefano and Esch, (2005) indicated that relaxation techniques are effective for a range of medical conditions including cardiac arrhythmias, hypertension, chronic pain as well as for the psychological difficulties including anxiety and mild to moderate depression. A systematic review conducted by Manzoni et al (2008) found that relaxation techniques are highly effective in reducing state anxiety. More profound results were seen in participants who were practicing relaxation skills. Jorm et al 2008 conducted a systematic review to evaluate the effectiveness of relaxation techniques for the treatment of depression. The relaxation techniques were found to be effective to treat depression compared to no treatment or minimal treatment. However, when compared with the cognitive behavioural therapy, relaxation techniques were less effective to treat depression. Thus, relaxation techniques can be used as a first-line psychological treatment for depression (Jorm et al, 2008).

Relaxation Techniques are a frequently cited active ingredient of trans-diagnostic, non-specialists delivered psychosocial interventions and are included in the World Health Organization (WHO) intervention packages for scaling-up care for mental health for adolescents in low resource settings globally (WHO mhGAP; Dawson et al., 2015; Dawson et al., 2019, Murray et al., 2018; Epping-Jordan et al., 2016; WHO, 2019; WHO 2015). Although, there is evidence for the feasibility, acceptability and effectiveness of relaxation based interventions with adolescents, there is little evidence on the efficacy of these interventions for specific target populations, (Burke, 2010). Furthermore, the relative impact of relaxation techniques when combined with other components of interventions is also unknown. There are several reasons for this. First, relaxation technique in multi-component interventions are often poorly described. Second, research designs of randomized trials generally do not cater to understanding the role of an individual element such as 'relaxation technique' in the overall effect of the intervention. Thirdly, it is difficult to tease out conditions under which a relaxation technique is effective or how it works in tandem with other elements. Finally, end-user perspectives about the usefulness of an individual element such as relaxation technique, are not considered in the design of multicomponent interventions. Such information could potentially be important in designing and tailoring psychosocial interventions to particular target groups and conditions and ensuring that scarce resource effort is invested on the most cost-effective interventions.

Systematic review of randomised trials for the effectiveness of relaxation techniques in adolescents at-risk of distress, anxiety and depression:

16816 records were identified from 10 databases and screened by independent reviewers. 233 full-text articles were independently screened for inclusion by two reviewers. 19 studies were included from the search strategy and 39 studies were included from the citations in the references of primary articles. A total of 58 RCTs with 8009 participants were included in the review and meta-analysis. Figure 2 describes the study selection process.

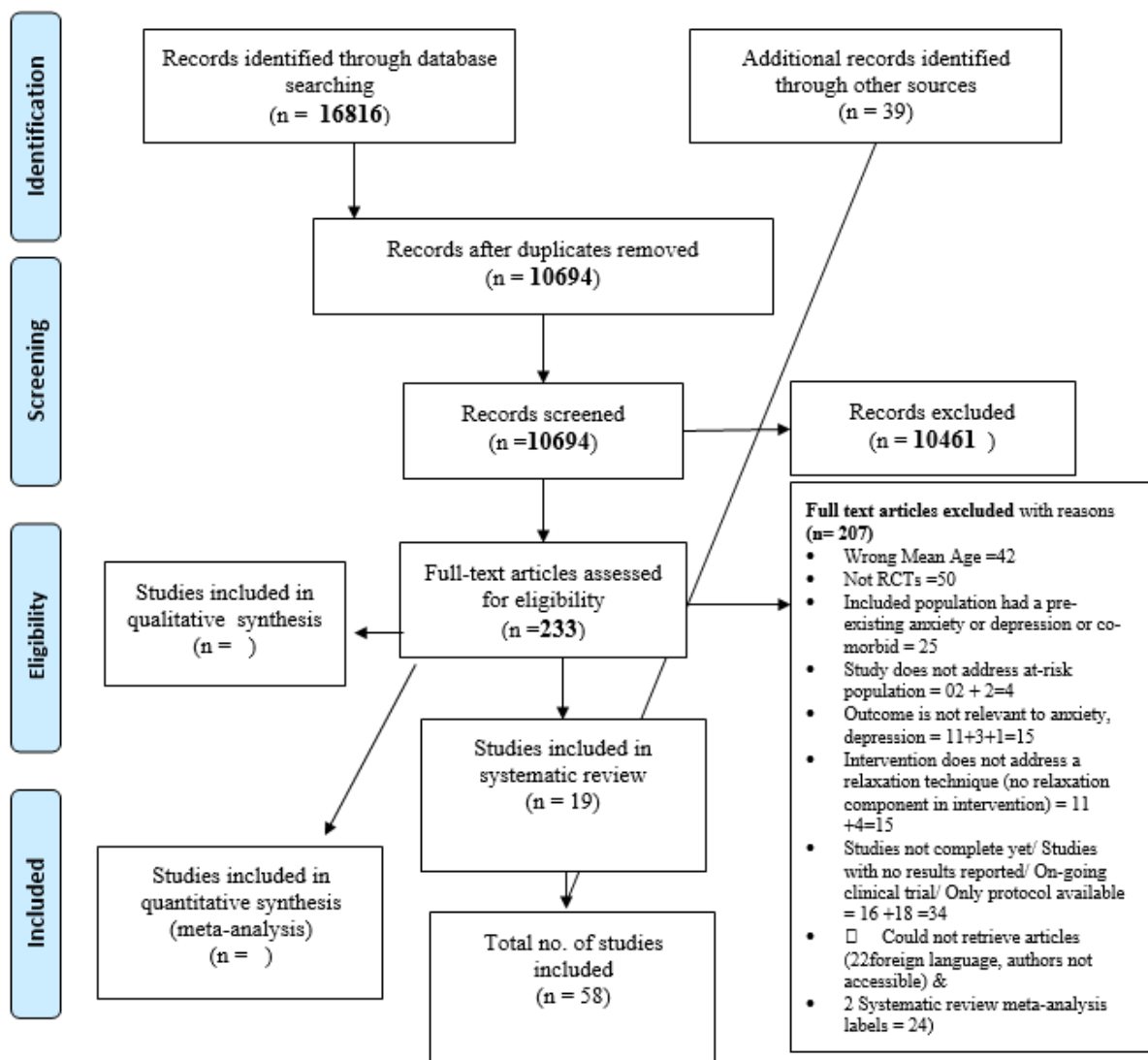
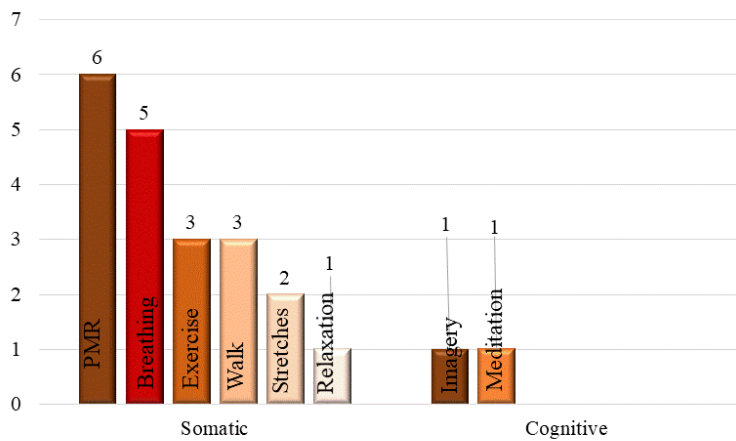


Figure 2: PRISMA Flow Chart

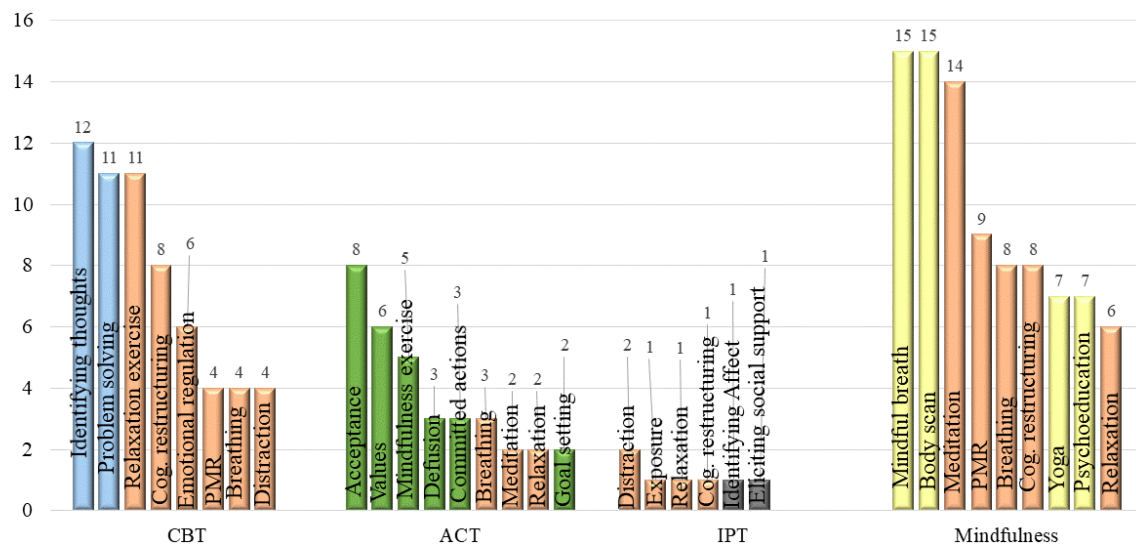
20% (12/58) of the studies used 'relaxation technique/s' as a standalone intervention to prevent and treat anxiety and depression in at-risk adolescents. The most commonly reported 'relaxation techniques' in the literature were somatic (PMR, breathing, exercise, walk, stretching, relaxation) and cognitive relaxation techniques (imagery and meditation). In 79% (53/58) of the studies relaxation techniques were implemented as an integral component of

other psychotherapies such as Cognitive Behavioural Therapy (CBT), Mindfulness and Acceptance and Commitment Therapy (ACT) (Graph 2). Other components of multicomponent interventions included identifying affect, psychoeducation and mindfulness exercises. A list of ‘relaxation techniques’ reported in the studies included in the current review is given in Table 5, Annexure A.

Graph 1: Specific components of relaxation focused interventions (N=12)



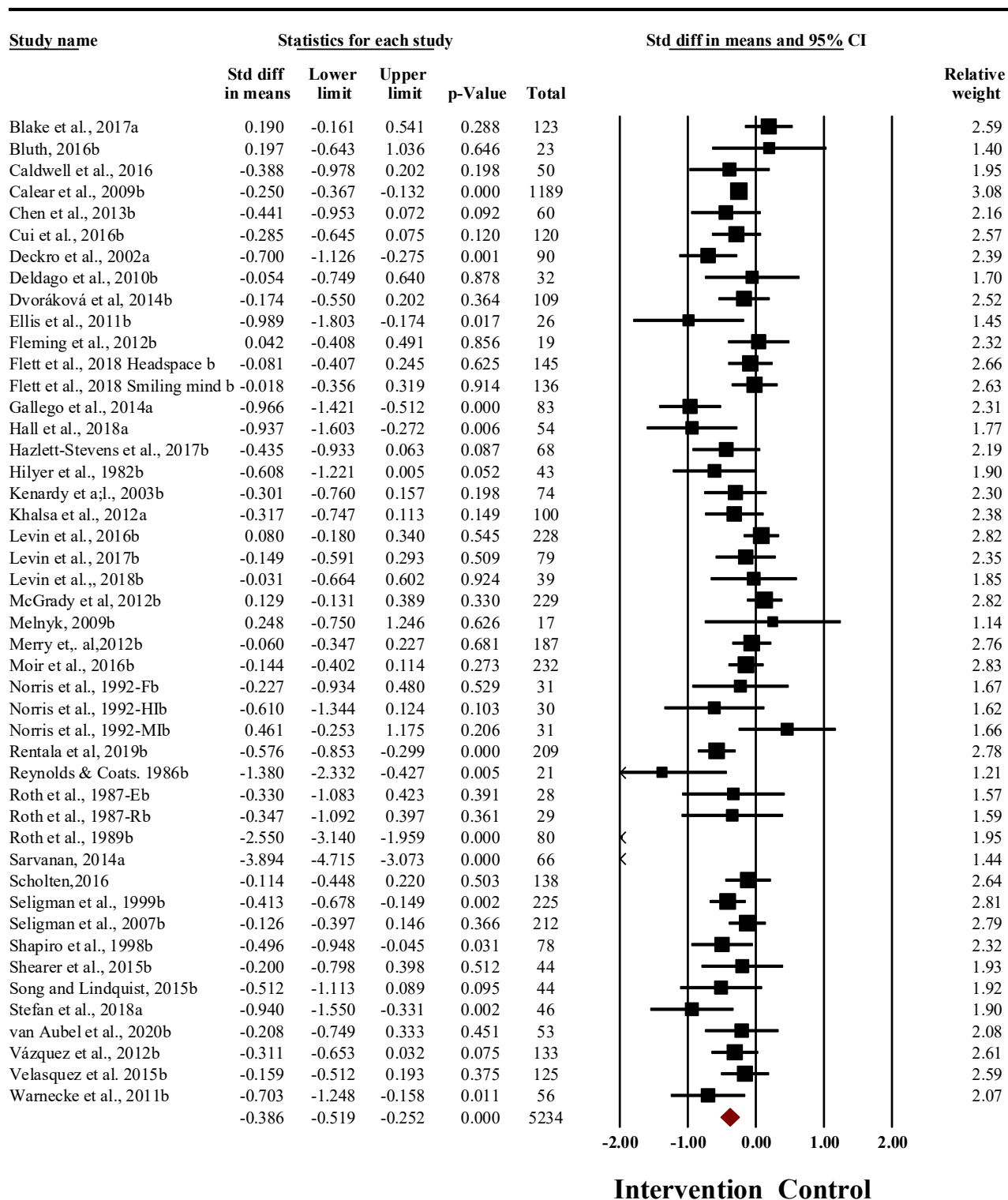
Graph 2: Specific components of relaxation techniques in multicomponent interventions



49/58 included studies were from High Income Countries, 6 studies were from Upper Middle-Income Countries and only 1 study was from Lower- and Middle-Income countries (i.e. India). Relaxation interventions in 32/52 (61.5%) studies were delivered in an educational setting (school/colleges/universities). 94% (55/58) of the study participants were students. Mean age of adolescents was 19.09 (± 2.92). Studies included adolescents with depression (22%, 13/58), anxiety (9%, 6/58), distress (34%, 10/58), behavioural problems, academic concerns and eating problems (9%, 5/58). Relaxation techniques were delivered in group format in 66% (35/58) of the studies. The average duration for a relaxation intervention programme was 9 (± 3.37) weeks; average number of sessions per week was 3 (± 1.3) and average session duration was 47.5 (± 11.7) minutes. The average programme duration for a multicomponent intervention programme was 8 (± 5.99) weeks and average number of sessions were 11.57 (± 10.71). The average session duration was 71 minutes (± 36.32). Booster sessions were delivered in 3 trials. In 35/51 (68%) studies, relaxation interventions were delivered by the specialists. Relaxation based interventions were self-administered in 14/51 (27%) studies and the intervention was delivered online in 12/58 (20%) studies. In 55 studies, mental health outcome was reported as a primary outcome.

