

Effectiveness of distance based suicide intervention programs, a multi-level meta-analysis
and systematic review.

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Abstract

Background: Distance based Interventions against suicidal thoughts and behaviours are an increasingly found intervention type. Because these are affordable and available they could supplement treatment options and narrow the gap between needed and provided care.

Aims: Evaluating the overall effectiveness of distance based interventions against suicidal thoughts and behaviours. Methods: We systematically searched Web of Science, Scopus and Pubmed for all distance based interventions primarily aimed at reducing suicidal thoughts and behaviours. We including all outcome measures of suicidality. Data was synthesised using a robust variance estimation corrected multilevel meta-analysis . Results: 41 studies were included, reporting 121 outcomes. Effectiveness against suicidal thoughts was low ($SMD = -0.17$ $CI_{95\%}[-0.21;-0.13]$), but comparable to face-to-face interventions. Against suicidal behaviours effectiveness were significantly lower ($SMD = -0.06$ $CI_{95\%}[-0.08;-0.03]$). Human involvement had no significant impact on effectiveness. Conclusion: Distance based interventions are an effective tool in a stepped care approach specially for reducing suicidal thoughts. Future research should focus on the development of mass distributable autonomous programs against suicidal ideation and plans.

Keywords: suicide, suicide prevention, meta-analysis, distance based intervention, remote intervention, e-based intervention

Word count: 3884

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Introduction

Suicidal thoughts and behaviours are both a challenge for public health and for service providers, given that annually 138 Million people experience suicide ideation, 20.7 Million people attempt suicide (Borges et al., 2010) and around 700.000 people die by suicide (World Health Organization, 2021). Still only 17% to 56% of them receive treatment (Bruffaerts et al., 2011). Besides these undressed needs, low treatment rates are linked to two structural barriers: Treatment cost and availability (Bruffaerts et al., 2011).

Improving affordability and accessibility of treatment means to provide suicide specific care in terms of tailored interventions according to the patients stage of suicidal progression, rather than using a one fits all solution. It has been suggested to implement a stepped care approach, least restrictive care at early stages and to increase restrictions gradually with advancement of suicidal progression (Jobes, Gregorian, & Colborn, 2018). In this sense, easily available and affordable treatment can lower treatment barriers and involve individuals otherwise hesitating to seek help at early suicidal stages (Bruffaerts et al., 2011). Early interventions at the stage of suicide ideation, have been suggested to lower human suffering and to prevent future suicides (Zuromski et al., 2019).

Distance based programs are least restrictive treatments, in terms of local availability, affordability and service opening hours. Under-serviced areas can be supported by both tele-health and Apps. A one time purchase of an App, costs a fraction of a single therapy session and is accessible 24h.

During the past two decades a number of randomized control trials examining distance based programs have been published. Starting at the turn of the millennium, with studies using phone-calls (Evans, Morgan, Hayward, & Gunnell, 1999) and post-cards

(Motto & Bostrom, 2001), leading to crisis hotlines and e-mail follow-ups (Luxton, Smolenski, Reger, Relova, & Skopp, 2020). Recently the field has expanded to online programs (Franklin et al., 2016; B. A. J. van Spijker, van Straten, & Kerkhof, 2014) and since the Covid-19 outbreak increasingly to tele-health approaches (Fernandez et al., 2021). Several Meta-analyses have been published on subsets of distance based programs (Milner, Carter, Pirkis, Robinson, & Spittal, 2015; Torok et al., 2020).

To give recommendations for future research, our meta-analysis differentiated between autonomous interventions (i.e. apps, online programs) and human involved interventions (phone calls, postcards, tele-health), which allows to investigate, whether the scalability of autonomous interventions can be utilized without risking effectiveness. To reach as many suicidal individuals as possible in early stages of progression, distance based programs need to be scalable and cost-effective. Autonomous interventions have superior scalability compared to human involved interventions (Batterham et al., 2015), as they are less expensive per intervention, less restricted by service opening hours, they are translatable, and immediately available.

In order to draw practical conclusions we asked three questions, implemented as moderation analyses: (a) Whether distance based programs are effective against suicide ideation and/or against suicidal behaviours, (b) How stable these interventions are over time and (c) Whether effectiveness of such programs was independent from the chosen control groups.

Methods

The systematic search followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Page et al., 2021) and was Pre-Registered on Prospero under the pre-registration number: CRD42020218791.

