

SUPPLEMENTARY MATERIALS

Effectiveness of online mindfulness-based interventions in improving mental health during the COVID-19 pandemic: A systematic review and meta-analysis of randomized controlled trials

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S1 Table. Search strategies.

Database	Keywords
PubMed	#1 "Mindfulness"[MeSH Terms] OR "mindful*"[All Fields]
	#2 "Online Systems"[MeSH Terms] OR "online"[All Fields] OR "on-line"[All Fields] OR "ehealth"[All Fields] OR "e-health"[All Fields] OR "virtual*"[All Fields] OR "web"[All Fields] OR "webs"[All Fields] OR "website*"[All Fields] OR "Internet"[MeSH Terms] OR "internet*"[All Fields] OR "app"[All Fields] OR "apps"[All Fields] OR "application*"[All Fields] OR "mobile*"[All Fields] OR "mhealth"[All Fields] OR "m-health"[All Fields]
	#3 "COVID-19"[MeSH Terms] OR "COVID 19"[All Fields] OR "SARS-COV-2"[MeSH Terms] OR "SARS-COV-2"[All Fields] OR "SARSCoV2"[All Fields] OR "2019-nCoV"[All Fields] OR "2019nCoV"[All Fields] OR "nCoV-2019"[All Fields] OR "nCoV2019"[All Fields] OR "coronavirus disease 2019"[All Fields] OR "novel coronavirus"[All Fields] OR "new coronavirus"[All Fields]
	#4 controlled clinical trial[MeSH Terms] OR randomized controlled trial[MeSH Terms] OR "random allocation"[MeSH Terms] OR "RCT"[All Fields] OR "random*"[All Fields] OR "control*"[All Fields] OR "trial*"[All Fields]
	#5 #1 AND #2 AND #3 AND #4
Scopus	#1 TITLE-ABS-KEY("mindful*")
	#2 TITLE-ABS-KEY("online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web*" OR "internet*" OR "app*" OR "mobile*" OR "mhealth" OR "m-health")
	#3 TITLE-ABS-KEY("COVID-19" OR "COVID19" OR "SARS-CoV-2" OR "SARSCoV2" OR "SARS-Cov-19" OR "SARSCoV19" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus")
	#4 TITLE-ABS-KEY("RCT" OR "random*" OR "control*" OR "trial*")
	#5 #1 AND #2 AND #3 AND #4
Web of Science	#1 ALL=("mindful*")
	#2 ALL=("online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web*" OR "internet*" OR "app*" OR "mobile*" OR "mhealth" OR "m-health")
	#3 ALL=("COVID-19" OR "COVID19" OR "SARS-CoV-2" OR "SARSCoV2" OR "SARS-Cov-19" OR "SARSCoV19" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus")
	#4 ALL=("RCT" OR "random*" OR "control*" OR "trial*")
	#5 #1 AND #2 AND #3 AND #4
ProQuest	#1 mesh.Exact("mindfulness")
	#2 noft("mindful*")
	#3 mesh.Exact("online systems" OR "internet")
	#4 noft("online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web*" OR "internet*" OR "app*" OR "mobile*" OR "mhealth" OR "m-health")
	#5 noft("COVID-19" OR "COVID19" OR "SARS-CoV-2" OR "SARSCoV2" OR "SARS-Cov-19" OR "SARSCoV19" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus")
	#6 mesh.Exact("Controlled Clinical Trial as Topic" OR "Randomized Controlled Trial as Topic" OR "Random Allocation")
	#7 noft("RCT" OR "random*" OR "control*" OR "trial*")
	#8 (#1 OR #2) AND (#3 OR #4) AND #5 AND (#6 OR #7)
CINAHL (via EBSCOhost)	#1 (MM "Mindfulness") OR "mindful*"
	#2 (MH "Online Systems+") OR (MH "Internet+") OR (MM "Internet-Based Intervention") OR "online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web" OR "webs" OR "website*" OR "internet*" OR "app" OR "apps" OR "application*" OR "mobile*" OR "mhealth" OR "m-health"
	#3 (MM "COVID-19") OR (MM "SARS-CoV-2") OR "COVID-19" OR "COVID19" OR "SARS-CoV-2" OR "SARSCoV2" OR "SARS-Cov-19" OR "SARSCoV19" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus"
	#4 (MH "Clinical Trials+") OR (MH "Randomized Controlled Trials+") OR "RCT" OR "random*" OR "control*" OR "trial*"
	#5 #1 AND #2 AND #3 AND #4
CENTRAL	#1 MeSH descriptor: [Mindfulness] explode all trees
	#2 "mindful*"
	#3 MeSH descriptor: [Online Systems] explode all trees
	#4 MeSH descriptor: [Internet] explode all trees
	#5 "online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web*" OR "internet*" OR "app*" OR "mobile*" OR "mhealth" OR "m-health"
	#6 MeSH descriptor: [COVID-19] explode all trees
	#7 MeSH descriptor: [SARS-COV-2] explode all trees

