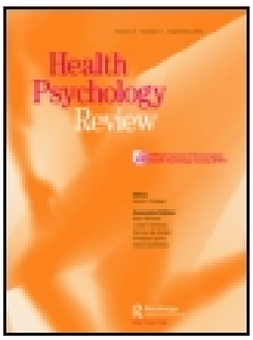

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Effective self-regulation change techniques to promote mental wellbeing among adolescents: a meta-analysis

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ABSTRACT

Mental wellbeing is influenced by self-regulation processes. However, little is known on the efficacy of change techniques based on self-regulation to promote mental wellbeing. The aim of this meta-analysis is to identify effective self-regulation techniques (SRTs) in primary and secondary prevention interventions on mental wellbeing in adolescents. Forty interventions were included in the analyses. Techniques were coded into nine categories of SRTs. Meta-analyses were conducted to identify the effectiveness of SRTs, examining three different outcomes: internalising behaviour, externalising behaviour, and self-esteem. Primary interventions had a small-to-medium ($\bar{g} = 0.16$–0.29) on self-esteem and internalising behaviour. Secondary interventions had a medium-to-large short-term effect (average $\bar{g} = 0.56$) on internalising behaviour and self-esteem. In secondary interventions, interventions including asking for social support ($\bar{g} = 1.55$, 95% confidence interval, CI = 1.11–1.98) had a great effect on internalising behaviour. Interventions including monitoring and evaluation had a greater effect on self-esteem ($\bar{g} = 0.39$, 95% CI = 0.21–0.57). For primary interventions, there was not a single SRT that was associated with a greater intervention effect on internalising behaviour or self-esteem. No effects were found for externalising behaviours. Self-regulation interventions are moderately effective at improving mental wellbeing among adolescents. Secondary interventions promoting 'asking for social support' and promoting 'monitoring and evaluation' were associated with improved outcomes. More research is needed to identify other SRTs or combinations of SRTs that could improve understanding or optimise mental wellbeing interventions.

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Meta-analysis; mental health; adolescents; promotion; evaluation; intervention

Introduction

Mental health problems, including internalising (e.g., depression and anxiety, and suicidal thoughts) and externalising behaviours (e.g., aggressive behaviours, conduct problems, and substance use) are common among adolescents (Hankin et al., 1998; Kieling et al., 2011). In most Western countries, the prevalence of mental disorders among adolescents is higher than 20%, and it has been suggested that the number of young people experiencing mental health problems is increasing (Bor, Dean, Najman, & Hayatbakhsh, 2014). Mental problems reduce quality of life and are likely to intensify

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and persist over time, resulting in poor mental health during adulthood (Patel, Flisher, Hetrick, & McGorry, 2007). Among adults, mental disorders have a mean past-year-to-lifetime prevalence of 38–57% (Moffitt et al., 2010).

Psychological wellbeing, is not so much the absence of negative states (WHO, 2013), but has been linked to basic psychological needs such as autonomy, environmental mastery and perceived competence, personal growth, positive relations with others, purpose in life, and self-acceptance (Deci & Ryan, 2008; Ryff, 1995). Poor psychological wellbeing, internalising and externalising problems have been associated with the inability to reach personal valued goals and poor self-regulation (e.g., Oldehinkel, Hartman, Ferdinand, Verhulst, & Ormel, 2007).

Self-regulation and psychological wellbeing

Self-regulation can be defined as 'the ability to flexibly activate, monitor, inhibit, persevere and/or adapt one's behaviour, attention, emotions and cognitive strategies in response to direction from internal cues, environmental stimuli and feedback from others, in an attempt to attain personally-relevant goals' (Moilanen, 2007). Self-regulation may improve psychological wellbeing, in three ways. Active pursuit of such goals, including goal setting and planning, may contribute to wellbeing because directing one's behaviour toward a certain goal may increase feelings of autonomy (Sheldon & Elliot, 1999; Sheldon, Kasser, Smith, & Share, 2002). Second, goal achievement has a positive effect. Studies have found that successful attainment of personal goals leads to fulfilment, a sense of meaning, competence and well-being (Carver & Scheier, 1990; Heckhausen, Wrosch, & Schulz, 2010; Loewenstein, Weber, Hsee, & Welch, 2001). Third, poor psychological wellbeing, and emotional and behavioural problems may result from unsuccessful or inadequate goal striving. However, the effects of goal frustration can be prevented by using the right (emotional) coping strategies, or timely goal disengagement and reengagement (Massey, Garnefski, & Gebhardt, 2009; Wrosch, Scheier, Miller, Schulz, & Carver, 2003). Thus, goal striving, goal achievement, and processing goal failure all contribute to mental wellbeing.

In other words, self-regulation interventions that focus on optimising self-regulation skills could have positive effects on the mental health of adolescents, by improving their emotion regulation and helping them to reach personally valued goals. Indeed, some evidence suggests that self-regulation interventions can indeed improve psychological wellbeing (MacLeod, Coates, & Hetherton, 2008; Wrosch et al., 2003).

Previous meta-analyses have evaluated the effectiveness of mental health prevention programmes for adolescents (e.g., Durlak & Wells, 1997; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Haney & Durlak, 1998). Nevertheless, to our knowledge, no systematic meta-analytic review has been conducted to examine what self-regulation strategies could be used to promote psychological wellbeing and could prevent mental health problems among adolescents. Hence, the present study aimed to examine to what extent self-regulation interventions have favourable effects on indicators of psychological wellbeing among adolescents.

Within the present study we aimed to differentiate between primary and secondary prevention mental health interventions. Primary prevention aims to promote mental health and to prevent emotional and behavioural problems within the general population. Secondary (indicated) prevention targets individuals with subclinical problems and aims to prevent serious dysfunctions (Haney & Durlak, 1998). There are multiple reasons to differentiate between these types of interventions: (1) given differences between populations differences in outcomes of psychological wellbeing are likely, (2) different intervention techniques may be used and useful for intervening, and (3) previous meta-analyses that have differentiated between primary and secondary prevention interventions have shown that secondary prevention tends to be more effective than those designed for the general population, particularly when the former are long-term interventions that are based on theory (Browne, Gafni, Roberts, Byrne, & Majumdar, 2004; Haney & Durlak, 1998; Jane-Llopis, Hosman, Jenkins, & Anderson, 2003; Merry, McDowell, Hetrick, Bir, & Muller, 2004).