Systematic Search

Search strings were defined using repeated searches combining the terms suicide prevention OR intervention, with the intervention types, (e.g.) Letter, App, Web-based, OR distance. The resulting search string was tested and refined using two related meta-analyses, focusing on human involved distance based interventions (Milner, Carter, Pirkis, Robinson, & Spittal, 2015) and autonomous interventions (Torok et al., 2020) (see Supplement A for the final strings).

Once search strings were established, the first one hundred search results of Web of Science were examined together by the authors J.S. and K.R., establishing a common degree of understanding. After which, both authors independently searched Web of Science, Scopus and Pubmed; Systematic searches were last updated on the Cohen's kappa between both authors was 0.806. [INTERNAL: As of 30.09 in WOS no new entries]

Inclusion and exclusion criteria

All peer reviewed randomized control trial studies were included, which investigated any form of distance based programs aimed at preventing self-harming thoughts and/or behaviours, such as suicidal ideation, suicidal planning, suicide attempts, non-suicidal self-injury (NSSI), and suicide. Face-to-face meetings were allowed, if these were not part of the intervention - i.e. for informing, testing or screening purposes.

Interventions which aimed at psychiatric disorders as a primary outcome and combined outcome measures, such as the total score of SBQ-R, summing thoughts and behaviours in a total score were excluded. Further, blended programs, such as phone-calls including home visits were excluded.

Data Extraction and Coding

Data was coded independently by two authors (J.S and K.R.). Where possible non-imputed results, were coded. The following variables were extracted : Author, Year, control group of study, Country of Study, Sample type, sample size, intervention type, sex ratio, mean age, mean age(SD), the outcome name (e.g. self-harm), intervention duration in weeks, the participant attrition rate, the follow up time, standard mean difference (*SMD*) and variance of *SMD*. In addition, all outcomes were coded for the moderation analysis into subgroups (see Table 1).

The authors compared finalized coding sheets, discussed differences and re-coded affected studies until a unanimous result was achieved (see Appendix).

Risk of bias and publication bias

Risk of bias was assessed using the RoB-2 (Sterne et al., 2019) and Trim and Fill was used as the publication bias detection (Fernández-Castilla et al., 2021; Renkewitz & Keiner, 2019).

Statistical Method

To incorporate all outcomes of interest we used a three level meta-analysis (Cheung, 2019; Van den Noortgate, López-López, Marín-Martínez, & Sánchez-Meca, 2015), with Robust variance estimation (RVE) (Hedges, Tipton, & Johnson, 2010; Moeyaert et al., 2017). RVE return valid confidence intervals in presence of dependent data (Park & Beretvas, 2019). While the three level model allowed for outcome-level heterogeneity investigation (Van den Noortgate, López-López, Marín-Martínez, & Sánchez-Meca, 2013), RVE return valid confidence intervals in presence of dependent data (Park & Beretvas, 2019). Models were fitted with restricted maximum likelihood estimation (REML), RVE correction was based on Pustejovsky and Tipton (2016).

Calculations were done in R (R Core Team, 2020) using the package *metafor* for the three level model (Viechtbauer, 2010) and the package *clubSandwich* (Pustejovsky, 2021) for the RVE correction. R Code is available on GitHub.

Calculations were done in R (4.1.1) (R Core Team, 2020) using the package *metafor* (Version. X.XXX.) for the three level model (Viechtbauer, 2010) and the package *clubSandwich* (Version XXX) (Pustejovsky, 2021) for the RVE correction. R-Code is available as online supplement.

Sensitivity Analysis

Given that NSSI (American Psychiatric Association, 2013) and suicidal behaviours (Joiner, 2005) may differ qualitatively, we employed two sensitivity analyses: (a) Including Non-Suicidal Self-Injury (NSSI) as an outcome, (b) Excluding suicide cases as an outcome.

Deviation from Pre-Registered Report

Deviation from Pre-Registered Report

Given most recent developments in meta-analysis research we adapted the procedure as follows: Firstly instead of the complex multi-level model , we employed a hybrid model of RVE correction and multilevel method (Pustejovsky & Tipton, 2021), thereby improving efficiency and reducing risk of bias. Secondly, we followed the publication bias detection method recommended by Fernández-Castilla et al. (2021), although following the originally planned method (Renkewitz & Keiner, 2019) would generate the same results.

Results

Emerged Data

We identified 3,287 papers in the databases and additional 11 studies from other sources (see Flow Chart), including 37 independent studies. The difference between

included studies in the Flow chart and reported independent studies is explained by follow-up studies that use the same sample as their parent study. These follow-up studies are reported as independent studies, but because they are statistically dependent to their parent, they were treated as dependent within our meta-analysis. Further one study included 3 statistically independent RCT trials (Franklin et al., 2016).

