Effects of mental health interventions for students in higher education are sustainable over time: a systematic review and meta-analysis of randomized controlled trials

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Background. Symptoms of depression, anxiety, and distress are more common in undergraduates compared to age-matched peers. Mental ill health among students is associated with impaired academic achievement, worse occupational preparedness, and lower future occupational performance. Research on mental health promoting and mental ill health preventing interventions has shown promising short-term effects, though the sustainability of intervention benefits deserve closer attention. We aimed to identify, appraise and summarize existing data from RCTs reporting on whether the effects of mental health promoting and mental ill health preventing interventions sustained at least 3 months post-intervention, and to analyse how the effects vary for different outcomes in relation to follow-up length. Further, we aimed to assess whether the effect sustainability varied by intervention type, study-level determinants and of participant characteristics.

Material and methods. A systematic search in MEDLINE, PsycInfo, ERIC and Scopus was performed for RCTs published in 1995-2015 and reporting an assessment of mental ill health and positive mental health outcomes for, at least, 3 months of post-intervention follow-up. Random-effect modeling was utilized for quantitative synthesis of the existing evidence with standardized mean difference (Hedges' *g*) used to estimate an aggregated effect size. Sustainability of the effects of interventions was analysed separately for 3-6 months, 7-12 months and 13-18 months of post-intervention follow-up. **Results.** 26 studies were eligible after reviewing 6571 citations. The pooled effects were mainly small, but significant for several categories of outcomes. Thus, for the combined mental ill health outcomes, symptom reduction sustained up to 7-12 months post-intervention [standardized mean difference (Hedges' *g*) effect size (ES)=-0.28 (95%CI; -0.49, -0.08)]. Further, sustainability of symptom-reductions were evident for depression with

intervention effect lasting up to 13-18 months [ES=-0.30 (95%CI; -0.51, -0.08)], for anxiety up to 7-12 months [ES=-0.27 (95%CI; -0.54, -0.01)], and for stress up to 3-6 months [ES= -0.30 (95%CI;-0.58, -0.03)]. The effects of interventions to enhance positive mental health sustained up to 3-6 months for the combined positive mental health outcomes [ES=0.32 (95%CI; 0.05, 0.59)]. For enhanced active coping, sustainability up to 3-6 months was observed with a medium and significant effect [ES=0.75 (95%CI; 0.19, 1.30)].

Discussion. The evidence suggests long-term effect sustainability for mental ill health preventive interventions, specially, for interventions to reduce the symptoms of depression and symptoms of anxiety. Interventions to promote positive mental health offer promising, but shorter-lasting effects. Future research should focus on mental health organizational interventions to examine their potential for students in tertiary education.

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Abstract

Background

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23 age-matched peers. Mental ill health among students is associated with impaired academic

24 achievement, worse occupational preparedness, and lower future occupational performance.

25 Research on mental health promoting and mental ill health preventing interventions has shown

26 promising short-term effects, though the sustainability of intervention benefits deserve closer

27 attention. We aimed to identify, appraise and summarize existing data from RCTs reporting on

28 whether the effects of mental health promoting and mental ill health preventing interventions

29 sustained at least 3 months post-intervention, and to analyse how the effects vary for different

30 outcomes in relation to follow-up length. Further, we aimed to assess whether the effect

31 sustainability varied by intervention type, study-level determinants and of participant

32 characteristics.

Material and methods

35 A systematic search in MEDLINE, PsycInfo, ERIC and Scopus was performed for RCTs

36 published in 1995-2015 and reporting an assessment of mental ill health and positive mental

37 health outcomes for, at least, 3 months of post-intervention follow-up. Random-effect modeling

38 was utilized for quantitative synthesis of the existing evidence with standardized mean difference

39 (Hedges' *g*) used to estimate an aggregated effect size. Sustainability of the effects of

40 interventions was analysed separately for 3-6 months, 7-12 months and 13-18 months of post-

41 intervention follow-up.

Results

44 26 studies were eligible after reviewing 6571 citations. The pooled effects were mainly small,

45 but significant for several categories of outcomes. Thus, for the combined mental ill health

46 outcomes, symptom reduction sustained up to 7-12 months post-intervention [standardized mean

47 difference (Hedges' *g*) effect size (ES)=-0.28 (95%CI; -0.49, -0.08)]. Further, sustainability of

48 symptom-reductions were evident for depression with intervention effect lasting up to 13-18

49 months [ES=-0.30 (95%CI; -0.51, -0.08)], for anxiety up to 7-12 months [ES=-0.27 (95%CI; -

50 0.54, -0.01)], and for stress up to 3-6 months [ES= -0.30 (95%CI;-0.58, -0.03)]. The effects of

51 interventions to enhance positive mental health sustained up to 3-6 months for the combined

52 positive mental health outcomes [ES=0.32 (95%CI; 0.05, 0.59)]. For enhanced active coping,

53 sustainability up to 3-6 months was observed with a medium and significant effect [ES=0.75

54 (95%CI; 0.19, 1.30)].

55

Discussion

57 The evidence suggests long-term effect sustainability for mental ill health preventive

58 interventions, specially, for interventions to reduce the symptoms of depression and symptoms of

59 anxiety. Interventions to promote positive mental health offer promising, but shorter-lasting

60 effects. Future research should focus on mental health organizational interventions to examine

61 their potential for students in tertiary education.

62

63

64 **INTRODUCTION**

65 Mental health problems among students in higher education is an emerging public health issue

66 and evidence-based prevention is essential (Christensson et al. 2010; Dahlin et al. 2011; Garlow

67 et al. 2008; Hunt & Eisenberg 2010; Steptoe et al. 2007). Recent systematic reviews on student

68 health raise concerns over high rates of mental ill health outcomes with pooled prevalence

69 ranging between 27% and 34% for depression and depressive symptoms and reaching 11% for

70 suicidal ideation (Ibrahim et al. 2013; Rotenstein et al. 2016; Tung et al. 2018). Also, a two-fold

71 risk for suicide is shown during ongoing university studies compared to when having attained

72 university studies (Lageborn et al. 2017). Elevated rates of mental ill health, namely symptoms

73 of distress, anxiety and depression, in undergraduates appear to substantially exceed the

74 corresponding estimates in age-matched peers (Cvetkovski et al. 2012; Dyrbye et al. 2006;

75 Leahy et al. 2010; Winzer et al. 2014) and the general population (Ibrahim et al. 2013;

76 Rotenstein et al. 2016). Female students, minority groups and students with financial problems

77 constitute groups with higher risks (Cvetkovski et al. 2012; Eisenberg et al. 2013; Said et al.

78 2013). Once heightened at the beginning of the study period, the symptoms of anxiety and

79 depression remain elevated over the academic years and at no time point drop down to pre-

80 registration levels (Bewick et al. 2010). Mental ill health among students may potentially be

81   caused by heavy workload, insufficient feedback from teachers and worries about future

82   endurance/competence (Dahlin et al. 2005), but may also reflect the increase in deteriorated

83   mental health among adolescents (Hunt & Eisenberg 2010). Mental ill health problems are often

84   accompanied by decrements in positive mental health through lowered self-perception,

85   inadequate social-emotional skills and poor interpersonal relationships (Conley et al. 2015).

86   Moreover, perceived academic stress and burn-out are associated with impaired academic

87   achievement (Andrews 2004; Keyes et al. 2012; Vaez & Laflamme 2008), worse occupational

88   preparedness and lower occupational performance after the graduation (Rudman & Gustavsson

89   2012). In prevention science the health promotion approach constitutes a substantial ingredient

90   of the integrative model for mental health intervention in youth (Weisz et al. 2005). Including

91   aspects of positive mental health, i.e. emotional, psychological and social well-being (Westerhof

92   & Keyes 2010) is a beneficial strategy in mental health interventions (Kobau et al. 2011). It has

93   been shown that psychological assets, e.g. boostering positive emotions, coping strategies and

94   compassion may help people to manage life's challenges. Thus, promoting mental health and

95   preventing mental ill health are two essential and complementary steps in reducing the burden of

96   disease (Jane-Llopis 2007; Keyes 2007; World Health Organization (WHO) 2002).

