


# BMJ Open Persuasive design principle of social support in digital interventions targeting mental health symptoms: a systematic review and meta-analysis

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## ABSTRACT

**Objective** This systematic review and meta-analysis evaluates the available evidence on efficacy of social support strategies, as defined by the persuasive system design framework, in internet-based and mobile-based interventions (IMI) targeting mental health.

**Design** Systematic review and meta-analysis.

**Data sources** PubMed, Embase, PsycINFO and the Cochrane Central Register of Controlled Trials.

**Eligibility criteria for selecting studies** Randomised controlled trials comparing IMI implementing a social support strategy for mental health symptoms to various control conditions. Publications up to June 2023 (date of search 6 June 2023) were considered.

**Data extraction and synthesis** Two independent reviewers screened and extracted data in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Risk of bias was assessed with the Risk of Bias Tool V.2.0. Data were pooled based on a random-effects model.

**Results** After screening 6484 records, a total of 45 studies met our inclusion criteria. At 96%, social support was predominantly implemented through the strategy of social facilitation, by which users recognising others using the intervention (eg, discussion forum). IMI implementing social support strategies showed moderate effect sizes of Hedges'  $g = -0.34$  (95% CI  $-0.47$  to  $-0.21$ ,  $p < 0.001$ ) in comparison to different control conditions. Heterogeneity was considerable ( $I^2 = 73.6\%$ ; 95% CI 64.8 to 80.3). Subgroup analyses revealed a significant influence of targeted psychological condition ( $p < 0.001$ ), type of social support ( $p < 0.001$ ) and control condition ( $p < 0.001$ ). In  $k = 11$  component studies (ie, comparison to a disentangled version of the same intervention), IMI with social support strategies were not significantly more effective in comparison to the same IMI without social support (Hedges'  $g = -0.08$  (95% CI  $-0.22$  to  $0.05$ ,  $p = 0.19$ ,  $I^2 = 0\%$ ). 64% ( $k = 7$ ) of component studies reported higher adherence rates in IMI with social support.

**Conclusions** Based on a small number of component studies, implementing social support strategies in IMI that target mental health symptoms has no significant incremental benefit on effectiveness. To draw more robust conclusions, the potential of other social support strategies besides social facilitation should be exploited in future component studies.

**PROSPERO registration number** CRD42020222810.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the first comprehensive systematic review and meta-analysis to evaluate the persuasive system design principle of social support.
- ⇒ A large number of studies targeting different populations were screened and included.
- ⇒ The overall quality of the studies was moderate, 4% had minor concerns and 74% had some concerns.
- ⇒ Only a small number of component studies were available, making it difficult to draw definite conclusions about the effectiveness of social support strategies.
- ⇒ There was considerable heterogeneity between studies, with substantial differences in subgroup size, making it difficult to draw firm conclusions.

## INTRODUCTION

Mental health symptoms among children, adolescents and adults<sup>1 2</sup> cause significant psychological strain and impairments in various areas of life.<sup>3</sup> There is a substantial treatment gap and people in need often remain without treatment.<sup>4</sup> Internet-based and mobile-based interventions (IMI) constitute one promising low-threshold approach to extend healthcare services.<sup>4</sup> Meta-analyses point to the effectiveness of therapist-guided IMI for a range of mental disorders in adults.<sup>5</sup> In order to achieve and foster behaviour changes by means of IMI, it is important to support participants in using interventions steadily.<sup>6</sup> The use of technological features that focus on the promotion of motivation represents an alternative approach to therapist guidance to achieve this goal.

One framework that combines such motivation-supporting interventions and technologies is the Persuasive System Design (PSD).<sup>7</sup> By definition, PSD technologies are interactive systems that aim to influence intervention users to modify their attitudes and behaviour without applying coercion

or deception.<sup>8</sup> The PSD construct focuses on human-machine interaction and is divided into four subcategories: primary task support, human-machine interaction, system credibility and social support.<sup>7</sup> PSD concentrates on how to build and maintain intervention users' motivation (ie, direction and intensity of behaviour) and volition (ie, invested efforts and commitment to the realisation of intended behaviour).<sup>6</sup>

PSD seems to have a positive effect on the effectiveness of and the adherence to unguided and guided IMI for children, adolescents and young adults (AYA) and adults.<sup>9-11</sup> However, it is not yet clear whether this can be generalised to different mental health disorders. Thus, a meta-analysis by McCall *et al* suggests that PSD is more strongly associated with outcomes of unguided IMI for depression than for anxiety.<sup>10</sup> To date, the individual principles have rarely been considered in isolation, and research does not demonstrate the importance of specific PSD principles.<sup>10</sup> In particular, principles of social support have been less studied.<sup>11</sup>

The aim of this social support category is to motivate users by leveraging social influence and thereby improving adherence and engagement with the intervention. This in turn could increase effectiveness of IMI. As proposed by Oinas-Kukkonen *et al*,<sup>7</sup> social support strategies can be divided into seven subcategories. In line with these seven subcategories, Kelders *et al*<sup>2</sup> suggest the following definition of the subcategories of social support: (1) social learning: opportunity for participants to see others' intervention usage and applying the learnt behaviour (eg, sharing progress); (2) social comparison: comparison of participants' behaviour (eg, comparing responses); (3) social facilitation: recognising that other users are using the intervention (eg, discussion board); (4) cooperation: stimulation for cooperation to achieve target behaviour (eg, shared goal achievement); (5) competition: stimulation of comparison between participants (eg, leader board); (6) recognition: showing participants adopting target behaviour (eg, stories of successful users); (7) normative influence: providing normative knowledge on target behaviour (eg, activity of healthy persons).