Overall, 121 outcomes emerged, with 65 outcomes of the category thinking, predominantly ideation and planning, and 56 outcomes of the category acting, including studies examining mostly deliberate self-harm, self-harm and suicide attempts.

29 outcomes were found in the human involved interventions category and 92 outcomes were found for autonomous interventions. The median duration of studies was 26.00 weeks, with a range of 24 to 24 weeks. The median time between post-intervention measures and follow up measures was 17 weeks, with a range of 522 weeks to 0.86 weeks.

The median attrition rate was 30.00 % with a maximum of 64.50 % and a minimum of 0 %.

Sample Characteristics. The studies included a total of 12821 at post-intervention 9201 at follow up. Out of all, 62.88 % female and on average 30.80 (SD= 9.95) years old. In studies the youngest reported mean sample age was 14.70 (SD= 1.4) years, the oldest mean sample age was 51.00 (SD= 11.3)years.

Out of a total of $n = 37$ studies, most data was retrieved from the United States ($k = 10$), followed by Australia ($k = 8$); and from non-westernised educated industrialised democracies (WEIRD; $k = 6$) countries.

Main Analysis

Distance based interventions were effective against suicidal thoughts and behaviours, standardized mean difference (SMD) = -0.11 CI95%[-0.16; -0.07]; Heterogeneity was significant at Q ($df = 114$) = 160.42, $p = 0.00$.

The moderation analysis was significant, showing that distance based programs were ($SMD = -0.11$ CI95%[-0.18; -0.05]) more effective against suicidal thoughts than suicidal behaviours. The average effectiveness against suicidal thoughts was $SMD = -0.17$ CI95%[-0.24; -0.10] compared to $SMD = -0.06$ CI95%[-0.08; -0.03] for suicidal behaviours. Heterogeneity was non-significant Q ($df = 113$) = 124.67, $p = 0.21$. See Appendix C for study average effects against suicidal thoughts and suicidal acts.

Given small study numbers, the comparison of waitlist and attention placebo groups showed statistically not trustworthy results according to the profile likelihood plots.

Therefore, waitlist and attention placebo were combined into a combined control group, and compared to TAU.

Comparing the combined control-group vs. TAU, TAU groups were significantly less impacted by distance based interventions ($SMD = -0.17$ CI95%[-0.26; -0.08]), than studies using a waitlist or attention placebo designs. Heterogeneity remained significant at Q ($df = 113$) = 146.85, $p = 0.02$.

Covariance was investigated by simultaneous visualization of control-group and outcome category. Suicidal behaviours and suicidal thoughts were unevenly distributed between different control-groups (see figure 2).

An exploratory analysis including both moderators was implemented.

When including both moderators, the difference between TAU and the combined control group was non-significant, with $SMD = 0.05$ CI95%[-0.05; 0.14], but suicidal acts and suicidal thoughts remained a significant moderator, with $SMD = -0.10$ CI95%[-0.18; -0.01] in favour of suicidal thoughts; heterogeneity was not significant at Q ($df = 112$) = 124.29, $p = 0.20$.

Effectiveness of distance based interventions decreased between time-points at $SMD = 0.03$ CI95%[-0.02; 0.08] non-significantly. Heterogeneity was significant at Q ($df = 113$) = 158.54, $p = 0.00$.

Human involvement had with $SMD = -0.04$ $CI_{95\%}[-0.12; 0.05]$ an non-significant negative impact on effectiveness. Heterogeneity was significant at $Q (df = 113) = 155.42, p = 0.01$.

Sensitivity Analysis

Both, inclusion of NSSI ($k = 6$) and exclusion of suicide studies ($k = 4$) had negligible impacts on the subgroup of behaviour outcomes. Inclusion of NSSI increased the effectiveness $SMD = -0.06$ to $SMD = -0.09$. and exclusion of suicide studies decreased effectiveness from $SMD = -0.09$ to $SMD = -0.05$.

Publication Bias and Risk of Bias Assessment

Risk of bias of all *independent* studies was mixed (see Figure 3.). Using Trim and Fill, no publication bias could be observed.

Discussion

In this meta-analysis we investigated the effectiveness of distance based programs in reducing suicidal thoughts and behaviours. On average distance based programs reduced both suicidal thoughts and behaviours. The quality of evidence was good, given a considerable number of RCTs, with a notable number of high and medium quality studies and no observed publication bias.