97   Previous research on mental health promotion and mental ill health prevention has

98   shown promising short-term effects of stress reduction techniques and meditation, self-hypnosis,

99   cognitive behavioural and mindfulness interventions (Conley et al. 2015; Conley et al. 2017;

100   Regehr et al. 2013; Shiralkar et al. 2013) as well as of technology based interventions (Conley et

101   al. 2016; Davies et al. 2014; Farrer et al. 2013). As mental health problems persist during the

102   study period (Bewick et al. 2010; Christensson et al. 2010) and negatively affect academic

103   performance and future working capacity (Rudman & Gustavsson 2012; Vaez & Laflamme

104 2008), the sustainability of intervention benefits as well as its determinants and moderators

105 deserve closer attention. Several reviews have approached the issue of intervention effect

106 sustainability by averaging the effects reported for the longest follow-up periods, although a

107 substantial variability in the ranges and means of the follow-up lengths made the comparions

108 difficult (Conley et al. 2015; Conley et al. 2016; Conley et al. 2017). The authors highlighted the

109 need for in-depth investigation of the intervention benefit sustainability over variable

110 postintervention follow-up periods since the effects may change their direction and strength over

111 time (Conley at al. 2015). Therefore, to further address the nature of sustainability of

112 intervention effects, in this review we aimed to systematically identify, appraise and summarize

113 the existing data from randomized control trials (RCT) reporting on whether the effects of mental

114 health promoting and mental ill health preventing interventions are sustained for at least 3

115 months of post-interventional follow-up. Further, we aimed to analyse how the direction and

116 magnitude of the effects vary for different outcomes in relation to the lengths of follow-up and to

117 assess whether effect sustainability varied by the types and major features of interventions,

118 study-level determinants, and characteristics of participants.

119

MATERIALS AND METHODS

Eligibility criteria

122 The protocol was registered in PROSPERO, CRD42015029353 (Data, S1). The study followed

123 the guidelines for conducting systematic review as suggested by the Cochrane handbook for

124 systematic reviews of interventions (Higgins et al. 2008) and reported the study findings and

125 procedure in relation to the sec statement (Moher et al. 2009) (Table, S5).

126   The PICO components (Population, Intervention, Comparator and Outcome) were

127   developed after discussing eligibility criteria with stakeholders from the student health services:

128   P= students in university settings; I= any types of mental health-promoting and mental ill health-

129   preventing interventions; C= any types of active or inactive controls; O= (i) positive mental

130   health, including well-being, coping, locus of control, resilience, self-esteem/self-compassion,

131   stress management, academic achievement or academic performance, and (ii) mental ill health,

132   including symptoms of anxiety, symptoms of depression, psychological distress, worry, fatigue,

133   sleeping problems, and perceived stress. The study design was restricted to RCTs with at least 3

134   months of post-intervention follow-up. No language restrictions were initially applied. Studies

135   focused on students with diagnosed psychiatric disorders and studies conducted in primary care

136   settings were excluded.

137

138   **Search strategy**

139   In collaboration with librarians (CG, AW: see Acknowledgements), a sensitive search strategy

140   was developed and adapted to the following databases: Medline (Ovid), PsycInfo (Ovid), Eric

141   (Ovid) and Scopus. Gray literature was searched in Dissertations & Theses (ProQuest), Dart

142   Europe, OpenGrey and Base Bielefeld. The searches were limited to studies published from

143   January 1, 1995 to December 31, 2015. Key words and MESH terms are reported in the

144   Supplemental Information (Data, S2 and Data, S3, respectively). Reference lists of the relevant

145   reviews and studies selected for inclusion were manually scrutinized and the following journals

146   were hand-searched from January 2012 to March 2016: *College Student Journal, Journal of*

147   *American College Health and Journal of College Counseling.*

148

Study selection, data extraction and quality assessment

149

150 Screening was conducted independently by two authors (RW, KG) and two colleagues (AF, AM:

151 see Acknowledgement). The eligibility of each article was initially evaluated by the title and

152 abstract and, if found appropriate, followed by full-text examination. At this stage only English-

153 language publications were assessed. This resulted in a loss of 20 publications in Chinese

154 (k=15), Japanese (k=3), Korean (k=1) and Spanish (k=1). Gray literature was taken into

155 consideration when accessible free of charge. Any disagreements were resolved through panel

156 discussions. Studies selected for inclusion were examined for potential overlap in study

157 populations, which was not found.

158   Data extracted from the articles included first author, country of origin, setting,

159 funding, inclusion and exclusion criteria, characteristics of the intervention and comparison

160 groups (age, gender, ethnicity), characteristics of the intervention (type, format, delivery level,

161 length of session, duration), type of comparison, outcome definition and measurement scale,

162 sample size, post-intervention length of follow-up, percent of withdrawals at each measurement

163 point and study quality (described below). If a study reported multiple outcomes and/or if

164 outcomes were assessed at multiple follow-up time points, quantitative data (means and standard

165 deviations (SD)) were extracted separately for each outcome at each follow-up period. The same

166 approach was utilized for multi-armed RTCs, from which separate extraction was performed for

167 each intervention-comparison pair. When data were missing in the original reports we contacted

168 authors for further clarification.

169   As suggested by Conley, et al. (Conley et al. 2015), original interventions were

170 grouped into: (i) cognitive behaviour therapy (CBT)-related if focusing on identifying and

171 changing unhelpful cognitions, behaviors and emotional regulation; (ii) mind-body-related, i.e.,

172 interventions that facilitate the mind's capacity to affect bodily function and symptoms; and (iii)

173 psycho-educational-related if focusing on information, discussion and didactic communication

174 on, e.g. stress-reduction and coping. Categorization was based on the original definitions, if

175 provided, and otherwise by us. Level of delivery was considered as universal if intervention

176 targeted students without reported mental ill health symptoms and as selective if provided for

177 those with adverse mental health symptoms. Interventions were further divided into group or

178 individual format. Comparators were sub-divided into active controls (i.e., another type of

179 intervention) and inactive controls (waitlist controls, placebo-controls, "living as usual" and no

180 intervention). Study outcomes were classified in two major categories: mental ill health

181 outcomes consisting of anxiety symptoms, depressive symptoms, psychological distress, stress,

182 self-reported worry, passive coping, and deteriorated quality of sleep; and positive mental health

183 and academic performance outcomes including self-esteem, self-compassion, self-efficacy,

184 mental or subjective well-being, resilience, active coping, happiness, stress management and

185 academic performance.

186 The quality of selected trials was assessed independently by three authors (RW,

187 KG, LL) and colleagues (AF, AM, SB: see Acknowledgements) using the Effective Public

188 Health Practice Project Quality Assessment Tool (EPHPP), as recommended by the Cochrane

189 Collaboration for public health reviews (Higgins et al. 2008). The EPHPP assesses selection bias,

190 study-design, confounders, blinding, data collection method and withdrawals and dropouts to

191 yield the study quality as either strong, moderate or weak. Discrepancies in quality assessment

192 were resolved by discussions with one of the three reviewers not involved in the review process.