Social support strategies have been successfully applied in health interventions (eg, IMI targeting physical activity, smoking cessation) and in disease management programmes.<sup>13</sup> Among others, Wang *et al* found that gamified team competition increased physical activity in medical interns for a short period.<sup>14</sup> Findings from qualitative research approaches indicate a positive effect of social support in IMI on engagement with the programme.<sup>15</sup>

In summary, the research findings to date demonstrate that components of the construct of PSD can have positive effects. However, it is not yet clear whether this can be generalised to different disorders, age groups and specific PSD strategies. To our knowledge, there is no meta-analysis to date that specifically addresses the social support strategy in IMI. Thus, the current systematic

review and meta-analysis aimed to close this gap and answer the following research questions:

1. Are IMI that are augmented with social support strategies targeting mental health symptoms more effective compared with various control conditions?
2. Are IMI that are augmented with social support strategies more effective when compared with the same IMI without social support in regard to effectiveness and adherence?
3. Are there theoretical or methodological factors (ie, age group, mental health symptoms, social support principle, risk of bias) moderating the effect of social support strategies in IMI targeting mental health symptoms?
4. Are social support strategies actually used by IMI users?

## METHODS

This systematic review and meta-analysis was conducted following the recommendations of the Cochrane Collaboration<sup>16</sup> and is reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.<sup>17</sup> The protocol of this study was preregistered at PROSPERO.

## Eligibility criteria

All included studies had to be published in English or German. In contrast to the study registration, only randomised controlled trials (RCT) were included for all research questions, due to the large number of high-quality studies that could be included. The five questions specified in the registration were all answered. For the sake of clarity, however, the questions on efficacy and adherence evaluated in component studies were summarised in one research question in this manuscript. Target groups were participants of all ages with mental health symptoms or psychological stress (ie, distress), diagnosed by structural clinical interviews, standardised observer-rated instruments with normed cut-off points, validated self-report measures or ratings by professional healthcare experts and non-clinical samples. Eligible interventions had to (1) be theory-based; (2) be delivered digitally through either internet-based or mobile-based means in an individual setting; (3) target mental health symptoms and (4) include a social support feature in addition to the IMI. The social support feature had to be internet-based or mobile-based and provided by other intervention users. Since we were interested in support from actual intervention users, we excluded the seventh social support subcategory of normative influence of the PSD framework. Eligible comparison conditions comprised RCT with at least one trial arm constituting of an IMI combined with a social support strategy. Various active and passive control groups as comparison conditions were eligible. To answer research question 2, only component studies comparing an IMI to a disentangled variation of the same intervention were included. Either the social support strategy was left out (ie, dismantling

study) or added to the treatment package (ie, additive design study).<sup>18</sup>

### Patient and public involvement

None.

### Search strategy, study selection and data extraction

Relevant articles were identified by searching the electronic databases of PubMed, Embase, PsycINFO and the Cochrane Central Register of Controlled Trials without restriction of publication date. For the precise, complete search strategy, please see online supplemental table S1. An additional hand-search of reference lists of selected articles was conducted. The initial search took place in December 2020 and was updated in June 2023. Publications up to June 2023 (date of search 6 June 2023) were considered. Titles and abstracts were screened by two independent reviewers (AM and MB). Afterwards, a full-text screening in terms of the eligibility criteria was conducted by the same reviewers. To reach consensus in case of disagreement, a third reviewer (MD) was consulted. The conduction and documentation of the systematic literature searches were done using the Covidence Systematic Review Software ([www.covidence.org](http://www.covidence.org)). Data from included studies were extracted by the two reviewers (AM and MB).

### Quality assessment

To assess the methodological quality of included RCT, we used the Risk of Bias Tool V.2.0 as recommended by the Cochrane collaboration.<sup>19</sup> Five domains were assessed for risk of bias: (1) arising from the randomisation process; (2) due to deviations from the intended intervention (effect of adhering to intervention); (3) due to missing outcome data; (4) due to measurement of the outcome with the participant declared as the outcome assessor; (5) due to the selection of the reported results. All quality assessments were conducted by two independent reviewers (AM and MB) and interrater reliability was determined by Cohen's Kappa.

### Statistical analysis

To answer research questions 1–3, we performed meta-analytic pooling using the package *dmetar* in the software R.<sup>20</sup> Since we assumed a considerable between-study heterogeneity, we applied a random-effects model. The heterogeneity variance  $\tau^2$  was calculated using the restricted maximum likelihood estimator.<sup>21</sup> To calculate the CI around pooled effects, we used the Knapp-Hartung adjustment.<sup>22</sup> Hedges' *g* and 95% CIs were calculated for the primary outcome symptom reduction to estimate intervention effects. Statistical heterogeneity was calculated using  $I^2$  statistics.<sup>23</sup> Forest plots were used to visualise heterogeneity. In the case of studies comparing more than two groups, we focused on active control conditions and omitted inactive controls to avoid double counting.<sup>24</sup> If a study used multiple instruments to measure the primary outcome, we selected the result of the primary outcome instrument with the best-reported psychometric

properties.<sup>24</sup> To identify possible moderators of the intervention effects, subgroup analyses were performed in the case of at least three studies per subgroup. As a methodological factor, we controlled for risk of bias.<sup>25</sup> Furthermore, in addition to the theoretically relevant factors of age group, type of mental health symptoms and social support strategy, we controlled for the type of control group. Control groups differ substantially and may influence the effects observed in a particular study.<sup>26</sup> In order to identify potential publication bias, Funnel plots and Egger's test were applied. Results on utilisation of the social support strategies were not pooled meta-analytically because of clinical heterogeneity regarding the respective definition of the construct. Instead, they were systematically reviewed and descriptively reported.