Contextualising results with other Meta-Analyses. We showed that suicidal behaviours were reduced (-0.17 $CI_{95\%}[-0.24; -0.10]$) by distance based programs. These reductions were in line with face-to-face therapeutic interventions. One recent meta-analysis on face-to-face therapeutic interventions (Ougrin, Tranah, Stahl, Moran, & Asarnow, 2015) reported a reduction of $SMD = -0.11$ $CI_{95\%} [-0.38; 0.15]$ for suicide attempts and a current meta-analysis (Kothgassner, Robinson, Goreis, Ougrin, & Plener,

2020) reported a reduction of $SMD = -0.13$ CI95% [-0.22;-0.04] for self harm. In contrast to these short-term interventions, a meta-analysis of higher-frequency and long-term psychoanalytic face-to-face interventions (Briggs et al., 2019) reported stronger results, for suicide attempts $SMD = -0.24$ CI95%[-0.50 to 0.03] and for self harm between $SMD = -0.73$ CI95% [-1.22;-0.22] and $SMD = -0.15$ CI95% [-3.88;0.09]; depending on how self harm was measured. Given that most distance based programs had very low frequencies (e.g. letter sent every few months), while Ougrin, Tranah, Stahl, Moran, and Asarnow (2015) and Kothgassner, Robinson, Goreis, Ougrin, and Plener (2020) mostly included low frequency face-to-face interventions and Briggs et al. (2019) mostly included higher frequency interventions. Frequency of intervention seems to be a moderating factor for effectiveness.

Although distance-based interventions seem to have a small effect size in comparison to face-to face interventions, especially high-frequency long-term interventions, they might have a role in the prevention of suicidal behaviour due to their availability, scalability and cost-efficacy. Even more, it remains to be analysed, whether the higher effectiveness of face-to-face interventions, which is based on rather small samples, would remain superior when their power would be increased. For example, although the effect size of the meta-analysis by Briggs et al. (2019) seems four times higher than the effect size of distance based interventions, our effect is more precise and statistically significant.

When we also draw on the effect-size estimates and their confidence intervals, we can observe the clinical potential of an intervention. For example, the effect size reported by Briggs et al. (2019) against suicide attempts, expressed as Number Needed to Treat, (NNT) is $= 7.4$ CI95% [Inf; 3.6], means that the interventions may be ineffective (Infinite number needed), but it could help up to every fourth person. In contrast, our results of distance based programs, expressed as $NNT = 29.5$ CI95% [59; 22.1] means that a reduction will occur with 95% certainty, but *at best* only every twenty-second person will be helped and on average one of 30 interventions will be helpful. Given the seriousness of suicidal behaviours and the currently low effectiveness of interventions against it, more

research on potentially more effective treatment is needed. For example, we suggest more research into high frequency interventions and on the question if the trend of larger effect-sizes in psychoanalytical therapies (Briggs et al., 2019) and DBT-A therapies (Kothgassner, Robinson, Goreis, Ougrin, & Plener, 2020) is retained, given more data. However, despite the low effect of distance based programs on suicidal behaviour, they nevertheless might have a role in the spectrum of preventive approaches. Especially the fact of high barriers to treatment seeking, especially to face-to-face treatment, are an argument to disseminate distance based interventions as a means for involvement where other treatment is not available or not accepted by those in need.

Effectiveness of distance based programs for suicidal thoughts. Similarly to suicidal behaviours, suicidal thoughts were reduced by distance based programs (-0.17 CI95% $[-0.24; -0.10]$). The result is line with face-to-face interventions according to Kothgassner, Robinson, Goreis, Ougrin, and Plener (2020) (SMD = -0.31 CI95% $[-0.5; -0.12]$). Comparing the intervention-type subgroups in Kothgassner, Robinson, Goreis, Ougrin, and Plener (2020), to our results, some face-to-face interventions like group therapy (SMD = 0.01 CI95% $[-0.17; 0.18]$) and Brief Interventions (SMD = -0.12 CI95% $[-0.27; 0.03]$) tended to be less effective, with other forms of intervention like DBT-A (-0.48 CI95% $[-0.8; -0.17]$) tending to be more effective; but none differed significantly.

Distance based programs can be applied on multiple levels of the stepped care model for suicide care (Jobes, Gregorian, & Colborn, 2018). This model includes 5 levels of intervention, ranging from least restrictive Telephone (level 1), Brief interventions (2), outpatient care (3), partial hospitalisation (4) to most restrictive interventions like inpatient care/full hospitalisation(5).