Second, our aim was to identify which intervention techniques contribute to favourable outcomes of an intervention. Even when self-regulation interventions contribute to favourable effects on indicators of psychological wellbeing heterogeneity between studies is to be expected. In response, within the field of health psychology, taxonomies of behaviour change techniques (e.g., Michie, Ashford, Dombrowski, Bishop, & French, 2011; Kok et al., 2016) have been developed to be able to code intervention components within a particular intervention, and to gain an understanding of why particular interventions are more effective than others (e.g., van Genugten, Dusseldorp, Webb, & van Empelen, 2016; Michie, Abraham, Whittington, McAteer, & Gupta, 2009). In the present study, we took a similar approach to identify core self-regulation change techniques, which favourably affect indicators of psychological wellbeing. This is of particular interest, as such an examination could contribute to gaining a better understanding of whether some change techniques are particularly useful for some outcomes (e.g., internalising problems (anxiety or depression), externalising problems (e.g., aggression or anger), and feelings of self-worth), given that different self-regulation functions may play a role (e.g., emotion regulation, impulse control, and goal pursuit). This would help to further optimise mental health interventions targeting adolescents.

In sum, this review aims to answer the following questions:

(1) What is the effectiveness of primary and secondary prevention self-regulation interventions on mental wellbeing among healthy adolescents and is there variation in the short- and long-term effects?
(2) Which self-regulation techniques (SRTs) are effective in these interventions and for which particular outcomes (internalising behaviours, externalising behaviours and self-esteem)?

Methods

The meta-analyses was conducted based on the Cochrane guidelines for reviews (Higgins & Green, 2011), with some adaptations in the search strategy.

Search strategy

A structured search of four electronic databases (PubMed, PsycINFO, Web of Science, and Embase) was conducted including intervention studies published between 1990 and November 2012 (as an exploratory search showed that many of the articles written before that time provide very little information on intervention strategies and characteristics). Each search included the following terms, and variations of the terms (using 'OR' functions): 'wellbeing', 'intervention', 'prevention', 'evaluation', 'adolescen*', and 'self-regulation'. The search was limited to papers written in English, German, or Dutch. The search was optimised for all consulted databases by adapting the query to the query language of the interfaces used. The queries can be found in supplement A. After excluding duplicates, the search resulted in 7881 unique manuscripts.

Eligibility and inclusion

A study was eligible for inclusion if it (1) described a self-regulation intervention that (2) aimed at improving mental or psychological wellbeing or behaviour and that reported changes in wellbeing (3) and is evaluated in a (quasi) randomised study among (4) adolescents. These criteria are described below in more detail.

(1) An intervention was defined as a self-regulation intervention if it used techniques that were related to behavioural or emotion self-regulation, including goal setting, planning,

self-monitoring, feedback, coping, and relapse prevention (Knittle, Maes, & de Gucht, 2010). Such aims should be mentioned in the abstract of the article or in the article itself.

(2) An intervention was considered to be aimed at improving well-being if at least one of the following proxies of psychological wellbeing or behaviour related to well-being was an outcome measure: well-being, quality of life, internalising and externalising behaviour (e.g., depression or depressive feelings/thoughts/symptoms anxiety and aggressive behaviour), self-esteem, (general) self-efficacy, self-perception and self-concept, locus of control, optimistic thinking and hopelessness, positive and negative affect, psychological distress, or resilience. Substance-related behaviours and body image outcomes were excluded from the meta-analysis.

(3) The effectiveness of the intervention had to be evaluated in a randomised controlled trial or a quasi-experimental design, in which pre- and post-intervention measurements must have taken place and the self-regulation intervention group was compared to a control group. Studies were excluded if they did not report both baseline and post-intervention data.

(4) The intervention needed to be developed and evaluated for adolescents. The inclusion criterion was that the mean age of the participants had to be between 12 and 18 years. The participants could be without symptoms (universal prevention), with an increased risk or with indications of decreased well-being (targeted or indicated prevention). Studies could not include clinically diagnosed participants (e.g., interventions aimed at adolescents with clinically diagnosed depression). Interventions including such participant samples were excluded from this study.

The inclusion of studies took place in three phases, based on title, abstract, and full publication (all by LVG and EM). If there was doubt about the suitability of a study in one phase, the study was included in the next phase. Disagreements about inclusion in the third phase were discussed with a third reviewer (PVE) until consensus was reached. A summary of the flow of study inclusion and exclusion can be found in Figure 1.

Data extraction

Data from the included studies were extracted and coded by LVG, EM, and PVE based on a standardised extraction form. The outcome variables were divided into three categories: internalising behaviour (e.g., depression, anxiety, and negative affect), self-esteem (e.g., positive affect, self-esteem, and resilience), and externalising behaviour (e.g., anger and aggression). In addition, the post-tests and follow-up measurements were divided into two periods: short-term (i.e., from final session up to six months) and long-term (i.e., longer than six months). Descriptions of the primary and secondary prevention studies, with outcomes and measurement periods are shown in Table 1; the intervention strategies were extracted from the manuscript and summarised in Table 2 (the coding form can be found in supplement B, the summarised results in supplement B and C).

Coding of the intervention characteristics and intervention strategies

There are two types of self-regulation: behavioural regulation and affect regulation (Austin & Vancouver, 1996). We aimed to include both types of self-regulation. Therefore, we developed a taxonomy of SRTs based on specific intervention strategies from the refined taxonomy of behaviour change techniques by Michie et al. (2011): this taxonomy specifically focusses on behaviour-related techniques, but pays less attention to emotion-focussed strategies. First, we identified possible SRTs from this taxonomy (as the taxonomy includes change techniques from many social cognitive models). These techniques were discussed among all authors, resulting in a list of 20 techniques. When coding the included articles according to this syntax, we came across other techniques that could also qualify as techniques promoting self-regulation processes but that were not included in the taxonomy by Michie et al. (2011) (or used other terminology). For example, cognitive restructuring was used in 15 studies and defined as a separate method. These additional techniques were also included.