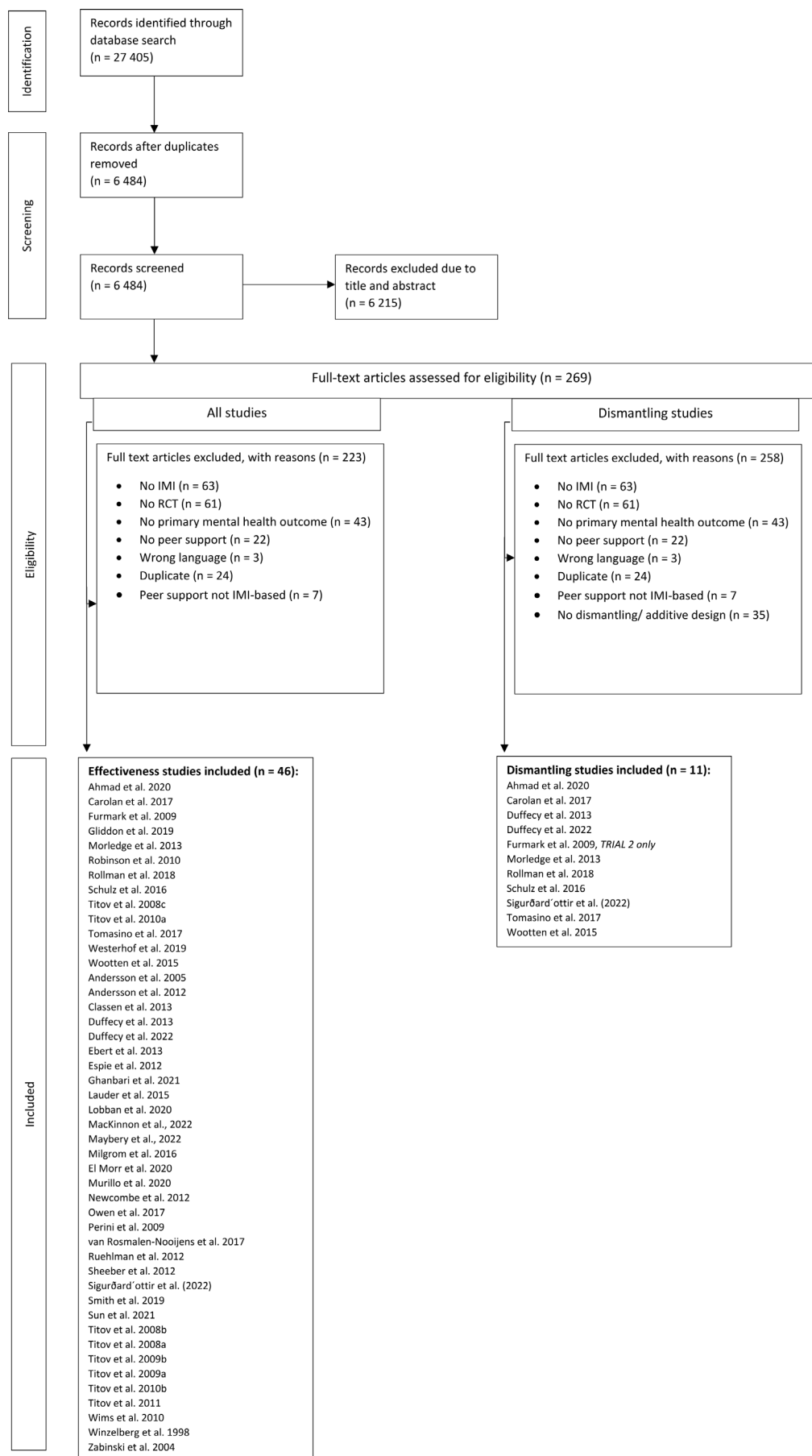
## RESULTS

### Study selection

A total of 27 405 records were identified. After removing 20 921 duplicates, 6 484 titles and abstracts were screened, resulting in 269 records eligible for full-text screening. Finally, taking all research questions into account, 45 studies were included in the systematic review and meta-analysis. Overall, 46 comparisons were included since the study of Furmark *et al*<sup>27</sup> was split in two trials. Reasons for exclusion of full texts across all research questions were: no IMI, no primary mental health outcome, no social support strategy as defined by PSD, language, duplicate and social support not IMI-based. For detailed information on the study selection process, please see the PRISMA flow diagram in [figure 1](#).