As such both the least costly and restrictive level of stepped care, ‘telephone interventions and follow ups’ and the second least costly and restrictive level, ‘Brief

interventions and follow ups' can be supplemented or supplanted by distance based interventions. Further, given that effect-sizes of distance based interventions were similar to other face-to-face interventions, even the level 3- outpatient care, can be supplemented with distance based programs. In summary, distance based interventions are capable to supply evidence-based, least-restrictive, and cost effective help. Distance based programs can even be a substitute to outpatient care, where it is not immediately available or not used by individuals seeking help.

Research recommendations. According to our results, autonomous distance based interventions (ADBI) (SMD= -0.13 CI95%[-0.19; -0.07]), were as effective as human involved interventions (SMD= -0.09 CI95%[-0.16; -0.02]). But ADBI promise a better scalability (Batterham et al., 2015), making them more feasible for studies with larger sample sizes and replication studies.

Studies with large sample sizes or study sets using close replications are needed, as only these allow us to control for the characteristics of distance based interventions and by such, to understand which components are most effective.

In general, the assumptions about Distance based interventions (DBI) for mental health often lack evidence (Musiat, Goldstone, & Tarrier, 2014). For example, some stated advantages of DBIs in suicide prevention are still unproven assumptions, for example that 24h availability of such an intervention might be advantageous. The best proven assumptions derived from meta-analytical evidence are delivered for cost effectiveness, acceptability and satisfaction of DBIs. However, this evidence is available for mental health interventions in general (Eze, Mateus, & Cravo Oliveira Hashiguchi, 2020; Musiat, Goldstone, & Tarrier, 2014), but not for the primary endpoint of suicidal behaviour or thoughts.

In this sense, the development of well powered ADBIs for suicide prevention is still in its infancy and needs to be addressed in future more scrupulously.

Implications for clinical practice. Suicide research shows that all interventions, face-to-face-, Human-Involved Distance Based- as well as autonomous Interventions are effective in reducing suicide. Further, all of these interventions were more effective against suicidal thoughts than against suicidal acts. Therefore, there is a strong argument for the implementation of such interventions among individuals with suicide ideation, as recently discussed by Jobes and Joiner (2019) . The availability of face-to-face interventions in mental health clinics and among individual mental health professionals such as psychiatrists and psychotherapists is unevenly distributed geographically (Kapusta et al., 2010; Pirkola, Sund, Sailas, & Wahlbeck, 2009) and may be limited in pandemic containment efforts against Covid-19. The resulting unavailability may be compensated for by ADBIs, which are not affected by geographic distribution or lockdowns. In addition the reality of psychiatric treatment includes high costs for individuals or the public health system (Wittchen et al., 2011), depending on whether psychiatric treatment is covered by insurance. This often results in long waiting times for patients in need (Zepf, Mengele, & Hartmann, 2003). In both cases, ADBIs can help mitigate the negative effects of barriers to help seeking, by offering an intermediate alternative, thereby bridging waiting times and at lower costs. Finally ADBI can help to scale up mental health services especially in countries with limited mental health expenditures and low resources, such as low and middle income countries (LMIC), as called by Chisholm et al. (2007) and thereby contribute to the Sustainable Mental Health Development Goals, set out by the UN (Patel et al., 2018).

Limitations

Given our comprehensive approach, some limitations should be noted. Firstly, we did not include any grey literature. This can cause selection bias, as the publication bias suppresses non-significant results. However RCT studies in a multidisciplinary field are rather unlikely. We expect non-publication due to reporting non-significant results is unlikely, given that almost all considered studies included non-significant results. This

decision reduced work load notably and is in line with previous meta-analyses to this field (Milner, Carter, Pirkis, Robinson, & Spittal, 2015 ; Torok et al., 2020).

The second potential limitation is that most studies included in this meta-analysis are already covered by different previously published meta-analyses (Milner, Carter, Pirkis, Robinson, & Spittal, 2015; Torok et al., 2020). However, these previously published meta-analyses used the Hedges-Olkin meta-analysis which allows only the inclusion of one independent data point, in contrast to our MLM analysis, which allows inclusion of all relevant data (Cheung, 2019).

Utilizing all relevant data has multiple advantages, such as higher precision (a) and less bias risk(b). (a) Including multiple non independent data points per study increases precision. Further it allows important moderator analysis to be implemented in one model, which allows to weigh evidence according to its information value. In contrast, previous meta-analysis had to use independent subgroup analyses, which lowers precision notably and only allows for an indirect comparisons of effectiveness. (b) Bias risk, as stated Hedges-Olkin meta-analyses (Milner, Carter, Pirkis, Robinson, & Spittal, 2015; Torok et al., 2020) must select one outcome per independent analysis. This can result in a selection bias can be introduced therefore not be excluded in these older meta-analyses. Based on these points and the fact that we updated and broaden the systematic searches of previous meta-analysis, the current meta-analysis substantially adds to the research field.