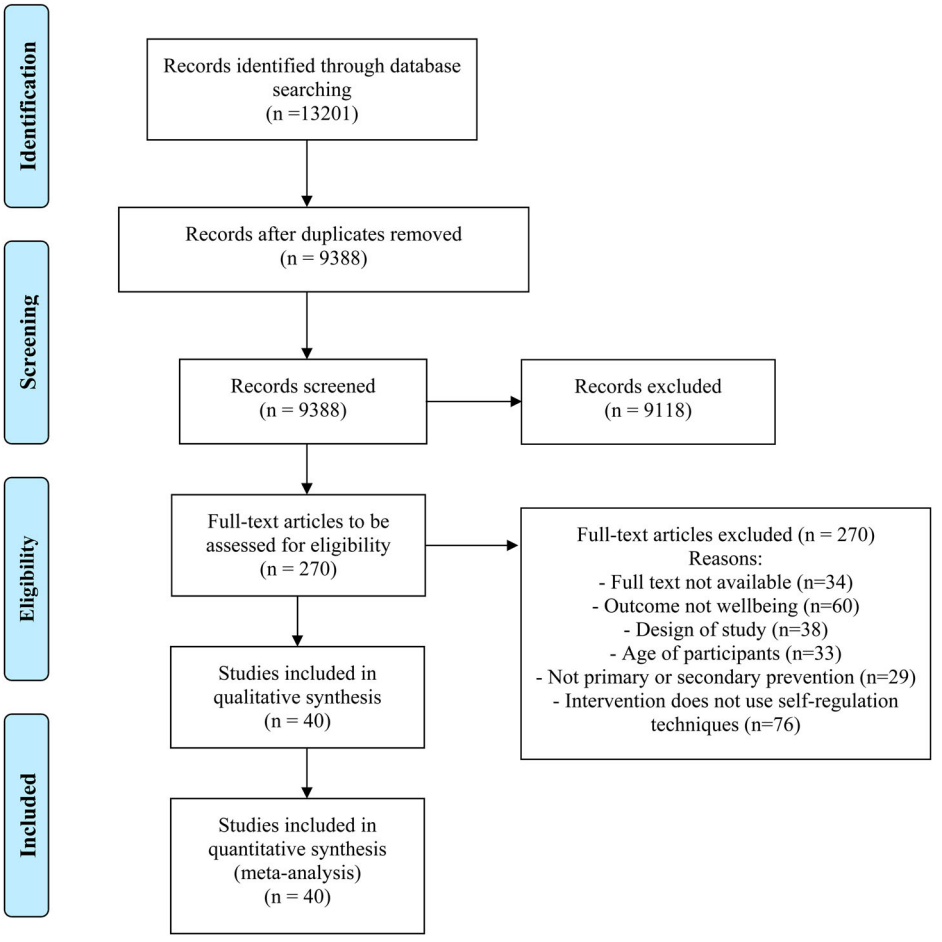

Figure 1. Prisma flow chart for inclusion and exclusion of studies.

SRTs were only coded as being present when they were not used in the control group (Peters, de Bruin, & Crutzen, 2015). Initial agreement between the reviewers on SRTs was 83.3%, calculated by dividing the sum of the agreement per technique by the number of techniques). SRTs and definitions were discussed among all authors until agreement was reached for all SRTs. Table 2 shows an overview of the SRTs coded. Given that most techniques were only used in one or two studies, which would decrease the ability to find an effect for those techniques, all of the techniques were grouped into categories. The categories were based on steps and determinants of self-regulation. For example, the category *goal setting* included the following: *Goal setting (behaviour), Goal setting (outcome), Planning for future, and Reflection of goals and aspirations*. Nine categories were created: goal setting, action planning, coping planning, management of stress and/or emotions, monitoring and/or evaluation, rewarding, cognitive behavioural therap (CBT) and/or cognitive restructuring, social skills, and social support. Using this method, each study had a 1/0 (present/not present) score for each group. For convenience, these nine groups will be referred to as SRTs.

Furthermore, the following intervention characteristics were extracted from the studies: theoretical basis, setting, level of prevention, level of delivery, person of delivery, duration of the intervention, and availability of homework assignments, a manual, or training. Duration of the intervention was coded as a continuous variable. Initial agreement between the reviewers on SRTs was 100%, calculated by dividing the sum of the agreement per characteristic aspects by the number of characteristics. Discrepancies were discussed among all authors.

Table 1. Study characteristics and effect size of primary interventions and secondary interventions.

Authors	Country	Description of study	Quality	Outcome internalising	Outcome positive affect	Outcome externalising	Measurement period[a]
Primary prevention interventions							
Sawyer et al. (2010)	Australia	School-based prevention of depression	7	Depression			Long-term
Gelkopf and Berger (2009)	Israel	School-based. programme for reducing terror-related traumatic reactions in Israeli youth	4	Depression			Short-term
Steinhardt and Dolbier (2008)	USA	Resilience intervention to enhance coping strategies	3	Depression, negative affect	Resilience, self-esteem		Short-term
Possel, Baldus, Horn, Groen, and Hautzinger (2005)	Germany	School-based universal primary programme to prevent depressive symptoms in adolescents	6	Depression	General self-efficacy		Short-term
McVey, Davis, Tweed, and Shaw (2004)	Canada	School-based programme designed to improve body image satisfaction, global self-esteem. and eating attitudes and behaviours	4		Self-esteem		Long-term
Wade, Davidson, and O'Dea (2003)	Australia	School-based media literacy programme and self-esteem programme for reducing eating disorder risk factors	2	self-perception/ self-esteem			Short-term
Shochet et al. (2001)	Australia	Universal school-based programme to prevent adolescent depression	4	depression (three measures)	Self-esteem		Long-term
Stewart, Carter, Drinkwater, and Fairburn (2001)	UK	Prevention of eating disorder and enhance self-esteem in adolescent girls	3				Long-term
O'Dea and Abraham (2000)	Australia	Improving the body image, eating attitudes. and behaviours of young male and female adolescents	3	Depression	Global self-worth, self-concept		Long-term
Orpinas, Parcel, Mcalister, and Frankowski (1995)	USA	Prevention of violence and reduce aggression in middle schools	3			Aggression	Short-term
Yahav and Cohen (2008)	Israel	Cognitive-behavioural intervention for adolescents to improve coping skills	3	State anxiety,	Self-esteem		Short-term
Green, Grant, and Rynsaardt (2007)	Australia	Life coaching for senior high school students to enhance cognitive hardiness	4	Depression, anxiety			Short-term
Gillham et al. (2007)	Australia	School-based prevention of depressive symptoms	6	Depression			Long-term
Kobal Grum (2006)	Slovenia	Mental Health Promoting School Programme to improve self-concept	3		Self-concept (self-description), self-esteem		Long-term
LeCroy (2004)	USA	Empowerment Programme for Early Adolescent Girls	2	Depression			Short-term
Cava and Musitu (2002)	Spain	Intervention programme for the reinforcement of self-esteem	0		Self-esteem		Short-term
Bosworth, Espelage, DuBay, Daytner, and Karageorge (2000)	USA	Multimedia violence prevention programme for adolescents	5			Aggression	Short-term
Bijstra and Jackson (1999)	Netherlands	Social skills training for early adolescents to improve social skills, well-being. self-esteem and coping	1	Anxiety	Self-esteem, well-being		Short-term
Hains (1994)	USA	School-based. cognitive-behavioural stress management programme for adolescents	1	anxiety, depression	Self-esteem	Anger	Short-term