193

Statistical analysis

194

195 Because of the variety of instruments used for measuring outcomes, a standardized mean

196 difference using Hedges' *g* was chosen as a common effect size (ES) for conducting quantitative

197 synthesis. ES was calculated separately at each post-intervention follow-up time point as a

198 difference in means between intervention and control group, divided by the pooled within-group

199 SD and incorporating a correction factor for small sample sizes (Borenstein et al. 2009). One

200 trial reported Hedges' *g* as the study ES (Braithwaite & Fincham 2009), while for other studies it

201 was calculated from the available raw data. Throughout the recalculations we kept the original

202 direction of scales indicating the improvement of outcome measures. Thus, for mental ill health

203 outcomes ESs below zero pointed to superiority of the intervention group over the controls,

204 while for positive mental health and academic performance outcomes, ESs above zero indicated

205 that the results favored the intervention. For one study where follow-up means, but not SDs,

206 were provided and the intervention effect was indicated as "non-significant" (Chiauzzi et al.

207 2008), we set ES to zero. To ease interpretation of the magnitude of Hedges' *g*, we applied

208 Cohen's convention (Cohen 1992) and defined the ES as small (0.2), medium (0.5), and large

209 (0.8).

210 Precautions were taken to overcome unit-of-analysis error and avoid using multiple

211 assessment of the same construct (Higgins et al. 2008). If more than one ES was reported in a

212 given study for the same outcome at a given follow-up point (e.g., for depression assessed by

213 both the Hamilton Depression Rating Scale and Beck Depression Inventory), we averaged ESs to

214 obtain the single outcome measure per intervention at each measurement point (Higgins 2006;

215 Jones & Johnston 2000; Kanji et al. 2006; Peden et al. 2001; Seligman et al. 1999). ESs were

216 also averaged within the trials with multiple interventions of similar nature, i.e. if interventions

217   belonged to the same category (Chiauzzi et al. 2008; Mak et al. 2015). A similar approach was

218   applied to studies with multiple comparisons (Chiauzzi et al. 2008; Rohde et al. 2014; Yang et al.

219   2014). An exception was the study by Kanji N et al. (Kanji et al. 2006), where two control

220   groups – an attention control and a time control – were included separately as considered to be

221   different in approach and content and, thus, representing active and inactive comparisons,

222   respectively.

223   Meta-analysis was conducted for all specific outcomes originally reported and for

224   outcomes combined within mental ill health and positive mental health and academic

225   performance categories. To analyze the combined outcomes, we applied a hierarchical approach

226   for selecting outcomes from the studies reporting more than one from the same category. The

227   hierarchy was based on descending order of outcome reporting, i.e. from the most often reported

228   to the least often reported. For mental ill health outcomes the hierarchical selection was ordered

229   as: depressive symptoms, anxiety symptoms, stress, psychological distress, self-reported worry,

230   quality of sleep and passive coping. For positive mental health and academic performance

231   outcomes the order was: self-esteem, academic performance, self-efficacy, self-compassion,

232   mental or subjective well-being, resilience, stress management, active coping, and happiness.

233   Because of the initial assumptions of between-study heterogeneity, a random-

234   effects model incorporating both within- and between-study variability was used for quantitative

235   synthesis. To assess the sustainability of intervention effect over time and address the variety of

236   the follow-up lengths reported in the original studies, we categorized the post-intervention

237   follow-ups as 3-6 months, 7-12 months, and 13-18 months. Each of the included studies reported

238   outcome measures for at least one of these categories and quantitative synthesis was conducted

239   separately for each category. If a given study provided several outcome measures falling in the

240   same length category (e.g., for both 3 and 6 month follow-ups), the ES for the follow-up close to

241   the upper boundary (i.e., 6 months) was chosen (Kanji et al. 2006; Seligman et al. 2007; Vazquez

242   et al. 2012). Only one study (Seligman et al. 1999) assessed outcomes at follow-up periods

243   longer than 18 months and the measurements of those periods (i.e., 24 months, 30 months and 36

244   months) were not included in the meta-analysis. Finally, to obtain comparability between trials,

245   if a study provided results based on both imputed data (i.e., intention-to-treat analysis) and non-

246   imputed data (i.e., follow-up completers) (Reavley et al. 2014) or if both crude and adjusted ESs

247   were available (Chase et al. 2013) we favored the imputed and crude measures for the main

248   analysis leaving the latter (non-imputed and adjusted measures) for sensitivity analysis.

249   We evaluated statistical heterogeneity among the studies using Q and I^2 statistics.

250   For Q, p-value <0.1 was considered as representative of statistically significant heterogeneity,

251   and I^2 values of 25%, 50% and 75% were indicating low, moderate and high heterogeneity,

252   respectively (Higgins et al. 2003).

253   The subgroup analyses were performed by stratifying the main analysis by *a priori*

254   identified moderators related to interventions (category of intervention, delivery level, type of

255   format, type of controls), study-level moderators (initial study size, study quality) and

256   moderators related to participant characteristics (gender, country). The analyses were performed

257   if at least two studies were included in each subgroup. Mixed-methodology was applied with

258   random-effect modeling used for within-group pooling, while between-group differences were

259   assessed with fixed-effect model. Leave-one-out influence analysis was conducted to assess the

260   potential impact of individual studies on the overall pooled ES by omitting one study at a time

261   (Tobias 1999). Following the approach suggested by Hart et al (Hart et al. 2012), sensitivity

262   analysis was conducted to assess whether the overall pooled ES differed if the lowest or the

263 highest original ES was selected from the studies with multiple outcome assessments or multiple

264 interventions or comparisons. In meta-analyses with three or more studies included, we assessed

265 publication bias by funnel plots, Egger's regression asymmetry test, and the Begg-Mazumdar

266 adjusted rank correlation test (Begg & Mazumdar 1994; Egger et al. 1997).

267   All statistical analyses were performed using STATA version 13.1 (StataCorp,

268 College Station, TX). P-values < 0.05 were considered statistically significant. All statistical

269 tests were two-sided.

270

RESULTS

271

272 After removing the duplicates, 6571 records were available for title and abstract screening.

273 Among these, 6519 records were excluded as not meeting the PICO-criteria, leaving 52 articles

274 for full-text examination. Further evaluation excluded another 26 studies: post-intervention

275 follow-up less than 3 months (k=11), not enough data to calculate ES (k=6), not a RCT (k=5),

276 population not relevant (k=3), and outcome not relevant (k=1). A selection process yielded a

277 final number of 26 RCTs to be included in the meta-analysis (Fig. 1).

278

279 **Figure 1** Flow diagram of the study selection process.

280

Characteristics of included studies

281

282   Table 1 summarizes the characteristics of studies eligible for inclusion. Among the 26 RCTs

283   (Braithwaite & Fincham 2009; Chase et al. 2013; Cheng et al. 2015; Chiauzzi et al. 2008; Erogul

284   et al. 2014; Fontana et al. 1999; Franklin & Franklin 2012; Gortner et al. 2006; Hamdan-

285   Mansour et al. 2009; Higgins 2006; Jones & Johnston 2000; Kanji et al. 2006; Kattelmann et al.

286   2014; Kenardy et al. 2006; Li et al. 2015; Mak et al. 2015; Pachankis & Goldfried 2010; Peden

287   et al. 2001; Reavley et al. 2014; Rohde et al. 2014; Seligman et al. 1999; Seligman et al. 2007;

288   Shapiro et al. 2011; Vazquez et al. 2012; Yang et al. 2014; Zheng et al. 2015), CBT-related

289   interventions were assessed in 11 studies, while mind-body- related and psycho-educational-

290   related interventions were assessed in 10 and 5 studies, respectively. Universal and selective

291   delivery levels were equally present (k=13 for both). Face-to-face group format was the most

292   common (k=16). At least one mental ill health outcome was assessed in 24 studies, while at least

293   one positive mental health outcome was appraised in 14 studies. Twenty-three trials reported at

294   least one outcome measurement during 3-6 months post-intervention follow-up, with 8 and 5

295   trials reporting corresponding measurements during 7-12 months and 13-18 months follow-ups.