Despite the above stated advantages a multilevel meta-analysis produces further potential limitations. First, the employed method requires more studies to reach adequate power. The number of included studies was relatively low, thus potentially leading to underpowered results (Tanner-Smith & Tipton, 2014). But results were reliable, based on Profile Likelihood Plots (R package *metafor*) and the reported degrees of freedom reported by the RVE Correction (R package *clubsandwich*) (Pustejovsky & Tipton, 2016). Second, RVE corrected models do not report heterogeneity estimations, therefore heterogeneity

estimations of the MLM were reported. However Q - test results are not biased by dependency and therefore statistically valid, while power of the Q -Test was sufficient (Maeda & Harwell, 2016).

Conclusion

The presented results of the MLM are based on 41 published peer-reviewed RCT trials on Distance based interventions. With an adequate power, no indication for publication bias and manageable heterogeneity. The results suggest that DBI, particularly autonomous distance based interventions, are an effective and affordable possibility to support treatment, specially against suicidal thoughts and in situations where availability of face-to-face treatments are limited. These results are encouraging as affordable and available DBI mean higher accessibility, in turn promising a reduction of human suffering and health care costs.

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Appendix

Online Supplement 1

Search Strings: Note: Search string was adapted in Scopus adding: TITLE-ABS-KEY. This is implied when using WOS and Pubmed. As in WOS and Pubmed Title, Abstract and Keywords were also searched, both strings are in practice identical.

For WOS and Pubmed.

((“Suic*” OR “Suicide prevention” OR “self harm*” OR “self poisoning*” OR “self injur*” OR “self mutilation”) AND (“telehealth”OR“postcard*”OR “onlin*”OR“Online Intervention” OR “Online Prevent*” OR “E Intervention” OR “E-Intervention” OR “E Prevention” OR “Electronic Intervention” OR “Electronic Prevention” OR “Mobile Intervention” OR “Mobile Prevention” OR “Web-Based*” OR “Web Based*” OR “Online Support” OR “E Therapy” OR “e-mail*” OR “e mail*” OR “App” OR “Apps” OR “App-Assis*” OR “mobile-App” OR “mobile health intervention” OR “telephone” OR “phone based” OR “letter*”) AND (RCT OR Random*))

Scopus:

(TITLE-ABS-KEY ((“Suic*” OR “Suicide prevention” OR “self harm*” OR “self poisoning*” OR “self injur*” OR “self mutilation”) AND (“telehealth” OR “postcard*” OR “onlin*” OR “Online Intervention” OR “Online Prevent*” OR “E Intervention” OR “E-Intervention” OR “E Prevention” OR “Electronic Intervention” OR “Electronic Prevention” OR “Mobile Intervention” OR “Mobile Prevention” OR “Web-Based*” OR “Web

Based*" OR "Online Support" OR "E Therapy" OR "e-mail*" OR "e
mail*" OR "App" OR "Apps" OR "App-Assis*" OR "mobile-App" OR "mobile
health intervention" OR "telephone" OR "phone based" OR "letter*") AND (
rct OR random*)))

Table 1

Outcome allocation to Moderator Analyses

Moderator group	Outcome Name
Acts	Suicide, suicide attempts, self harming behaviours.
Thoughts	Suicidal thoughts, suicidal ideation, suicide plans.
Human involved	Phone calls, cognitive behavioural treatment, personalized letters or personalized e-mails.
Autonomous	Applications, websites, non-individualized letters or non-individualized e-mails.