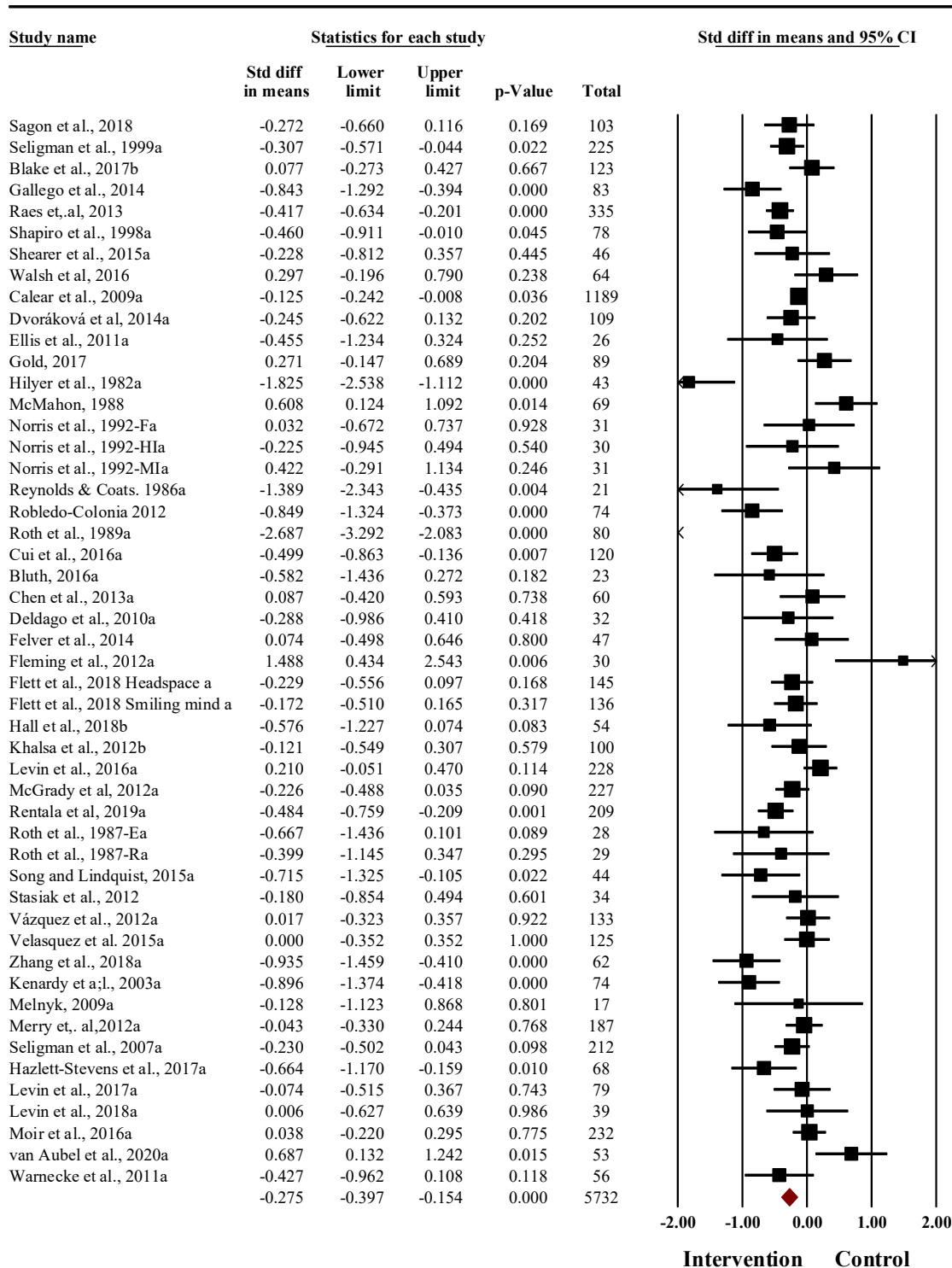
Meta-analysis was conducted with 8009 participants. Effectiveness of relaxation therapies in the treatment of anxiety was explored in a total of 46 studies, with a cumulative sample size of 5234 participants. Meta-analysis with random effects model showed that relaxation techniques are effective in the treatment of anxiety in at-risk adolescents, pooled effect size of -0.386 (95% CI: -0.52 to -0.25) in favour of the intervention group (Figure 3). There was an evidence for substantial heterogeneity across the studies ($I^2 = 79.16\%$, $t^2 = 0.15$). No significant changes in pooled effect size was observed on sensitivity analysis. Egger's regression statistic was significant ($t = 2.32$, $p = 0.02$), demonstrating significant publication bias in reporting of anxiety (Figure 4-Annexure B). Duval & Tweedie's trim & fill method was run for adjusting the pooled effect size for publication bias. It led to an increase in pooled effect size -0.54 (95% CI: -0.69 to -0.40).

Figure 3: Anxiety Forrest plot



Depression was reported as an outcome in a total of 50 studies, with a cumulative sample size of 5732 participants. There was a small evidence to support relaxation techniques being effective to treat depression in at-risk adolescents, aged 14-24 years. The moderator analysis of the data revealed that characteristics of 'relaxation techniques' (format, dosage, components) do not have any effect for the treatment of depression in at-risk adolescents aged 14 to 24. There was substantial heterogeneity in reporting of depression outcome ($I^2=76.82\%$, $t^2=0.13$). Meta-analysis revealed a small effect size in favour of the intervention group $SMD= -0.28$ (95% CI: -0.40% to -0.15) (Figure 5). No change in significance of depression outcome was observed in sensitivity analyses. There was no evidence of publication bias (Egger's regression $p=0.36$, Figure 6).

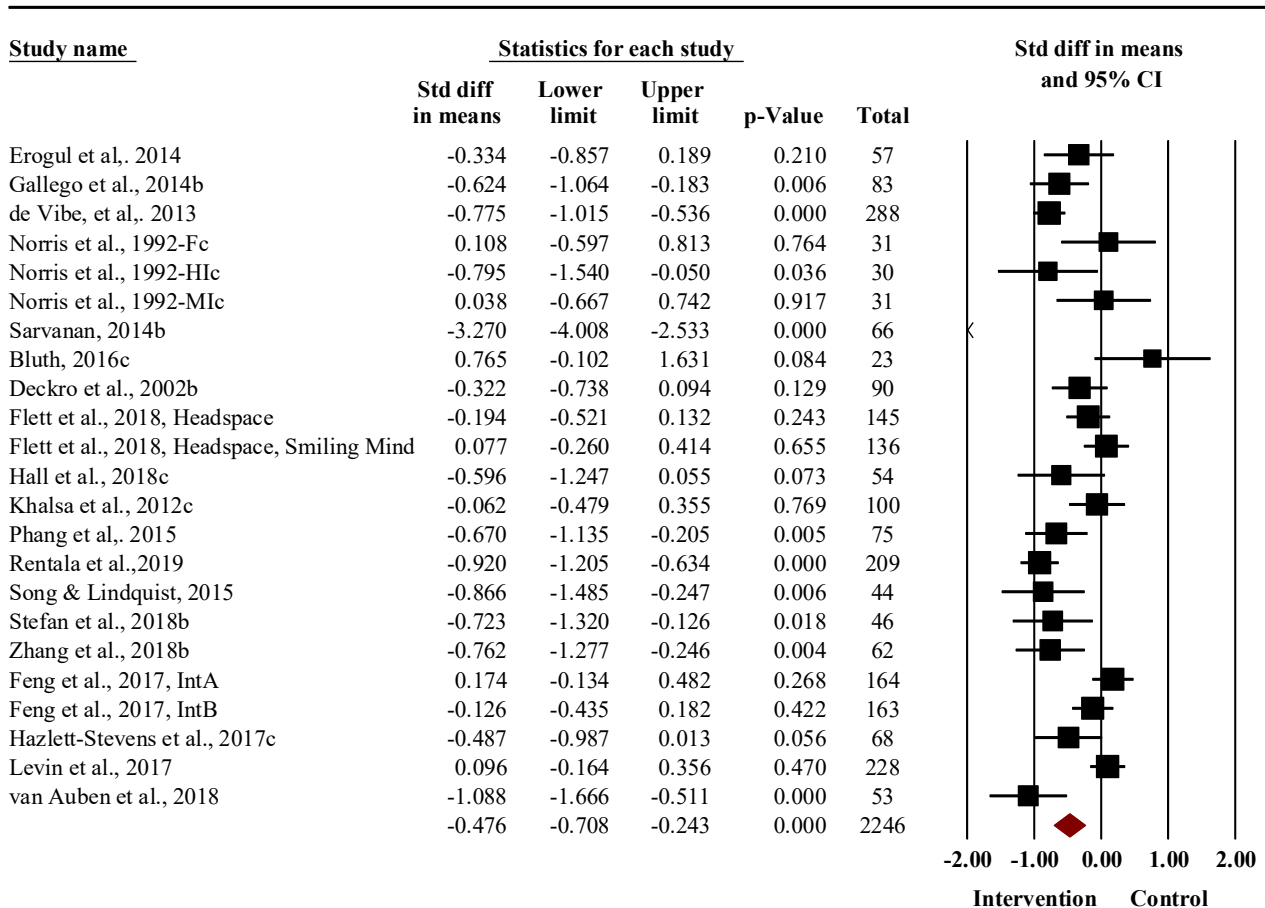
Figure 5: Depression forest plot



Distress was reported in a total of 23 studies, with a cumulative sample size of 2246 participants. There was substantial heterogeneity in reporting of this outcome ($I^2= 85.08\%$, $t^2= 0.26$). Meta-analysis revealed a moderate effect size in favour of the intervention group (SMD=

-0.48, 95% CI: -0.71 to -0.24) (Figure 7). Removal of studies in sensitivity analyses did not reveal any significant changes in pooled effect size. Egger's regression statistic revealed a non-significant publication bias in reporting of this outcome (P=0.30, Figure 8).

Figure 7: Distress forest plot



Sub-group analysis

We did a sub-group analyses and meta-regression analyses to evaluate in which settings relaxation techniques work for the treatment of anxiety and depression in at-risk adolescents.

The results of sub-group analyses for the effectiveness of relaxation techniques for anxiety, distress and depression are summarized in Table 7.

Anxiety: Subgroup analyses revealed that face to face, individually delivered, multicomponent interventions with a booster session yielded a higher effect size. However, these subgroup analyses were statistically non-significant (Table 7). Data regarding density of dosage were provided in 30 studies reporting anxiety outcome. Meta-regression analyses were run to analyse association of dosage of intervention with improvement in anxiety (effect size), after removing three of the outlier studies (Hilyer et al., 1989; Roth et al., 1989; Stefan et al., 2018). Together, these variable (number of sessions; duration of sessions and overall programme) explained 44% of the variation in overall effect size (Figure 9, 10 & 11). Age of participants explained 13% of variance in anxiety outcome, with age associated inversely with effect size ($B = -0.07$, $SE = 0.03$, $p = 0.04$). Table 8 shows the results of meta-regression analysis showing association between anxiety outcome and density of dosage of interventions.

Depression: Subgroup analyses did not reveal any significant subgroup differences based on mode of delivery, format of delivery, types of intervention and booster sessions (Table 7). A total of 33 studies reported statistics pertaining to density of dosage of interventions. Multivariate meta-regression analyses revealed that 5% of the variation in effect size was explained by density of dosage of interventions. None of the indicators of the dose of interventions reached statistical significance (Table 9, Figure 12, 13 & 14). Age did not yield any significant association with effect size, explaining only 4% of variance in the outcome ($B = -0.04$, $Se = 0.04$, $p = 0.33$).

Distress: Subgroup analyses revealed that studies with low risk of bias, multicomponent, individually delivered face to face interventions, with a booster dose were more effective in reduction of distress. However, out of these subgroup analyses, only mode of delivery and booster dose were found to be statistically significant (Table 7). Multivariate regression model pertaining to density of dosage of intervention explained 47% of variation in effect size for distress outcome. None of the indicators of dose of interventions emerged as a significant predictor in this model (Table 10, Figure 15, 16 & 17). The results remained consistent even after removal of the outlier study (Stefan et al., 2018). Age did not yield any significant association with effect size, explaining only 1% of variance in the outcome ($B = -0.03$, $SE = 0.06$, $p = 0.64$).

Meta-regression analyses revealed important insights pertaining to active ingredients of interventions employed in included studies. Active ingredients of interventions explained 9% to 25% of variance in heterogeneity across studies targeting distress, anxiety, and depression.

Highest variance in heterogeneity amongst different studies was explained in the interventions targeting anxiety as an outcome (25%). It identified somatic mode of relaxation as the most effective method of relaxation in reducing anxiety. However, this effect was statistically non-significant. (Table 11 & Figure 18). Meta-regression analysis revealed that 20% of the variance in intervention effects for anxiety were explained by different therapeutic strategies coupled with relaxation. Although mindfulness coupled with relaxation was associated with a better improvement in anxiety than relaxation alone, this effect was statistically non-significant.

Different types of intervention components explained 9% of heterogeneity in reporting of depression outcome. It revealed that somatic mode of relaxation and combined somatic and behavioural relaxation training generally yielded slightly better improvement in depression post-intervention. However, these statistics were statistically non-significant (Table 12, Figure 19).

For depression, meta-regression analysis revealed that 17% of the variance in intervention effects were explained by different therapeutic strategies coupled with relaxation. Although ACT coupled with relaxation was associated with a poor improvement in anxiety, nevertheless this effect was statistically non-significant.

The multivariate meta-regression revealed a non-significant model for distress outcome. It explained 15% of heterogeneity, with somatic relaxation methods yielding stronger effect size, albeit statistically non-significant (Table 13, Figure 20).

For distress, meta-regression analysis revealed that 14% of the variance in intervention were explained by different therapeutic strategies coupled with relaxation. Generally multicomponent interventions were associated with a better improvement in anxiety than relaxation alone, still this effect was statistically non-significant.

Certainty of outcomes pertaining to anxiety, depression and distress using GRADE (Grading of Recommendations, Assessment, Development and Evaluations) framework:

Certainty of outcomes pertaining to anxiety, depression and distress reported in the trials was assessed using the GRADE guidelines (Balshem et al, 2011). The certainty for the outcome of anxiety was downgraded by three levels to very low for serious concerns pertaining to risk of bias in the studies, substantial heterogeneity and publication bias in reporting of this outcome. The outcomes of depression and anxiety were downgraded to low by two levels, due to high risk of bias in intervention design and presence of substantial heterogeneity, explained by clinically heterogeneous study samples and interventions.

Adolescents' experience of receiving relaxation therapies for anxiety and depression:

Relaxation techniques have been used in adolescents to improve a variety of conditions including anxiety and depression, executive functioning, emotion regulation, social skills social-emotional competence, coping, positive affect, optimism, and classroom behaviour (Felver et al, 2016). Several studies have been conducted to explore adolescents' experience of receiving 'relaxation techniques' for anxiety and depression. The findings of our narrative review (methods section is provided in Annexure A) showed that participants reported relaxation- based intervention guide easy to understand, helpful and useful (Shepherd et al 2016; Shepherd, et al.,2018, Fleming et al., 2019; Kuosmanen, 2018);

"It was really good and helpful. Like when I needed to calm down using the technique, it actually helped a lot. Yes, so overall it was pretty good, the breathing in out one. At first, I thought it was a bit weird and I was like 'oh, my god, this is not going to work' but by just taking my time and working through it, it actually helped me. [Female participant P2 with depressive symptoms]"

"I didn't think I would enjoy it but actually I did . . . The guide was on to it... I liked choosing the character. . . thoughts, feelings, actions I liked that. What the guide said was really useful." (Female with depressive symptoms, received multicomponent intervention: Fleming et al., 2019)

A number of qualitative feasibility studies of relaxation therapies with at-risk adolescents reported that relaxation based programmes improved interpersonal skills of participants; helped them to regulate their emotions such as anger; increased their awareness and facilitating distance from thoughts and strong emotions; increased relaxation and awareness and reported feeling calm, composed and relaxed after experiencing the mindfulness practices; and found them inspirational and helpful (Mastropieri et al, 2015; Ames et al, 2014; Burrows, 2017; Lau, 2011; Maria et al, 2019; Schwind et al, 2017; Tandon et al., 2018; Duberg, 2016; Strömbäck et al, 2013)

"It's like your life is in slow motion and you see everything you're doing and understand it more...life is more exciting knowing mindfulness exists (P4 with depression)."

"For people who came in super jittery, when they started to do the deep breathing, they got all calm. It relaxed them" (Female participant describing the effect she saw deep breathing had on other participants, Maria et al (2019)

... "It helped with managing stress" ... "I felt more relaxed" ... "Great way to start the day" ... (Adolescent with anxiety symptoms)

“Allowed me to focus” ... “Mindfulness was a nice thing to bring into graduate studies to help with stress” (Adolescent with anxiety symptoms) (Schwind et al, 2017)

“There’s been a certain amount of change. Previously I had more, yes, a lot more heart palpitations, and I had very, very tense, shallow breathing. Now it’s gone down a bit, at least to my stomach, and I’m beginning to breathe a bit better. I’m not as tense and stiff as I was previously, more relaxed now, as it were. Anyway, that’s what I believe. (Student on sick leave, 22 years)” (Strömbäck et al, 2013)

Participants also indicated that these interventions should be administered to all adolescents as everyone faces down phase in his/her life and adolescents especially, do not recognize when they start experiencing depression or they might not approach help out of embarrassment (Fleming et al, 2016).

Many participants experienced unpleasant emotions while doing relaxation exercises including heightened sensory sensitivity, perceptual and physical changes (Burrows, 2017). Technical limitations and lengthiness caused disengagement in online programmes (Kuosmanen, 2018). Participants found it hard to meditate in presence of others, for example if the programme was being delivered in the classroom (Burrows, 2017).

“I don’t seem to really relax or feel too much of anything. The thing I struggle with in mindfulness is to accept my emotions instead of ignoring or repressing them” (Burrows, 2017).

“Sometimes there are light spots that float around. One time I felt my heart beating madly, going crazy, as if my body was freaking out. I feel my heart rate increasing, my self-talk racing” (Burrows, 2017).

The biggest challenge reported by participants was finding time to do the homework and asked if the content of the intervention could be delivered using audio recording (Schwind et al.,2017).

Conclusion:

Relaxation techniques reduce stress by altering the somatic (physiological), cognitive (psychological) and behavioural (observable actions) responses to stressful stimuli. Relaxation techniques most commonly reported in the studies include, somatic (Progressive Muscle Relaxation (PMR), deep breathing, exercise, walk, stretching, relaxation) and cognitive relaxation techniques (imagery and meditation). Our insight analysis showed that relaxation techniques are highly effective in reducing anxiety; moderately effective in improving distress and have only a weak effect on improving depression in at-risk adolescents. Combining relaxation training with other intervention strategies resulted in slightly better improvement in

anxiety and distress as compared to relaxation techniques alone. The results of this study need to be interpreted with caution because majority of the studies included in our analysis are conducted in High Income Countries (HIC) and in educational settings, with no studies from low income countries and the certainty of outcomes for depression, anxiety and distress was low.