	#8	"COVID-19" OR "COVID19" OR "SARS-CoV-2" OR "SARSCoV2" OR "SARS-Cov-19" OR "SARSCoV19" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus"
	#9	MeSH descriptor: [Controlled Clinical Trial] explode all trees
	#10	MeSH descriptor: [Randomized Controlled Trial] explode all trees
	#11	MeSH descriptor: [Random Allocation] explode all trees
	#12	"RCT" OR "random*" OR "control*" OR "trial*"
	#13	#1 OR #2
	#14	#3 OR #4 OR #5
	#15	#6 OR #7 OR #8
	#16	#9 OR #10 OR #11 OR #12
	#17	#13 AND #14 AND #15 AND #16

WHO	#1	tw:("mindful" OR "mindfulness")
COVID-19	#2	tw:("online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web" OR "webs" OR "website" OR "websites" OR "internet" OR "app" OR "apps" OR "application" OR "applications" OR "mobile" OR "mhealth" OR "m-health")
Research	#3	tw:("COVID-19" OR "COVID19" OR "SARS-CoV-2" OR "SARSCoV2" OR "SARS-Cov-19" OR "SARSCoV19" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus")
Database	#4	tw:("RCT" OR "random" OR "randomized" OR "randomised" OR "control" OR "controls" OR "controlled" OR "trial" OR "trials")
	#5	#1 AND #2 AND #3 AND #4

MedRxiv		("mindfulness") AND ("online" OR "internet" OR "application") AND ("COVID-19") AND
and BioRxiv		("randomized" OR "trial")

CENTRAL, Cochrane Central Register of Controlled Trials; **CINAHL**, Cumulative Index to Nursing and Allied Health Literature; **COVID-19**, Coronavirus Disease 2019; **WHO**, World Health Organization.

S2 Table. PICOS framework.

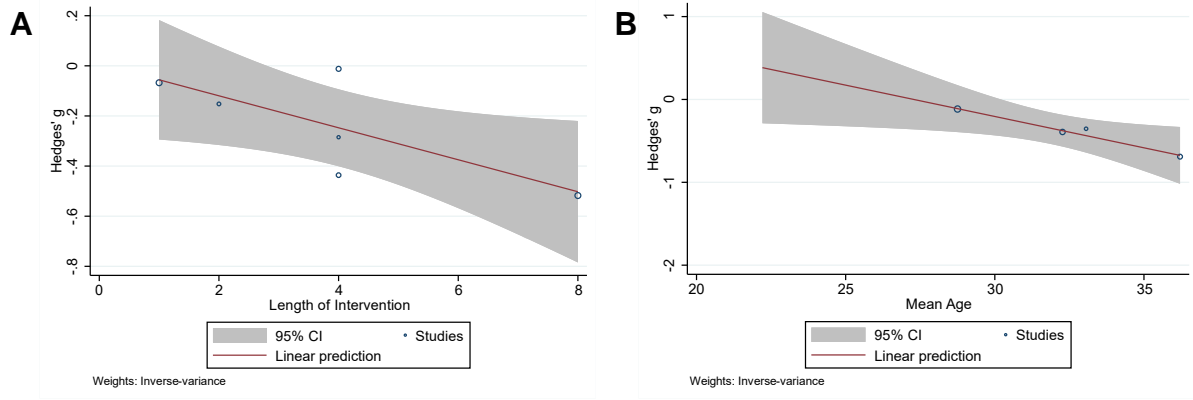
Components of PICOS	Definition
Population	Adults aged 18 years and older
Intervention	Online MBIs (including MBSR or MBCT)
Comparison	Active or inactive control group
Outcome	To reduce symptoms of depression, anxiety, or stress
Study Design	RCT conducted during the period of the COVID-19 pandemic