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only

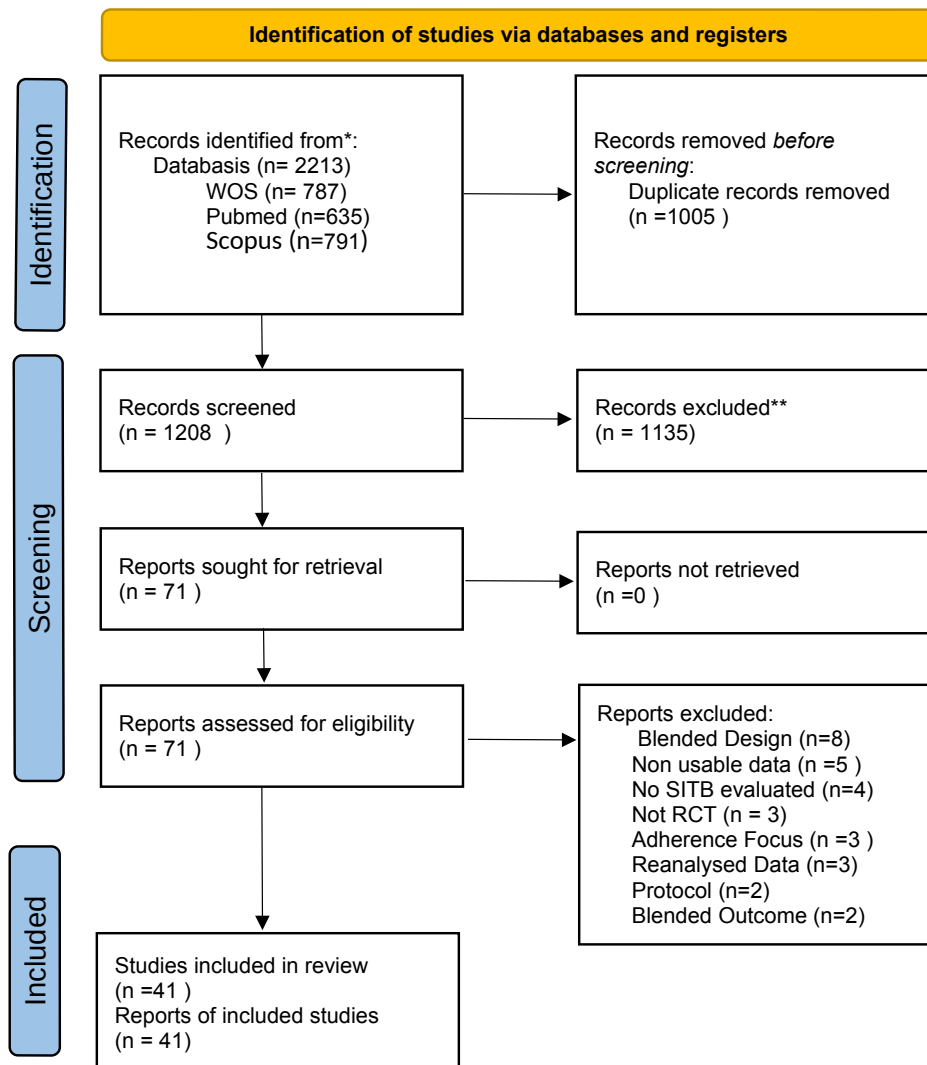


Figure 1. Flow Chart of all studies

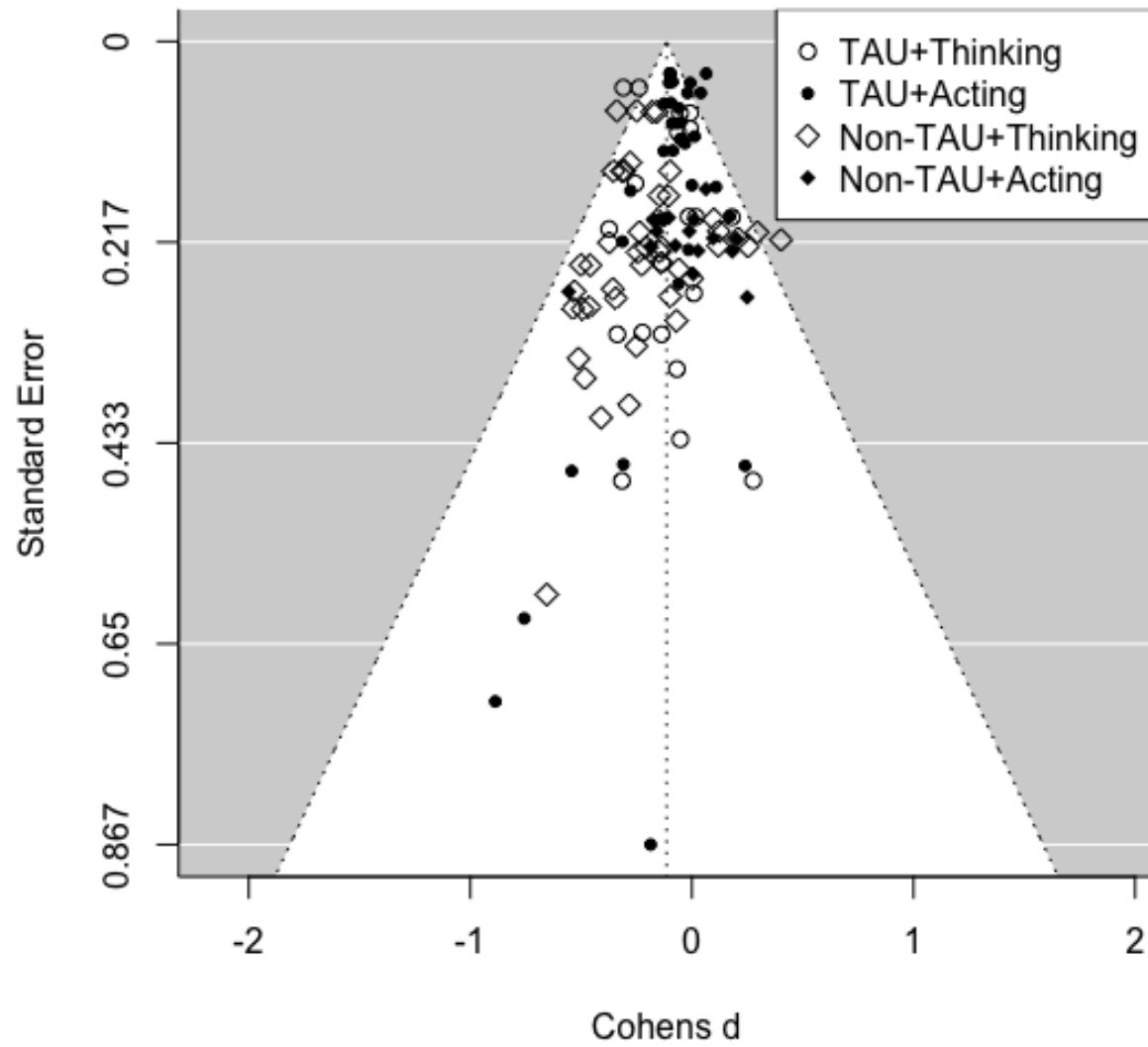


Figure 2. Funnel Plot, including all outcomes according to moderator type

Study ID	D1	D2	D3	D4	D5	Total	
Amadéo et al., (2015)	+	!	+	-	!	-	Low risk
Batterham et al., (2018)	+	+	+	+	+	+	Some concerns
Beautrais et al., (2010)	-	+	+	+	+	-	High risk
Bertolote et al., (2010)	+	+	+	+	+	+	
Bush et al., (2017)	+	!	+	!	!	!	D1 Randomisation process
Carter et al., (2005)	+	+	+	+	+	+	D2 Deviations from
Cederke et al., (2002)	+	!	+	+	+	!	the intended interventions
Christensen et al., (2013)	+	+	+	-	+	-	D3 Missing outcome data
Comtois et al., (2019)	+	!	+	+	+	!	D4 Measurement of the outcome
De Jaegere et al., (2019)	+	+	-	+	+	-	D5 Selection of the reported result
Evans et al., (1999)	+	+	+	+	!	!	