296   None of the interventions had an organizational approach. More detailed characteristics of the

297   selected studies are presented on-line (Table S1). The study quality assessed in all 26 RCTs

298   varied between strong (k=4),moderate (k=12) and week (k=10). When subdivided by the

299   outcome categories, 24 trials with at least one mental ill health outcome revealed their study

300   quality as strong (k=4), moderate (k=11) and weak (k=9), and 14 trials with at least one positive

301   mental health outcome and academic performance of strong (k=3), moderate (k=6) and weak

302   (n=5) quality. Across all studies included in the analysis, selection bias was the most commonly

303   assessed weakness component (n=21). (Table S2).

304

305 **Table 1** Summary of descriptive characteristics of randomized controlled trials included in the

306 systematic review and meta-analysis**.**

307

Effects and sustainability over time

Interventions preventing mental ill health

310 As presented in Table 2, for the combined mental ill health outcomes an aggregated ES for all

311 preventive interventions yielded a superiority of interventions over the comparisons at 3-6

312 months and 7-12 months of post-intervention follow-up, although the effects were small. Pooled

313 ES did not reach statistical significance for follow-up periods of 13-18 months. High-to-

314 moderate heterogeneity was detected at all three follow-up periods with I^2 of 79.5%, 74.2%, and

315 58.2%, respectively. Publication bias was evident for studies with 3-6 months follow-up (Egger's

316 test p-value=0.013), though not for studies with longer follow-up periods (7-12 months: p-

317 value=0.151; 13-18 months: p-value=0.141), (Figure, S1). Influence analysis revealed no

318 indication that individual RCTs, if omitted, would significantly influence the observed overall

319 ESs (data not shown). As previously noted, sensitivity analyses were performed for studies with

320 multiple outcome measures reported for the same follow-up and for studies with multiple

321 interventions or comparisons. Pooling together the highest ESs originally reported for these

322 studies did not alter the results of the main analysis 3-6 months: ES= -0.28 (95% CI -0.44, -

323 0.12); 7-12 months: ES= -0.35 (95% CI -0.60, -0.10); 13-18 months: ES= -0.23 (95% CI -0.54,

324 0.08)). Neither were the results influenced when the lowest originally reported ESs were used (3-

325 6 months: ES= -0.24 (95% CI -0.39, -0.09); 7-12 months: ES= -0.23 (95% CI -0.43, -0.03); 13-

326 18 months: ES= -0.06 (95% CI -0.18, 0.06)). Only one study reported the results using both

327   imputed and non-imputed data (Reavley et al. 2014), with the former included in the main meta-

328   analysis. Alternative inclusion of the latter did not change the overall ES (data not shown).

329   In sub-group analyses for the combined mental ill health outcomes, studies

330   employing CBT-related interventions revealed singificant pooled ESs for 3-6 month and 13-18

331   month follow-ups (Table 2 and Figure 2). Less consistent results were observed for mind-body-

332   related interventions. No superiority of intervention group appeared among studies with psycho-

333   educational interventions. Pooled ESs for universal preventive interventions yielded significant

334   results for follow-up up to 7-12 months. Less consistency appeared in the aggregated results for

335   selective interventions and interventions conducted face-to-face in groups. Trials with small

336   sample size and trials comprising more than 60% females yielded significant effects for up to 7-

337   12 months of follow-up. The small numbers of studies might explain the lack of consistency in

338   the results of other sub-group comparisons. The high heterogeneity seen for studies with 3-6

339   months of follow-up might reflect differences in delivery level (p-value for Q between sub-

340   groups=0.006) and study size (p<0.001), while for studies with follow-up periods of 7-12

341   months, heterogeneity could be explained by differences in type of comparison (p<0.001), study

342   size (p=0.01), and country where the RCT was conducted (p=0.003). We were unable to detect

343   between-group differences for trials with follow-up of 13-18 months because of the small

344   number of studies in the sub-groups.

345   Assessment of the specific mental ill health outcomes, revealed a sustainable effect

346   of all interventions combined lasting up to 13-18 months for symptoms of depression (ES= -0.30

347   (95% CI -0.51, -0.08)), (Table, S3). For symptoms of anxiety sustainability was observed up to

348   7-12 months (ES=-0.27 (95%CI; -0.54, -0.01)). Only one study assessed the effect of

349   interventions targeting anxiety during 13-18 months of post-intervention follow-up and, hence,

350 we were unable to perform meta-analysis. For symptoms of stress, reductions lasted up to 3-6

351 months post intervention (ES=-0.30 (95%CI; -0.58, -0.03)). Other comparisons were either

352 inconclusive or quantitative synthesis was not performed because of the small number of studies.

353

354 **Table 2** Meta-analysis and sub-group analyses for hierarchically selected mental ill health

355 outcomes, stratified by the length of post interventional follow-up periods.

356 **Figure 2** The effects of mental ill health preventing interventions on hierarchically selected

357 mental ill health outcomes stratified by the length of post interventional follow-up periods.

358

359 **Interventions promoting mental health and academic performance – a paucity**

360 **of outcomes**

361 Table 3 presents overall ESs for the combined positive mental health and academic performance

362 outcomes with rather limited data available, in particular, for the follow-up periods longer than

363 3-6 months. All interventions combined showed superiority over the controls during 3-6 months

364 of follow-up with small, but significant pooled ES. For longer follow-up periods the results were

365 inclonclusive. High heterogeneity was detected when studies with 3-6 months follow-up were

366 pooled (I^2=86.5%). Because of the small number of studies, publication bias were only assessed

367 for studies with 3-6 months of follow-up and were detected (Egger's test p-value=0.03) (Figure,

368 S5). Influence analysis indicated that four individual studies (Erogul et al. 2014; Hamdan-

369 Mansour et al. 2009; Pachankis & Goldfried 2010; Peden et al. 2001), if omitted, would drop the

370 significant overall ES for the studies with 3-6 months follow-up to borderline significance (data

371   not shown). Overall ESs at follow-ups of 7-12 and 13-18 months remain non-significant

372   regardless of individual study influences (data not shown). Sensitivity analyses pooling the

373   highest ESs originally reported for studies with multiple outcome assessment or multiple

374   interventions or comparison groups showed no alteration to the overall results at 3-6 months

375   follow-up (ES= 0.32 (95% CI 0.06, 0.58)), but made the overall ESs for 7-12 months follow-ups

376   significant (ES= 0.53 (95% CI 0.20, 0.87)), as well as for 13-18 months follow-up (ES= 0.53

377   (95% CI 0.21, 0.86)). However, only 2 studies were assessed within each category of 7-12 and

378   13-18 months follow-ups. Use of the lowest originally reported ES did not affect the results of

379   the main analysis (3-6 months: ES= 0.32 (95% CI 0.06, 0.58); 7-12 months: ES= 0.16 (95%CI -

380   0.18, 0.50); 13-18 months: ES= 0.16 (95% CI -0.17, 0.49)). One study reported both crude and

381   adjusted outcome assessment (Chase et al. 2013). Use of the adjusted ES for sensitivity analysis

382   did not alter the results observed in the main analysis.

383   Sub-group analyses for the combined positive mental health and academic

384   performance outcomes were performed only for studies with 3-6 months follow-up (Table 3 and

385   Figure 3). Superiority of interventions over comparisons was shown for CBT-related

386   interventions, selective delivery level, face-to-face group format, RCTs with inactive

387   comparisons, studies with small sample size and trials conducted in US. Between-group

388   difference was significant for delivery level (p<0.001), format type (p<0.001), study size

389   (p<0.001) and gender mix (p=0.02). Sub-group analyses for studies with longer follow-up

390   revealed either non-significant results or were impossible to conduct owing to the small number

391   of trials in the sub-groups.

392   Because of lack of data on the specific positive mental health and academic

393   performance outcomes, only studies on active coping, self-esteem and self-efficacy with 3-6

394 months follow-up were quantitatively assessed (Table, S4). Sustainability of the intervention

395 effect was observed for active coping (ES=0.75(95%CI; 0.19, 1.30)) with no significant effects

396 shown for other outcomes.