COVID-19; Coronavirus Disease 2019; **MBI**, mindfulness-based intervention; **MBCT**, mindfulness-based cognitive therapy; **MBSR**; mindfulness-based stress reduction; **PICOS**, Population, Intervention, Comparison, Outcome, and Study Design; **RCT**, randomized controlled trial.

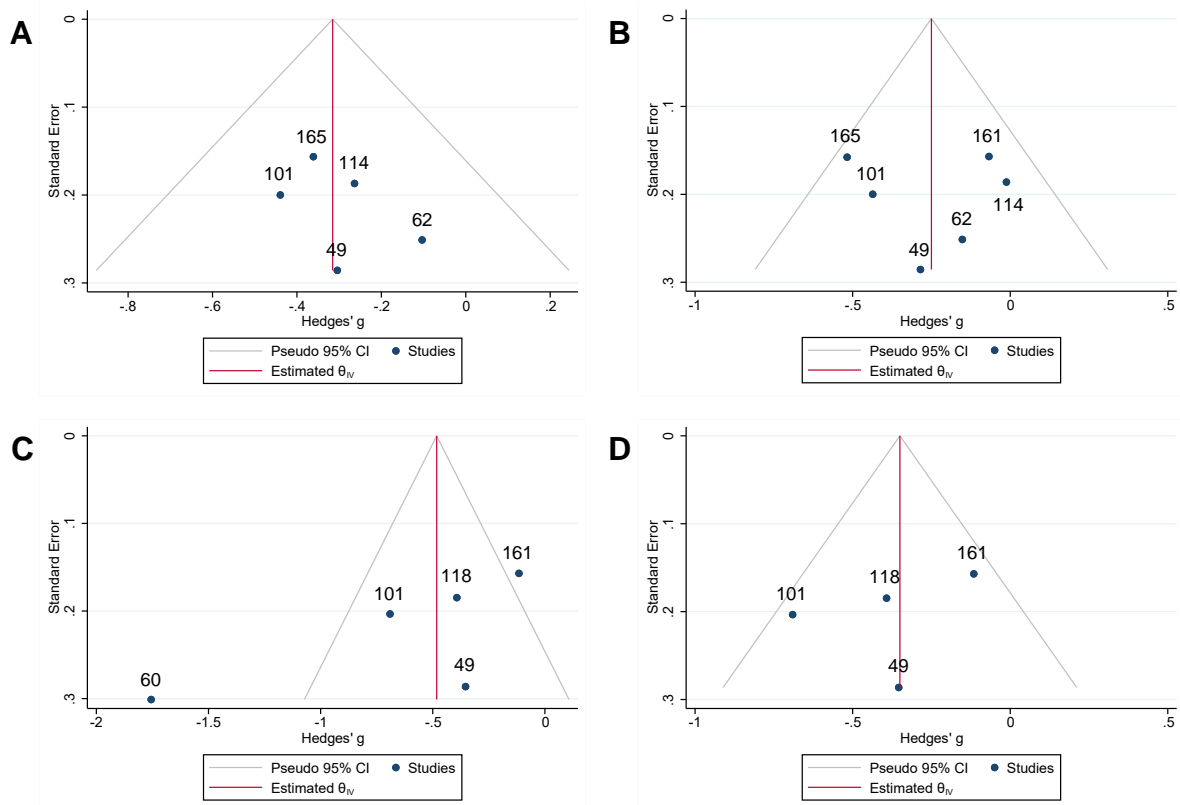
S3 Table. Outcomes of included studies.