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Annexure A

Section A: **Methods of systematic review**

Eligibility criteria

Inclusion criteria

1. Randomized controlled trials and cluster randomized controlled trials reporting effectiveness of interventions employing relaxation techniques for prevention of depression and anxiety were included.
2. Only those studies were included which reported either or both depression and anxiety as an outcome. We considered both ICD/DSM criteria of symptom severity of anxiety and depression as measured on psychometric scales.
3. We only included those studies that reported use of relaxation training for children and adolescents aged 14 to 24 years old.
4. We only considered studies focusing on vulnerable or at risk children and adolescents. At risk or vulnerable children included but not limit to those exhibiting prodromal symptoms of depression and anxiety or near cut-off scores on psychometric scales.
5. Trials where more than 20% of participants were depressed or anxious at trial entry were excluded. However, participants at risk or reporting prodromal symptoms of anxiety and depression were included.
6. All settings of interventions were considered for inclusion.

Exclusion criteria

1. Studies that did not report on adolescent anxiety and depression were excluded.
2. Interventions conducted among adolescents with medical comorbidities were excluded.

Table 3: Search strategy of peer-reviewed articles

Focus	Search Terms
1) Population	(Adolescent OR teen* OR "youth*" OR "young*") AND ("* risk" OR "at-risk" OR "high-risk" OR "prone" OR susceptib* OR prodrom* OR predispos* OR "poor neighborhoods" OR "vulnerab*")
2) Intervention	AND ("* relaxation" OR "relaxation *" OR "* breathing" OR "breathing *" OR "* meditation" OR "meditation *" OR "progressive muscle relaxation" OR imagery OR "Autogenic training" OR spiritual* OR walk* OR gardening OR yoga OR massage OR acupuncture OR "self-regulation" OR hypnosis OR biofeedback OR music OR "art *" OR "stress management" OR exercise OR mindful*)

3) Mental Health Outcome	AND ("anxiety" OR "depression" OR "mental health" OR wellbeing OR "self-esteem" OR "suicid*" OR stress OR "depress*" OR "anxious" OR "emotion*" OR "internaliz*" OR distress OR social)
4) Study Type: Clinical	AND ("* controlled trial" OR "trial" OR "intervention" OR "RCT")
5) Region	All

Search strategy and selection criteria: Using an elaborate search strategy, we searched ten academic databases (Pubmed, Cochrane CENTRAL, Psycinfo, Virtual Health Library, Scopus Open access, Web of Science all databases (Russian database), Psycharticles, Psychextra, Proquest Dissertation and thesis). Four reviewers working independently from one another reviewed titles and abstracts, followed by full text screening of eligible studies, as per our inclusion and exclusion criteria. This process was aided by use of Rayyan software. Discrepancies in the inclusion process were discussed and resolved, in conjunction with senior authors, if necessary (UH and ZeH). Further, the references of included studies were carefully screened to identify and include relevant trials. We included both individual and cluster randomized controlled trials. Eligible trials included participants aged 14-24 years at risk of anxiety and depression. Studies included if they included depression, anxiety and stress as an outcome (primary or secondary outcomes). Psychological interventions were eligible if they used 'relaxation techniques' as a standalone intervention or mentioned it as one of the components intervention to prevent and treat anxiety, depression and stress. All modes of intervention delivery were included (on-site, technology). All types of control arm were eligible to be included. Four types of control studies were included (active control group, wait list control, no intervention, treatment as usual). Studies in which 20% of participants has psychiatric problems were excluded.

Information pertaining to characteristics of study sample and interventions was extracted. Data extraction was performed across three broad matrices: i) study sample ii) implementation characteristics and iii) orientation and underpinnings of intervention used 'relaxation techniques'. Variables pertaining to study sample included important characteristics such as age range, inclusion and exclusion criteria, and setting of intervention used 'relaxation techniques'. Implementation characteristics included variable such as measures of intervention setting, dosage, duration and type of delivery agents. While intervention was evaluated for their theoretical underpinning using the distillation and matching framework by Chorpita et al. (2005). Interventions were critically analysed to identify individual active

elements of interventions comprising them. The data was collected from primary trial papers as well as linked articles which included trial protocols and intervention development articles. All data of interventions was critically reviewed to identify active ingredients of interventions and the terminologies employed to describe them. Thereafter, we employed Cochrane risk of bias tool to appraise risk of bias in the trials. We excluded studies in which more than 20% participants had an identifiable mental disorder. Studies addressing medical comorbidities in adolescents were excluded. Studies with in-patient participants were excluded. Results are reported in accordance with the PRISMA.

Outcome measures: The primary outcome was effectiveness based on self-report anxiety or depression or stress measured using valid and reliable psychometric scales that are scored on a continuum (McElroy & Patalay, 2019). We included results of data for anxiety, depression or stress scales either these were reported as composite outcome or mentioned subscales wise.

We used the primary end-point in each study wherever it was provided. To estimate a standardized mean difference (SMD), we calculated effect size for each listed primary outcome, using means and standard deviations. The data on binary data and unadjusted statistical effect sizes was extracted where data on means and standard deviation was not reported. Using previously-recommended assumptions and formulae (Chinn, 2000), these binary outcomes were transformed to SMD, based on the assumption that a) continuous measurements follow a logistic distribution and b) the variability of the outcomes is the same in both intervention and control groups (Higgins et al., 2011). For the primary endpoint outcome, we used the end point specified in the studies. When no primary endpoint was mentioned, we used the longer term follow-up in the primary intervention group.

Recognizing the fact that several complex interventions utilized relaxation techniques as one of many components, we employed matching and distillation techniques to split the interventions into its active ingredients. First, we identified the 'active ingredients' of each intervention used and type of relaxation techniques used; then combined these active ingredients with other intervention features and dimensions (e.g. theoretical underpinning, format, dosage and settings).

Statistical analysis: Risk of bias among RCTs was assessed using the Cochrane tool for risk of bias assessments. GRADE (Grading of Recommendations, Assessment, Development and Evaluations) evidence criteria was used to grade the certainty of evidence for these interventions for two outcomes: a) rates of anxiety disorders and their symptom severity and b) rates depressive disorders and their symptom severity. Using GRADE profiling method, the strength of evidence for these outcomes was rated from very low to high.

Statistical methods: Effect size relevant quantitative data was extracted such as mean (SD) for continuous outcomes and frequency of events and sample size of intervention and control group for binary outcomes. A series of meta-analyses was run, where studies were weighted using random effects model and generated forest plots exhibiting effect size for each study along with their 95% confidence intervals. Random effects were applied throughout the analyses due to expected clinical, methodological and statistical heterogeneity in the studies. Sensitivity analyses were employed to assess contribution of each study especially outliers to the pooled effect size. Publication bias was assessed using Egger's regression statistic where there were more than ten studies. In addition, we also visualized Begg's funnel plot. Subgroup analyses were run when specific subgroups were reported in more than 4 studies and meta-regression when covariates were reported in more than ten studies. To reveal the important insights pertaining to impact of other active ingredients of interventions employed in included studies compared with 'relaxation techniques' we used meta-regression analysis.

Section B: Methods of Narrative Review

We did narrative review to explore adolescents' experience of receiving relaxation therapies for distress, anxiety and depression. A narrative synthesis was performed to synthesize the qualitative findings of the studies included for systematic review to explore the experience of relaxation techniques among adolescents. The qualitative data was extracted from primary studies, linked qualitative studies and from secondary references.

Using a search strategy, we searched ten academic databases (APA psychinfo, APA psycharticles, Scopus, Virtual Health Library, Pubmed, Web of Science, Cinahl plus, Cochrane, Medline full text, Proquest). Moreover, we included process evaluation studies identified in the systematic review and meta-analysis of literature to explore the adolescents' experience of receiving relaxation therapies.

Eligibility criteria

Inclusion criteria

- Qualitative studies reporting adolescents' (aged 14 to 24 years) experience of receiving relaxation.

Exclusion criteria

- Studies which had population with medical comorbidities were excluded.
- Studies which did not have depression or anxiety as outcome were excluded.

Search strategy

Using an elaborate search strategy, we searched ten academic databases. Two reviewers working independently screened titles and abstract, as per the inclusion and exclusion criteria. Data extraction was performed around experiences of adolescents receiving relaxation techniques in terms of facilitators, barriers and perceived effectiveness of relaxation therapies. Next, the references of included studies were carefully screened to find out further relevant studies. Then, data related to characteristics of study sample and interventions was extracted. Finally, the data was read and reread to make themes.

Data extraction and data management

First, we used thematic analysis to present the findings in tabular form. Then the results were discussed again and structured into themes. Afterwards, summarizing of included studies in a narrative synthesis within a framework was performed by senior author. This framework consisted of the following factors: age and gender of participants, type of intervention settings, format, dosage and duration. These components were then discussed in relation to potential

facilitators, barrier, acceptability and feasibility of relaxation techniques as reported by adolescents. The data on analysis, limitations and recommendations was also extracted.

Table 14: Studies included for Adolescents' experience of receiving 'relaxation therapies for anxiety and depression

Study (Author, year)	Sample	Intervention components	Intervention dosage
Shepherd et al., 2018	Anxiety & depression	SPARX (CBT, computerized intervention)	7 Sessions
Mastropieri et al.,2015	Anxiety & depression	Group interpersonal psychotherapy with mindfulness component	16 weeks 16 sessions, 90 minutes
Burrows, 2017	Anxiety & depression	Mindfulness meditation	-
Kuosmanen et al.,2018	Anxiety & depression	SPARX-R (Computerized intervention)	7 sessions, 25 min each session
Tandon et al., 2018	Depression	- The Mothers and Babies (MB) Course - Manualized cognitive-behavioural intervention	15 sessions
Lau , 2011	Depression	Mindfulness-based stress reduction program (MBSR)	6 weeks, 6 sessions 120 minutes each session
Fleming et al., 2019	Depression	- SPARX - CBT computerized intervention	-
Van der Gucht et al.,2019	Depression	The Mindfulness Based Intervention (MBI) program	8 weeks, 8 sessions, 90 minutes each session
Schwind et al., 2017	Anxiety	Mindful breathing	-
Duberg , 2016	Anxiety	The after-school intervention with dance	32 weeks, 64 sessions, 75 minutes each session
Ramasubramanian, 2016	Anxiety	Mindful communication.	14 weeks, 14 session, 40 minutes
StrombackMalmgren-Olsson et al.,2013	Stress	Stress management course	8 sessions, 120 minutes each session

Reference:

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Annexure B: Tables and Figures

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Table 4: Characteristics of studies (N=58)

Sr. No.	Study (Author, year)	Country	Sample	Trial Design	Population	Gender/ Age	Recruitment setting	Relaxation Type	Clinical outcome
1	Caldwell et al., 2016	USA	50	RCT	University Students	Both, Age=18-40 years	University	Relaxation	Anxiety
2	Gold et al., 2017	Australia	100	cRCT	School Students	Both, M(SD)=13.84(0.74)	School	Relaxation	Depression
3	Robledo-Colonia et al., 2012	Cali, Colombia	74	RCT	Pregnant Women	Female, Mean= 21	Prenatal Care Services of three Hospitals	Relaxation	Depression
4	Harmat et al., (2007)	Hungary	65	RCT	University Students	Both, M(SD)=22.6 (2.83)	University	Relaxation	Depression
5	Nabkasorn et.,al, 2005	Thailand	49	RCT	Nursing Students	Female, M(SD)=18.8(0.7)	Not Specified	Relaxation	Depression
6	Putra et al., 2018	Indonesia	31	RCT	School Students	Female, Age=15-17 years	School	Relaxation	Depression
7	MacMahon, 1988	USA	69	RCT	juvenile	Male, Mean=16.3	juvenile detention facilities	Relaxation	Depression
8	Reynolds & Coats. 1986	California	21	RCT	School Students	Both, Mean=15.65	School	Relaxation	Depression and anxiety
9	Roth, 1989	USA	80	RCT	College students	Both, Mean=20.8	College	Relaxation	Depression and anxiety
10	Roth, 1987	UK	57	RCT	College students	Both, M(SD)=18.9 (1.3)	College	Relaxation	Depression and anxiety
11	Velasquez et al. 2015	Columbia	125	RCT	School age children	Not specified,	Not specified	Relaxation	Depression and anxiety

12	Norris, 1992	UK	91	RCT	School students	Both, M=16	School	Relaxation	Depression anxiety and stress
13	Walsh et al., (2016)	USA	64	RCT	Students	Female, M(SD)= 19.15	Not Specified	Multicomponent	Depression
14	Raes et al., 2013	Belgium	335	cRCT	School Students	Both, Age=13-20 years	School	Multicomponent	Depression
15	Sagon et al., (2018)	USA	103	RCT	Freshmen University Students	Both, M(SD)=18.15(.46)	University	Multicomponent	Depression
16	Stasiak et al., 2012	New Zealand	34	Pilot RCT	School Students	Both, Age=13-18 years	School	Multicomponent	Depression
17	Cui et al., 2016	China	120	RCT	College Students	Both, M(SD)=19.42(1.66)	College	Multicomponent	Depression
18	Felver, 2014	USA	47	RCT	School students	Both, 15 years	School	Multicomponent	Depression
19	Khalsa et al., (2012)	USA	100	RCT	School Students	Both, M(SD)=16.8(0.6)	School	Multicomponent	Stress
20	de Vibe, et al, 2013	Norway	288	RCT	University students	Both, M=23	University	Multicomponent	Stress
21	Erogul et al, 2014	New York, USA	57	RCT	Medical students	Both, M(SD)=23.5(1.7)	college	Multicomponent	Stress
22	Phang et al, 2015	Malaysia	75	RCT	Medical students	Both, M(SD)=21.14(1.10)	college	Multicomponent	Stress
23	Scholten et al., 2016	The Netherlands	138	RCT	School Students	Both, M(SD)=13.90 (.91)	School	Multicomponent	Anxiety
24	Grassi et al., 2011	Not specified	75	RCT	University Students	Female, M(SD)=20.86(1.27)	University	Multicomponent	Anxiety

25	Dvořáková et al., 2014	USA	107	Pilot RCT	College Students	Both, M(SD)= 18.2 (0.4)	College	Multicomponent	Depression and anxiety
26	Vázquez et al., (2012)	Spain	133	RCT	University Students	Both, M(SD)= 23.3	University	Multicomponent	Depression and anxiety
27	McGrady et al., 2012	USA	105	RCT	First year Medical Students	Both, Age=not specified	Not Specified	Multicomponent	Depression and anxiety
28	Levin et al. 2016	USA	79	RCT	College Students	Both, M(SD)=21.61(5.48)	College	Multicomponent	Depression and anxiety
29	Blake et al., (2017)	Australia	123	RCT	School Students	Both, M(SD)= 14.48	School	Multicomponent	Depression and anxiety
30	Merry et, al,2012	New Zealand	187	RCT	School Student	Both, M(SD)=15.6	School	Multicomponent	Depression and anxiety
31	Seligman et al., (2007)	USA	212	RCT	first year undergraduate Students	Both, Age not specified	College	Multicomponent	Depression and anxiety
32	Kenardy et al., 2003	Australia	74	RCT	University Students	Both, M(SD)=19.92(4.78)	University	Multicomponent	Depression and anxiety
33	Seligman et al., 1999	USA	225	RCT	University Students (1st year Under-graduates)	Both, Age not specified	University	Multicomponent 35	Depression and anxiety
34	Calear et al., 2009	Australia	1477	cRCT	School Students	Both, M(SD)=14.34 (0.75)	School	Multicomponent	Depression and anxiety
35	Chen, 2013	China	60	RCT	Nursing students	Both, M(SD)=19.5(0. 87)	University	Multicomponent	Depression and anxiety
36	Deldago, 2010	Not specified	32	RCT	University students	Female, 18-24 years.	university	Multicomponent	Depression and anxiety
37	Shapiro et al. 1998	USA	78	RCT	Medical students	Both,	University	Multicomponent	Depression and anxiety