397

398

399 **Table 3** Meta-analysis and sub-group analyses for hierarchically selected positive mental health

400 and academic performance outcomes stratified by the length of post interventional follow-up

401 periods.

402

403 **Figure 3** The effects of mental health promoting interventions on hierarchically selected positive

404 mental health and academic performance outcomes stratified by the length of post interventional

405 follow-up periods.

406

407

DISCUSSION

409 Our systematic review and meta-analysis showed sustainability of the benefits of mental health

410 interventions targeting students in higher education, though in most of the analyses, the pooled

411 ESs yielded significant, but small overall effects. For the combined mental ill health outcomes,

412 the observed effects across all preventive interventions were sustained for up to 7-12 months

413 post-intervention. Sustainability of effects was most pronounced for interventions designed to

414   reduce the symptoms of depression, for which the superiority of intervention groups over the

415   comparisons remained significant for up to 13-18 months post-intervention. For the combined

416   positive mental health and academic performance outcomes, aggregated results across all

417   promotion interventions revealed slightly shorter, but still evident sustained effects, which

418   remained significant at post-intervention follow-up of 3-6 months.

419   To our knowledge, this is the first systematic review and meta-analysis focusing

420   primarily on the sustainability of the effects of mental health promoting and mental ill health

421   preventing interventions among students in higher education and analyzing different categories

422   of follow-up duration. A direct comparison to the existing literature was therefore difficult as

423   other reviews mostly assessed the effects measured at the completion of interventions. The

424   closest comparisons are three reviews by Conley at al. on universal and indicated mental health

425   prevention programs (Conley et al. 2015; Conley et al. 2017) and technology-delivered

426   preventive interventions (Conley et al. 2016). The reviews by Conley et al. assessed the effects

427   of interventions across all types of adjustment outcomes in university students at the longest

428   follow-up period reported, which varied from 2 to 52 weeks (Conley et al. 2015), 13 to 52 weeks

429   (Conley et al. 2016) and 4 to 157 weeks (Conley et al. 2017). The first review (Conley et al.

430   2015) showed the duration of follow-up to be negatively correlated with aggregated ES across

431   mental ill health and positive mental health outcomes combined as well as no effect for psycho-

432   educational interventions. A similar tendency for the effects of intervention to become non-

433   significant as the duration of follow-up increases was observed in our study, though the

434   sustainability of effects differed between ill-health and positive mental health outcomes. As in

435   Conley's review (Conley et al. 2015), no effects of psycho-educational interventions on any

436   outcomes were evident in our data, regardless of the duration of follow-up. The second review

437   (Conley et al. 2016) reported a significant effect of universal interventions at any follow-up

438   periods ranging between 13 to 52 weeks as well as a positive effect of selective interventions

439   during the follow-up periods of 2-26 weeks. Similarly, in our study mental ill health outcomes

440   were reduced by universal interventions for up to 7-12 months of follow-up and by selective

441   interventions at follow-ups of up to 3-6 months, although our results on positive mental health

442   and academic performance outcomes were less conclusive. Similar to the third review (Conley et

443   al. 2017), our results indicated that the most sustainable effects were observed for interventions

444   designed to reduce the symptoms of depression and symptoms of anxiety.

445   Although our literature search for intervention studies was not limited to

446   psychological interventions, only this type was retrieved. The scarcity of organizational mental

447   health promoting interventions was verified by a scoping review (Enns et al. 2016). However, an

448   exception may be a recent systematic review on learning environment interventions for medical

449   student well-being, suggesting changes to curriculum (Wasson et al. 2016). Their results support

450   previous findings suggesting that to maximize the effectiveness of mental health promotion, all

451   levels of delivery must contribute, i.e., not just individual and group levels, but also structural,

452   and societal levels (Hamilton & Bhatti 1996). To further improve the sustainability of student

453   mental health promotion, psychological interventions may be combined with a whole-setting

454   approach, as endorsed by the WHO initiative Health Promoting Universities (HPU) (World

455   Health Organization 1995).

456

457

458   **Limitations**

459   Systematic reviews on student mental health have indicated lack of follow-up data on outcome

460   assessment as a major obstacle for determining the long-term effect of interventions (Conley et

461   al. 2015; Conley et al. 2016; Davies et al. 2014; Farrer et al. 2013). Likewise, the scarcity of

462   studies assessing the effects of interventions at post-interventional follow-ups of longer than 3

463   months along with a substantial variability in the lengths of follow-ups reported in the original

464   studies should be considered as major limitations of our review. In particularly, the lack of

465   original evidence affected our analysis of positive mental health outcomes as it restricted us to

466   mainly aggregating the effects of interventions with 3-6 months of follow-up. Other limitations

467   must also be considered. First, in most cases low numbers of studies in sub-groups prevented us

468   from exploring the moderating effect of types of interventions, study-level determinants and

469   participant characteristics during follow-up periods longer than 6 months making the results of

470   sub-group analyses tentative. This also precluded us from conducting in-depth investigation of

471   sources for heterogeneity, which was found to be mostly high. Second, our intention to analyse

472   two dimentions of mental health, that resulted in combining the original outcomes into the

473   "mental ill health" and "positive mental health and academic performance" outcome categories,

474   with a hierarchical approach applied, could have boosted heterogeneity. In a subsequent

475   analyses, we attempted to reduce heterogeneity by pooling together the studies with the same

476   specific outcomes reported, though for several outcomes it was not possible due to data scarcity.

477   Third, the evidence was insufficient to obtain any aggregated ESs for the specific outcomes, in

478   particular, for self-reported worries, passive coping, academic performance, self-compassion,

479   mental and subjective well-being, resilience and happiness rating. Fourth, a substantial

480   variability exists in measurements instruments and, in several cases, the same outcome was

481   measured by different scales. We tried to address this limitation by choosing Hedges' g as an ES

482 and by investigating how sensitive the aggregated results were to our initial approach of

483 combining the original ESs in cases of multiple outcome measures or in multi-armed RCTs. The

484 sensitivity analyses proved the robustness of our findings for mental ill health, though for

485 positive mental health outcomes the use of the lowest ESs from the original studies altered the

486 results for studies with 7-12 and 13-18 months of follow-up. Fifth, more than 30% of the original

487 studies were assessed as being of weak quality. To address this issue, we conducted sub-group

488 analyses stratifying the trials by study quality. For both categories of outcomes, these analyses

489 revealed inconclusive results when trials with insufficient quality were pooled that should be

490 accounted when interpreting our results. Furthermore, selection bias as the most commonly

491 identified weakness. This bias, whether induced by the investigators or caused by self-selection

492 may have resulted in either underestimation or overestimation of the original ES and therefore

493 could affect the aggregated results. Finally, the results should be seen in the context of the

494 presence of publication bias among the studies with 3-6 months of follow-up and of our inability

495 to assess publication bias for positive mental health outcomes at follow-ups longer than 6

496 months, which may have resulted from our restriction to English-language publications at the

497 final stage of selection.

498

499 # CONCLUSIONS

500 Despite the limitations, the evidence suggests long-term effect sustainability for mental ill health

501 preventive interventions, in particular, for interventions to reduce the symptoms of depression

502 and symptoms of anxiety. Interventions designed to promote positive mental health offer

503 promising, but shorter-lasting effects. As the research field of health promoting interventions for

504   students expands, future studies may improve our attempts to establish the effectiveness and

505   sustainability of those interventions, e.g., ascertaining the effects for specific positive mental

506   health outcomes. In addition, future research should also focus on mental health organizational

507   interventions to investigate their potential for students in tertiary education.

508

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515

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726

Summary of study characteristics of randomized controlled trials included in the systematic review and meta-analysis.