First Author, Year	Depression (Online MBIs)				Depression (Control)				Anxiety (Online MBIs)				Anxiety (Control)				Stress (Online MBIs)				Stress (Control)				
	Post-Test		Follow-Up		Post-Test		Follow-Up		Post-Test		Follow-Up		Post-Test		Follow-Up		Post-Test		Follow-Up		Post-Test		Follow-Up		
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	
Alvarado-García et al., 2021 [1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37.83	6.07	-	-	50.58	8.12	-	-
Hosseinzadeh Asl, 2021 [2]	9.5	8.03	11.21	8.01	12.1	8.89	13.14	8.04	4.79	4.05	5.5	3.34	6	4.35	6.67	4.31	9.93	6.7	10.86	6.15	12.48	7.59	13.24	7.2	
Huang et al., 2021 [3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.25	30.12	-	-	59.17	11.24	-	-
Kam et al., 2021 [4]	15.84	7.04	-	-	16.57	6.89	-	-	17.84	7.66	-	-	19.07	8.33	-	-	-	-	-	-	-	-	-	-	-
Peh et al., 2020 [5]	-	-	-	-	-	-	-	-	12.59	4.94	13.91	5.53	12.92	4.8	13.31	5.59	4.02	1.58	4.52	2.11	4.22	1.86	3.86	1.98	
Simonsson et al., 2021 [6]	8.81	3.75	8.94	3.83	10.23	4.06	9.56	4.12	9.81	3.54	9.57	3.76	11.7	3.72	10.87	3.45	-	-	-	-	-	-	-	-	
Smith et al., 2021 [7]	4	2.9	-	-	5.4	3.4	-	-	5	3.9	-	-	6.9	4.7	-	-	12.7	5.6	-	-	17	6.7	-	-	
Sun et al., 2021 [8]	6.42	3.76	5.98	3.64	7.63	5.24	7.77	4.91	6.08	3.99	5.54	3.48	6.13	4.26	7.04	4.75	-	-	-	-	-	-	-	-	

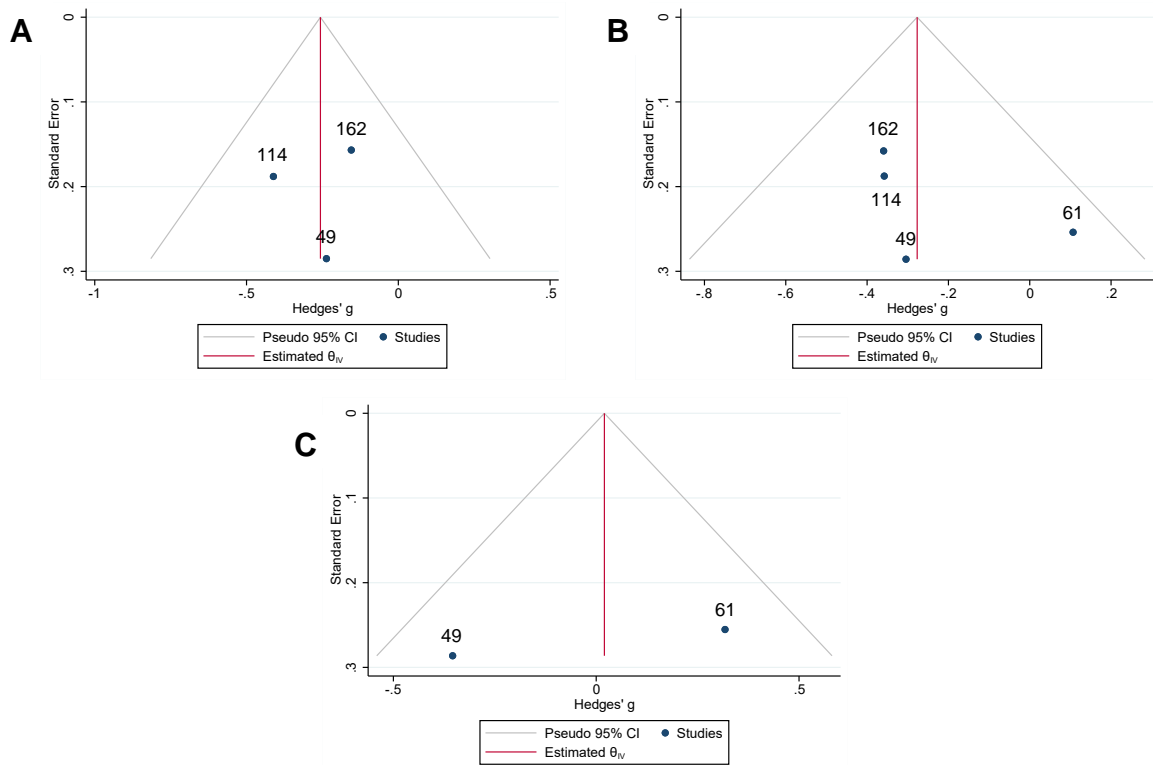
M, mean; MBI, mindfulness-based intervention; SD, standard deviation.