						Age not specified			
38	Astin, 1997	USA	28	RCT	University students	Both, Age not specified	University	Multicomponent	Depression and anxiety
39	Shearer, Hunt, Chowdhury, and Nicol, 2015	USA	46	RCT	University students	Both, age not specified	university	Multicomponent	Depression and anxiety
40	Hilyer et al., 1982	USA	43	RCT	School students	Male, 15-18 years	school	Multicomponent	Depression and anxiety
41	Melnyk, 2009	USA	47	RCT	Adolecents	Both, 14-16 years	Not specified	multicomponent	Depression and anxiety
42	Ştefan et al., (2018)	Romania	46	RCT	College Students	Female, Mean= 18.92	College	Multicomponent	Anxiety and stress
43	Chiauszi et al., 2008	USA	157	RCT	College Students	Both, Age= 18-24 years	College	Multicomponent	Anxiety and stress
44	Sarvanan et al., 2014	Malaysia.	66	RCT	Medical Students	Both, M(SD)= 19 (1.04)	University	Multicomponent	Anxiety and stress
45	Fleming et al., (2012).	New Zealand	30	RCT	School Students	Male, M(SD)=14.9(.79)	School	Multicomponent	Anxiety and stress
46	Deckro et al., (2002).	USA	90	RCT	College Students	Both, Mean= 24	College	Multicomponent	Anxiety and stress
47	Feng et al., 2016	USA	243	RCT	College Students	Both, Age=18-21 years	College	Multicomponent	Anxiety and stress
48	Zhang et al., (2018)	China	62	RCT	University Students	Both, M(SD)=18.41(2.01)	University	Multicomponent	Depression and stress
49	Bluth et al., 2016	North Carolina (Usa)	23	RCT	School Students	Both, Mean= 16.8 (1.3)	School	Multicomponent	Depression, anxiety and stress
50	Flett et al., 2018	New Zealand	208	RCT	University Students	Not specified, M(SD)=20.08(2.8)	University	Multicomponent	Depression, anxiety, and stress

51	Song and Lindquist, 2015	South Korea	44	RCT	Undergraduate Nursing Students	Both, M(SD)=19.6 (1.7)	Not Specified	Multicomponent	Depression, anxiety, and stress
52	Rentala et al., 2019	India	209	RCT	College Students	Female, Age=16-19 years	College	Multicomponent	Depression, anxiety and stress
53	Hall et al., (2018)	China	54	RCT	University Students	Both, M(SD)=22.30(2.63)	University	Multicomponent	Depression, anxiety, and stress
54	Hindman et al., 2015.	USA	34	RCT	University Students	Both, Mean=22.35	University	Multicomponent	Depression, anxiety, and stress
55	Levin et al. 2016	USA	228	Pilot trial RCT	University Students	Both, M(SD)=20.51(2.73)	College	Multicomponent	Depression, anxiety, and stress
56	Ellis Louise et al., 2011	Australia	26	RCT	University Students	Both, M(SD)=19.67(1.66)	University	Multicomponent	Depression, anxiety, and stress
57	Gallego, 2014	Spain	53	RCT	University students	Both, Mean=20.07	University	Multicomponent	Depression, anxiety and stress.
58	Berger, 1988	USA	232	RCT	College students	Both, Mean=20 years	college	multicomponent	Depression anxiety and stress

Table 5: List of relaxation techniques used in studies (N=58)

Category of relaxation technique	Techniques
Somatic	PMR
	Breathing
	Exercise
	Walk
	Stretches
	Relaxation (music, art)
Cognitive	Cognitive restructuring
	Imagery
	Goal directed visualization
	Autogenic training
	Positive self-talk
	self-awareness
	Meditation (sitting, eating, walking)
Behavioural	Assertiveness
	Communication skills
	Distraction
	Graded exposure

Table 6: Intervention characteristics (N=58)

Sr. No.	Study (Author, Year)	Intervention name and theoretical underpinning	Components	Dosage	Delivery agent	Clinical outcome	Recruitment Setting	Beneficiary population (age [Mean (SD)], gender)	Effectiveness Time-points	Relaxation type
1.	Caldwell et al., 2016	Tai chi chuan intervention	Tai chi chuan (TCC) (static and dynamic qigong exercises, assigning homework)	10 weeks, 20 sessions, 60 minutes each	instructors	Anxiety	Educational settings	18-40 Both	10 weeks	Relaxation
2.	Gold et al., 2017	Group Music Therapy Theoretical basis not specified	Music, writing, group improvisation, song contributions, song writing, playlist creation	8 sessions	Music therapists	Depression	Educational settings	13.84 (0.74) Both	3 months	Relaxation
3.	Robledo-Colonia et al., 2012	Not specified	Relaxation*, Walk, Aerobic exercise, stretching, music,	Three per week, starting between week 16 and 20 of gestation and continuing for 3 months, 60	Physiotherapist and physician	Depression	Health centre	21 Females	3 months	Relaxation

				minutes each						
4.	Harmat et al., 2007	Music therapy Theory: Not specified	Relaxing classical music	3 weeks, 45 minutes	CD delivered	Depression	Home based	22.6 (2.83) Both	3 weeks	Relaxation
5.	Nabkasorn et al., 2005	Physical exercise/ jogging Theory: Not specified	Physical exercise (jogging)	8 weeks, 40 sessions, 50 minutes each	Physical fitness instructor	Depression	Educational settings	18.8 (0.7) Females	post training	Relaxation
6.	Putra et al., 2018	None (banana consumption)	Banana consumption, walk	Missing	Self-delivered	Depression	Home based	15-17 Females	2 weeks	Relaxation
7.	MacMahon et al., 1988	aerobic exercise. not specified	exercise, long-running, vigorous basketball	12 weeks, 36 sessions, 40 min each.	Physical education staff	Depression	Others (Juvenile detention facilities)	16.3 (SD missing) Male.	Post intervention	Relaxation
8.	Reynolds et al., 1986	Relaxation training Theoretical: Not specified	Relaxation (Assigning homework, practicing relaxation, PMR, reviewing homework)	10 sessions, 50 minutes each	Doctoral-level school psychology graduate student (School psychologist)	Depression and anxiety	Educational settings	15.65 Both	5 months after the intervention	Relaxation
9.	Roth et al., 1989	Aerobic exercise Not specified	Aerobic exercise (Bodyguard 990 bicycle ergometer)	Only 1 sessions of 120 minutes	Not specified	Depression & Anxiety	Not specified	20.8 Both	Post intervention	Relaxation

10.	Roth et al., 1987	Two intervention group; aerobic exercise training and Progressive relaxation training	Aerobic Exercise Training (Running and brisk walking, stretches), Jacobson's Progressive Relaxation Training, mental imagery procedures	11 weeks, 29 sessions, 90 minutes each	Trained instructor	Depression & Anxiety	Educational settings	18.9 (1.3) Both	2 months	Relaxation
11.	Velasquez et al., 2015	Yoga Not specified	Postures (asanas), breathing exercises (pranayamas), relaxation (yoga nidra), and meditation techniques*	12 weeks, 24 sessions, 120 minutes each	Yoga instructor	Depression & Anxiety	Educational settings	Not specified	Post intervention	Relaxation
12.	Norris et al., 1992	3 intervention groups 1) high intensity exercise 2) moderate intensity exercise 3) stretching and flexibility Not specified.	aerobic exercises	10 weeks, 20 sessions, 30 min each	Experienced instructors	Depression, anxiety and stress.	Educational settings	16 (SD missing) Both.	Post intervention	Relaxation

13.	Walsh et al., 2016	Brief Mindfulness Training,	Mindfulness (body scan, sitting meditation, yoga)	4 weeks, 4 sessions, 50 minutes each	Clinical psychologist	Depression	Not specified	19.15 Females	3 weeks post	Multicomponent
14.	Raes et al., 2013	Mindfulness group program Mindfulness-Based Cognitive Therapy (MBCT) and Mindfulness-Based Stress Reduction (MBSR)	Guided experiential mindfulness exercises (e.g., mindfulness of breathing, breathing space, body scan), sharing of experience of these exercises; reflections in small groups, inspiring stories; psycho-education (e.g., stress, depression, self-care), and review of homework.	8 weeks, 8 sessions, 100 minutes each	Trained mindfulness instructor (two psychologists, one medical doctor)	Depression	Educational settings	13- 20 Both	6 months after the intervention	Multicomponent
15.	Sagon et al., 2018	The Mindful Way through the Semester	Mindfulness practices (awareness & acceptance,	2 hours, 4 videos, 10-15 minutes	Instructor	Depression	Educational settings	18.15 (.46) Both	2 months	Multicomponent

		Acceptance Based Behavioral Therapy (ABBT)	mindfulness exercises [mindfulness of breath, inviting a difficulty]), journal writing, social support, problem solving, and distraction or avoidance, identifying thoughts, self-awareness, behavioural choices (values concept)							
16.	Stasiak et al., 2012	Computer-Based CBT & Computerized Psychoeducation CBT & psychoeducation	cCBT (Behavioural activation and pleasant activity scheduling, Problem solving, conflict resolution, Cognitive restructuring: identifying unhelpful thoughts,		Online Modules	Depression	Online	13-18 Both	1 month	Multicomponent

			<p>challenging unhelpful thoughts, thought stopping. Relaxation techniques)</p> <p>computerize d psychoeduc ation i.e. CPE</p> <p>[Depression education and mind-body connection, Physical health (nutrition, exercise, sleep) and how to stay healthy, Friendships, conflict and anger, Time management: making schedules and routines (exam time), reaching goals (setting realistic goals and</p>							
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			rewards)], Stress management: signs of stress, some stress can be OK but how much is too much?, Personal fulfilment (creativity, music, poetry, community involvement)] (imploding and exploding)							
17.	Cui et al., 2016	Group Cognitive Behavioural Intervention having relaxation component CBT	Weekly goal setting, relaxation techniques*, homework task, psychoeducation about depression; 2) behavioural activation, graded exposure, (identifying thoughts and feelings);	8 weeks, 8 sessions, 120 minutes	Senior graduate student	Depression	Educational settings	19.42 (1.66) Both	post intervention	Multicomponent

			problem solving, identifying affect, identifying thoughts, cognitive restructuring, distraction, mood monitoring, assigning homework							
18.	Felver et al., 2014	Yoga Not specified	Yoga (physical exercises, muscular strength, balance, coordination, and somatic awareness, breathing exercises), mindfulness practices (ability to control attention, mind-body awareness), somatic self-awareness, introducing basic	3 weeks, 15 sessions, 35 minutes each	Yoga practitioner	Depression	Educational settings	15 Both	Post intervention	Multicomponent

			physiological response of stress (i.e., the fight-or-flight response), mindful breathing, brief relaxation activity (e.g., 5 min spent lying on back and focusing on somatic sensations of non-activity), group discussion (e.g., dealing with stress, non-judgmental self-awareness).							
19.	Khalsa et al., 2012	Yoga intervention Theoretical basis not specified	Simple yoga postures, breathing exercises, visualization, and games with an emphasis on fun, relaxation	11 weeks, 23 -32 sessions, 30-40 minutes	Yoga instructors	Stress	Educational settings	16.8 (0.6) Both	immediate	Multicomponent

			(breathing exercises), mindfulness* , meditation, self-awareness, non-violence, mind–body interactions and awareness, body systems, stress management* , emotional intelligence, self-talk and critical voice, contentment, discipline, decision making, values and principles, commitment, and acceptance							
20.	de Vibe et al., 2013	Mindfulness-Based Stress Reduction (MBSR) programme Mindfulness	MBSR programme (physical and mental exercises, didactic teaching on mindfulness,	7 weeks, 7 sessions, duration of 1-6 sessions was 1.5 hours,	Trained MBSR instructors	Stress	Educational setting	23 (SD missing) both	2 weeks	Multicomponent

			stress management and mindful communication using a course manual and CDs for home practice, a group process to facilitate reflections)	while 7th session was of 6 hours, 30 minutes' homework practice						
21.	Erogul et al., 2014	MBSR programme Mindfulness	Mindfulness (meditation*, body scan, and breathing-based yoga), psychoeducation (mindfulness, provide a cognitive curriculum about understanding stress and how best to manage reactivity)	8 weeks, 8 sessions, 75 minutes each.	Psychotherapist	stress	Educational settings	23.5 (SD missing) Both.	8 weeks	Multicomponent
22.	Phang et al., 2015	Mindful-Gym: mindfulness-based stress management	Mindfulness (e.g. mindful breathing, mindful	5 weeks, 5 sessions, 120	Psychiatrist	stress	Educational settings	Experimental group: 21.14 (SD = 1.10), control group	1 week	Multicomponent

		(MBSM/Mindfulness program)	stretching, and body scan).	minutes each.				: 20.94 (SD = 1.17), Both		
		Mindfulness								
23.	Scholten et al., 2016	Dojo (Game) Theoretical basis (Not specified)	Biofeedback system, guided imagery, positive self-talk, muscle relaxation, Deep Breathing	3 weeks, 6 sessions, 60-120 minutes each	Game	Anxiety	Educational settings	11-15 Both	3 weeks	Multicomponent
24.	Grassi et al., 2011	A Stress Inoculation Training-based protocol CBT	Stress management (Imaginary exercises, emotional regulation, muscular relaxation, relaxation exercise*)	1 week, 6 sessions	Multimedia (CD, DVD, Mp3, Universal mobile telecommunication system)	Anxiety	Educational settings	20.86 (1.27) Females	Pre post	Multicomponent
25.	Dvořáková et al., 2014	Learning to BREATHE (L2B) program Mindfulness-based curriculum	Breathing, Stress management*, mindfulness (three mindful breaths), emotional regulation, guided	8 weeks, 8 sessions, each session of 80 minutes	Not specified	Depression and anxiety	Others	18.2 (0.4) Both	6 weeks	Multicomponent

			meditations (body scan, loving-kindness practice)							
26.	Vázquez et al., 2012	Relaxation training	Breathing, Meditation, PMR, Imagery, Mood monitoring, Assigning homework,	8 sessions, 90 minutes each	Clinical psychology PhD students	Depression and anxiety	Not specified	23.3 Both	3 months	Multicomponent
27.	McGrady et al., 2012	Wellness program Mindfulness based stress reduction	Stress Management (deep breathing, progressive relaxation, guided imagery, survival thinking, mindfulness meditation, nutrition, coping, managing fatigue and anxiety and balancing life) Relaxation technique (mindful	8 sessions, 45 minutes each	Experienced practitioner (psychologist, counselor, or physician)	Depression and anxiety	Others	first year medical students Both	9 months follow up	Multicomponent

			breathing or imagery)							
28.	Levin et al., 2016	Acceptance and commitment therapy ACT with mindfulness components	Acceptance, values, mindfulness (audio guided mindfulness exercises* mindful breathing exercise; Mindfulness of internal experiences), goal setting, ACT skills, writing,	3 weeks, 6 sessions	Online	Depression and anxiety	Educational settings	21.61 (5.48) Both	After completion of sessions: 4 weeks	Multicomponent
29.	Blake et al., 2017	Sleep SENSE intervention Cognitive behavioral Therapy	Stress management* , Psychoeducation*, sleep education, sleep hygiene, stimulus control, and cognitive restructuring, Motivational interviewing techniques,	7 sessions, each session of 90 minutes	Clinical psychologists or graduate clinical psychologists	Depression and anxiety	Educational settings	14.48 Both	7 weeks	Multicomponent

			problem solving, identifying thoughts, sleep diaries, thought monitoring, assigning & reviewing homework, goal setting, empathy,							
30.	Merry et al.,2012	Computerised CBT (SPARX) CBT	CBT (Psychoeducation about depression, Relaxation: controlled breathing, Activity scheduling and behavioural activation, progressive muscle relaxation, Basic communication, and interpersonal skills, dealing with strong emotions, Interpersonal	7 modules	CD delivered	Depression and anxiety	Online	15.6 Both	3 months follow up	Multicomponent

			skills, Problem solving, Cognitive restructuring, recognizing different types of negative automatic thoughts, Mindfulness: tolerating distress)							
31.	Seligman et al., 2007	Classroom-based cognitive-behavioral workshop CBT with relaxation	identifying automatic negative thoughts and underlying beliefs, replacing automatic negative thoughts, thought stopping, distraction, behavioural activation, problem solving, assertiveness , stress management (relaxation training*),	8 weeks, 8 sessions, 120 minutes each	Trained and experienced cognitive therapists	Depression and anxiety	Educational settings	first year undergraduates Mean age missing Both	6 months	Multicomponent

			emotional regulation							
32.	Kenardy et al., 2003	Online Anxiety Prevention Program CBT with relaxation	Psychoeducation about anxiety, relaxation training, interceptive exposure, cognitive restructuring and relapse prevention, self-monitoring,	12 weeks 6 sessions	Online	Depression and anxiety	Both educational settings & home	19.92 (4.78) Both	6 weeks: Post session	Multicomponent
33.	Seligman et al., 1999	Cognitive-behavioural workshop CBT	identifying automatic negative thoughts and underlying beliefs; replacing automatic negative thoughts, stopping, distraction techniques); behavioural activation strategies, antiprocrastination techniques,	8 sessions, 120 minutes each	Cognitive therapist	Depression and anxiety	Educational settings	1st year Undergraduates Both	8 week	Multicomponent

			creative problem solving, assertiveness training, (f) interpersonal skills (active listening, taking each other's perspectives, controlling emotions, passive vs. assertive vs. aggressive behaviours), stress management (relaxation training*), games, emotional regulation, , role play, assigning & reviewing homework, motivational interviewing,							
34.	Calear et al., 2009	MoodGYM Program Theory: CBT	CBT (identify negative thinking patterns and change them,	5 weeks, 5 sessions, 20-40 minutes	Online/self-paced	Depression and anxiety	Educational settings	14.34 Both	post intervention	Multicomponent