ᵃ E.g. a different variant of the same intervention, a different intervention.

ᵇ E.g. no intervention, "living as usual", a waiting list control

ᶜ Percentage does not add to 100 because studies could fall into multiple categories.

ᵈ Assessed by The Effective Public Health Practice Project Quality Assessment Tool (EPHPP).

1 **Table 1 Summary of descriptive characteristics of randomized controlled**
2 **trials included in systematic review and meta-analysis**

	Number of comparisons (k)	%
Total number of studies	26	100
Participant characteristics		
Gender mix, Study population		
Approx. even (40 – 60 females)	6	23.0
More than 60% females	17	65.0
More than 60% males	1	4.0
Not reported	2	8.0
Region (countries)		
US	14	54.0
Australia	3	11.5
Europe (UK, Scotland, Spain)	3	11.5
East Asia and Pacific (China + Hong Kong)	5	19.0
Middle East and North Africa (Jordan)	1	4.0
Intervention characteristics		
Intervention classification		
CBT-related	11	42.0
Mind-body-related	10	39.0
Psycho-educational-related	5	19.0
Enlarged with Material/Home-work/Training/Booster		
Yes	15	58.0
No/Unclear	11	42.0
Type of delivery		
Universal	13	50.0
Selective	13	50.0
Type of format		
Internet-based individual	5	19.0
Internet-based individual and in groups	2	8.0
Face-to-face individual	2	8.0
Face-to- face in group	16	61.0
Face-to-face in pairs	1	4.0
Length of intervention		
< 1 week	4	15.0
1 - 4 weeks	1	4.0
5 - 7 weeks	7	27.0
8 weeks	8	31.0
9-12 weeks	5	19.0
13-16 weeks	0	0.0
> 16 weeks	1	4.0
Comparison condition		
Active control [a]	8	31.0
Inactive control [b]	18	69.0
Study characteristics		
Length of follow-up [c]		
3 months	13	50.0
4-6 months	14	54.0

7-9 months	3	11.5
10-12 months	7	27.0
13-15 months	0	0.0
>15 months	5	19.0
Study size (participants)		
n≤ 100	16	62.0
n> 100	10	38.0
Study quality [d]		
Weak	10	39.0
Moderate	12	46.0
Strong	4	15.0

5   [a] E.g. a different variant of the same intervention, a different intervention.

6   [b] E.g. no intervention, "living as usual", a waiting list control

7   [c] Percentage does not add to 100 because studies could fall into multiple categories.

8   [d] Assessed by The Effective Public Health Practice Project Quality Assessment Tool (EPHPP).

Meta-analysis and sub-group analyses for hierarchically selected mental ill health outcomes, stratified by the length of post interventional follow-up periods.

k; number of studies; n/a; not applicable

(*) p<0.1 * p<0.05, ** p< 0.01, ***p<0.001

The format type "face-to-face in pair" was not utilized for mental ill health outcomes. [p]

1 **Table 2** Meta-analysis and sub-group analyses for hierarchically selected mental ill health outcomes,
2 stratified by the length of post interventional follow-up periods.
3

Variables	Length of post intervention follow-up periods (months)		
	3-6	**7-12**	**13-18**
All interventions (k)	21	9	3
Hedges' g (95% CI)	-0.28 (-0.44, -0.12)	-0.28 (-0.49, -0.08)	-0.17 (-0.39, 0.05)
Q / I^2	97.50*** / 79.5%	31.00*** / 74.2%	4.78(*) / 58.2%
Subgroup analyses			
Type of interventions			
CBT-related (k)	11	4	2
Hedges' g (95% CI)	-0.40 (-0.64, -0.16)	-0.12 (-0.51, 0.16)	-0.30 (-0.51, -0.08)
Q / I^2	44.60*** / 77.6%	7.61(*) / 60.6%	0.28 / 0.0%
Mind-body related (k)	9	3	0
Hedges' g (95% CI)	-0.20 (-0.44, 0.04)	-0.43 (-0.66, -0.20)	---
Q / I^2	33.30*** / 76.0%	1.00 / 0.0%	---
Psychoeducational (k)	1	2	1
Hedges' g (95% CI)	0.09 (-0.05, 0.23)	-0.64 (-1.83, 0.54)	-0.02 (-0.16, 0.16)
Q / I^2	---	16.58*** / 94.0%	---
Group difference Q (df) / p for Q	3.38 (1) / 0.06	5.82 (2) / 0.05	n/a
Delivery level			
Universal (k)	8	5	1
Hedges' g (95% CI)	-0.23 (-0.46, -0.01)	-0.46 (-0.83, -0.09)	-0.02 (-0.16, 0.12)
Q / I^2	34.23*** / 79.6%	23.04*** / 82.6%	---
Selective (k)	13	4	2
Hedges' g (95% CI)	-0.31 (-0.54, -0.08)	-0.12 (-0.39, 0.16)	-0.30 (-0.51, -0.08)
Q / I^2	55.74*** / 78.5%	7.61(*) / 60.6%	0.28 / 0.0%
Group difference Q (df) / p for Q	7.48 (1) / 0.006	0.35 (1) / 0.55	n/a
Format type			
Face-to-face in group (k)	15	6	2
Hedges' g (95% CI)	-0.35 (-0.54, -0.16)	-0.20 (-0.42, 0.03)	-0.30 (-0.51, -0.08)
Q / I^2	55.20*** / 74.6%	11.68* / 57.2%	0.28 / 0.0%
Face-to-face individual (k)	2	0	0
Hedges' g (95% CI)	0.06 (-0.30, 0.42)	---	---
Q / I^2	1.91 / 47.5%	---	---
Internet-based individual (k)	2	2	0
Hedges' g (95% CI)	-0.28 (-1.09, 0.53)	-0.64 (-1.83, 0.54)	---
Q / I^2	6.26* / 84.0%	16.58*** / 94.0%	---
Internet-based individual and in groups (k)	2	1	1
Hedges' g (95% CI)	-0.30 (-1.10, 0.50)	-0.45 (-0.84, -0.07)	-0.02 (-0.16, 0.12)
Q / I^2	15.17*** / 93.4%	---	---
Group difference Q (df) / p for Q	n/a	0.56 (1) / 0.45	n/a
Type of comparison			
Active (k)	2	2	0
Hedges' g (95% CI)	-0.34 (-1.21, 0.53)	-0.88 (-1.59, -0.18)	---
Q / I^2	12.40*** / 91.9%	4.45* / 77.5%	---
Inactive (k)	19	7	3
Hedges' g (95% CI)	-0.28 (-0.44, -0.11)	-0.14 (-0.28, 0.01)	-0.17 (-0.39, 0.05)
Q / I^2	83.38*** / 78.4%	10.17 / 41.0%	4.78 / 58.2%
Group difference Q (df) / p for Q	1.67 (1) / 0.20	16.39 (1) / <0.001	n/a
Study quality			
Strong (k)	2	2	1
Hedges' g (95% CI)	-0.22 (-0.63, 0.19)	-0.17 (-0.34, 0.01)	-0.26 (-0.52, -0.01)
Q / I^2	2.50 / 60.0%	0.06 / 0.0%	---