### Study characteristics

Most of the included interventions were based on cognitive behavioral therapy (CBT,  $k=35$ ; 78%), followed by psychoeducation ( $k=4$ ; 9%), mindfulness ( $k=2$ ; 4%), mindfulness combined with CBT ( $k=2$ ; 4%), coping ( $k=1$ ; 2%) and narrative therapy ( $k=1$ ; 2%). Intervention duration was on average  $M=9.08$  weeks ( $SD=2.5$ ; range: 4–18 weeks). In total, primary studies comprised  $N=6$  999 participants (74% women) with a mean age across studies of  $M=39.60$  ( $SD=11.86$ ). The mean sample size was  $n=156$  ( $SD=169.64$ ; range: 27–800). Included studies were published between 2004 and 2022 with 31% ( $k=14$ ) published within the past 5 years (2018–2023). Regarding country, most studies were conducted in Australia or USA ( $k=30$ ; 66%). Overall, 4% ( $k=2$ ) were conducted in non-western countries. In most of the studies, depression was the primary target condition ( $k=15$ ; 33%), followed by anxiety ( $k=14$ ; 31%) and mental distress ( $k=7$ ; 16%). Of the 46 included trials, 43% ( $k=20$ ) deployed a waitlist control group (CG), 11% ( $k=5$ ) used standard care CG (control group), while 46% compared the intervention group (IG) to an active CG ( $k=21$ ). 24% ( $k=11$ ) of studies implemented a component study design with regard to the social support strategy. For further information on



**Figure 1** PRISMA flowchart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

study characteristics, please see online supplemental table S2.

### Implemented social support strategies

Social facilitation was the most implemented strategy, mainly realised by asynchronous discussion boards or forums (k=43; 96%).<sup>27–68</sup> In 20 of the 43 studies implementing social facilitation, it was specified that the discussion boards and forums were moderated. Thereby, a coach encouraged discussion (eg, by posting specific topics).<sup>30–32 34 37 39 40 42 43 46 48 50 51 55 57 61–63 65 69</sup> In k=7 studies, it was reported that the discussion was monitored but not moderated.<sup>27 29 38 41 56 66 67</sup> Furthermore, k=5 (11%) studies implemented social facilitation by synchronous moderated live chats<sup>62 66 70–72</sup> or k=4 (9%) with live video-conferences.<sup>36 52 67 72</sup> By the opportunity of posting own progress and/or commenting on others' progress, the principle of social learning was implemented in k=9 (20%) studies.<sup>27 33 35 46 48 50 61 67 73</sup> In two studies (4%), it was possible to compare the comments, which enables the principle of social comparison.<sup>27 48</sup> The strategy of cooperation was implemented by sending and receiving reminders to/ from other participants (k=2; 4%)<sup>34 61</sup> or working on a shared goal (k=1; 2%) (eg, planting a common virtual garden).<sup>33</sup> The strategy of competition was included in one study (2%) by contests between participants to encourage logins.<sup>48</sup> In one study (2%) former participants acted as moderators, thereby facilitating the principle of recognition.<sup>40</sup> For detailed information on the implementation in each study, please see online supplemental table S2.

### Risk of bias of included studies

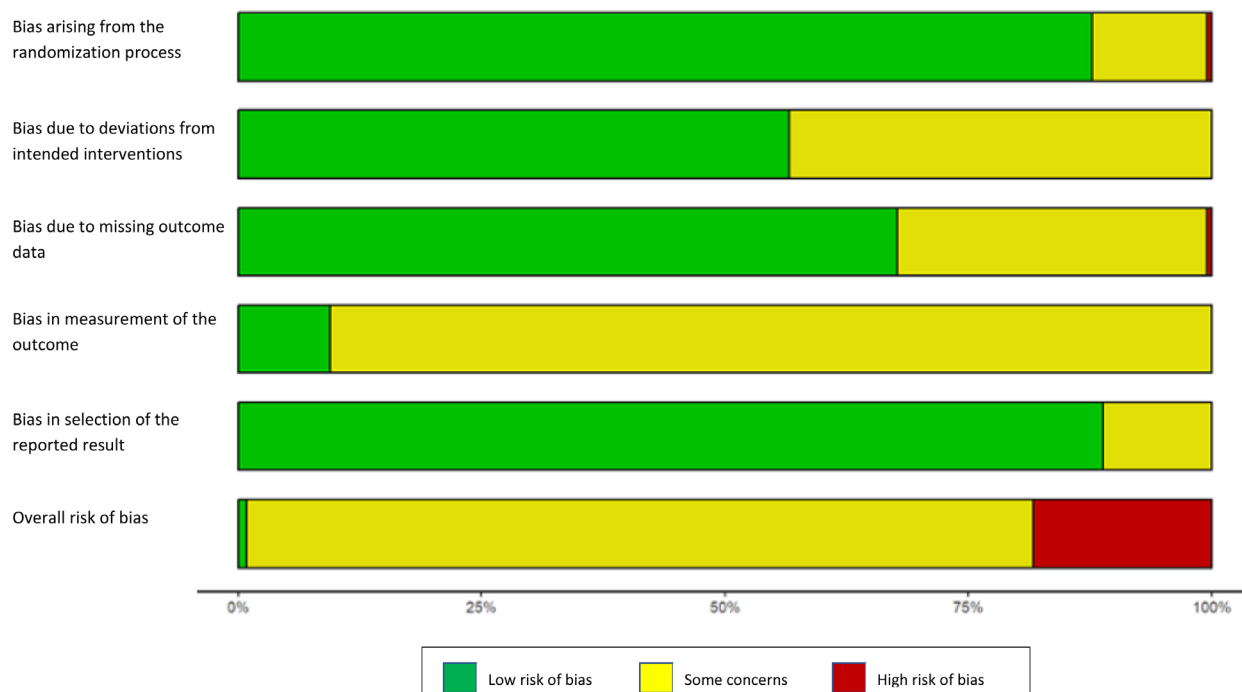
Overall, two studies were assessed to have a low risk of bias, 33 studies had some risk of bias and 10 studies were judged to have a high risk of bias (figures 2 and 3). Inter-rater reliability was acceptable with Cohen's kappa  $\kappa=0.69$ . The risk of bias judgement for each study can be found in online supplemental figure S1.