			identify the situations or events that may precipitate negative thinking, Relaxation techniques, Teaches users about relationship breakups and how to cope with them, problem solving)							
35.	Chen et al., 2013	Mindfulness meditation training Mindfulness	Mindfulness (cognitive practice of mindfulness meditation, concentration on breathing with eyes closed, non-judgmental awareness of thoughts, feelings, and sensations with a focus on the flow of breath	1 week, 7 sessions, 30 minutes	Senior psychological counsellor	Anxiety and Depression	not specified	19.5 (0.87) Both	post intervention	Multicomponent

			through the nostrils; body scan, paying attention to the breath and focusing on the dynamic sensations of the whole body, mindfulness with the help of background music)							
36.	Deldago et al., 2010	mindfulness based stress reduction Mindfulness	Mindfulness (Guided meditation, breathing, recognition of the experience of the present mental state.; body scan, focus on present mental and emotional state, generating positive, feelings of acceptance; relaxation	5 weeks, 10 sessions, 60 minutes	not specified	Anxiety and Depression	not specified	18-24 Females	post intervention	Multicomponent

			training (guided relaxation practice, muscle relaxation, relaxation training of speech and imagination)							
37.	Shapiro et al., 1998	meditation based stress reduction and relaxation mindfulness	Body scan, sitting meditation, Hatha yoga, mindful breathing, lovingkindness and forgiveness meditation, empathy, mindful listening skills	8 weeks, 7 sessions, 150 minutes	Not specified	Anxiety and Depression	Educational setting	Not specified, both	Post intervention	Multicomponent
38.	Astin et al., 1997	mindfulness meditation-based stress reduction Mindfulness and CBT based	body scan, sitting meditation, Hatha yoga	8 weeks, 8 sessions, 120 minutes	Researcher trained in meditations	Anxiety and Depression	both educational and residential setting	not specified, both	6 to 9 months	Multicomponent
39.	Shearer et al., 2015	Mindfulness meditation intervention	Mindfulness (breathing exercises, basic yoga	4 weeks, 4 sessions, 60 mins.	Not specified	Depression, anxiety and stress.	Educational settings	Undergraduate students, age is not	Post intervention	Multicomponent

		mindfulness	including light stretching and balancing exercises, short meditation sessions, and education About the physiology of the stress response.)					specified, both.		
40.	Hilyer et al., 1982	physical fitness program & counselling not specified	Flexibility exercise, praise, reinforcements, movements	20 weeks, 60 sessions, 90 minutes each.	Physical fitness trainer	Depression and anxiety	Educational setting	Experimental group: 17.01, control group: 16.90, Male.	Post intervention	Multicomponent
41.	Melnyk et al., 2009	The COPE Healthy Lifestyles TEEN Program CBT	Psychoeducation (creating a healthy lifestyle, strategies to build self-esteem, stress management, goal setting, effective communication, nutrition, and physical activity), physical	9 weeks, 15 sessions, 50 minutes each	Research personnel	Depression & Anxiety	Educational settings	14-16 Both	Post intervention	Multicomponent

			activity (Frisbee, kickball, walking, and relay games), self-esteem, positive self-talk, goal setting, problem solving, stress & coping, emotional & behavioural regulation, communication skills, stretching, food groups, nutrients, influence of feeling on eating, social eating strategies, role plays							
42.	Ştefan et al., 2018	Mindfulness-Based Stress Reduction Intervention Mindfulness-based stress reduction and	Psychoeducation (mindfulness, initial meditation and body scan) Meditation, walk,	6 weeks, 6 sessions, 90-120 minutes each session	CBT trainer with experience in mindfulness meditation	Anxiety and stress	Not specified	18.92 (1.04) Females	1 week	Multicomponent

		mindfulness-based cognitive therapy	mindfulness (sound and walking, breathing with spaciousness) identifying thoughts,							
43.	Chiauzzi et al., 2008	Mystudentbody-stress website CBT	Stress management (Strategies include tips on time management, developing good sleep habits, practicing relaxation skills or meditation, handling depression and anxiety, developing social support, and communicating with family members)	4 sessions, 20 minutes each	Self-delivered	Anxiety and stress	Not specified	18-24 years Both	6 months	Multicomponent
44.	Sarvanan et al., 2014	PMRT, systematic desensitization	Psychoeducation* , PMR (assigning homework), systematic desensitization	3 weeks, 5 sessions	Clinical psychologist	Anxiety and stress	Educational settings	19 (1.04) Both	3 weeks	Multicomponent

		Theoretical basis (Not specified)	on (exposure, relaxation technique)							
45.	Fleming et al., 2012	Computerized CBT, SPARX CBT	Psychoeducation*, problem solving, relaxation*, social skills, cognitive restructuring, activity scheduling	5 weeks, 7 sessions, 30 minutes each	Self/computerized	Anxiety and stress	Educational settings	14.9 (0.79) Males	5 weeks	Multicomponent
46.	Deckro et al., 2002	Mind/Body Intervention CBT and relaxation	Relaxation (Diaphragmatic breathing, Guided imagery, Progressive muscle relaxation, Brief relaxation exercises ("minis"), yoga stretches, mindfulness.), Cognitive behavioural interventions (Identifying automatic thoughts, Challenging cognitive distortions,	6 weeks, 6 sessions, 90 minutes each	Trainers	Anxiety and stress	Educational settings	24 Both	immediate	Multicomponent

			Affirmations, Goal setting) Psychoeducation (Stress, stress symptoms, and coping, Mind/body connection, Physiology of stress and the relaxation response, Weekly discussion of relaxation practice)							
47.	Feng et al., 2016	Web-based stress management intervention Theory: Not specified	Present control+mindfulness (psychoeducational video on mindfulness, completed mindfulness exercises such as listening to mindfulness meditation audio files that taught breath awareness and noticing	4 weeks, 3 sessions, 20 minutes each	Not specified	Anxiety and stress	Online	Age not specified Both	4 weeks	Multicomponent

			emotions that arise)							
48.	Zhang et al., 2018	Mindfulness-based Tai Chi Chuan	Breathing, Meditation, Tai-chi, mindfulness (mindfulness based breathing, walking meditation), muscle relaxation, gentle stretches, chest expanding, knee movement, shape up exercise	16-8 weeks, twice a week, 90 minutes each	Experienced Physical Exercise coaches	Depression and stress	Educational settings	18.41 (2.01) Both	8 weeks	Multicomponent
49.	Bluth et al., 2016	Learning to BREATHE (L2B) Mindfulness based stress reduction	Meditation, walk, yoga, music, exercise, mindfulness (the body scan, sitting meditation, lovingkindness practice, walking meditation and mindful	11 sessions, 50 minutes each	Experienced mindfulness practitioner	Depression, anxiety and stress	Educational settings	16.8 (1.3) Both	post-intervention	Multicomponent

			movement, mindfulness of thoughts and emotions),							
50.	Flett et al., 2018	Two Mobile mindfulness meditation applications (Headspace & Smiling Mind) Mindfulness	Mindfulness (mindful breathing, body scan, mindful eating, sitting meditation, other guided meditations)	4 weeks, 10 sessions, 10 minutes each	Online	Depression, anxiety, and stress	Others	20.08 (2.8) Not specified	10 days	Multicomponent
51.	Song and Lindquist, 2015	Mindfulness-based stress reduction (MBSR) Mindfulness	Mindfulness (Hatha yoga, sitting, eating & walking meditation, gentle stretching, breath-work, body scan, and, assigning & reviewing homework),	8 weeks, 8 sessions, 120 minutes each	Trained instructor	Depression, anxiety, and stress	Educational settings	19.6 (1.7) Both	Post intervention (8 weeks)	Multicomponent
52.	Rentala et al., 2019	Stress management program Chan's body-mind-spirit (BMS) model & psychoeducation	psychoeducation strategies (emotional management, stress reduction techniques such as acupressure exercises,	4 weeks, 8 session, 90-120 minutes	Psychiatrist	Depression, anxiety and stress	Educational settings	16-19 years Females	1 month	Multicomponent

			breathing techniques and meditation, connecting to spiritual and self-healing resources), holistic stress management program (Singing activity Hand swinging exercises, Breathing exercises, Clay therapy, Meditation Acupressure exercises Craftwork Stress sorting exercise focusing on stressful situation, their reaction, and ways of coping, Therapeutic writing Drawing, Self-love techniques							
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			Mirror exercises, Progressive muscle relaxation Storytelling, Mindful eating)							
53.	Hall et al., 2018	Low intensity Health enhanced mindfulness intervention Mindfulness	Mindfulness & meditation (mindful eating, sitting, and breathing), mindfulness exercises (body scan and mindful walking), home based practice	7 weeks, 7 sessions, 90 minutes each	Facilitator head of student counselling section	Depression, anxiety, and stress	Home based	22.30 (2.63) Both	week 7	Multicomponent
54.	Hindman et al., 2015	Mindful Stress Management (MSM) MBSR, mindfulness-based cognitive therapy (MBCT and ACT)	Psychoeducation (mindfulness), stress management [mindfulness (a focus on the present moment, acceptance, reviewing progress, mindful	6 weeks, 6 sessions, 60 minutes each	Group leaders. One co-leader (experienced clinical psychologist having mindfulness (meditation) experienc	Depression, anxiety, and stress	Educational settings	22.35 Both	immediate	Multicomponent

			walking, eating, listening to music, meditation, free association task],		es)					
55.	Levin et al., 2016	Acceptance and commitment therapy & Mental Health Education Website ACT with mindfulness component	costs of experiential avoidance, (diffusion), (mindfulness), (acceptance of difficult emotions),(clarifying personal values), and(committed action and goal setting), breathing mindful exercise, imagery, goal setting,	3 weeks, 2 sessions	Online	Depression, anxiety, and stress	Educational settings	20.51 (2.73) Both	3 month	Multicomponent
56.	Ellis et al., 2011	MoodGYM (online CBT) and Mood Garden (online social support) CBT	Problem solving, enhancing relationship, stress management (relaxation*),	3 weeks, 5 sessions, 60 minutes	Online	Depression, anxiety, and stress	Others	19.67 (1.66) Both	Post intervention	Multicomponent

			identifying thoughts,							
57.	Gallego et al., 2014	mindfulness training Mindfulness Based Cognitive Therapy (MBCT)	Body scan, mindful breathing, breathing space, yoga, sitting meditation	8 weeks, 8 sessions, 60 minutes	Therapist	Anxiety, Depression and Stress	both educational and home based	20.07 (SD missing) both	Post intervention	Multicomponent
58.	Berger et al., 1988	Jogging, Benson relaxation Not specified	Jogging, Benson relaxation, group interaction*	12 weeks, 14 sessions, 45 minutes each	Not specified	Depression, Anxiety & stress	Not specified	20 Both	Post intervention	multicomponent

Table 7: Sub-group analysis

Variable	No. of studies	SMD (95% CI)	I ²	Q-value	df	p-value
Anxiety						
Risk of bias						
High	40	-0.41 (-0.57 to -0.26)	80.73	0.64	1	0.43
Low	6	-0.25 (-0.62 to 0.11)	57.36			
Mode of delivery						
Mixed	1	-0.13 (-0.87 to 0.62)	0%	3.0	2	0.22
Onsite	33	-0.47 (-0.64 to -0.30)	83.10%			
Technology	12	-0.22 (-0.48 to 0.04)	31.54%			
Format of delivery						
Group	28	-0.30 (-0.48 to -0.11)	48.56%	2.72	2	0.26
Individual	15	-0.53 (-0.77 to -0.29)	90.84%			
Mixed	1	-0.13 (-0.97 to 0.72)	0%			
Type of therapy						
Multicomponent	28	-0.38 (-0.56 to -0.21)	80.59%	0.004	1	0.95
Relaxation only	18	-0.39 (-0.62 to -0.17)	77.73%			
Booster sessions						
No	37	-0.38 (-0.54 to -0.22)	70.76%	0.90	2	0.34
Yes	5	-0.59 (-1.00 to -0.18)	94.96%			
Intervention focus						
Preventive	24	-0.38 (-0.56 to -0.19)	74.81%	1.07	2	0.59
Treatment	21	-0.42 (-0.62 to -0.22)	83.70%			
Both	1	0.25 (-1.02 to 1.51)	0%			
Depression						
Risk of bias						
High	40	-0.30 (-0.55 to -0.16)	77.92%	0.68	1	0.41
Low	10	-0.18 (-0.44 to 0.09)	68.35%			
Mode of delivery						
Mixed	1	-0.23 (-1.02 to 0.56)	0	0.15	2	0.93
Onsite	38	-0.29 (-0.44 to -0.14)	70.79%			
Technology	11	-0.24 (-0.49 to 0.02)	57.46%			
Format of delivery						
Group	33	-0.21 (-0.37 to -0.05)	70.65%	1.88	2	0.39
Individual	14	-0.41 (-0.65 to -0.17)	86.06%			
Mixed	1	-0.23 (-1.032 to 0.57)	0%			
Type of therapy						
Multicomponent	29	-0.26 (-0.34 to -0.06)	70.07%	0.14	1	0.71
Relaxation only	21	-0.27 (-0.45 to -0.08)	83.02%			
Booster sessions						
No	42	-0.31 (-0.47 to -0.19)	78.64%	1.75	1	0.19
Yes	4	-0.03 (-0.45 to 0.39)	67.58%			
Intervention focus						
Both	1	-0.13 (-1.36 to 1.10)	0%	0.65	2	0.72
Preventive	26	-0.32 (-0.49 to -0.15)	79.92%			
Treatment	23	-0.23 (-0.41 to -0.15)	74.10%			
Distress						
Risk of bias						

High	19	-0.43 (-0.68 to -0.17)	86.23%	0.85	1	0.36
Low	4	-0.71 (-1.25 to -0.16)	0%			
Mode of delivery						
Mixed	0	-				
Onsite	16	-0.62 (-0.87 to -0.38)	88.39%	6.28	1	0.01
Technology	6	-0.06 (-0.42 to 0.30)	33.49%			
Format of delivery						
Group	14	-0.47 (-0.78 to -0.17)	64.06%	2.31	2	0.31
Individual	6	-0.64 (-1.08 to -0.19)	93.72%			
Mixed	2	0.02 (-0.71 to 0.75)	45.24%			
Type of therapy						
Multicomponent	13	-0.60 (-0.90 to -0.29)	90.07%	1.42	1	0.23
Relaxation only	10	-0.30 (-0.67 to 0.07)	61.69%			
Booster sessions						
No	19	-0.38 (-0.64 to -0.11)	79.86%	3.28	1	0.07
Yes	4	-0.96 (-1.53 to -0.39)	95.87%			

Table 8: Meta-regression analysis showing association between anxiety outcome and density of dosage of interventions

Covariate	Coefficient	Standard error	Z-value	P
Intercept	-0.29	0.14	-2.10	0.04
Number of sessions	0	0.010	-0.40	0.69
Duration of sessions	0	0	-1.54	0.12
Duration of programme	0.03	0.03	0.86	0.40

R² analog= 44%

Table 9: Meta-regression analysis showing association between depression outcome and density of dosage of interventions

Covariate	Coefficient	Standard error	Z-value	P
Intercept	-0.015	0.22	-0.71	0.48
Number of sessions	-0.01	0.01	-0.93	0.35
Duration of sessions	0	0.0	-0.66	0.51
Duration of programme	0	0.01	0.27	0.79

R² analog= 0.05

Table 10: Meta-regression analysis showing association between distress outcome and density of dosage of interventions

Covariate	Coefficient	Standard error	Z-value	P
Intercept	-0.48	0.24	-1.98	0.05
Number of sessions	0.02	0.01	1.61	0.11
Duration of sessions	0	0	-1.46	0.14
Duration of programme	-0.01	0.01	-0.70	0.49

R² analog= 0.47

Table 11: Meta-regression analyses for studies according to components of interventions targeting anxiety as an outcome

	Covariate	Coefficient	Standard Error	Z-value	P-value	Set
	Intercept	-0.41	0.54	-0.77	0.44	
Quality of the study		0.25	0.26	0.98	0.33	
Relaxation methods	Cognitive	-0.02	0.61	-0.03	0.98	Q=9.36, df=5, p < 0.10
	Somatic	-0.53	0.57	-0.93	0.35	
	Somatic & behavioral	0.13	0.77	0.17	0.87	
	Somatic & cognitive	0.11	0.56	0.20	0.84	
	Somatic, cognitive & behavioral	0.25	-0.9	-0.40	0.69	

R² analog = 0.25; Reference group= Interventions based on cognitive & behavioral methods

Table 12: Meta-regression analyses for studies according to components of interventions targeting depression as an outcome

	Covariate	Coefficient	Standard Error	Z-value	P-value	Set
	Intercept	-0.27	0.50	-0.54	0.59	
Risk of bias		0.19	0.19	0.99	0.32	
Relaxation methods	Cognitive & behavioral	-0.03	0.70	-0.05	0.96	Q=2.21, df=6, p=0.90
	Cognitive	-0.06	0.55	-0.11	0.92	
	Somatic	-0.27	0.53	-0.50	0.61	
	Somatic & behavioral	-0.23	0.71	-0.32	0.75	
	Somatic & cognitive	0.02	0.52	0.04	0.96	
	Somatic, cognitive & behavioral	-0.11	0.57	-0.20	0.84	