Franklin et al., (2016)	!	+	!	-	+	-	
Guille et al., (2015)	+	+	+	!	!	!	
Hassanian-Moghaddam et al., (2011)	+	+	+	+	+	+	
Hetrick et al., (2017)	!	-	-	+	+	-	
Hill et al., (2019)	+	!	+	-	!	-	
Hooley et al., (2018)	+	!	+	+	+	!	
Kasckow et al., (2016)	!	-	+	-	!	-	
Luxton et al., (2020)	-	+	+	+	+	-	
Motto et al., (2001)	!	+	+	+	!	!	
Mouaffak et al., (2015)	+	!	+	+	!	!	
Mousavi et al., (2001)	!	!	+	+	!	!	
Niederkrötenhaler et al., (2020)	+	+	+	+	+	+	
O`Conner et al., (2017)	+	+	+	+	+	+	
Robinson et al., (2012)	!	!	+	-	+	-	
Rodante et al., (2020)	!	+	+	!	!	!	
Tighe et al., (2017)	+	!	!	-	+	-	
van Spijker et al., (2014)	+	!	-	+	!	-	
Van Spijker et al., (2018)	+	!	-	-	+	-	
Vavia et al., (2006)	+	+	+	+	+	+	
Vavia et al., (2018)	+	+	+	+	+	+	
Wei et al., (2013)	!	+	!	+	+	!	
Wilks et al., (2018)	!	!	+	+	+	!	
Wilksch et al., (2019)	+	+	+	+	+	+	

Figure 3. Quality Assessment of all independent studies