### Effectiveness in comparison to various control conditions and potential moderating factors

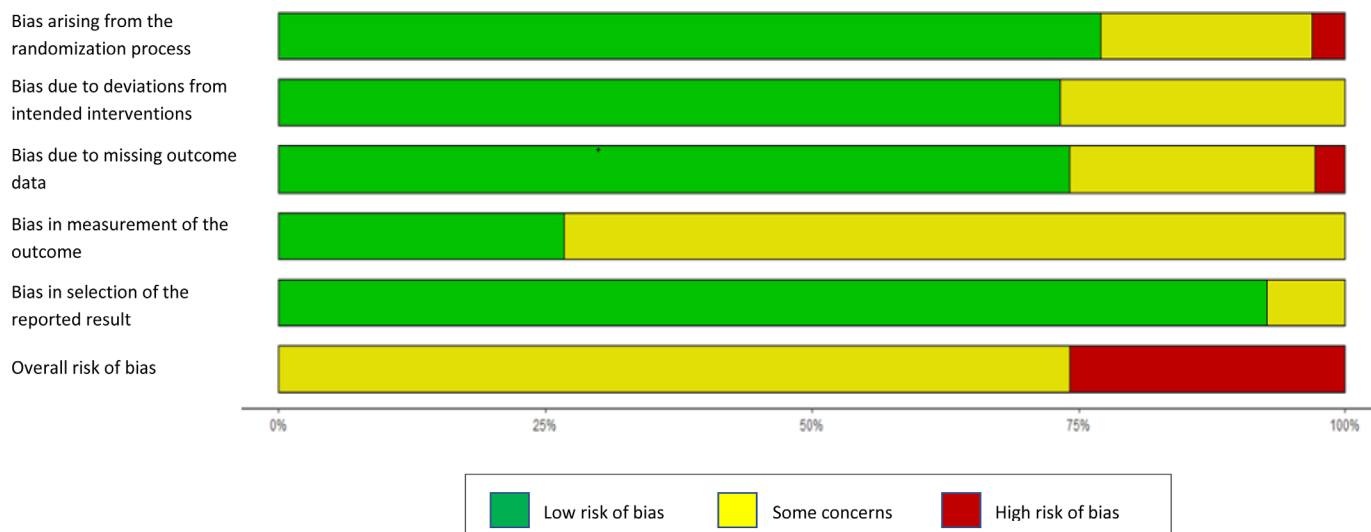
A total of 46 trials reported on the effectiveness of IMI augmented with social support compared with different control conditions. The SMDs ranged from Hedges'  $g=-1.28$  to  $0.56$ , resulting in a pooled effect size of Hedges'  $g=-0.34$  (95% CI  $-0.47$  to  $-0.21$ ,  $p<0.001$ ; figure 4). Since there was a considerable between-study heterogeneity with  $\tau^2=0.14$  (95% CI  $0.07$  to  $0.26$ ), with an  $I^2$  value of 73.6% (95% CI 64.8% to 80.3%) and  $Q(45)=170.71$  ( $p<0.001$ ), we performed subgroup analyses. In table 1, we report on the results of the subgroup analyses. There was a significant influence of the targeted mental health condition ( $p<0.001$ ), the type of social support ( $p<0.001$ ) and the control condition ( $p<0.001$ ), but not of the age group ( $p=0.22$ ) or risk of bias ( $p=0.09$ ). Regarding publication bias, the visual inspection of the funnel plot asymmetry (online supplemental figure S2) and the regression test revealed no significant asymmetry ( $t(44)=-1.38$ , intercept= $-0.92$ , 95% CI  $-2.23$  to  $0.39$ ,  $p=0.17$ ).

### Effectiveness in component studies and potential moderating factors

To gain insights whether IMI augmented with social support are more effective compared with the same IMI without a social support strategy, we pooled k=11



**Figure 2** Risk of bias summary for all included effectiveness studies (k=45).



**Figure 3** Risk of bias summary for component studies (k=11).

component studies. The SMDs ranged from Hedges'  $g=-0.37$  to  $0.33$ , resulting in a non-significant pooled SMD of Hedges'  $g=-0.08$  (95% CI  $-0.22$  to  $0.05$ ,  $p=0.19$ ). Estimated  $\tau^2$  was  $0.0001$  (95% CI  $0$  to  $0.06$ ) with an  $I^2$  value of  $0\%$  (95% CI  $0$  to  $60.2\%$ ;  $Q(10)=7.12$ ,  $p=0.71$ ). Preplanned subgroup analyses revealed no significant moderating influences of mental health symptoms ( $p=0.47$ ), age group ( $p=0.71$ ), type of social support ( $p=0.39$ ) or risk of bias ( $p=0.45$ ). Detailed information on these subgroup analyses is found in table 2. With regard to potential publication bias, the visual inspection of the funnel plot symmetry (online supplemental figure S3) and the regression test revealed no significant asymmetry ( $t(9)=1.11$ , intercept= $0.71$ , 95% CI  $-0.54$  to  $1.96$ ,  $p=0.30$ ).