R² analog = 0.09; Reference group= Interventions based on behavioral methods of relaxation

Table 13: Meta-regression analyses for studies according to components of interventions targeting distress as an outcome

	Covariate	Coefficient	Standard Error	Z-value	P-value	Set
	Intercept	-0.48	0.46	-1.05	0.30	
Risk of bias		-0.21	0.38	-0.56	0.58	
Relaxation methods	Somatic	-0.38	0.51	0.26	0.79	Q=2.02, df=2, p=0.36
	Somatic & cognitive	0.13	0.38	-0.56	0.58	

R² analog = 0.15; Reference group= Interventions based on cognitive relaxation only

Table 14: Certainty of outcomes pertaining to anxiety, depression and distress using GRADE framework

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	relaxation training	treatment as usual	Relative (95% CI)	Absolute (95% CI)		

Anxiety (assessed with: Psychometric scales)

46	randomised trials	serious ^a	serious ^b	not serious	not serious	publication bias strongly suspected ^c	2486	2759	-	SMD 0.39 SD lower (0.52 lower to 0.25 lower)	⊕○○○ VERY LOW	CRITICAL
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Depression (assessed with: Psychometric scales)

50	randomised trials	serious ^d	serious ^e	not serious	not serious	none	2719	3013	-	SMD 0.28 SD lower (0.4 lower to 0.15 lower)	⊕⊕○○ LOW	CRITICAL
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Distress (assessed with: Psychometric instruments)

Better Stress Response via 'Relaxation'

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	relaxation training	treatment as usual	Relative (95% CI)	Absolute (95% CI)		
23	randomised trials	serious ^f	serious ^g	not serious	not serious	none	1122	1124	-	SMD 0.48 SD lower (0.71 lower to 0.24 lower)	⊕⊕○○ LOW	CRITICAL

CI: Confidence interval; **SMD:** Standardized mean difference

Explanations

a. A total of 40 out of 46 studies were rated as having a high risk of bias overall, with \geq matrices rated as high risk on Cochrane tool for risk of bias assessment in RCTs. Subgroup analyses using mixed effects revealed high risk studies yielding higher effect sizes than studies at low risk of bias. However, this subgroup difference was statistically non-significant.

b. The reporting of this outcome was substantially heterogeneous with an I squared of 79%, this was explained by clinically heterogeneous population and interventions.

c. Egger's regression test revealed significant publication bias (P=0.02)

d. A total of 40 out of 50 studies were rated as having a high risk of bias overall, with \geq matrices rated as high risk on Cochrane tool for risk of bias assessment in RCTs. Subgroup analyses using mixed effects revealed high risk studies yielding higher effect sizes than studies at low risk of bias. However, this subgroup difference was statistically non-significant.

e. The reporting of this outcome was substantially heterogeneous with an I squared of 73%, this was explained by clinically heterogeneous population and interventions.

f. 19 out 23 studies were rated as having high risk of bias, with studies with low risk of bias yielding lower effect sizes.

g. The reporting of this outcome was substantially heterogeneous with an I squared of 85%, this was explained by clinically heterogeneous population and interventions.