S1 Fig. Bubble plots of meta-regression analyses of online MBIs effect on mental health outcomes at post-intervention. (A) Length of intervention on anxiety. (B) Mean age on stress.



S2 Fig. Funnel plots of meta-analyses of online MBIs effect on mental health outcomes at post-intervention. (A) Depression. (B) Anxiety. (C) Stress (including outliers). (D) Stress (excluding outliers). The number above or below each dot indicates the sample size of the corresponding study in the analysis.



S3 Fig. Funnel plots of meta-analyses of online MBIs effect on mental health outcomes at follow-up. (A) Depression. (B) Anxiety. (C) Stress. The number above or below each dot indicates the sample size of the corresponding study included in the analysis.

REFERENCES

1. Alvarado-García PAA, Soto-Vásquez MR. Effect of an online mindfulness program on stress during the covid-19 pandemic. *Med Natur.* 2021;15: 46–49.
2. Hosseinzadeh Asl NR. A randomized controlled trial of a mindfulness-based intervention in social workers working during the COVID-19 crisis. *Curr Psychol.* 2021; 1–8. doi:10.1007/s12144-021-02150-3
3. Huang X, Li J, Yu H, Huang L, Huang X, Wang X. Comparison of Psychological Intervention Effects of Mindfulness-Based Stress Reduction and Mental Health Education on Medical Staff in COVID-19 Isolation Ward. *J Chengdu Med Coll.* 2021;16: 197–202. doi:10.3939/j.issn.1674-2257.2021.02.016
4. Kam JWY, Javed J, Hart CM, Andrews-Hanna JR, Tomfohr-Madsen LM, Mills C. Daily mindfulness training reduces negative impact of COVID-19 news exposure on affective well-being. *Psychol Res.* 2021; 1–12. doi:10.1007/s00426-021-01550-1
5. Peh K-S, Tan H-C, Tan C-S. Effects of an Ultra-brief Online Mindfulness-based Intervention on Mental Health during the Coronavirus Disease (COVID-19) Outbreak in Malaysia: A Randomized Controlled Trial. *Makara Hum Behav Stud Asia.* 2020;24: 118. doi:10.7454/hubs.asia.2140920
6. Simonsson O, Bazin O, Fisher SD, Goldberg SB. Effects of an eight-week, online mindfulness program on anxiety and depression in university students during COVID-19: A randomized controlled trial. *Psychiatry Res.* 2021;305: 114222. doi:10.1016/j.psychres.2021.114222
7. Smith RB, Mahnert ND, Foote J, Saunders KT, Mourad J, Huberty J. Mindfulness Effects in Obstetric and Gynecology Patients During the Coronavirus Disease 2019 (COVID-19) Pandemic: A Randomized Controlled Trial. *Obstet Gynecol.* 2021;137: 1032–1040. doi:10.1097/AOG.0000000000004316
8. Sun S, Lin D, Goldberg S, Shen Z, Chen P, Qiao S, et al. A mindfulness-based mobile health (mHealth) intervention among psychologically distressed university students in quarantine during the COVID-19 pandemic: A randomized controlled trial. *J Couns Psychol.* 2021. doi:10.1037/cou0000568