Moderate (k)	10	4	0
Hedges' g (95% CI)	-0.26 (-0.44, -0.09)	-0.38 (-0.99, 0.24)	---
Q / I²	21.12* / 57.4%	21.82*** / 86.2%	---
Weak (k)	9	3	2
Hedges' g (95% CI)	-0.30 (-0.62, 0.02)	-0.23 (-0.61, 0.02)	-0.15 (-0.50, 0.20)
Q / I²	71.20*** / 88.8%	8.29* / 75.9%	2.82 / 64.6%
Group difference Q (df) / p for Q	2.63 (2) / 0.27	0.85 (2) / 0.65	n/a
Study size			
100 participants or less (k)	14	7	1
Hedges' g (95% CI)	-0.45 (-0.68, -0.23)	-0.38 (-0.71, -0.05)	-0.39 (-0.80, 0.02)
Q / I²	44.08***/70.5%	23.91**/74.9%	---
More than 100 participants (k)	7	2	2
Hedges' g (95% CI)	-0.01 (-0.10, 0.08)	-0.09 (-0.20, 0.00)	-0.12 (-0.34, 0.12)
Q / I²	7.07 / 15.1%	0.69 / 0.0%	2.66 / 62.4%
Group difference Q (df) / p for Q	46.3 (1) / <0.001	6.41 (1) / 0.01	n/a
Participants' gender mix			
Approx. even (40% – 60% females) (k)	3	1	1
Hedges' g (95% CI)	-0.31 (-0.65, 0.04)	-0.16 (-0.34, 0.02)	-0.26 (-0.52, -0.01)
Q / I²	5.40 / 63.0%	---	---
More than 60% females (k)	14	8	2
Hedges' g (95% CI)	-0.32 (-0.52, -0.11)	-0.32 (-0.58, -0.06)	-0.15 (-0.50, 0.20)
Q / I²	80.27***/83.3%	31.0***/77.4%	2.82 / 64.6%
More than 60% males (k)	1	0	0
Hedges' g (95% CI)	0.30 (-0.17, 0.77)	---	---
Q / I²	---	---	---
Not reported (k)	3	0	0
Hedges' g (95% CI)	-0.25 (-0.94, 0.44)	---	---
Q / I²	7.73*/74.1%	---	---
Group difference Q (df) / p for Q	0.45 (2) / 0.80	n/a	n/a
Country			
US (k)	10	6	2
Hedges' g (95% CI)	-0.22 (-0.47, 0.03)	-0.20 (-0.45, 0.06)	-0.30 (-0.51, -0.08)
Q / I²	35.73***/74.8%	21.48**/76.7%	0.28 / 0.0%
Other countries (k)	11	3	1
Hedges' g (95% CI)	-0.33 (-0.55, -0.11)	-0.45 (-0.66, -0.25)	-0.02 (-0.16, 0.12)
Q / I²	60.57***/83.5%	0.71 / 0.0%	---
Group difference Q (df) / p for Q	1.15 (1) / 0.28	8.82 (1) / 0.003	n/a

6 k; number of studies; n/a; not applicable
7 (*) p<0.1 * p<0.05, ** p< 0.01, ***p<0.001
8 The format type "face-to-face in pair" was not utilized for mental ill health outcomes.
9
10

Meta-analysis and sub-group analyses for hierarchically selected positive mental health and academic performance outcomes stratified by the length of post interventional follow-up periods.

k; number of studies; n/a; not applicable (*) p<0.1 * p<0.05, ** p< 0.01, ***p<0.001. The

format type "Internet-based individual and in groups" was not utilized for positive mental

health and academic performance outcomes.

1 **Table 3** Meta-analysis and sub-group analyses for hierarchically selected positive mental health and
2 academic performance outcomes stratified by the length of post interventional follow-up periods.
3

Variables	Length of post intervention follow-up periods (months)		
	3-6	7-12	13-18
All interventions (k)	11	2	2
Hedges' g (95% CI)	0.32 (0.05, 0.59)	0.34 (-0.05, 0.73)	0.33 (-0.06, 0.72)
Q / I²	73.8*** / 86.5%	0.00 / 0.0%	0.04 / 0.0%
Subgroup analyses			
Type of interventions			
CBT-related (k)	4	0	1
Hedges' g (95% CI)	0.52 (0.06, 0.98)	---	0.29 (-0.29, 0.87)
Q / I²	24.5*** / 87.8%	---	---
Mind-body related (k)	6	1	0
Hedges' g (95% CI)	0.23 (-0.16, 0.61)	0.35 (-0.35, 1.05)	---
Q / I²	41.68*** / 88.0%	---	---
Psychoeducational (k)	1	1	1
Hedges' g (95% CI)	0.10 (-0.38, 0.58)	0.34 (-0.14, 0.82)	0.37 (-0.17, 0.91)
Q / I²	---	---	---
Group difference Q (df) / p for Q		n/a	n/a
Delivery level			
Universal (k)	5	2	1
Hedges' g (95% CI)	0.05 (-0.23, 0.33)	0.34 (-0.05, 0.74)	0.37 (-0.17, 0.91)
Q / I²	21.75** / 77.0%	0.00 / 0.0%	---
Selective (k)	5	0	1
Hedges' g (95% CI)	0.64 (0.18, 1.09)	---	0.29 (-0.29, 0.87)
Q / I²	34.8*** / 88.5%	---	---
Group difference Q (df) / p for Q	17.26 (1) / <0.001	n/a	n/a
Format type			
Face-to-face in groups (k)	6	1	1
Hedges' g (95% CI)	0.53 (0.16, 0.91)	0.35 (-0.35, 1.05)	0.29 (-0.29, 0.87)
Q / I²	27.34*** / 81.7%	---	---
Face-to-face individual (k)			
k	2	0	0
Hedges' g (95% CI)	0.51 (-0.63, 1.66)	---	---
Q / I²	16.17*** / 93.8%	---	---
Face-to-face in pairs (k)	0	1	1
Hedges' g (95% CI)	---	0.34 (-0.14, 0.82)	0.37 (-0.17, 0.91)
Q / I²	---	---	---
Internet-based individual (k)	3	0	0
Hedge's g (95% CI)	-0.14 (-0.36, 0.07)	---	---
Q / I²	4.42 / 54.8%	---	---
Group difference Q (df) / p for Q	25.88 (2) / <0.001	n/a	n/a
Type of comparison			
Active (k)	1	0	0
Hedges' g (95% CI)	-0.11 (-0.50, 0.28)	---	---
Q / I²	---	---	---
Inactive (k)	10	2	2
Hedges' g (95% CI)	0.36 (0.08, 0.65)	0.34 (-0.05, 0.74)	0.33 (-0.06, 0.73)
Q / I²	72.53*** / 87.6%	0.00 / 0.0%	0.04 / 0.0%
Group difference Q (df) / p for Q	n/a	n/a	n/a
Study quality			
Strong (k)	2	1	0

Hedges' g (95% CI)	0.49 (-0.53, 1.51)	0.35 (-0.35, 1.05)	---
Q / I^2	12.33***/91.9%	---	---
Moderate (k)	5	0	0
Hedges' g (95% CI)	0.18 (-0.11, 0.47)	---	---
Q / I^2	17.02**/76.5%	---	---
Weak (k)	4	1	2
Hedges' g (95% CI)	0.48 (-0.30, 1.25)	0.34 (-0.14, 0.82)	0.33 (-0.06, 0.73)
Q / I^2	43.94*** / 93.2%	---	0.04 / 0.0%
Group difference Q (df) / p for Q	0.53 (2) / 0.77	n/a	n/a
Study size			
100 participants or less (k)	5	1	1
Hedges' g (95% CI)	0.84 (0.46, 1.23)	0.35 (-0.35, 1.05)	0.29 (-0.29, 0.87)
Q / I^2	11.97* / 66.6%	---	---
More than 100 participants (k)	6	1	1
Hedges' g (95% CI)	-0.04 (-0.20, 0.13)	0.34 (-0.14, 0.82)	0.37 (-0.017, 0.91)
Q / I^2	12.01* / 58.4%	---	---
Group difference Q (df) / p for Q	49.84 (1) / <0.001	n/a	n/a
Participants' gender mix			
Approx. even (40% – 60% females) (k)	4	1	1
Hedges' g (95% CI)	0.49 (-0.06, 1.03)	0.34 (-0.14, 0.82)	0.37 (-0.017, 0.91)
Q / I^2	22.88***/86.9%	---	---
More than 60% females (k)	6	1	1
Hedge's g (95% CI)	0.10 (-0.19, 0.40)	0.35 (-0.35, 1.05)	0.29 (-0.29, 0.87)
Q / I^2	29.73***/83.2%	---	---
More than 60% males (k)	1	0	0
Hedges' g (95% CI)	1.12 (0.62, 1.63)	---	---
Q / I^2	---	---	---
Not reported (k)	0	0	0
Hedges' g (95% CI)	---	---	---
Q / I^2	---	---	---
Group difference Q (df) / p for Q	5.18 (1) / 0.02	n/a	n/a
Country			
US (k)	6	1	1
Hedges' g (95% CI)	0.52 (0.11, 0.93)	0.35 (-0.35, 1.05)	0.29 (-0.29, 0.87)
Q / I^2	38.79***/87.1%	---	---
Other countries (k)	5	1	1
Hedges' g (95% CI)	0.09 (-0.25, 0.44)	0.34 (-0.14, 0.82)	0.37 (-0.017, 0.91)
Q / I^2	24.24***/83.5%	---	---
Group difference Q (df) / p for Q	10.78 (1) / 0.001	n/a	n/a