### Adherence in component studies

Of the  $k=11$  component studies, four reported the mean and SD of completed modules.<sup>31 50 61 74</sup> There was a non-significant standardised mean difference between groups with versus without social support of Hedges'  $g=0.07$  (95% CI  $-0.29$  to  $0.44$ ,  $p=0.57$ ). Estimated  $\tau^2$  was  $0$  (95% CI  $0$  to  $0.84$ ) with an  $I^2$  value of  $0\%$  (95% CI  $0$  to  $84.7\%$ ;  $Q(3)=1.92$ ,  $p=0.59$ ). Furmark *et al*<sup>27</sup> also reported on the module completion rate but without reporting the standard deviation (IG:  $M=7.35$  vs CG:  $M=6.41$ ). Two studies reported on the rate of participants completing all modules: Rollman *et al*<sup>48</sup> found that  $36.1\%$  of the IG completed all modules, whereas in the CG  $37.2\%$  completed all modules. In the study of Wootten *et al*,<sup>65</sup> the completion rate was  $60\%$  in the IG and  $57\%$  in the CG. Ahmad *et al*<sup>28</sup> reported that in the group with social support, more participants watched 7–12 of 12 videos (IG:  $65\%$  vs CG:  $38\%$ ). Furthermore, two studies compared the number of logins between groups: neither Duffecy *et al*<sup>34</sup> (IG:  $M=21.5$ ,  $SD=18.7$ ; CG:  $M=11.3$ ,  $SD=8.6$ ,  $p=0.20$ ) nor Duffecy *et al*.<sup>33</sup> ( $t(193.07)=0.51$ ,  $p=0.60$ ) found a significant difference between logins over 8 weeks between groups. Morledge *et al*<sup>42</sup> found that in the IG  $37\%$  practiced at least one exercise versus  $43\%$  in the CG. In total,

$64\%$  of the component studies reported a higher adherence in groups with social support.

### Utilisation of social support strategies

Overall,  $k=23$  ( $50\%$ ) studies reported on the usage of social support features. In average across six studies, participants made  $M=7.40$  ( $SD=3.26$ ; range of mean  $2.20$ – $10.50$ ) contributions to social support features (eg, commenting).<sup>31 32 40 48 50 69</sup> The percentage of participants accessing the social support feature at least once was reported in eight studies and ranged from  $28\%$  to  $100\%$ .<sup>38 40–42 48 61 67 74</sup> Across these eight studies, the reported mean percentage was  $67.50\%$  of participants. EIMorr *et al* ( $M=1.92$ )<sup>36</sup> and Sun *et al* ( $M=3.39$ ,  $SD=1.10$ )<sup>52</sup> reported on the number of visitors per live session.

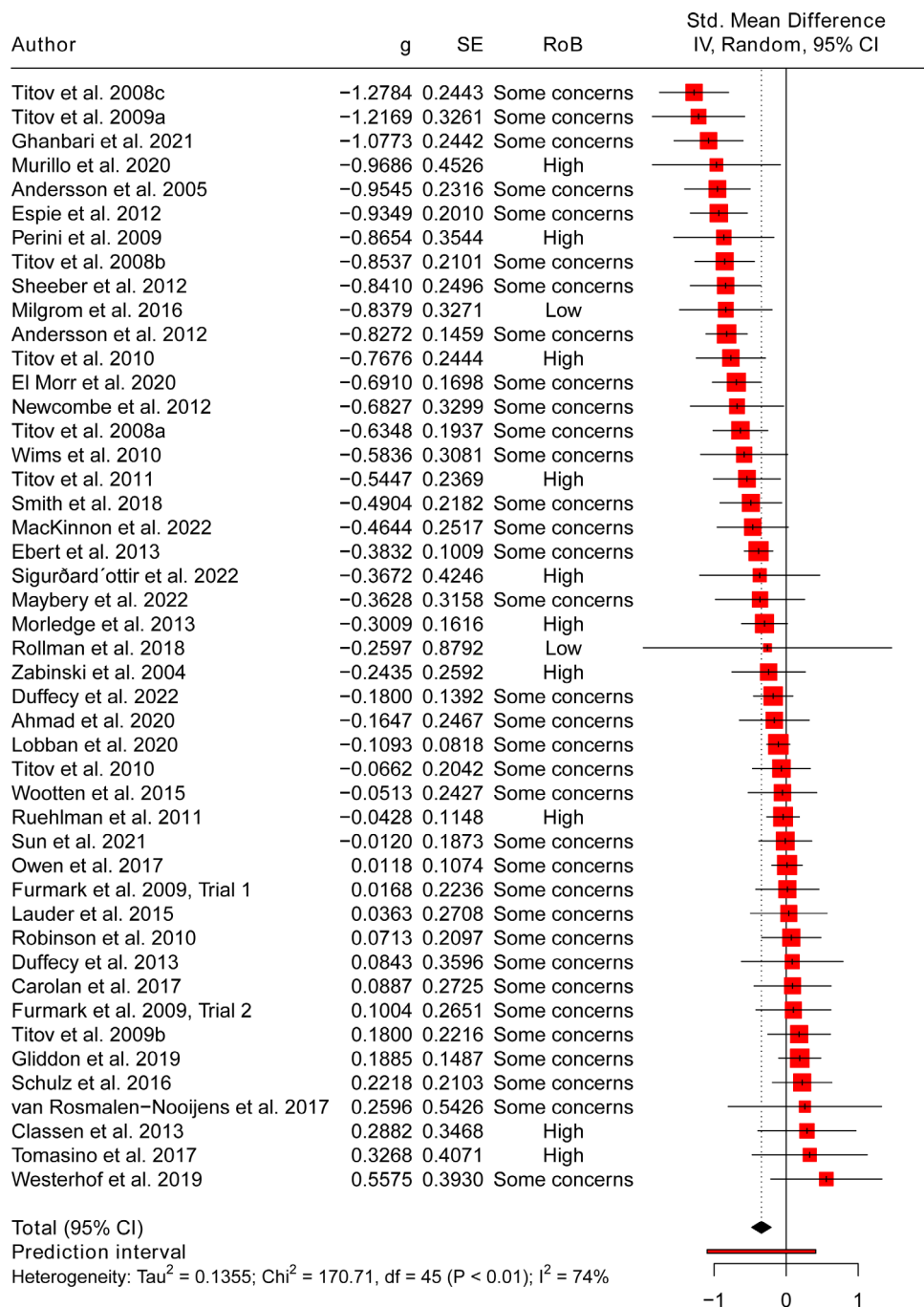
Activity per session (eg, number of comments, access and performing any activity at least once) was reported in five studies with different operationalisations.<sup>41 43 62 63 71</sup>