Benson et al. (1995)	USA	Relaxation-response curriculum in high school students	4		Self-esteem		Short-term
McCabe, Ricciardelli, and Karantzas (2010)	Australia	Healthy body image programme for adolescent boys on body image, negative affect, and body change strategies	4	Negative affect	Self-esteem		Short-term
Melnyk et al. (2009)	USA	Improve Mental Health, Healthy Lifestyle Choices and Physical Health in Hispanic students	3	Depression, anxiety			Short-term
Wong et al. (2012)	Hong Kong	Universal school-based programme for preventing depression in Chines adolescents	4	Depression	Self-esteem		Short-term
Foret et al. (2012)	USA	Relaxation response-based curriculum in public high school	4	Anxiety	Self-esteem		Short-term
Rivet-Duval, Heriot, and Hunt (2011)	Mauritius	Universal school-based programme to prevent Adolescent depression	4	Depression	Self-esteem		Long-term
Secondary prevention interventions							
Stice, Rohde, Seeley, and Gau (2009)	USA	Brief cognitive-behavioural depression prevention programme for high-risk adolescents	6	Depression			Long-term
Hyun, Nam, and Kim (2010)	Korea	Cognitive-behavioural therapy to enhance resilience for at-risk Korean male adolescents	5	Depression	Self-concept, resilience		Short-term
Apinuntavech, Panichpong, Shuaytong, and Ngoenwiwatkul (2009)	Thailand	Enhance the self-esteem of female adolescents among homeless girls	2		Self-esteem		Short-term
Hyun, Chung, and Lee (2005)	Korea	Cognitive-behavioural group therapy on the self-esteem, depression, and self-efficacy of runaway adolescents in a shelter	4	Depression	Self-esteem, self-efficacy		Short-term
Rohde, Jorgensen, Seeley, and Mace (2004)	USA	Cognitive-behavioural intervention to enhance coping skills in incarcerated youth	2	Internalising	Self-esteem	Externalising behaviour	Short-term
Randell, Eggert, and Pike (2001)	USA	Brief youth suicide prevention intervention	2	Depression	Self-esteem	Anger control	Short-term
Barrett, Sonderegger, and Xenos (2003)	Australia	School-based programme to prevent anxiety and promote resilience among young migrants	3	Internalising symptoms	Self-esteem		Long-term
Eggert, Thompson, Herting, Nicholas, and Dicker (1994)	US	School-based social network development programme to prevent adolescent drug abuse and school drop-out	3		Self-esteem		Long-term
Bauer, Sapp, and Johnson (2000)	USA	Group counselling strategies to improve self-concept and school behaviour	4	Self-esteem			Short-term
Creed, Machin, and Hicks (1999)	Australia	Cognitive-behaviour therapy based intervention to Improve mental health status and coping abilities for unemployed youth	3	Negative affect, questionnaire	Self-esteem, positive affect, general health		Short-term
Harrell, Mercer, and DeRosier (2009)	USA	Social Skills Group Intervention for adolescents	5		Self-concept		Short-term
Arnarson and Craighead (2009)	Iceland	Prevent depression in at-risk adolescents	5	Depression			Long-term
Murray and Malmgren (2005)	USA	Teacher–student relationship programme in a high-poverty urban school to improve social, emotional, and academic adjustment	3	Internalising symptoms		Externalising symptoms	Short-term
Dorsey and Solomon (2012)	USA	Educational-entertainment Intervention for black adolescents exposed to community violence	2	Anxiety			Short-term

Table 2. SRTs: correspondence with taxonomy by Michie et al. (2011) and additional techniques.

Self-regulation processes	CT by Michie et al. (+ corresponding number in that list)	Additional techniques (examples)
Goal setting	5. Goal setting (behaviour) 6. Goal setting (outcome)	– Planning for future – Reflection of goals and aspirations
Action planning	7. Action planning 9. Set graded tasks 23. Teach to use prompts/ cues 24. Environmental restructuring 34. Prompt use of imagery	– Prompt practice
Coping (planning)	8. Barrier identification/ problem solving 35. Relapse prevention/ coping planning. 15. Prompt generalisation behaviour	– Improving coping skills – Review past risk factors
Management of stress and/ or emotions	36. Stress management/emotion control training 38. Time management	– Coping with stress and learning relaxation – Relaxation response training – Emotion regulation – Mood management
Monitoring and/or evaluation	10. Prompt review of behavioral goals 11. Prompt review of outcome goals 16. Prompt self-monitoring of behavior 17. Prompt self-monitoring of behavioral outcome	– Evaluating progress – Self-observation
Rewarding	12. Prompt rewards contingent on effort or progress towards behavior 13. Provide rewards contingent on successful behavior. 14. Shaping contingent rewards 40. Stimulate anticipation of future rewards	– Enhancing positive reinforcement
Social skills	39. General communication skills training	– Social skills training – Social problem solving strategies – Anger management
Social support	29. Plan social support/social change	– Help-seeking behaviour – Strategies for eliciting community support – Finding help
CBT and/or cognitive restructuring		– Cognitive restructuring – Re-interpretation of situation – Methods based on CBT (often undefined) – Exploring and changing dysfunctional cognitions – Understand relation between cognitions, emotions and behaviour