Figure 4: Anxiety Funnel plot

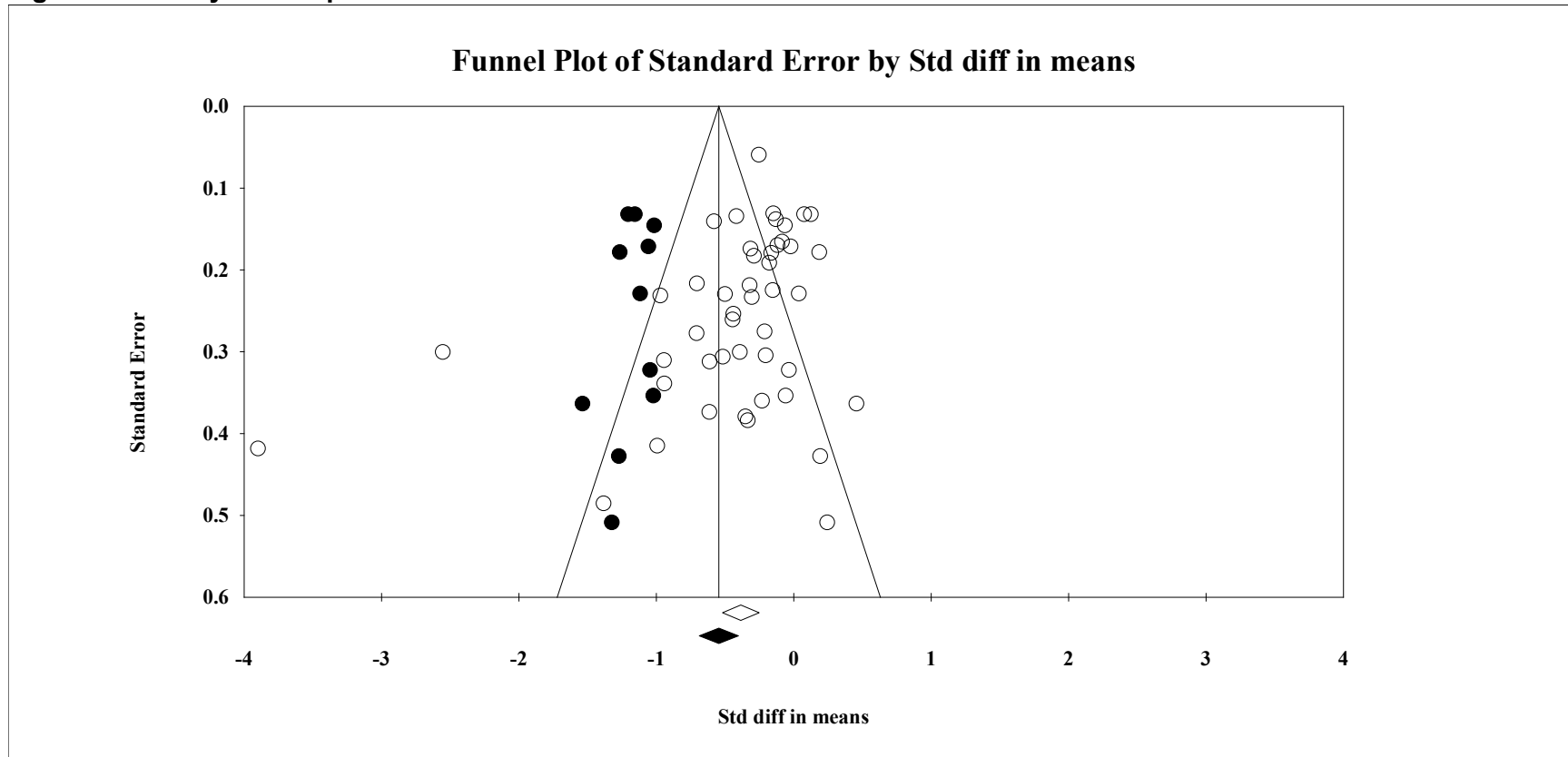


Figure 6: Depression funnel plot

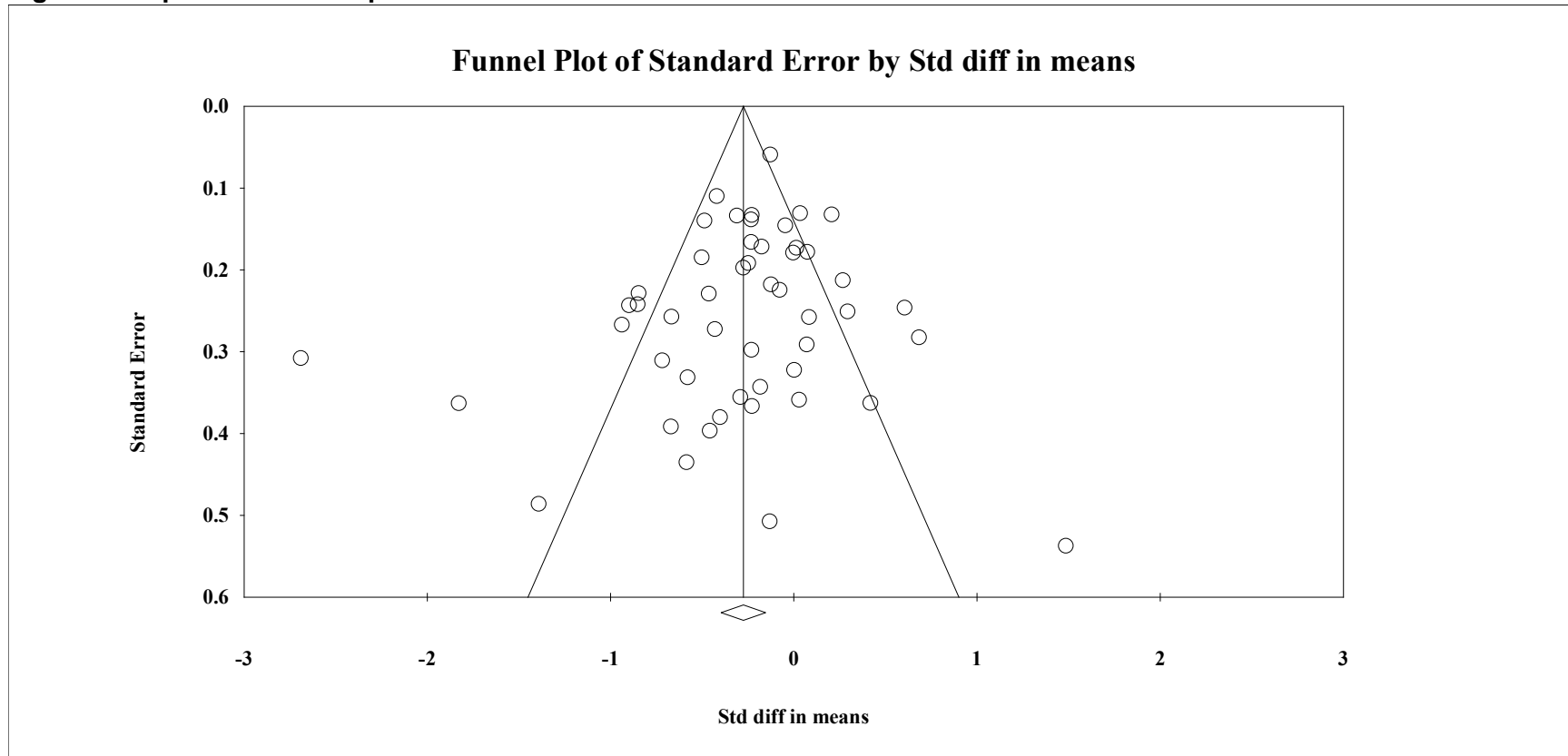


Figure 8: Distress funnel plot

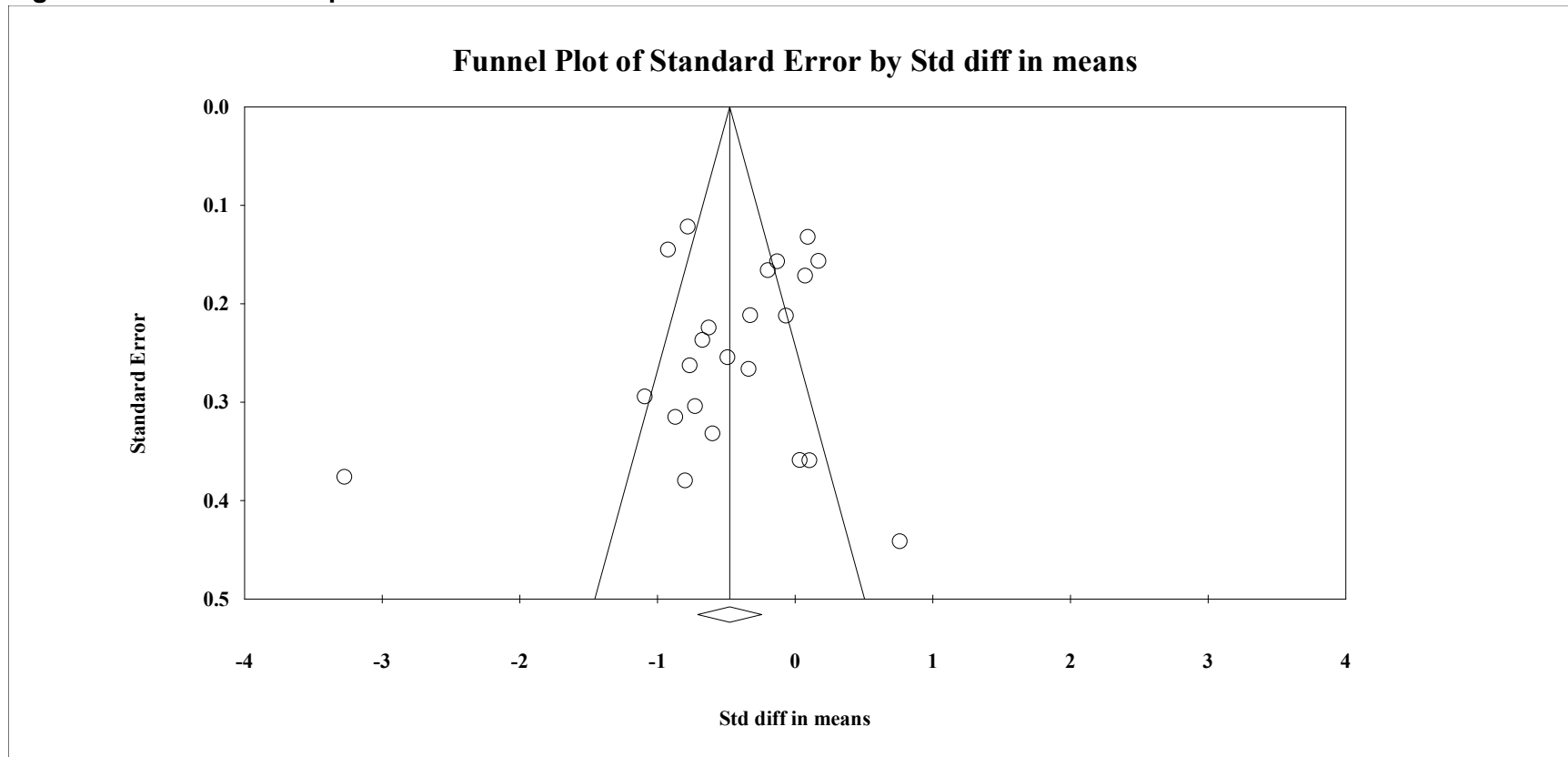


Figure 9: Anxiety outcome and duration of program

Regression of Std diff in means on Duration of program

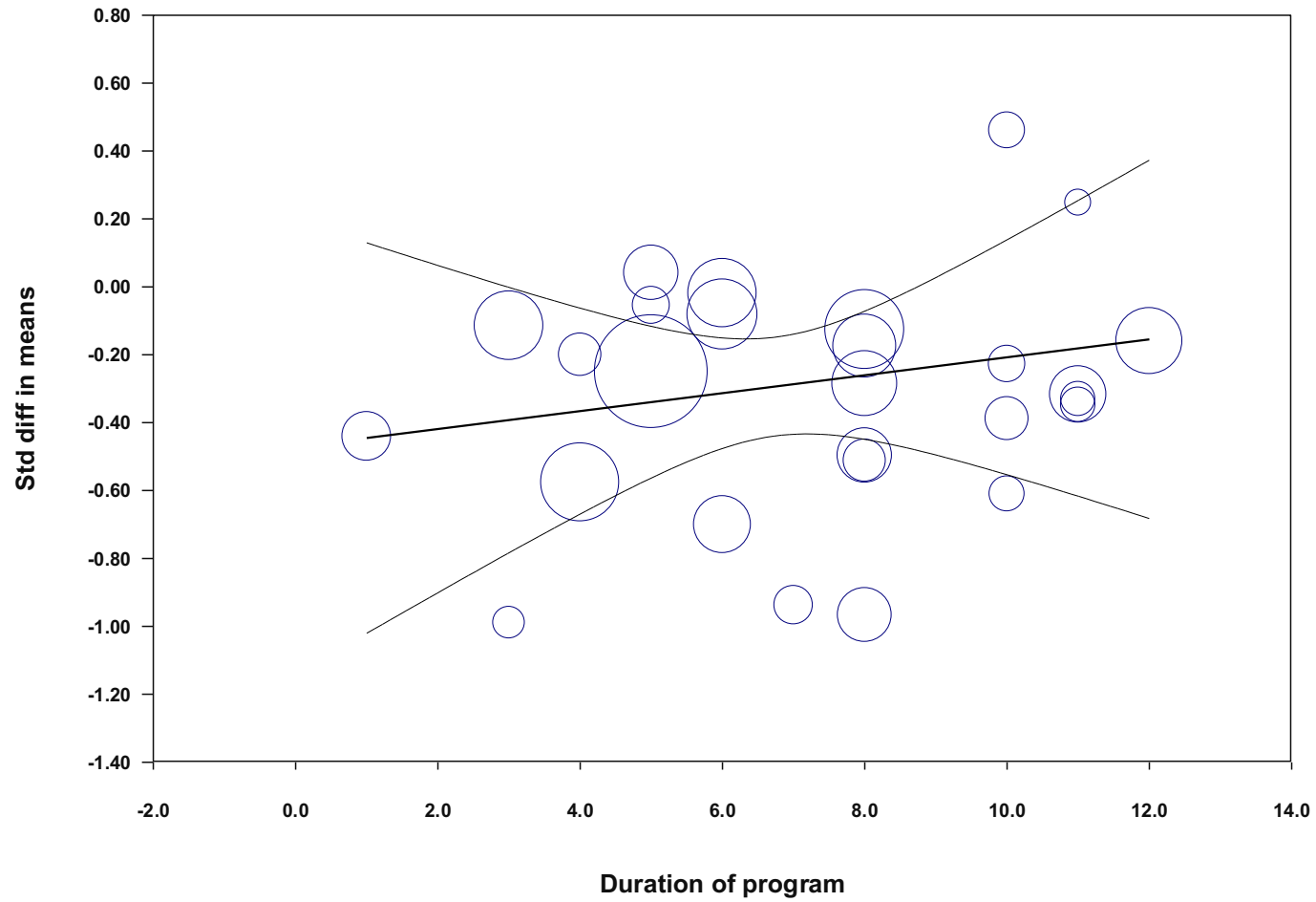


Figure 10: Anxiety & duration of session

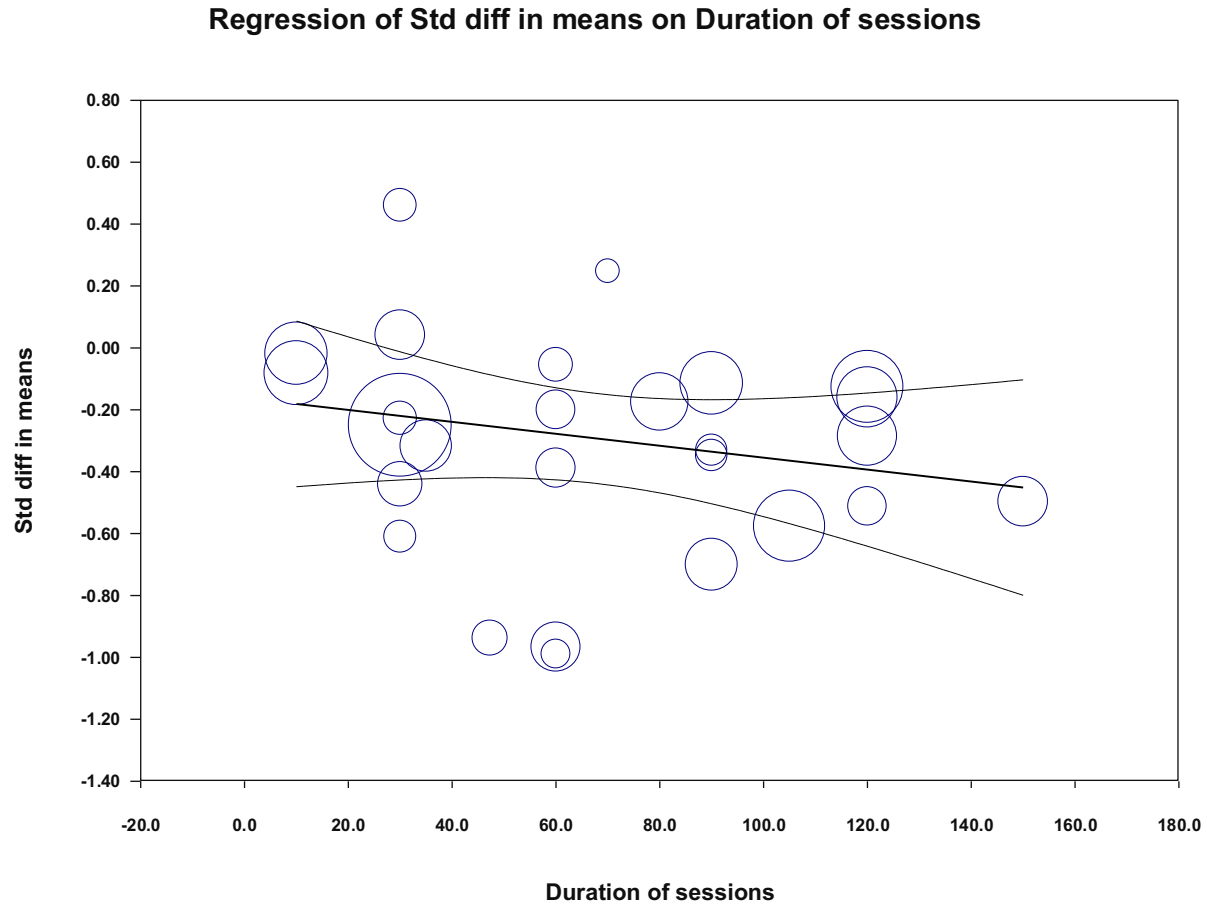


Figure 11: Anxiety outcome and number of sessions

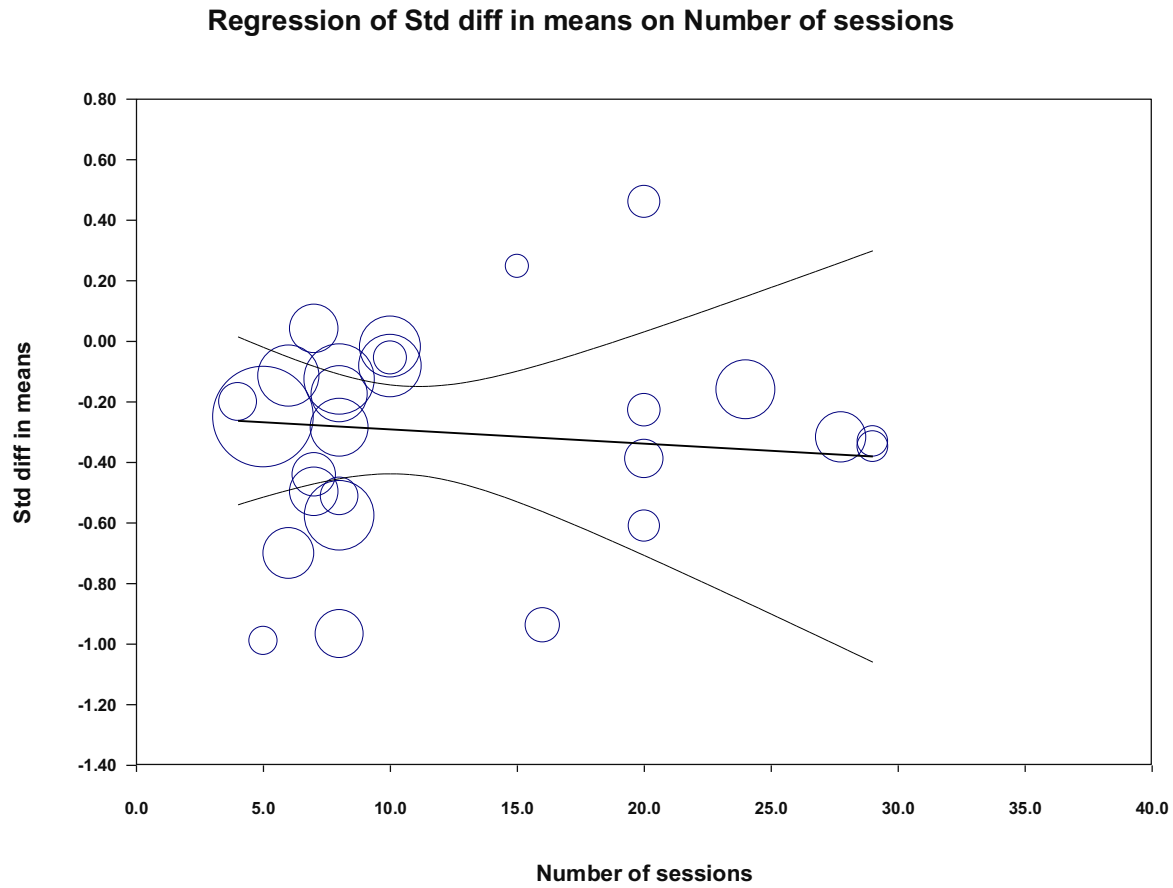


Figure 13: Depression & duration of session

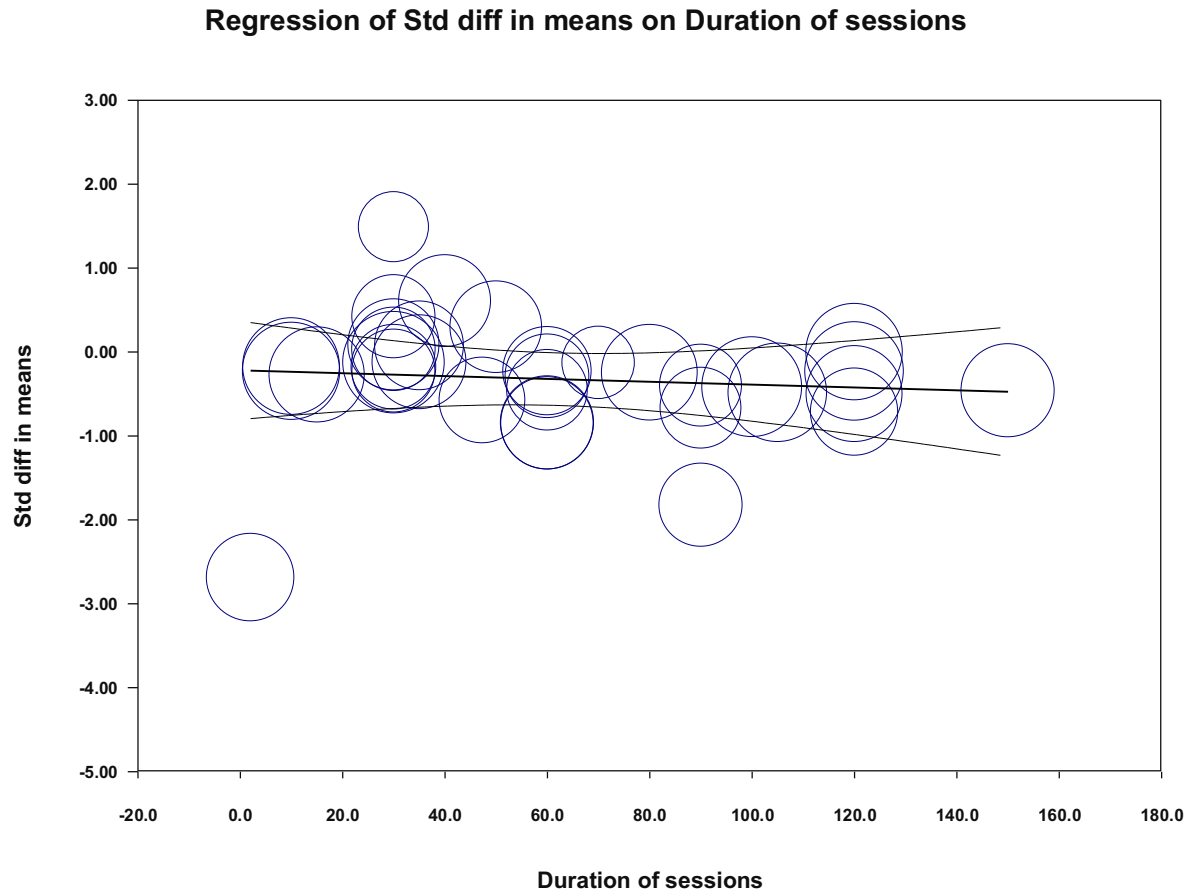