The values ranged from  $M=0.54$  to  $3.8$  and the percentage values from  $17\%$  to  $82\%$ . Furthermore, number of visits ( $M=13.4$ ,  $SD=9.1$ ),<sup>51</sup> percentage of participants using live sessions ( $31\%$ ),<sup>32</sup> overall contributions ( $n=233$ ),<sup>29</sup> and time spent with features ( $M=2$  hours  $40$  min)<sup>50</sup> were reported in one study each. Please see online supplemental table S3 for an overview of engagement results.

### DISCUSSION

This systematic review and meta-analysis evaluated research implementing social support strategies in digital interventions targeting mental health symptoms. As a framework, we used the PSD principles. Across all research questions, 45 studies were included in this systematic review and meta-analysis. Of these, 11 component studies provided information on the direct effect of social support strategies on effectiveness and adherence.

The results of this systematic review and meta-analysis suggest that social support is predominantly implemented by the strategy of social facilitation (ie, forum, discussion



**Figure 4** Forest plot for all effectiveness studies (k=46).

boards). According to our subgroup analysis, the type of social support seems to play a significant role in terms of effectiveness of IMI. Notably, except the social facilitation strategy, no other social support strategy or combination of different strategies was represented by more than three studies and could thus not be interpreted, given the methodological standard, recommending to not interpret subgroups with fewer than three studies.<sup>24</sup> Within the subgroup of social facilitation, we found a considerable heterogeneity. This could be due to the fact that the forums and discussion boards are structured very differently. There are forums that are moderated, meaning that posts are actively posted by the team to stimulate

discussion. On the other hand, there are forums where only content is monitored and activity is left entirely to the participants themselves. Taking only the component studies into account, five studies report on the additional effect of implementing social facilitation, and the result is a non-significant effect.

Other social support strategies such as competition or cooperation are implemented rarely. One reason for this could be that extensive technical implementations are necessary for a mature competition or cooperation system. For instance, Alvarez *et al*<sup>75</sup> implemented an extensive social support programme in a digital intervention targeting AYA with ultra-high risk for psychosis. There

**Table 1** Results on subgroup analyses for all included effectiveness studies (k=46)

Subgroup	g	95% CI	I <sup>2</sup>	P <sub>subgroup</sub>
Mental health symptoms				< 0.001
Depression (k=15)	-0.40	-0.65 to -0.16	56.1%	
Anxiety (k=14)	-0.45	-0.77 to -0.13	82.7%	
Mental distress (k=7)	-0.15	-0.42 to 0.12	62.5%	
Age group				0.22
Adult (k=41)	-0.35	-0.50 to -0.20	76.2%	
AYA (k=4)	-0.20	-0.48 to 0.08	0.00%	
Type of social support				< 0.001
Social facilitation (k=35)	-0.41	-0.57 to -0.25	76.6%	
Control condition				< 0.001
Active (k=21)	-0.10	-0.247 to 0.05	49.0%	
Waitlist (k=20)	-0.56	-0.78 to -0.34	80.1%	
TAU (k=5)	-0.45	-0.66 to -0.25	0.00%	
Risk of bias				0.09
Some concerns (k=34)	-0.33	-0.50 to -0.17	77.7%	
High (k=10)	-0.33	-0.61 to -0.05	53.6%	

AYA, adolescents and young adults; g, Hedges' g; TAU, treatment as usual.

are not only various functions for exchange involved in their study but also cooperation and common problem-solving approaches. For example, participants have the ability to post a challenge in which other participants can join.<sup>75</sup> Their piloting points to successful deployment of the intervention design.

The combination of different principles has also been implemented rarely. Wildeboer *et al*<sup>76</sup> found that the combination of the principles of social learning and comparison might be promising. In regard to this, it is also of paramount importance to consider which types of PSD strategies work well together and which ones might have a diminishing or unapparent effect.<sup>11 76</sup> To answer this question, further studies are needed that not only

combine different social support strategies in a step-wise manner but also consider the combination of social support strategies with other PSD principles.