Assessment of study quality

As studies with a weaker design tend to find stronger intervention effects, the relationship between study quality and study effect was also examined (Moher et al., 1998). A nine-item coding scheme, based on the Cochrane Collaboration Depression, Anxiety and Neurosis Review Group (Cochrane Depression, Anxiety and Neurosis Group, 2012), was used to assess the quality of the included studies. This scheme was adapted because the original one included items that were not applicable for this study (e.g., availability of post-intervention data: in this review, studies that did not have post-intervention data available were not included in this review). The adapted scheme had the following parameters: method of allocation, length of follow-up measurement, conducting a process evaluation, response rate, drop-out, comparability of study groups, inclusion of withdrawals in analyses, and conducting multilevel analyses in cluster randomised studies. Initial agreement between the reviewers on SRTs was 95%, calculated by dividing the sum of the agreement per quality aspects by the number of aspects. Discrepancies were discussed among all authors. These criteria were scored as 0 or 1 according to the scheme (see supplement C for a more detailed understanding of the scoring). Next, the scores for these parameters were summed, resulting in an overall quality score ranging from 0 to 8, with a higher score indicating better quality. Such an overall score prevents

multiple testing (i.e., testing each quality indicator separately). Year of publication and continent of origin were also coded.

Calculation of effect sizes

The effect sizes were computed in comprehensive meta analyses (Borenstein, 2005), using the means and standard deviations of the intervention and control groups at the pre-test and post-test (or follow-up). If pre-post-test correlations were not reported ($n = 37$), a correlation of .50 was assumed between baseline and follow-up measurement. All effect sizes were expressed as Hedges' $\bar{g}$, the unbiased estimate of Cohen's d, the standardised mean difference between the intervention and control group.

If there was more than one control condition, the most passive one was used, for ease of interpretation (Portnoy, Scott-Sheldon, Johnson, & Carey, 2008; Webb, Joseph, Yardley, & Michie, 2010).

Meta-analysis

A random effects model was used to compute the overall effect size (i.e., the weighted average effect size across studies), because it was assumed beforehand that the variability between effect sizes would be due to sampling error and variability in the population of effects. In other words, it was assumed that there are unique differences in the set of true population effect sizes that are, for example, associated with procedures, measures, or settings (Lipsey & Wilson, 2001).

If more than one indicator per outcome category was reported (e.g., both the beck depression inventory and center for epidemiologic studies depression scale to assess internalising behaviour), the mean was used as the outcome. If multiple post-tests or follow-up measurements were available in the above-defined short-term and long-term measurement period, the mean was used of the post-measurements within the corresponding period.

To estimate the robustness of the overall effect sizes, the trim and fill method was used (Duval & Tweedie, 2000). Funnel plots with the imputed values were inspected (see Figure 2), as well as the difference between the overall effect size and the adjusted one. Some differences between the

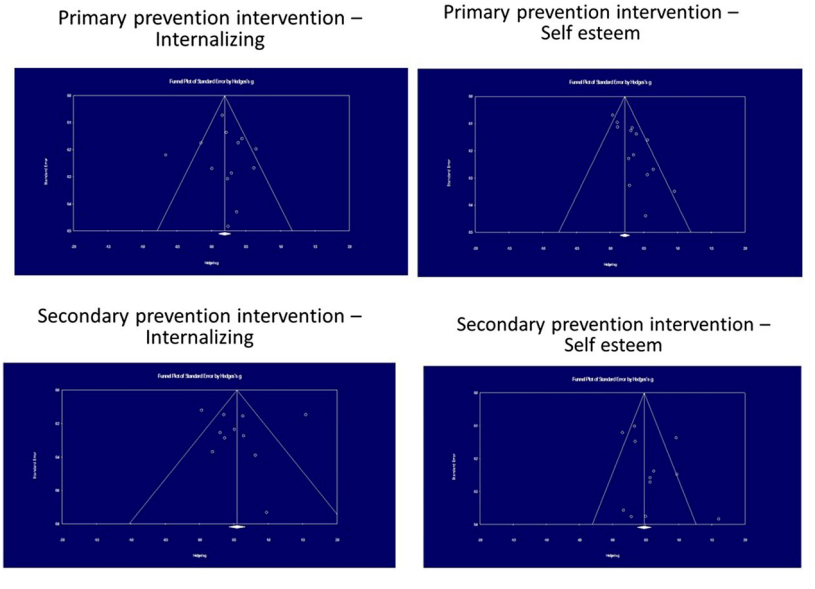

Figure 2. Funnel plots of standard error by standard means.

observed and adjusted estimates were found for primary interventions but not for secondary interventions. This indicates that the latter effect-size estimates were robust but that there may be some publication bias for primary interventions.

Subgroup meta-analyses (also called moderator analyses) were conducted to study whether the mean effect size of interventions that included a SRT differed significantly from the mean effect size of interventions without an SRT. If so, the specific SRT can be considered a moderator of intervention effectiveness. A mixed effects model was used in the meta-regression analysis, that is, a random effects model within subgroups and a fixed effect model across subgroups, which is a recommended approach (Borenstein, Hedges, Higgins, & Rothstein, 2009). The *p*-value of the between groups *Q*-statistic (contrast *Q*) indicated whether the grouping effect was significant (Borenstein et al., 2009). A two-sided significance level of .05 was used to calculate confidence intervals (CIs) for each effect size. The meta-analyses and subgroup analyses were performed in CMA, version 2.2 (Borenstein, 2005).