Figure 14: Depression & number of session

Regression of Std diff in means on Number of sessions

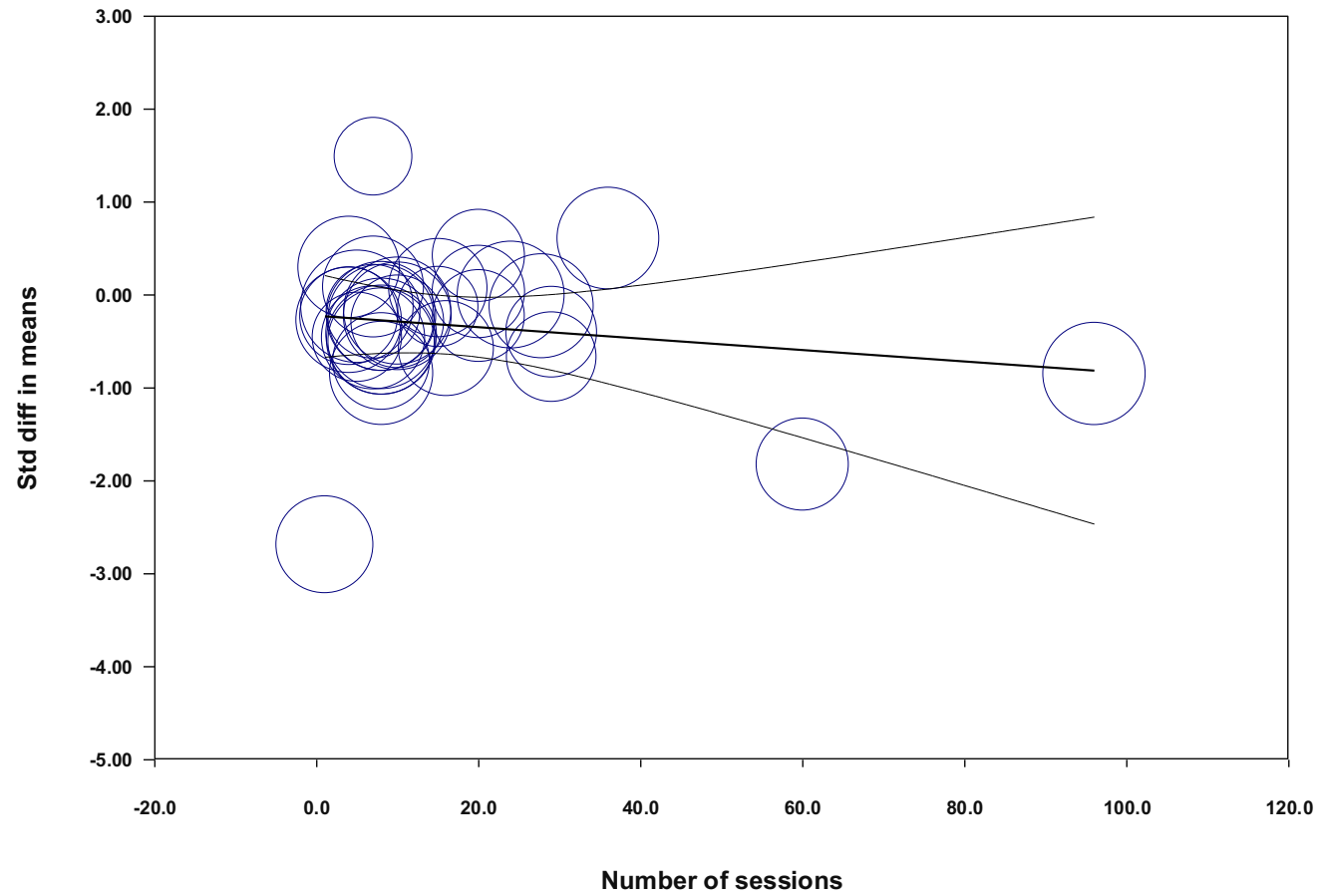


Figure 15: Distress & duration of program

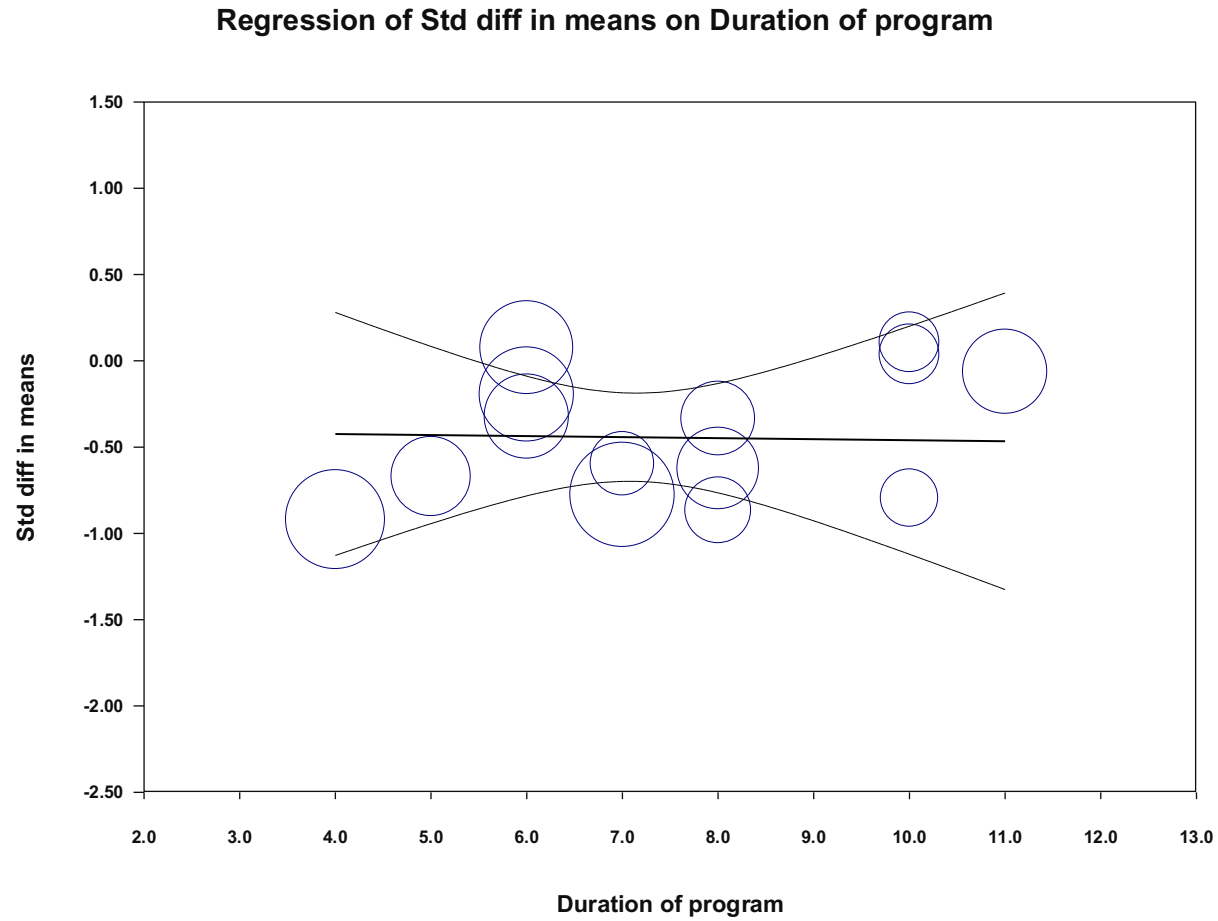


Figure 16: Distress & duration of sessions

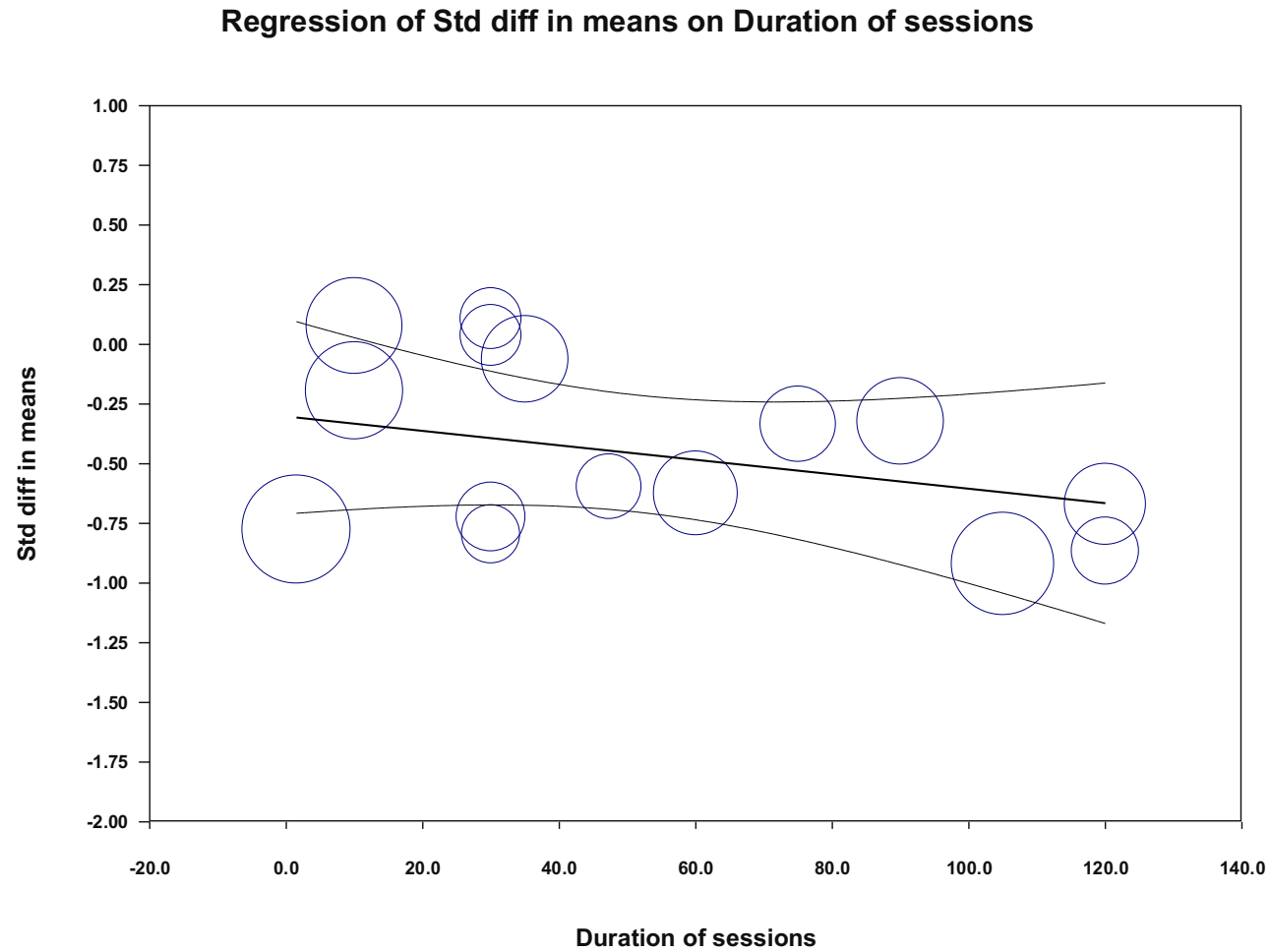


Figure 17: Distress & number of session

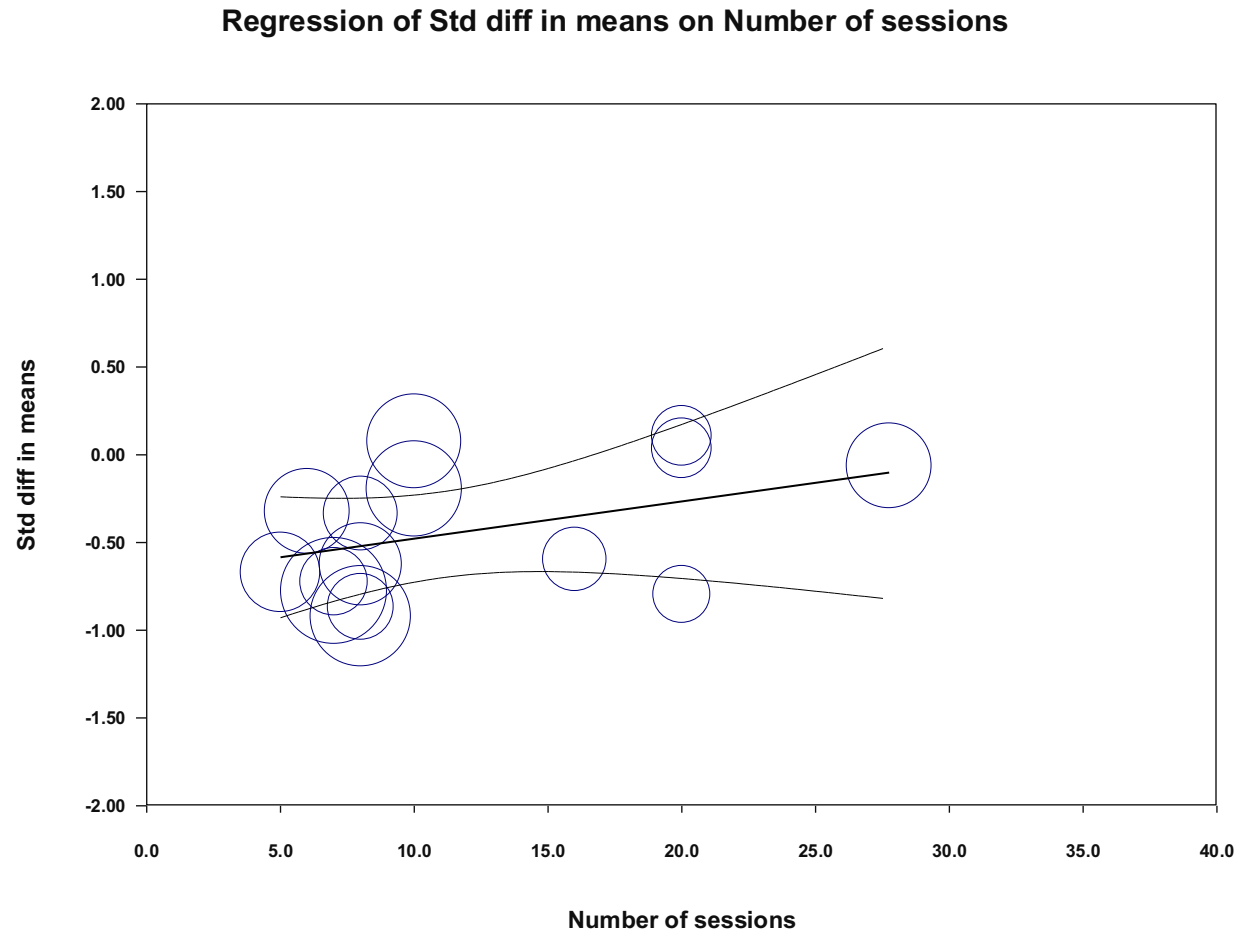


Figure 18: Meta-regression analysis Anxiety and relaxation type

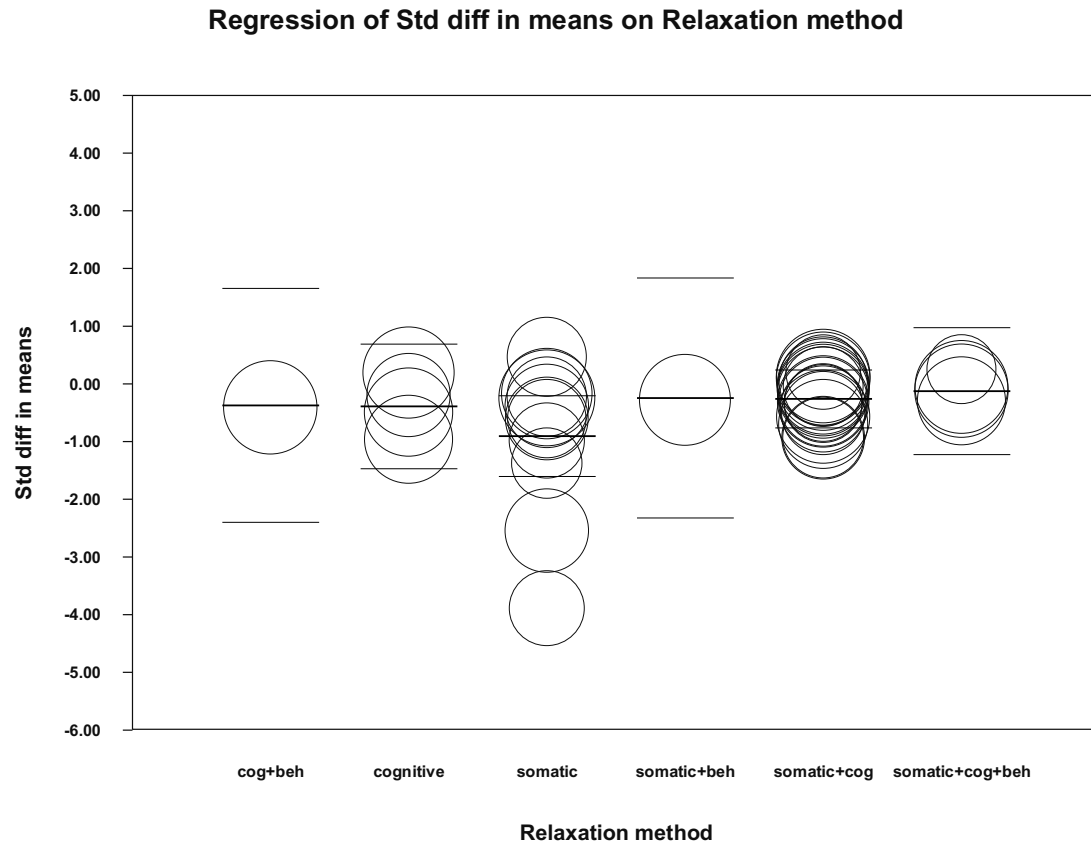


Figure 19: Meta-regression analysis depression and relaxation type

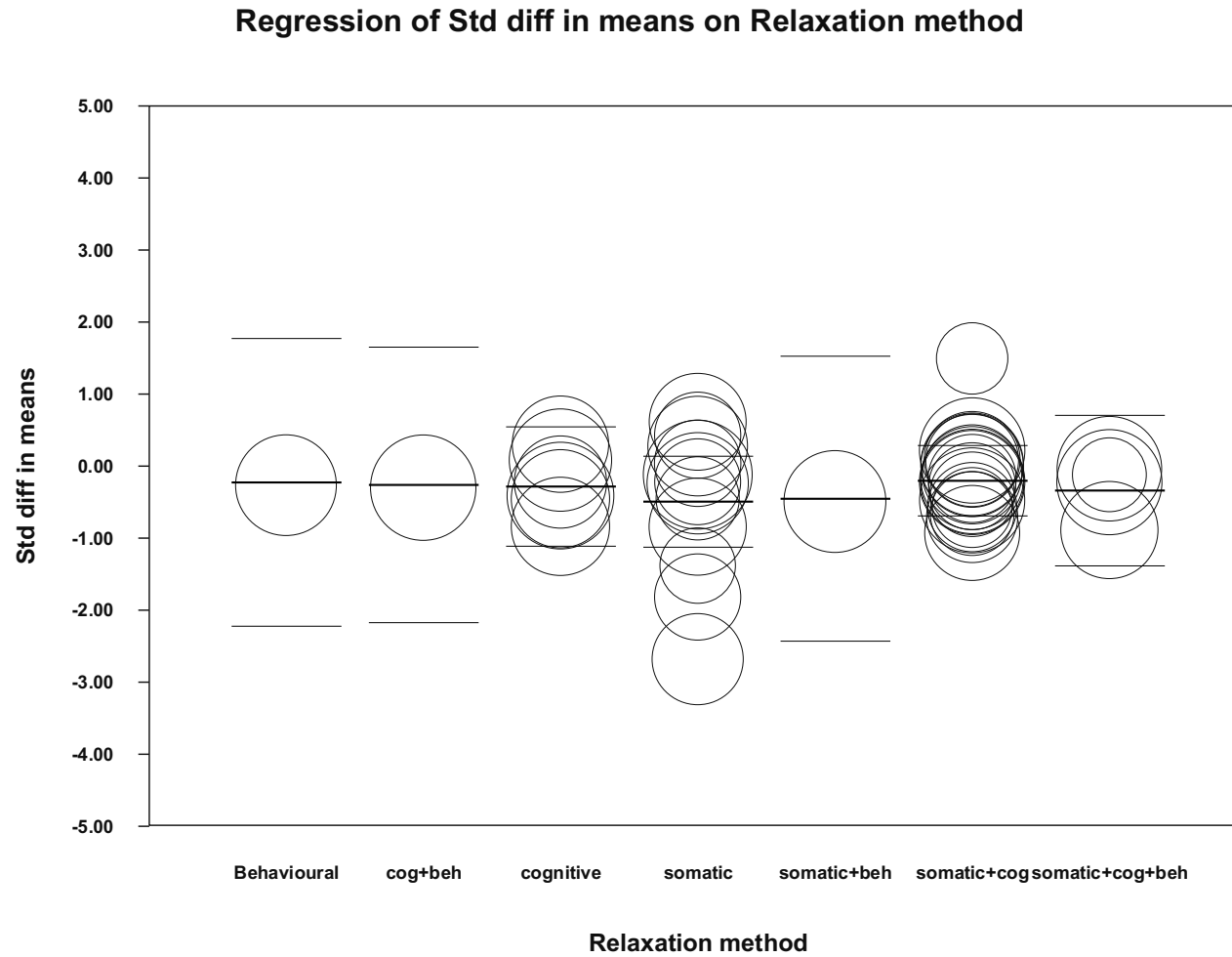


Figure 20: Meta-regression distress and relaxation type