6 k; number of studies; n/a; not applicable

7 (*) p<0.1 * p<0.05, ** p< 0.01, ***p<0.001

8 The format type "Internet-based individual and in groups" was not utilized for positive mental health and academic

9 performance outcomes.

Flow diagram of the study selection process.

PRISMA flow diagram From: Moher D, Liberati A, Tetzlaff J, Altman DG, P referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097
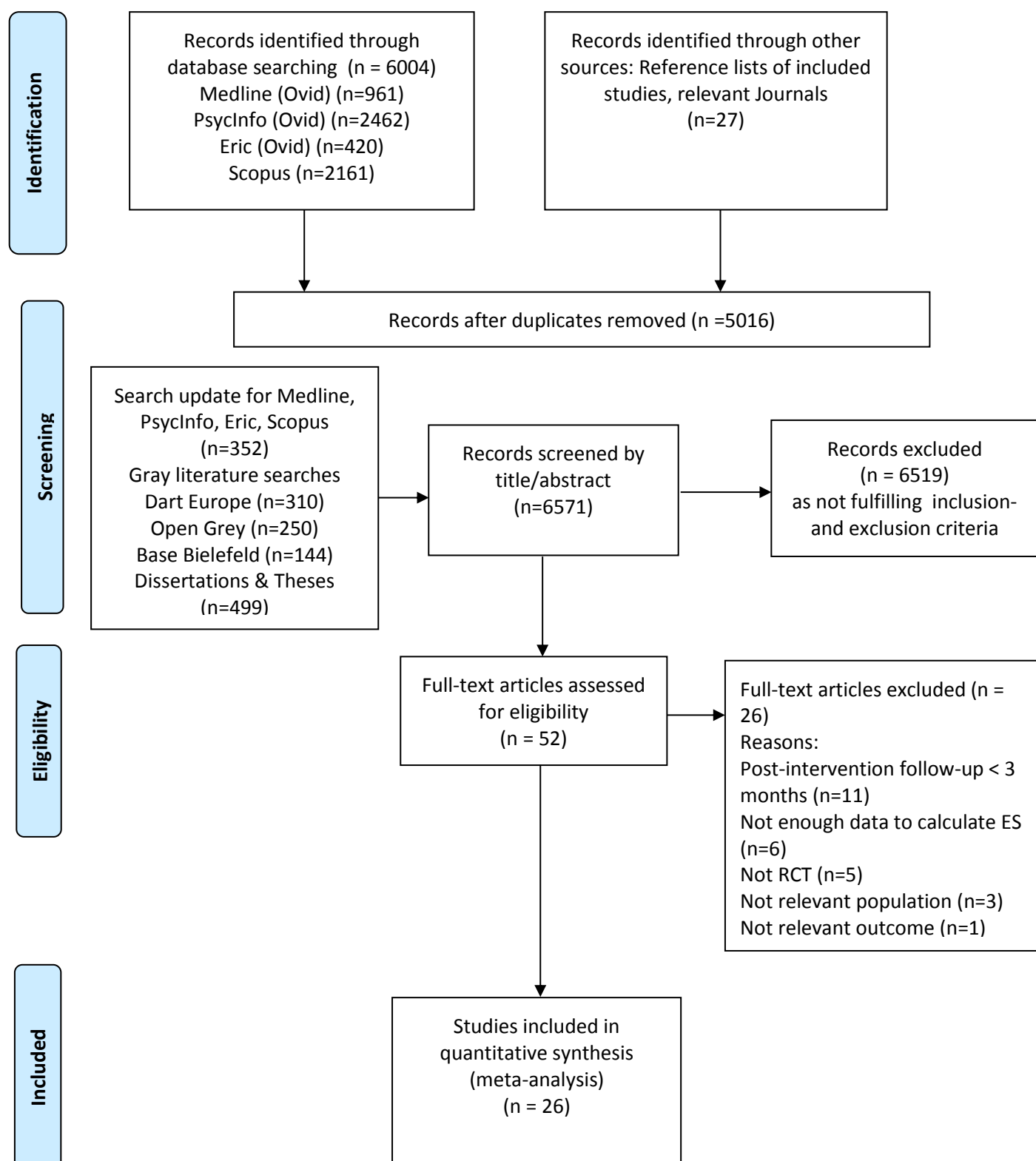
Figure 2

The effects of mental ill health preventing interventions on hierarchically selected mental ill health outcomes stratified by the length of post interventional follow-up periods.

Lines represent standardized difference in means (Hedges'g) and 95% confidence intervals (CI); the size of the box represents the weight of each study.
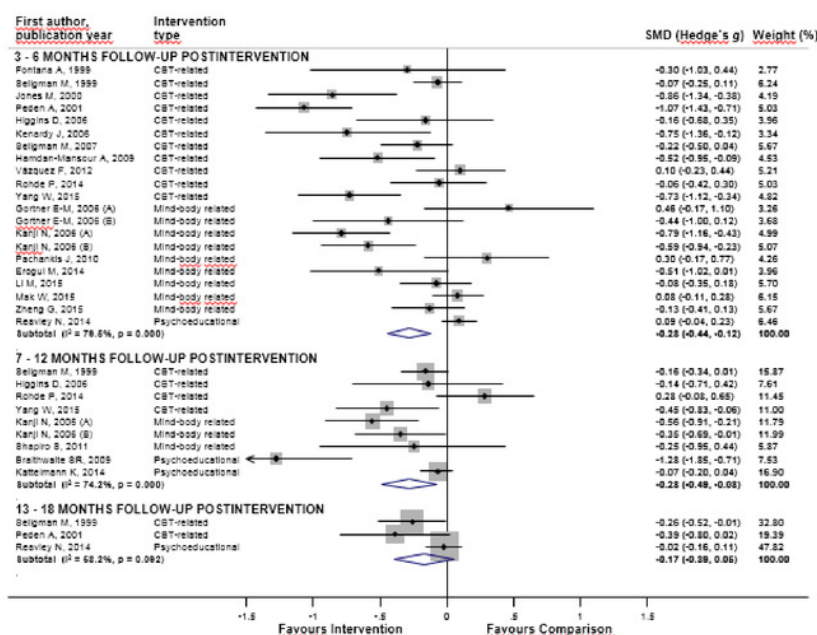
Figure 3

Theeffects of mental health promoting interventions on hierarchically selectedpositive mental health and academic performance outcomes stratified by thelength of post interventional follow-up periods.

The effect sizes of all interventions and combined subtotals for positive mental health and academic performance outcomes by the length of follow-up. Lines represent standardized difference in means (Hedges'g) and 95% confidence intervals (CI); the size of the box represents the weight of each study.