Results

Primary interventions: description and overall effectiveness

Twenty-five interventions were aimed at primary prevention, that is, they targeted a universal population. All interventions were delivered in school, and 11 interventions were delivered by a teacher, the others mostly by a health professional. The mean length of the intervention was 11 weeks; 11 interventions lasted less than 10 weeks. Twelve interventions had less than 12 hours of content, while 15 interventions had more than 8 intervention sessions. Five studies included home assignments for the participants, and 16 interventions had a manual or training for the health promoter.

In primary preventive interventions, the studies describing the short-term effects on internalising behaviour ($\bar{g} = 0.20$; 95% CI 0.03–0.38, *Q*-model 31.50), and the short-term ($\bar{g} = 0.29$; 95% CI 0.18–0.41, *Q*-model 25.58) and long-term effects ($\bar{g} = 0.16$; 95% CI 0.05–0.26, *Q*-model 20.26) on self-esteem showed positive effects (see Table 3). Primary preventions generally showed lower effect sizes at longer term.

Primary interventions: SRTs and effectiveness

On average, the intervention used 3.72 behaviour change technique (BCT). Two interventions used only SRT, and three interventions used six SRTs. Only three interventions used *rewarding*. The most popular SRTs were *coping planning* (used 21 times) and *management of stress and emotions* (20 times). The largest effect sizes were found for *asking for social support* ($\bar{g} = 0.42$*, 95% CI 0.10–0.73) and *management of stress and emotions* ($\bar{g} = 0.26$*, 95% CI 0.04–0.47).

Next, we examined which SRTs could explain differences in effects across primary prevention studies. There was no SRT for which studies including this SRT were statistically significant more effective on improving internalising behaviour or self-esteem than studies excluding this SRT (and vice versa) (Table 4).

Table 3. Overview of overall effect sizes per outcome category, separately for the primary and for the secondary prevention interventions.

		Primary prevention interventions				Secondary prevention interventions			
Outcome category	Measurement period[a]	#	ES	95% CI	*Q*	#	ES	95% CI	*Q*
Internalising	Short-term	13	0.20*	0.03–0.38	31.50*	11	0.56*	0.22–0.90	69.50*
	Long-term	6	0.09	−0.01–0.20	54.45*	–	–	–	–
Self-esteem	Short-term	14	0.29*	0.18–0.41	25.58*	12	0.56*	0.34–0.77	37.03*
	Long-term	5	0.16*	0.05–0.26	20.26*	–	–	–	–
Externalising	Short-term	4	0.01	−0.38–0.39	13.22*	4	0.56	−0.09–1.20	26.64*
	Long-term	–	–	–	–	–	–	–	–

Notes: ES: overall effect size Hedges' *g* of random effects model; CI: confidence interval; *Q*: *Q*-statistic of heterogeneity.
[a]Measurement period in two categories: Short-term: from final session up to 6 months; Long-term: longer than six months.
*$p < .05$.

Table 4. Moderator analyses of SRTs on the outcomes Internalising behaviour and Self-esteem for *primary prevention* interventions.

	YES: uses the technique			NO: does not use the technique			*Q*-	*p*-
Self-regulation technique	# Studies	ES	95% CI	# Studies	ES	95% CI	between	Value[a]
Internalising behaviour								
Asking for social support	3	0.42*	0.10–0.73	10	0.11	−0.09–0.32	2.53	**.112**
Monitoring and evaluation	6	0.07	−0.18–0.33	7	0.33*	0.08–0.57	1.93	**.165**
Management of stress and emotions	11	0.26*	0.04–0.47	2	0.03	−0.38–0.43	0.96	.328
CBT and cognitive restructuring	8	0.14	−0.11–0.39	5	0.29*	0.00–0.58	0.62	.431
Goal setting	4	0.27	−0.08–0.63	9	0.18	−0.06–0.41	0.19	.663
Action planning	4	0.22	−0.11–0.55	9	0.20	−0.04–0.44	0.01	.912
Rewarding	2	0.22	−0.24–0.69	11	0.20	0.00–0.41	0.01	.939
Coping (planning and skills)	12	0.20*	0.02–0.39	1	0.24	−0.82–1.30	0.01	.943
Social skills	1	0.22	−0.37–0.80	12	0.20*	0.00–0.40	0.00	.971
Self-esteem								
Social skills	6	0.22*	0.07–0.37	8	0.37*	0.21–0.54	1.86	.173
Asking for social support	4	0.22*	0.05–0.39	10	0.34*	0.19–0.50	1.12	**.291**
CBT and cognitive restructuring	8	0.36*	0.19–0.53	6	0.23*	0.04–0.42	1.05	.305
Action planning	3	0.23	−0.03–0.50	11	0.32*	0.18–0.46	0.33	.563
Rewarding	2	0.23	−0.05–0.51	12	0.32*	0.18–0.46	0.33	.567
Monitoring and evaluation	4	0.25*	0.02–0.48	10	0.32*	0.17–0.47	0.28	**.600**
Goal setting	1	0.33	−0.05-0.71	13	0.29*	0.17–0.42	0.03	.871
Coping (planning and skills)	12	0.30*	0.17–0.43	2	0.28	−0.15–0.71	0.01	.933
Management of stress and emotions	12	0.30*	0.17–0.43	2	0.30	−0.02–0.61	0.00	.994

Note: For each study, the short-term measurement period (up to six months) was used. Within each outcome, the SRTs were ordered from most important to least important, based on the *Q*-between value. ES: subgroup effect size Hedges' *g* of random effects model; CI: confidence interval; *Q*-between: statistic of moderator effect using a mixed effects model.

[a]*p*-Value of moderator effect; significant moderators are displayed in boldface.

*$p < .05$.

Secondary interventions: description and overall effectiveness

About half of the interventions were delivered in school ($n = 8$), other locations were community centres and training programmes. Ten interventions were delivered by a health professional, only two by a teacher. Four interventions lasted longer than 10 weeks, the average duration was 9.9 weeks. Seven interventions had less than 12 hours of content, 3 lasted 20 hours or longer (mean duration was 16.7 hours). Eight interventions had more than eight intervention sessions. The average number of sessions was 16.2. One intervention consisted of 90 sessions. Five studies included home assignments for the participants, and nine interventions had a manual or training for the health promoter.