Besides the combination of different strategies, Owen *et al*<sup>77</sup> found that different channels for social support strategies (ie, chat, discussion board, e-mail or blog) reached different types of users. Moderators included gender, symptom severity and recruitment strategy, among others. Overall, it would be useful to apply additional and varied implementations of social support to ensure the maximal reach and inclusion of the target groups. In order to perform such extensive implementation procedures in a goal-oriented way, the application of instructional design process based on Behaviour Change Model for digital

**Table 2** Results on subgroup analyses for component studies (k=11)

Subgroup	g	95% CI	I <sup>2</sup>	P <sub>subgroup</sub>
Mental health symptoms				0.47
Depression (k=4)	-0.11	-0.38 to 0.15	0.00%	
Mental distress (k=3)	-0.16	-0.65 to 0.33	0.00%	
Anxiety (k=3)	-0.10	-0.48 to 0.68	0.00%	
Age				0.71
Adult (k=10)	-0.07	-0.22 to 0.08	0.00%	
Type of social support				0.39
Social facilitation (k=5)	-0.18	-0.38 to 0.03	0.00%	
Risk of bias				0.45
Some concerns (k=7)	-0.03	-0.19 to 0.12	0.00%	
High (k=3)	-0.23	-0.87 to 0.40	7.7%	

g, Hedges' g.



interventions could be useful.<sup>78 79</sup> In this regard, it is important to emphasise that it cannot be assumed that every participant needs the same solution. Rather than a one-fits-all model, it might be important that tailoring options are implemented so that users can decide about using specific IMI features based on their preferences.

Regarding effectiveness of the implemented social support strategies, we found 11 component studies. Component studies are important since they allow an assessment of whether the construction of social support characteristics can be worthwhile.<sup>80</sup> Currently, the data suggest no additional benefit of social support strategies compared with the same IMI without the examined strategies. One potential explanation for the non-significant effect might be the low utilisation of the features. To ensure that social support strategies can be effective, it is crucial that they are sufficiently used.<sup>81</sup> Geramita *et al*<sup>81</sup> reported that participants with a higher utilisation of social support features showed significant improvements in anxiety and quality of life compared with non-users. Furthermore, research suggests that active users in particular find the features more helpful than inactive users.<sup>82</sup> In the studies included in this review, the reported utilisation rates are quite low. However, we note that in the included studies, utilisation has been measured heterogeneously, which restricts the comparability of the results. Based on the data about access to a social support feature, uptake does not seem to pose a problem, but constant and active use of the interventions does. Therefore, possibilities that promote active use of the features should be considered. One opportunity could be reminders in the form of a combination of the social cooperation strategy. For example, 'buddy' pairs could remind each other of an active contribution to the forum.<sup>83</sup>

Furthermore, it might be valuable to pay more attention to potential sociodemographic or clinical differences between users and non-users as it may be necessary to tailor social support features depending on the target group. For example, it is conceivable that not all participants take part in social support features spontaneously, for example, due to shyness. In a face-to-face setting, such participants can be supported by therapists. This might be also important in IMI, for example, by active motivation by eCoaches in guided IMI. In general, the low utilisation rates of social support features are not uncommon in the field of digital marketing. The 90-9-1 rule suggests that 1% of online group members create approximately 90% of the content, 10% creates <10% and 90% of participants only observe the activities without an active contribution.<sup>84 85</sup> The same phenomenon has already been observed in digital intervention research. Thus, in various studies, participants were spending time in forums without making active contributions.<sup>32 86</sup>

Including all studies with different control conditions, we found a moderate effect size with considerable heterogeneity and thus limited interpretability of the effect. The considerable heterogeneity might be due to the variety of included target populations and intervention

designs (ie, guidance, intervention duration, theoretical background). The subgroup of targeted mental health symptoms was significant. Our finding is in line with the general research on peer support, suggesting similar large positive effects for depression and anxiety.<sup>87</sup> However, our results contradict with preliminary findings that indicate PSD had a significant impact on the effectiveness of unguided IMI for depression, but not on IMI for anxiety.<sup>10</sup> Component studies could support a more robust conclusion about the effect of social support in different disorders. However, in our analysis, there was no significant subgroup effect of different mental health symptoms between component studies. Notably, the number of component studies was small and a predominance of studies targeting adults and affective disorders was observed.

Finally, PSD aims to increase adherence. We found that groups with social support were more adherent to the treatment compared with control groups without social support in the majority of studies (64%). This result maintains the idea that social support can promote adherence to IMI.<sup>77</sup> However, it should be noted that adherence was reported differently among the studies, making it difficult to compare adherence values with each other. A pooled effect across four studies reporting on the mean of completed modules was non-significant. Since a dose-response relationship is postulated repeatedly in the field of digital intervention research, it becomes of utmost importance to define adherence in a uniform way, so that pooled statements can be made on the basis of a larger number of studies.

### Strengths and limitations

The strength of this first comprehensive systematic review and meta-analysis evaluating the PSD principle of social support lies in the large number of included studies. The inclusion of different populations increases generalisability. As a further strength, the overall quality of the studies was moderate, with 4% having minor concerns and 74% having some concerns. Besides these strengths, there are some limitations of this systematic review and meta-analysis that should be considered when interpreting the findings. First, the number of eligible component studies was rather small. Second, due to the different sizes of subgroups, drawing distinctive conclusions pose a challenge. Third, the results might not be generalisable to young age groups and to non-western countries. Fourth, we did not evaluate the long-term effectiveness, only the postintervention effect. Fifth, the moderate bias between the studies limits the interpretability of the results. Furthermore, only German or English studies were included in this study.

### CONCLUSION

Implementing social support strategies in IMI targeting mental health has non-significant add-on effect beyond the effectiveness of respective IMI without social support

optimisation. The majority of component studies reported an increase in adherence due to the introduction of social support features to the intervention, although in a direct comparison, this result was found non-significant. Utilisation of social support features should be expanded. Implementing and combining new strategies apart from discussion boards and forums could create new opportunities. Further component studies are needed to draw more robust conclusions.

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