Secondary interventions had statistically significant effects on internalising behaviour ($\bar{g} = 0.56$; 95% CI 0.22–0.90, *Q*-model 69.50) and self-esteem ($\bar{g} = 0.56$; 95% CI 0.34–0.377, *Q*-model 37.03).

Secondary interventions: SRTs and effectiveness

On average, secondary interventions used 3.8 SRTs. Only one intervention used *(asking for) social support*. The most popular SRTs were *coping planning and skills* (11 studies) and *management of stress and emotions* (9 studies).

The intervention that include *asking for social support* ($\bar{g} = 1.55$, 95% CI = 1.11–1.98) was more effective on internalising behaviour than those not including this SRT ($\bar{g} = 0.39$, 95% CI = 0.21–0.57, *Q*-between = 23.07, $p < .001$) (see Table 5).

Interventions that included *monitoring and evaluation* ($\bar{g} = 0.87$, 95% CI = 0.63–1.12) had a stronger effect on self-esteem than interventions that did not ($\bar{g} = 0.35$, 95% CI = 0.18–0.52; *Q* model = 12.31, $p < .001$).

Table 5. Moderator analyses of SRTs on the outcomes internalising behaviour and self-esteem for *secondary prevention* interventions.

	YES: uses the technique			NO: does not use the technique				
Self-regulation technique	# Studies	ES	95% CI	# Studies	ES	95% CI	*Q*-between	*p*-Value[a]
Internalising behaviour								
Asking for social support	**1**	**1.55***	**1.11–1.98**	**10**	**0.39***	**0.21–0.57**	**23.07**	**<.0001**
Monitoring and evaluation	4	0.84*	0.43–1.25	7	0.36*	0.02–0.70	3.12	.077
Social skills	4	0.31	−0.12–0.74	7	0.74*	0.37–1.10	2.25	.134
Action planning	6	0.42*	0.00–0.83	5	0.75*	0.27–1.23	1.06	.303
CBT and cognitive restructuring	5	0.71*	0.28–1.14	6	0.41	-0.03–0.84	0.94	.332
Coping (planning and skills)	8	0.46*	0.07–0.84	3	0.78*	0.21–1.35	0.86	.354
Goal setting	6	0.47	−0.03–0.96	5	0.67*	0.13–1.21	0.29	.589
Rewarding	1	0.63	−0.51–1.76	10	0.55*	0.16–0.94	0.02	.900
Management of stress and emotions	8	0.55*	0.15–0.95	3	0.59	−0.16–1.34	0.01	.932
Self-esteem								
Monitoring and evaluation	**5**	**0.87***	**0.63–1.12**	**7**	**0.35***	**0.18–0.52**	**12.31**	**<.0001**
Asking for social support	1	0.96*	0.45–1.48	11	0.49*	0.29–0.68	2.86	.091
Rewarding	3	0.91*	0.43–1.38	9	0.48*	0.25–0.70	2.54	.111
Management of stress and emotions	8	0.47*	0.23–0.71	4	0.81*	0.40–1.22	2.00	.158
Social skills	4	0.37*	0.04–0.71	8	0.67*	0.41–0.94	1.94	.164
Action planning	4	0.39*	0.02–0.76	8	0.65*	0.38–0.91	1.20	.274
Goal setting	7	0.68*	0.36–0.99	5	0.46*	0.17–0.75	1.00	.317
CBT and cognitive restructuring	6	0.67*	0.37–0.97	6	0.46*	0.18–0.74	0.99	.321
Coping (planning and skills)	10	0.53*	0.29–0.78	2	0.66*	0.20–1.11	0.23	.634

Notes: For each study, the short-term measurement period (up to six months) was used. Within each outcome, the SRTs were ordered from most important to least important, based on the *Q*-between value.
ES: subgroup effect size Hedges' *g* of random effects model; CI: confidence interval; *Q*-between: statistic of moderator effect using a mixed effects model.
[a]*p*-Value of moderator effect; significant moderators are displayed in boldface.
*$p < .05$.

Discussion

The present meta-analytic study provides insight into the effectiveness of interventions to promote mental wellbeing in adolescence, and the effect of SRTs in those interventions. Primary interventions had a small-to-medium ($\bar{g} = 0.16–0.29$) on self-esteem and internalising behaviour. Secondary interventions had a medium-to-large short-term effect ($\bar{g} = 0.56$) on internalising behaviour and self-esteem. For primary interventions the effect sizes were lower at longer term follow-up, whereas secondary interventions showed that positive outcomes were maintained at longer term follow-up. No significant effects on externalising behaviour were found for either group of interventions. Interventions on average used four out of the nine SRT categories. For primary interventions, there was not a single SRT that was associated with a greater intervention effect on internalising behaviour or self-esteem. In secondary interventions, those including *asking for social support* had a great effect on internalising behaviour. Those including *monitoring and evaluation* had a greater effect on self-esteem.

Overall effect sizes

Secondary interventions were more likely to improve mental wellbeing, which confirms findings of previous research (Browne et al., 2004; Haney & Durlak, 1998; Merry et al., 2004). This effect is higher than the effects found by Durlak et al. (2011), in a meta-analysis of 213 school-based universal interventions, and also higher than the effect size (ES) found in this meta-analyses for primary interventions. *Secondary interventions* are likely to be more effective, because their participants have lower baseline values on positive outcomes (and higher baseline values on negative outcomes). In other words, there is greater possibility for improvement than the general adolescent population. Other

reasons for the differences in effect sizes may, however, have to do with particular content of interventions. For secondary interventions we were able to show that effect size differences exist due to the use of particular SRTs, but not for primary interventions.

Only two SRTs that significantly improve the effectiveness of secondary interventions could be identified: *asking for social support* and *monitoring and evaluation*.

Asking for social support is an aspect of healthy social interaction; social interaction has a positive relationship with various aspects of mental wellbeing. For example, feelings of relatedness are associated with self-worth and self-esteem (Oberle, Schonert-Reichl, & Thomson, 2010), and interventions aimed at improving communication skills improve well-being more than other types of interventions (Durlak & Wells, 1997). This finding also corresponds to meta-analytic findings on the positive relationship of social support on depression (Rueger, Malecki, Pyun, Aycock, & Coyle, 2016): The type of social support and support sources, however, needs further investigation. Possibly, social support helps to overcome negative thinking. However, when interpreting this finding, we must be aware that only one intervention included this SRT.

The positive effect of monitoring and evaluation is in line with other studies and meta-analyses, among others for its beneficial effects well-being (Cook et al., 2011), self-awareness (Kauer et al., 2012), and changing health-related behaviour (Bravata et al., 2007; de Bruin et al., 2012; Dombrowski et al., 2012; Greaves et al., 2011; Michie et al., 2009; Webb et al., 2010), behaviour in secondary interventions. Combining self-monitoring with other SRTs was found to be even more effective for behaviour change, by Michie et al. (2009). We could not confirm this univariate effect of self-monitoring on mental wellbeing in primary interventions.

Possibly, monitoring and evaluation may not be useful when adolescents are at risk for anxiety and depression as these may promote negative thoughts, because it has been shown that self-focus is associated with depression and anxiety because of maladaptive coping strategies (Mor & Winquist, 2002). Nevertheless, self-monitoring and evaluation, however, may be a very useful means to increase feelings of self-control, when adolescence use adaptive coping strategies. It should be pointed out, that increasing self-esteem may have an effect on internalising behaviours, in particular depression (e.g., Sowislo & Orth, 2013).

As discussed, the meta-analyses did not identify SRTs that significantly increased the effectiveness of primary interventions on internalising behaviour or self-esteem. Perhaps the identified SRTs in this study are not the key intervention characteristics that determine the effectiveness of primary interventions. Based on theory, it was expected that more SRTs would be effective in promoting well-being in adolescence. For example, *goal setting* has previously been identified as a positive contributor to well-being (Carver & Scheier, 1982; Sheldon, Ryan, Deci, & Kasser, 2004). Personal goals are important because they contribute to the process of defining one's sense of self and thus have an important effect on the way in which people direct their development. Other interventions may also influence well-being. For example, Rebar et al. (2015) showed that physical activity intervention has a medium effect on depression and a small effect on anxiety in non-clinical adult populations.

Another problem may be concerning our grouping of SRTs. Although we had reasons to group similar SRTs, the categorisation of SRTs may have been too broad, which may have masked the true effects of the individual SRTs. Furthermore, operationalisation or implementation of the SRTs may not have been optimal. In other words, recommendations for implementation may not have been followed. For example, *coping planning* requires identification of high-risk situations and practice of the coping response (Bartholomew et al., 2010). When these parameters are not met, it is unlikely that *coping planning* is effective. Ideally, studies would mention not only whether they use an SRT or BCT, but also the quality of implementation (de Bruin, Viechtbauer, Hospers, Schaalma, & Kok, 2009; Peters et al., 2015). Unfortunately, the studies in this review did not describe the implementation in any detail. Therefore, we cannot check whether the recommendations were met. Further, at the intervention level, successful implementation is an important predictor of intervention success (Durlak & DuPre, 2008; Weare & Nind, 2011). In the studies in the current meta-analyses, little was reported about implementation and implementation problems.

Strengths and limitations

This is one of the first studies that investigated the effect of self-regulation change technique categories on mental wellbeing outcomes. However, only 40 studies met the criteria to be included in this review; most studies were rejected because of the intervention did not have self-regulation ingredients, did not assess indicators of well-being as an outcome or had a weaker study design. In order to increase statistical power and thus gain a better understanding of the effectiveness of SRTs, it would be valuable to repeat the analyses with a larger set of studies. This highlights the need for methodologically stronger studies with longer term measurements aimed at promoting well-being among adolescence. In this meta-analysis, studies indexed in four online databases were included. As such, this computer search may have resulted in a limited sample of the relevant literature. A larger set of studies can be achieved by broadening the search strategy, for example, also include grey literature, approaching authors from this field for unpublished results. However, it remains important to check the quality of such studies and its relation with effectiveness. Furthermore, 19 studies used a clustered design. This clustered design was not taken into account in our meta-analyses.

As most interventions included multiple SRTs ($n = 34$), and because we categorised individual techniques into self-regulation change techniques, no conclusions about the effects of individual techniques can be made. In addition, there was a large variety in the reporting of change techniques used. For example, several techniques were used relating to coping: coping planning, coping training, coping skills, and relapse prevention. Many studies failed to define such techniques any further and they could not be further defined in the taxonomy. Therefore, there is a risk that SRTs were incorrectly categorised. This also demonstrates the need for clear explanations of the SRTs used in intervention studies. Furthermore, existing taxonomies often define SRTs for behaviour change only and were therefore not suitable for this review on mental wellbeing, where emotional regulation is also very important. We conclude that affect regulation was under-represented in existing taxonomies.

Recommendations for research and practice

This study shows that interventions employing self-regulation change techniques have a small-to-positive effect on well-being among adolescents. However, we were only able to identify a few effective SRTs. More methodologically stronger studies and reviews should be conducted to study the effectiveness of self-regulation interventions, also those with other outcomes (e.g., weight management) and those for other target groups (e.g., elderly people). In this meta-analysis, many articles were excluded because of their design (e.g., no baseline measurement). Although we examined the contribution of SRTs, it should be noted that most interventions used several SRTs. As such, the effects of a study cannot be fully related to the SRT. New studies should ensure that the effects of specific techniques are evaluated by describing these techniques explicitly. Also, intervention studies should report more information on parameters of use, quality of delivery, control group content (de Bruin et al., 2009; Peters et al., 2015), and moment of measurement. Moreover, the mechanisms of change techniques need to be explored in order to understand why techniques are or are not important for certain outcomes or target groups. For example, Ashford and colleagues have studied which techniques can be used to promote self-efficacy for physical activity (Ashford, Edmunds, & French, 2010).

To conclude, self-regulation interventions were found to be small to moderately effective at promoting well-being. Targeting adolescents at high risk for psychological wellbeing could benefit from the SRTs 'asking for social support' and 'monitoring and evaluation', possibly in that order. It is essential that future studies are well designed, methodologically strong and pay attention to reporting in order to facilitate meta-analyses and thereby develop the field.

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